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(54) Tooth system for earth-working tools.

(57) Tooth system for soil-working tools such as excavator and loader buckets, rotary dredging cutters, etc. comprising an adapter (2) and a tooth tip (1) detachably attached to the adapter (2). The adapter is provided with a wedge shaped male member (3) which is inclined relative to the working direction of the tool and the tooth tip is provided with a female member (9) adapted to said male member. The relative movements of the adapter and the tooth tip once they have been brought together are blocked by means of a locking element (151) which is inserted into a locking seat which is partly formed in the adapter and partly formed in the tooth tip. Said male member of the adapter displaying at least two contact surfaces (4, 10; 5, 11) facing the main working direction of the tool and one contact surface (18, 19) facing away from said direction.

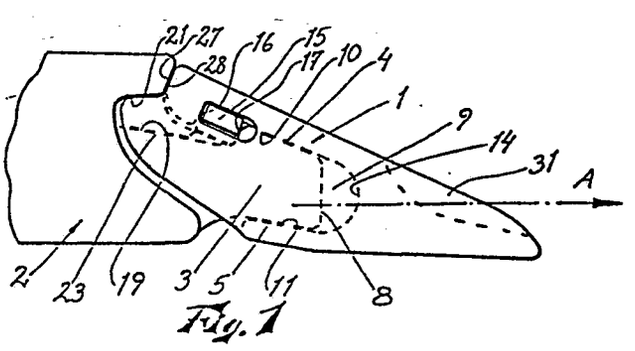

Fig. 1

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Tooth system for earth-working tools

This invention relates to a tooth system for earth-working tools such as excavators, loaders, mechanical shovels, rotary dredging cutters, etc. Because the teeth of earth-working tools are exposed to very severe wear it is customary for them to be divided into an adapter more or less permanently secured to the tool and a readily replaceable tooth tip detachably fitted in the adapter. The tooth tip is the part which is exposed to the major share of the wear and which therefore has to be replaced relatively frequently. It is therefore usually so designed that it also protects the adapter against wear to the greatest possible extent. In large wear part systems there are also different types of intermediate parts between the tooth tip and the adapter. In these designs it can readily can be envisaged that the tooth tip is divided into a front and a rear part. The interconnection between the adapter and the tooth tip is very often achieved by means of male and female members adapted to each other, formed in the tooth tip and/or adapter respectively. In the interconnection the male member is thus entered into the female member, whereupon their relative movements are blocked with the locking element disposed crosswise to the direction of interconnection of the parts. If the male member is a part of the adapter or of the tip is conceptually of no real interest. To ensure the least possible play between the male and female members the male member is usually made slightly wedge-shaped and the insides of the female member are adapted to the same wedge shape. It is further normal for the main direction of the male member to coincide with the interconnection direction of the parts, which, in turn, coincides with the main working direction of

the tool. The male and female members will thus be pressed towards each other in order to give a play-free fit between them as soon as the tool is engaged in working the soil. This arrangement, however, has the disadvantage that the previously mentioned locking element has to absorb all the extraction forces acting upon the tip when the tool is withdrawn back through the worked soil. The extraction forces may be of considerable magnitude and are also of an extremely frequently recurring load type. There has therefore been a tendency to introduce increasingly stout locking elements at the same time as modified wear part systems have been introduced on the market.

The object of the present invention is to introduce a new wear part system in which a portion of the extraction forces acting upon the interconnection between the parts of the system is transferred directly between the male and female members of the parts without use of a locking element as an intermediate piece. This has been accomplished through the special geometry of the tooth system, based on a modification of prior art technique according to which the adapter formed with a truncated, wedge-shaped male member protruding in the main working direction of the tool and the tooth tip with a female member formed in a corresponding manner intended to be passed over the male member and a locking seat running across the interconnected parts into which a locking element can be fitted to prevent relative movements of the parts.

The special geometry which is a distinguishing feature of the tooth system according to the invention is based on the manner in which the various contact surfaces between the tooth tip and the adapter are located relative to each other and how these contact surfaces are angled relative to each other and relative to the anticipated main working direction of the tool.

The contact surfaces formed in the adapter which thus interact with corresponding contact surfaces in the tooth fit when this is fitted give through their angular setting relative to the main working direction of the tool and their mutual location along the adapter a virtually entirely playfree clamping of the tool tip, at the same time as the angular setting of the contact surfaces ensures that the working forces acting upon the tooth tip force the parts together to even better contact with each other, while the extraction forces acting on the tooth tip, thanks to the angular setting of the same contact surfaces, are distributed to the opposing sides of the adapter partly along one side thereof where portions of the extraction forces are transmitted in a conventional manner with the locking element as an intermediate part and partly along the other side of the holder where portions of the extraction forces are transmitted directly from the tooth tip to the adapter via the contact surface of the adapter towards the tooth tip, since the said contact surface, along this side of the adapter, is inclined relative to the main working direction of the tool but faces away from this direction.

The mutual positions of the contact surfaces relative to each other also give the tooth tip a powerful overhang rearwards behind the locking element. This overhang enables the tooth tip to cope with very large breaking forces.

In more detail, the tooth system according to the invention may be said to comprise an adapter, the truncated, wedge-shaped male member of which displays a first broad side which is inclined relative the main working direction of the tool but facing in this direction, whereas the male organ is limited in the opposite direction by a second broad side which is also inclined relative the main working direction of the tool but faces away from the said direction. The female member in its turn displays opposing first and second broad sides adapted to the broad sides of the male member. The respective broad sides of the male and

female member are united towards the side by edge sides adapted to each other. The male member further displays a third contact surface facing towards the tooth tip which is parallel with its own second broad side but which is located on the same side of the male member as the first broad side and faces in the same direction as this first broad side, i.e. obliquely forward in the main working direction of the tool. The female member naturally displays a third contact surface adapted to this third contact surface which thus faces in the opposite direction. The part of the locking seat which is formed in the male member is located between the broad side of the male member and the third contact surface. The second part of the locking seat is formed in the female member. In the male member, the locking seat forms a step between its third broad side and its third contact surface which lies at a slightly lower level so that the step forms a locking surface or locking edge facing away from the main working direction of the tool. In the male member there is also a fourth contact surface towards the female member. This fourth contact surface is formed in the adapter at the same height as the base of the male member where it forms a pointed angle to the third contact surface extending in the main working direction of the tool. These third and fourth contact surfaces are appropriately disposed opposite eachother.

The tooth system according to the invention is naturally also further characterized in that the tooth tip, in addition to its own said first and second broad sides and edge sides respectively adapted to the male organ of the adapter and a third contact surface, also displays a fourth contact surface adapted to the fourth contact surface of the adapter. The third and fourth contact surfaces of the tooth tip are formed in an overhang formed partly behind the female member in the main working direction of the tool where the tooth tip portion of the locking seat adapted for the locking member forms a step or locking surface running

across the tooth tip between the first broad side of the female member and its third contact surface located at a lower level and wherein the fourth contact surface of the tooth tip is located on the opposing side of the overhang, i.e. its top side.

On many occasions it may be appropriate to divide the said third and fourth contact surfaces into two parts by means of a cam disposed in either part, tooth tip or adapter, and a recess provided in the corresponding part. The overhang of the tooth tip can also be fitted to advantage with a stop edge against the holder at the same time as it is appropriate to permit the side edges of the tooth tip to extend to the rear end of the overhang and to provide apertures for the locking element in its side edges on a level with the previously mentioned locking edges.

The entire length of the male member and the length of the second broad side of the female member shall now be so adapted that the following method can be exploited for interconnection of the two associated parts.

Initially, the parts are angled more relative to each other than is indicated by what corresponds to the difference between the main working direction and the interconnection direction of the parts. The interconnection direction of the parts is defined as the direction along which the male and female members are pushed together to close contact between the parts. The interconnection direction for tooth systems with the geometry according to the present invention coincides with the angular setting of the second broad sides and third contact surfaces of the tooth tip and adapter respectively relative to the anticipated main working direction of the tool. In the aforesaid first angled position the parts (tooth tip and adapter) are pushed together so far that the locking edge of the female member or tooth tip reaches the locking edge in the male member. The angle between the parts is then reduced in that the third contact surface of the tooth tip is angled

down to rest against the third contact surface of the male member. In order for this procedure to be possible the male member may not be too long and the second broad side of the female member, which thus lies opposite the third contact surface of the tooth tip, may not extend farther rearwards in the interconnection direction than to roughly the same height as the locking surface of the male member. When the parts have now been angled in towards each other they can be pushed together in the interconnection direction to close contact between the male and female members, whereafter the locking element is inserted between the parts and locks their relative movements.

The tooth system according to the invention is defined in the accompanying claims and will now be described in greater detail and with reference to a preferred embodiment illustrated in the accompanying drawings, wherein Fig. 1 shows a side projection of the tooth system according to the invention, Fig. 2 shows a plan view of the parts of the tooth system in the non-connected condition, Fig. 3-5 shows, with figures partly sectioned along line III-III in Fig. 2, how the interconnection between the tooth and the adapter according to Fig. 1 and Fig. 2 is accomplished and Fig. 6 shows an inclined projection of the locking element.

Similar parts are identified by the same reference numerals in the different figures.

The tooth system according to the invention thus consists of two parts in the form of a tooth tip 1 and an adapter 2. The design of the rear part of the adapter depends upon the appearance of the tool to which it is intended to be welded. This design is in full agreeement with known technique and has therefore not been included in the figures.

The main working direction for the tool in which the tooth system according to the figures is intended to be included is indicated by the arrow A.

The adapter 2 displays a wedge-shaped male member 3, truncated towards its outer end and protruding forwards in the main working direction A.

The male member 3 is limited by a first broad side 4 facing upwards in the figures and a second broad side 5 facing downwards from this, as well as opposing edge sides 6 and 7 uniting these broad sides, which edge sides can also run together to form a truncated wedge-shape towards the outer end of the male member. The male member is terminated in the main working direction A by a leading edge surface 8.

The tooth tip 1 displays in its turn a female member 9 adapted to the male organ and expanding away from the main working direction a first upper broad side 10, and opposing second broad side 11 and two edge sides 12 and 13 opposite to each other. The female member 9 is appropriately terminated in the main working direction with a soft recess 14 which is sufficiently large to prevent the edge surface 8 of the male member from bottoming in the female member.

A contact between the male and female members takes place in addition along the previously mentioned edge sides of the adapter and the tooth tip.

Included now in the invention is that one broad side of the male member, in this case the first broad side 4, is angled relative to the main working direction A and faces in this direction whereas the second broad side 5 is also angled relative to the main working direction but faces away from this direction. Since the corresponding broad sides of the female member rest against the male member along the said first and second broad sides, parts of the extraction forces acting upon the tooth tip will be transmitted directly between the second broad side 11 of the female member facing obliquely in the main working direction A and the broad side 5 of the male member facing obliquely away from the main working direction. In the example shown in the figures the angle between the main working direction A and the first broad side of the male and female member

respectively is 158° and the angle between the main working direction and the second broad side of the male and female member respectively 170°. The wedge-shape of the male and female members respectively is thus 12°.

Portions of the extraction forces acting on the tooth tip are thus transmitted to the adapter 2 directly between the second broad sides 11 and 5. The remainder of the extraction forces is transmitted in a conventional manner with a locking element 15 as intermediate piece between opposing locking surfaces formed in the male and female member respectively which extend across the lengthwise direction of the parts. The locking surface 16 of the tooth tip is then turned forwards in the main working direction while the locking surface 17 of the adapter is turned away from the said direction.

Also included in the tooth system according to the invention is that the male member, apart from the previously mentioned contact surfaces adapted to the female member, also displays a third contact surface which may be divided into two contact surfaces 18, 19 disposed adjacent to eachother, which is parallel with the second broad side but turned in the same direction as its first broad side 4 and wherein a portion formed in the male member for the locking seat required for the locking element 15 forms with its locking edge 17 facing away from the main working direction A a step between the first broad side of the male member and the said third contact surface 18, 19, located at a lower level corresponding to the height of the locking edge 17. In the adapter there is also a fourth contact surface which can also be divided into two partial surfaces 20, 21, and which is opposite to the third contact surface and forms an acute angle extending forwards in the main working direction with the said third contact surface 18, 19. The third and fourth contact surfaces are appropriately located opposite each other in the adapter on a level with the base of the male member. Also included in the invention is that the tooth

tip, in addition to the previously mentioned contact surfaces, also displays its own third and fourth contact surfaces 22, 23 (22 not shown) and 24, 25 (24 not shown) respectively which are adapted to the third and fourth contact surfaces of the adapter. These third and fourth contact surfaces of the tooth tip are elaborated in an overhang formed behind the female member in the said main working direction A so that the tooth tip portion of the locking seat adapted to the locking element forms with its locking surface 16 a step between the first broad side 10 of the female member and the third contact surface 22, 23 of the tooth tip located at a lower level.

The fourth contact surface 24, 25 of the tooth tip 1 is located on the top side of the overhang. Above the said fourth contact surface are stop edges 27, 28, interacting with each other in the tooth tip and adapter.

The division of the third and fourth contact surfaces into two parts is accomplished with a cam 29 formed in the adapter and a corresponding recess 30 in the tooth tip. As shown by Fig. 2, the overhang actually forms two lugs on which the third and fourth contact surfaces of the tooth tip are formed.

In order to make the tooth tip self-sharpening the tip is provided with a front recess 31.

The side edges 12, 13 of the tooth tip are formed into walls 32, 33 which, in a gentle curve, extend from the rear edge of the second broad side of the tooth tip to the rear edge of the overhang. Openings 34, 35 for the locking element 15 are provided in these walls so that the locking element can be introduced between the locking edges 16 and 17. The locking element 15 consists of steel wedge but it can be held in place with a separate blocking member of one or other per se known type.

The interconnection between tooth tip and adapter is evident from figures 3 to 5. Initially, the tooth tip is inclined so much that the third contact surface 22, 23 of

the overhang runs clear of the first broad side 4 (Fig. 3) of the male member. The parts are then brought together with this direction until the locking surfaces 16 and 17 have passed each other (Fig. 4), whereupon the tooth tip is dropped down to the position shown in Fig. 5, whereafter the parts are pushed together along the direction defined by the second broad sides of the male and female members respectively by the third contact surfaces of the holder and tooth tip. This direction could be referred to as the interconnection direction of the parts.

When the parts are pushed together a wedge effect is obtained partly between the broad and edge sides of the male and female members and partly between the third and fourth contact surfaces of the overhang and the adapter. When the parts have been pushed completely together their position relative to each other is locked in that the locking member is inserted in position.

CLAIMS

1. On a tooth system for soil-working tools such as excavator and loader buckets, rotary dredging cutters, etc. comprising two mutually interconnectable parts (1, 2) of which one consists of an adapter (2) attached to the tool whereas the other consists of a replaceable tooth tip (1) detachably attached to the adapter, the adapter (2) displaying a truncated wedge-shaped male member (3) protruding towards its outer end in the main working direction (A) of the tool, delimited by first and second wedge-shaped converging broad sides (4, 5) facing away from each other towards the outer end of the male member, and opposing edge sides (6, 7), uniting the said broad sides, and a front edge surface (8) facing forwards in the main working direction of the tool, whereas the tooth tip (1) protruding in the main working direction (A) of the tool and interconnectible in connected condition with the adapter (2) displays a female member (9) adapted to the said male member (3) comprising opposing broad sides (10, 11) and edge sides (12, 13) respectively counter-directed for contact against the said first and second broad side and the said edge sides and in which the relative movements of the parts (1, 2) once they have been brought together are blocked by means of a locking element (15) which is inserted into a locking seat which is partly formed in the adapter (2) and partly formed in the tooth tip (1) and which, when the parts are interconnected, extends across the lengthwise direction of the parts and where the locking element (15), mounted in place, bridges the distance between opposing locking surfaces (16, 17) formed in the adapter (2) and tooth tip (1) respectively, c h a r a c t e r i z e d in that the first broad side (4) of the male member is inclined relative to the main working direction (A) of the tool but facing in this direction, whereas its second broad side (5) which is also inclined relative to the main working direction (A)

faces away from the said direction and in which the adapter (2), in addition to the first and second broad sides (4, 5) of the male member and its uniting edge sides (6, 7) also displays additionally at least one third contact surface (18, 19) facing the tooth tip (1), the said third contact surface being parallel with the second broad side (5) of the male member but facing in the same direction as its first broad side (4) and in which the portion of the locking seat formed in the adapter (2) for the locking element displays a locking surface or locking edge (17) running across the adapter (2) and facing away from the main working direction (A) of the tool which forms a step between the first broad side (4) of the male member and the third contact surface (18, 19) of the adapter located at a lower level and in which a fourth contact surface (20, 21) facing towards the said third contact surface (18, 19) is formed in the adapter on a level with the base of the male member and in which this fourth contact surface (20, 21) forms an acute angle extending in the main working direction (A) of the tool with the said third contact surface (18, 19) and in which the tooth tip, in addition to the corresponding broad and edge sides (10-13) of the female member (9) adapted to the broad sides (4, 5) and edge sides (6, 7) of the male member (3) also displays its own third and fourth contact surfaces (22, 23 and 24, 25 respectively) adapted to the said third and fourth contact surfaces (18, 19 and 20, 21 respectively) of the adapter (2) which are formed in the tooth tip in an overhang formed behind the female member in the main working direction (A) of the tool, the tooth tip's (1) portion of the locking seat adapted to the said locking element (15) then displaying a locking surface (16) running across the tooth tip (1) which forms a step between the first broad side (10) of the female member and its third contact surface (22, 23) located at a lower level and in which the fourth contact surface (25, 26) of the tooth tip (1) is located on the opposite side of the overhang.

2. A tooth system as claimed in Claim 1, c h a r a c - t e r i z e d in that the third and fourth contact surfaces of the adapter (2) and tooth tip (1) are each divided into two contact surfaces by a cam (29) running along the centre plane of the adapter - tooth system in one part and a thereto adapted recess (30) in the other part.

3. A tooth system as claimed in Claim 1 or Claim 2 c h a r a c t e r i z e d in that the second broad side (11) of the female member (9) facing in the main working direction (A) of the tool with the parts in interconnected condition rest against the second broad side (5) of the male member from the front part of the male member rearwards in the main working direction (A) of the tool to level with the locking edge (17) of the male member whilst the respective side edges of the female member extend from this position in the form of a wall in a gentle curve up to the rear edge of the overhang in the main working direction of the tool and in which the said walls, level with the locking seat, display openings adapted to the locking element (15).

4. A tooth system as claimed in any of Claims 1-3, c h a r a c t e r i z e d in that the tooth tip (1) and adapter (2) in interconnected condition display mutually interacting stop edges (27, 28) arranged in direct conjunction with the said fourth contact surfaces.

5. A tooth system as claimed in any of Claims 1-4, c h a r a c t e r i z e d in that the said first broad side (4) of the male member forms an angle of 158° with the main working direction (A) of the tool whereas its third contact surface (18, 19) forms an angle of 170° with the said direction while its fourth contact surface is parallel with the said direction.

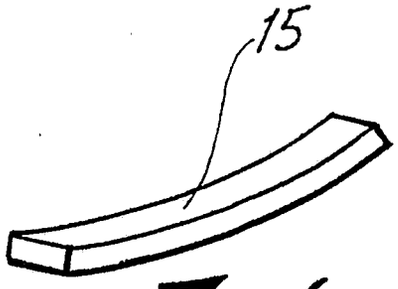

Fig. 6

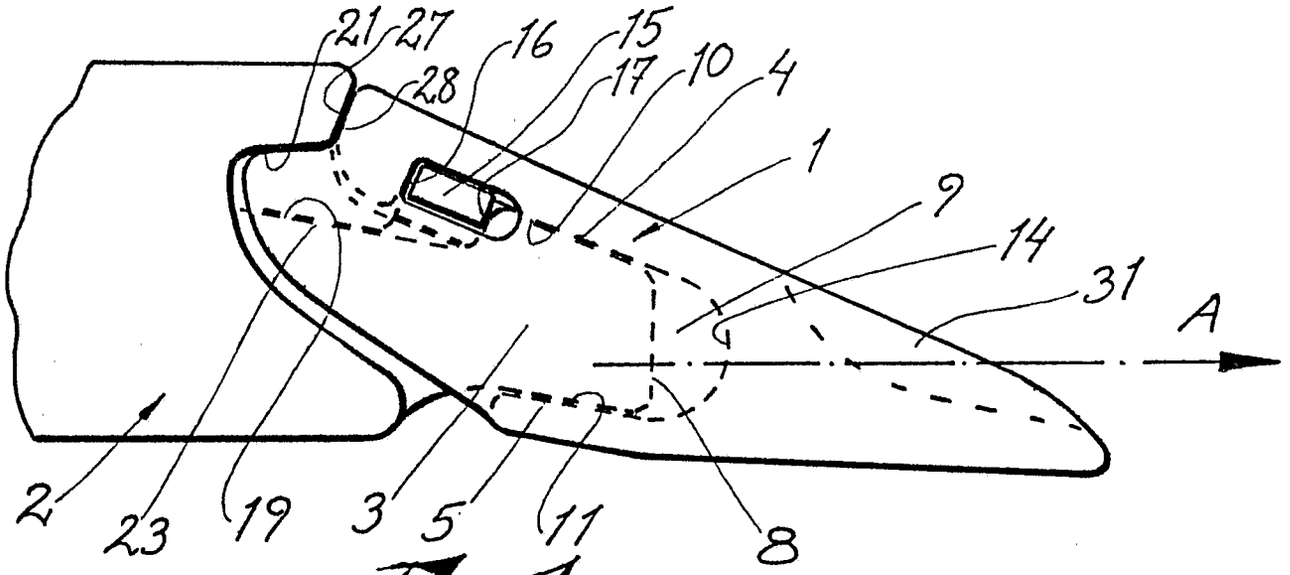

Fig. 1

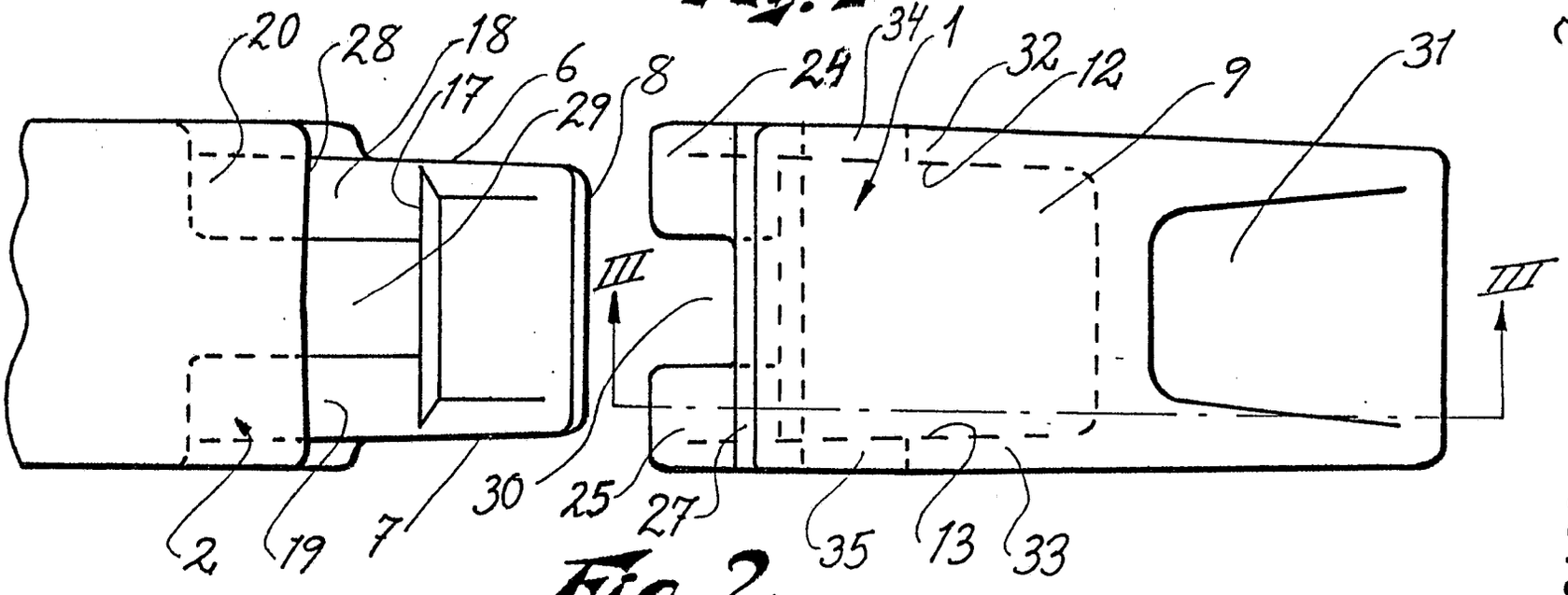

Fig. 2

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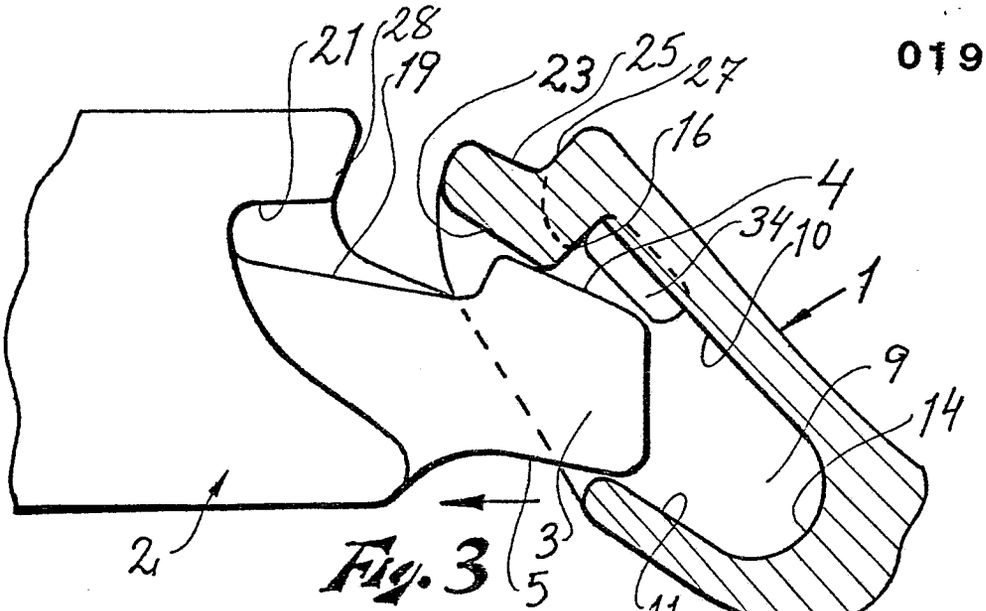

Fig. 3

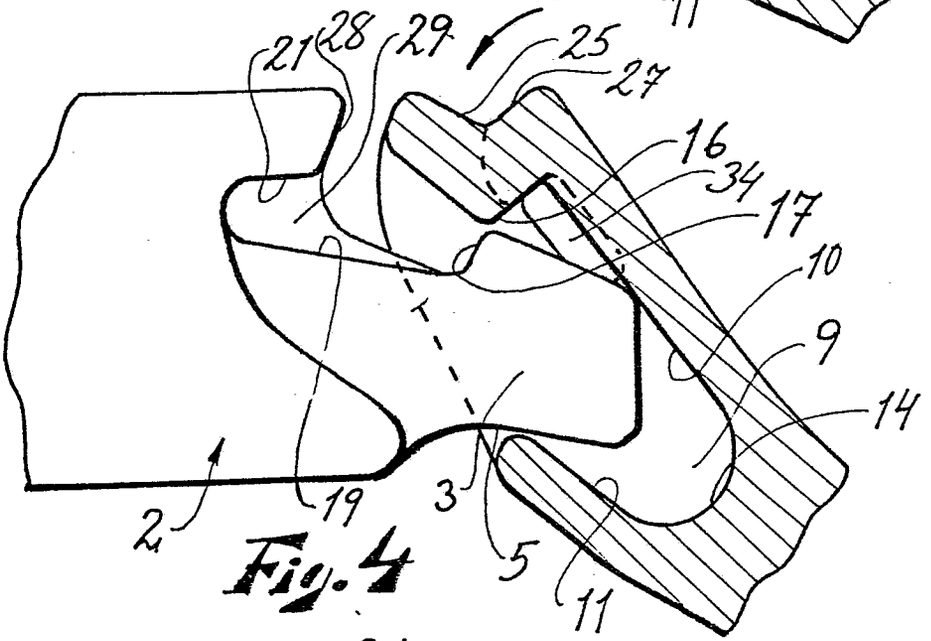

Fig. 4

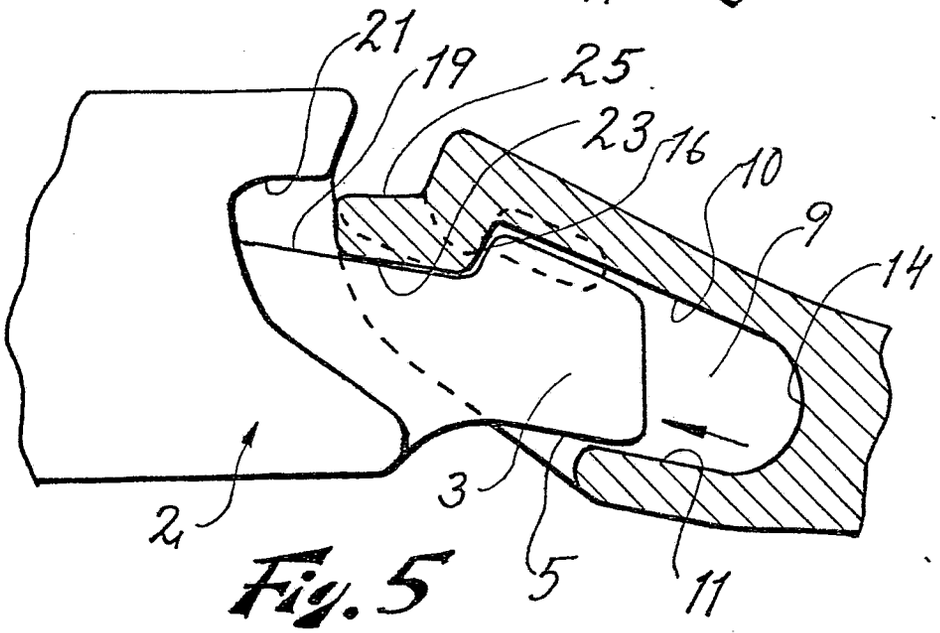

Fig. 5

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EUROPEAN SEARCH REPORT

0195107
Application number

EP 85 10 3368

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	FR-A-2 175 120 (BOFORS) * Figures *	1	E 02 F 9/28
A	DE-A-1 912 098 (AULFINGER) * Figures 4,5 *	1	
A	US-A-2 307 359 (CRAWFORD) * Figures *	1	
A	US-A-4 071 967 (KLETT) * Figure 2 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 02 F
E 21 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-11-1985	RAMPELMANN J.

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