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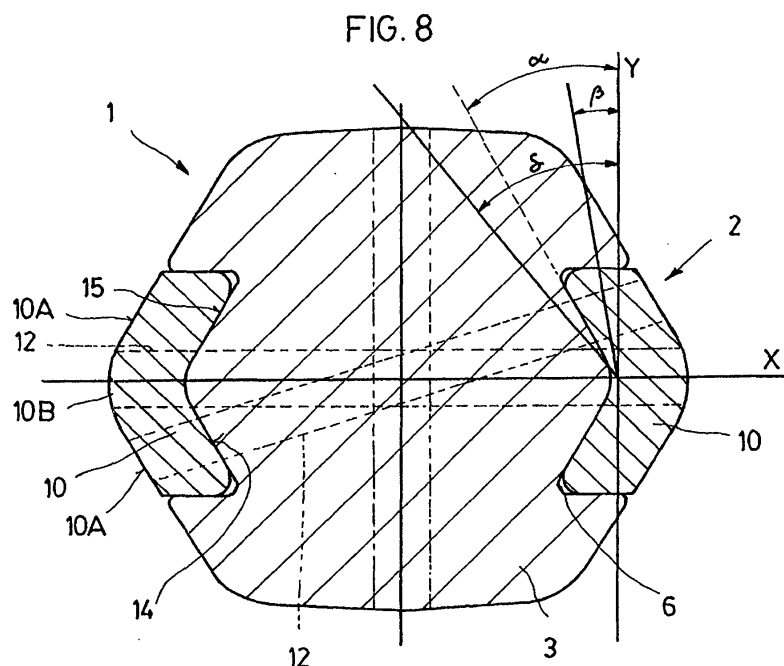
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(54) **COUPLING SYSTEM FOR THE TEETH OF AN EXCAVATOR**

(57) This engagement system for digger teeth, in particular a tooth from which there extend in the axial direction two rectilinear lugs which, being noticeably parallel to one another, emerge cantilevered from the mouth of a central housing and complement respective rectilinear, open recesses which are provided, also in the axial direction, on an adapter member, consisting in

that the straight section of each of the rectilinear lugs of the tooth member, which is concave in one part and substantially complements the convex profile of the back of the rectilinear recesses of the adapter, has two end sections which meet in a convergent fashion on an intermediate section differentiated from the afore-mentioned sections and impinge thereon at a angle of between approximately 10° and 40°.



Description

[0001] This invention relates to an engagement system for digger teeth, particularly for the teeth formed by the association of an adapter member, which is attached to the active edge of the bucket or shovel of the digger or the like, with a tooth member, which is engageable with said adapter member and can be retained therein by means of one or more pins.

[0002] More particularly, the invention relates to the case in which one of the afore-mentioned adapter member and tooth member, preferably the tooth member, extends in the axial direction in two rectilinear lugs which, being noticeably parallel to one another, emerge cantilevered from the mouth of a central housing in the axial direction and complement respective rectilinear, open recesses arranged, also in the axial direction, on the adapter member, which, at the same time, is provided with an axial cantilever projection that complements said central housing in the tooth member, said tooth member lugs having their inner surface, which is in contact with the back of the adapter member recesses, as a flat or slightly arched curvilinear surface.

[0003] Several patents are known which relate to multiple aspects of the constitution, configuration and organisation of the tooth member lugs and the recesses of the corresponding adapter member, and it is worth mentioning the following: patent US 4.404.760, wherein the tooth member is provided with respective flat lugs which, having an inner step, bear against the sides of the adapter, in which no guiding or positioning recesses are provided, that has a grooving in part of its perimeter for inserting a fork that abuts against the inner step of the tooth member lugs in order to retain said member engaged in the adapter member; US 5.379.535, wherein the lugs of the tooth member and the corresponding recesses of the adapter member are inclined with respect to the axis of the engaged ensemble and the lugs have their inner face as a noticeably conical surface, with one of said lugs being provided with an internal recess for the insertion of a pin; US 5.386.653, wherein the tooth member lugs have their longitudinal edges inclined outwardly and their inner faces as a curvilinear arched concave surface, whereas the rectilinear recesses have their longitudinal walls inclined towards the back, which is a curvilinear convex arch; US 5.456.029, relating to a support member for an adapter member, the former being provided with rectilinear recesses and the latter with lugs, the said rectilinear recesses having their longitudinal walls inclined towards the back thereof, said backs having a slightly convex, dihedral surface with a sharp edge; EP 0 835 963, wherein the tooth member lugs have their longitudinal edges shaped as an outwardly descending step, whereas the adapter member recesses have some steps in their longitudinal walls, which complement those of the said longitudinal edges of the lugs, which descend towards the back of the corresponding recess, with said back having a con-

tinuous surface that can be flat or have a transverse curvilinear arch that substantially complements in both cases the surface of the inner faces of the tooth member lugs; and, finally, ES 9902161, wherein, an arrangement of the tooth member lugs with respect to the adapter member recesses is also provided, similar to that adopted in the preceding European patent, with the particularity that in the former case the lugs are noticeably parallel, whereas in this Spanish patent the lugs are inclined in a symmetrical and convergent fashion.

[0004] By means of the various systems shown of the engagement of an adapter member to a tooth member by means of simple recesses and lugs provided on one or the other thereof, as occurs in US patents Nos. 5.379.535 and 5.423.138, in general, the following is achieved: an improvement in the attachment of the tooth to the adapter, thanks to a more stable system; the removal of the stress that the pin undergoes, also thanks to a more stable system; and an increase in the strength of the ensemble, by providing a larger lever arm.

[0005] Practice has shown that, in all engagements involving lugs and recesses the problem arises whereby the tooth member lugs tend to project and separate from the adapter member, when the latter transmits the stresses which the tooth member has undergone, whereby this tendency of the tooth member lugs to separate from the adapter member increases the risk of said lugs breaking.

[0006] In order to overcome this drawback, US Patent No. 5.386.653 was filed, wherein angles were created on the upper and lower longitudinal edges of the tooth member lugs and on the longitudinal walls of the adapter member, to avoid the expulsion thereof, together with EP 0.835.963, wherein the tooth member lugs have their longitudinal edges in a stepped configuration complementary to the longitudinal walls of the adapter member recesses, forming guiding arrangements.

[0007] In both cases, the tooth member lugs still tend to open or project from the adapter member recesses, but the inclined surfaces or the guiding arrangement keep them in place. In fact, the lugs are prevented from separating from the adapter, but a concentration of forces is created on the support surfaces of the lugs in the adapter member recesses, which lead to breakage.

[0008] In another solution, which has been adopted in ES 9902161, two rectilinear lugs are fitted, albeit on respective convergent planes. In this case, when the tooth member receives an upper vertical force (see Figure 23), the lugs close, in a compressed state whereas when a lower vertical force is received, the lugs open.

[0009] In order to overcome the cited drawbacks, the solution has been adopted to shape the tooth member lugs in a closed manner, that is, whereby they have a straight section that has a concave part facing the adapter member recesses, the backs of which are complementarily convex with respect to the afore-mentioned part.

[0010] In accordance with the foregoing solution, the

system which is the subject matter of this invention has been developed, according to which the straight section of each of the tooth member lugs, that is concave in one part and substantially complements the convex profile of the back of the adapter member recesses, has two end sections which meet in a convergent fashion in an intermediate section differentiated from the afore-mentioned sections. One feature of the invention consists of the two end sections of the straight section of each tooth member lug, impinging on the intermediate section at an angle of between approximately 10° and 40° .

[0011] The invention comprises the fact that the differentiated intermediate section of the straight section of the tooth member lugs can have a curvilinear or rectilinear configuration, without excluding other composite configurations (mixed, fractioned, etc).

[0012] Furthermore, the invention comprises the fact that the end sections of the straight section of each lug can have a rectilinear or curvilinear configuration, without excluding other possibilities, including the cases where both end sections have the same or different configuration, the same or different length in any of the preceding cases, and an angle of incidence on the differentiated intermediate section, which is the same or different for the two end sections of one and the same straight section.

[0013] Another feature of the invention lies in the fact that the two lugs of one and the same tooth member can be specularly symmetrical or symmetrical with respect to one point.

[0014] A further feature of the invention lies in the fact that the tooth member lugs have diametrically opposite orifices which, being positioned in one of the end sections or in the differentiated intermediate section, are aligned in registration with an orifice which is traversed by the cantilever projection of the adapter member.

[0015] It is also characteristic of this invention that the two lesser sides of the straight section of the tooth member lugs are rectilinear and noticeably parallel to one another and that the straight section of each tooth member lug has an equal width along its whole extension, however, it can have one or more areas of reduced extension with a different width from the prevailing width.

[0016] Finally, another feature of the invention lies in the fact that in the tooth member lugs, the longer end sections are facing the direction of the stresses to be withstood.

[0017] In order to facilitate the understanding of the preceding premises, the object of the invention is described below, with reference to the accompanying illustrative drawings, in which:

Figure 1 is an angular exploded perspective view of the adapter and tooth members according to the invention, viewed from their mutual engagement parts.

Figure 2 is a side elevation view of the adapter and tooth elements of the preceding figure in their en-

gagement position.

Figure 3 is a top plan view of the adapter and tooth members of the preceding figure.

Figure 4 is a diagrammatic view of an engaged adapter and tooth ensemble according to the invention, in which a downward vertical stress is supposedly applied to the end of the tooth, with an indication of the resulting reactions caused by said stress. Figure 5 is a diagrammatic cross section along the line V-V of Figure 4, showing the effects that the downward vertical stress causes to the tooth member lugs.

Figure 6 is a similar view to Figure 4, showing the adapter and tooth ensemble in which the vertical stress is supposedly applied in an upward direction to the end of the tooth, with an indication of the reactions caused by said stress.

Figure 7 is a diagrammatic cross section along the line VII-VII of Figure 6, showing the effects which the upward vertical stress causes on the tooth member lugs.

Figure 8 is a similar cross section to that of Figures 5 and 7, showing the position of the tooth member lugs, housed in the adapter member recesses, and the limit angles between which, in use, the end sections of the tooth member lugs must be with respect to the vertical that is perpendicular to the central axis of said lugs, with three possibilities for positioning the housing for the engagement retaining pin being indicated by dotted lines.

Figure 9 is a cross section similar to that of the preceding figure, in which the differentiated intermediate section and the end sections of the straight section of both tooth member lugs have a rectilinear configuration and the angle of incidence of the end sections on the differentiated intermediate section is constant.

Figure 10 is a similar section to that of the preceding figure, in which the tooth member lugs are symmetrical to one another with respect to one point, with the straight section of the lugs having its end sections, rectilinear and of a different length on each and those of one being in a staggered position with respect to the other, and the differentiated intermediate section having a curvilinear shape, with the position of the housing for the retention pin also being indicated by dotted lines.

Figure 11 is a cross section similar to that of Figure 10 in which the tooth member lugs are specularly symmetrical having rectilinear end sections of different lengths and a curvilinear shaped differentiated intermediate section, the short end sections being, in this case, in a lower position, it being possible to place them in a lower position in another case, not specifically shown.

Figure 12 is a diagrammatic view of some of the various shapes that the straight section of a tooth member lug can adopt.

Figure 13 is a diagrammatic view of half of a section similar to that of Figures 5, 7 and 8 to 11, showing a straight section of a tooth member lug where the intermediate section has a different width, and the back of the adapter member recess, which is provided with a projection that complements the depression in the differentiated intermediate section.

[0018] Figure 1 shows an angularly exploded perspective view of an ensemble made up of an adapter member 1 and a tooth member 2.

[0019] Adapter member 1 is made up of a central core 3 from which there extend in the axial direction, on one side, a fork 4, for engaging adapter member 1 on the active edge of the bucket or shovel of a digger, and, on the other side, a cantilever projection 5, or nose, having a prismatic shape. Central core 3 is provided, on both sides, with respective rectilinear recesses 6 and, in the transverse direction, with an orifice for housing a retention pin, with both arrangements being positioned so as not to reduce the section of nose 5.

[0020] Tooth member 2 is made up of central core 7 which, in the axial direction, comprises a central housing 8, from which there emerge from the mouth 9 thereof respective rectilinear lugs 10, and a working point 11.

[0021] As shown in Figures 2 and 3, when the adapter member 1 and tooth members 2 are engaged, rectilinear lugs 10 of tooth member 2 are housed in rectilinear recesses 6 of adapter 1, with the engagement being maintained, in one embodiment example, by means of a passage 12, made up of orifices provided in alignment in rectilinear lugs 10 of tooth member 2 and in central core 3 of adapter member 1, into which a retention pin 13 is inserted.

[0022] The preceding details must be considered to be included in the state of the art, as shown by the citation of patents at the beginning of this specification.

[0023] The object of the invention consists, as shown in Figures 5 and 7, in relation to Figures 4 and 6, in the fact that the straight section of each of rectilinear lugs 10 of tooth member 2, which is concave in one part 14 and substantially complements the convex profile of back 15 of the rectilinear recesses of adapter member 1, has, as detailed in Figure 8, two end sections 10A which meet in a convergent fashion in an intermediate section 10B differentiated from the afore-mentioned sections. In order to facilitate the understanding of the preceding and the following description, said sections 10A y 10B have been separated by imaginary dotted lines M.

[0024] As can be seen in Figures 4 to 7, a stress F_s applied in a downward vertical direction on working point 11 of tooth member 2, causes reactions R_{s1} on nose 5 and R_{s2} on the upper edge of rectilinear recesses 6, which result in a component force C_s , which tends to apply end sections 10A of rectilinear lugs 10 against backs 15 of rectilinear recesses 6. The same occurs, when stress F_i is applied in an upward vertical direction

on working point 11 of tooth member 2, in which case the reactions are R_{i1} and R_{i2} and the component force is C_i . The tendency of end sections 10A of rectilinear lugs 10 of tooth member 2 against backs 15 of rectilinear recesses 6 is indicated in dotted lines.

[0025] It has been ascertained, as shown in Figure 8, that the angle of incidence α of end sections 10A on differentiated intermediate sections 10B of the straight sections of rectilinear lugs 10 of tooth member 2, must be between the limit angles β and δ defined with respect to the vertical Y perpendicular to the transverse axis X of the straight section, said limit angles being valued as $\beta = 10^\circ$ y $\delta = 40^\circ$.

[0026] On the other hand, the same Figure 8 indicates various possible positions of passage 12 suitable for inserting retention pin 13.

[0027] Figures 5, 7 and 8, illustrate the case where, in the straight section of rectilinear lugs 10, end sections 10A are rectilinear and equal and differentiated intermediate section 10B is curvilinear, being separated from each other by the imaginary lines M.

[0028] Figure 9 illustrates the case where, in the straight section of rectilinear lugs 10, end sections 10A are rectilinear and equal and differentiated intermediate section 10B is rectilinear, with a possible passage 12 for a retention pin also being indicated.

[0029] Figures 10 and 11 illustrate the case where rectilinear lugs 10 show their end sections 10A and 10C, with a rectilinear shape, at a different length and with an equal angle of incidence on differentiated intermediate section 10B, positioned in Figure 10 symmetrical with respect to one point, whereas in Figure 11 the symmetrical arrangement is specular. The case in this last figure, can adopt an inverse position, in which end sections 10A, the longer ones, are positioned underneath end sections 10C, the shorter ones. In all cases, in rectilinear lugs 10 of tooth member 2 the longer end sections 10A are facing the direction of the stresses to be withstood.

[0030] Figure 12 illustrates some of the different variations of the straight section that can be adopted when manufacturing rectilinear lugs 10. There is shown, *inter alia*, the straight section of a rectilinear lug 16 showing its end sections 16A with a curvilinear shape and differentiated intermediate section 16B with a curvilinear shape with a curve different to that of end sections 16A. The straight section of rectilinear lug 17 shows its end sections 17A with a curvilinear shape and its differentiated intermediate section 17 with a rectilinear shape. The straight section of rectilinear lug 18 shows its end sections 18A with a rectilinear shape and its differentiated intermediate section 18B with a curvilinear shape. Finally, the straight section of rectilinear lug 19 shows its end sections 19A with a rectilinear shape, the same as its differentiated intermediate section 19B. Obviously, a great variety of straight sections can be obtained by combining the end sections according to their length, trajectory and angle of incidence with straight, curved, short, long, etc. differentiated intermediate sections.

[0031] Figure 13 shows half a section of the engagement between adapter member 1 and tooth member 2 similar to that shown in Figures 5, 7 and 8 to 11, which illustrates a straight section of a rectilinear lug 20 where its differentiated intermediate section 20B has a different width to end sections 20A, and back 15 of rectilinear recess 6 of adapter member 1 is provided with a projection 21 which complements depression 22 in differentiated intermediate section 20B.

[0032] With this system of closed lugs, greater system robustness is achieved, reducing the risk of breakage by succeeding that the lugs work in a compressed state to transmit the force of tooth 2 to adapter 1.

[0033] Furthermore, in the particular case of a nose 5 which develops from a hexagon, it can adapt to the latter without the need to remove material from nose 5 to apply rectilinear lugs. In this way the robustness of nose 5 is not reduced and neither is the number of sharp edges increased, therefore reducing the risk of having concentrations of stress and achieving a simple but effective geometric arrangement.

[0034] In the new engagement system, the lugs are completely closed, working in a compressed state when vertical stress, either upward or downward, is applied to the ensemble.

Claims

1. An engagement system for digger teeth, in particular for the teeth of the type formed by the association of an adapter member, fixed to the bucket or shovel of the digger, and a tooth member, coupled to the former and retained thereon by means of a pin, in which one of said members, preferably the tooth member, extends in the axial direction in two rectilinear lugs which, being noticeably parallel to one another, emerge cantilevered from the mouth of a central housing, and complement respective rectilinear, open recesses arranged, also in the axial direction, on the adapter member, which, at the same time, is provided with a cantilever projection that complements the central housing in the tooth member, said tooth member lugs having their inner surface, which is in contact with the back of the adapter member recesses, as a flat or slightly arched curvilinear surface, wherein the straight section of each of the rectilinear lugs of the tooth member, which is concave in one part and substantially complements the convex profile of the back of the rectilinear recesses of the adapter, has two end sections which meet in a convergent fashion on an intermediate section differentiated from the afore-mentioned sections.
2. The system, according to the preceding claim, wherein the two end sections of the straight section of the tooth member lugs, impinge on the differentiated intermediate section, at an angle of between approximately 10° and 40°.

3. The system, according to claim 1, wherein the differentiated intermediate section of the straight section of the tooth member lugs is curvilinear.
4. The system, according to claim 1, wherein the differentiated intermediate section of the straight section of the tooth member lugs is rectilinear.
5. The system, according to claim 1, wherein the end sections of the straight section of each of the tooth member lugs are noticeably rectilinear.
6. The system, according to claim 1, wherein the end sections of the straight section of each of the tooth member lugs are slightly curvilinear.
7. The system, according to claim 1, wherein one of the end sections of the straight section of each of the tooth member lugs is noticeably rectilinear, whereas the other remaining end section is slightly curvilinear.
8. The system, according to claim 1, wherein the straight section of the tooth member lugs is transversally symmetrical, whereby the two end sections of said straight section of the tooth member lugs are the same length and the angle of incidence of the two end sections on the intermediate section is the same value for each of them.
9. The system, according to claim 1, wherein the straight section of the tooth member lugs is asymmetrical in a transverse direction, whereby the two end sections of said straight section of the tooth member lugs are a different length and the angle of incidence of the two end sections on the differentiated intermediate section is a different value for each of them.
10. The system, according to claim 1, wherein the straight section of the tooth member lugs, being asymmetrical, has the two end sections of the same length and different angle of incidence on the differentiated intermediate section.
11. The system, according to claim 1, wherein the straight section of the tooth member lugs, being asymmetrical, has the two end sections of different length and equal angle of incidence on the differentiated intermediate section.
12. The system, according to claim 1, wherein both lugs of the tooth member have diametrically opposite orifices which, being positioned in one of the end sections or in the differentiated intermediate section,

are aligned in registration with an orifice which is traversed by the cantilever projection of the adapter member.

13. The system, according to claim 1, wherein the two smaller sides of the straight section of the lugs of the tooth member are rectilinear and noticeably parallel to one another. 5
14. The system, according to claim 1, wherein the straight sections of the two lugs of a tooth member are specularly symmetrical. 10
15. The system, according to claim 1, wherein the straight sections of the two lugs of a tooth member are symmetrical with respect to one point. 15
16. The system, according to claim 1, wherein the straight section of each lug of the tooth member has an equal width along its whole extension. 20
17. The system, according to claim 1, wherein the straight section of each lug of the tooth member has one or more areas of reduced extension and a different width from the prevailing width. 25
18. The system, according to claims 9 and 11, wherein in the lugs of the tooth member the longer end sections are facing the direction of the stresses to be withstood. 30

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FIG. 1

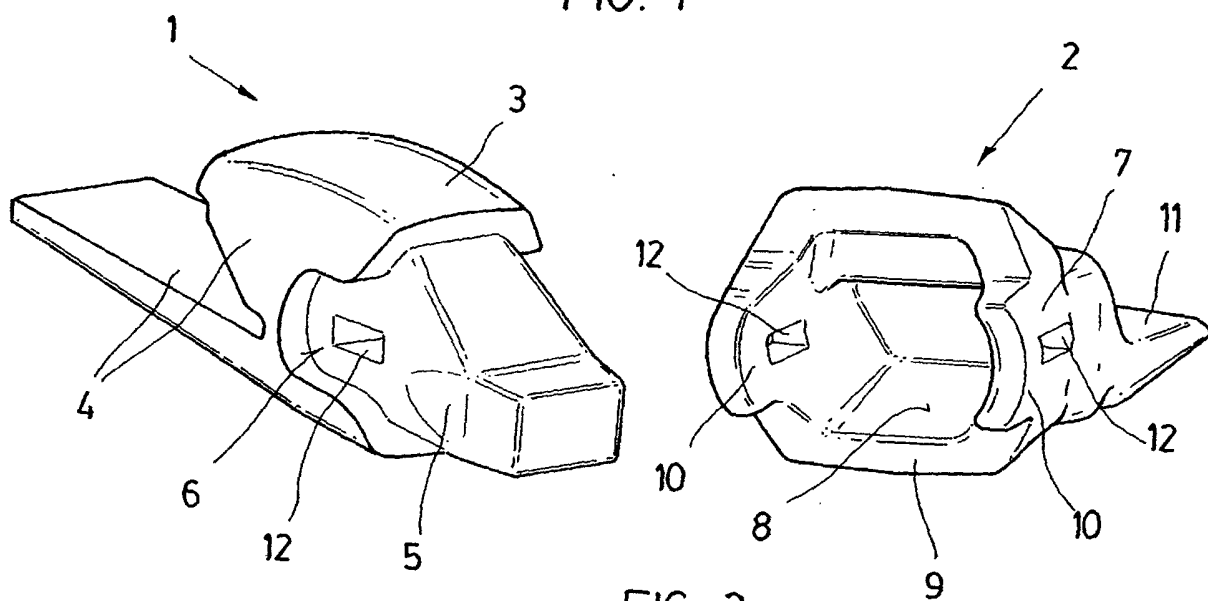


FIG. 2

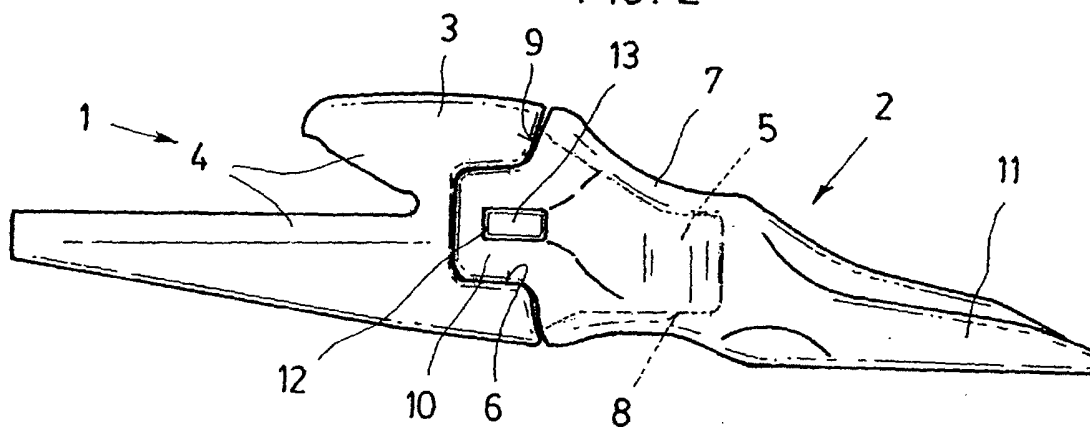
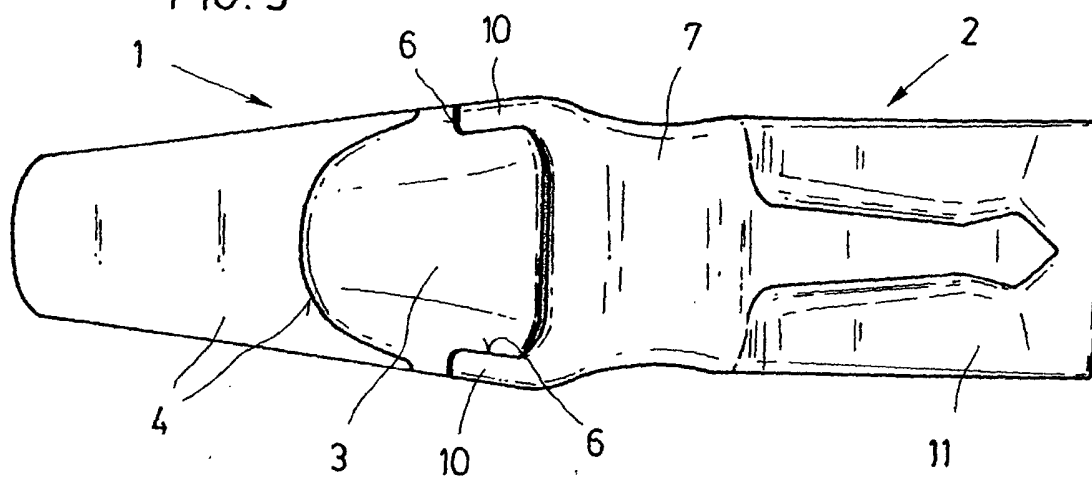


FIG. 3



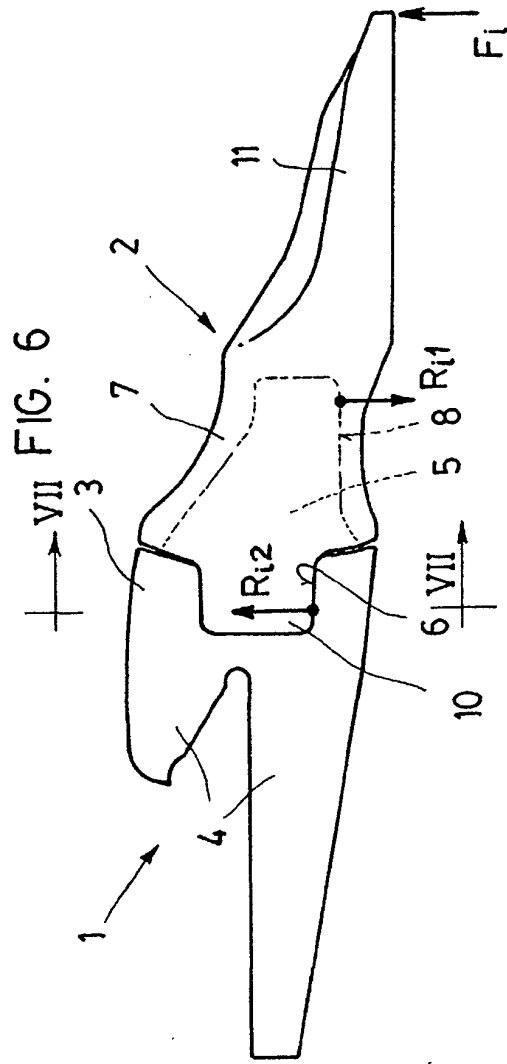
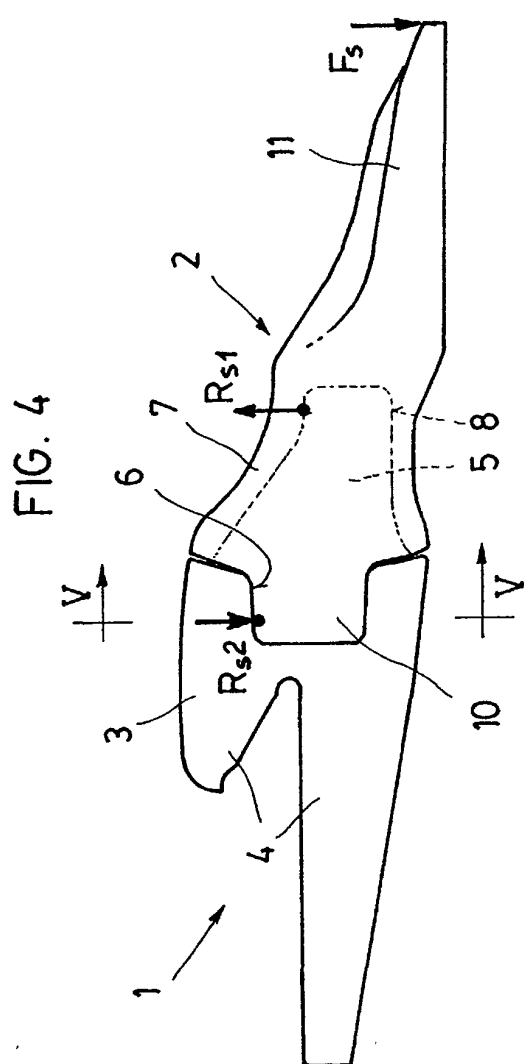
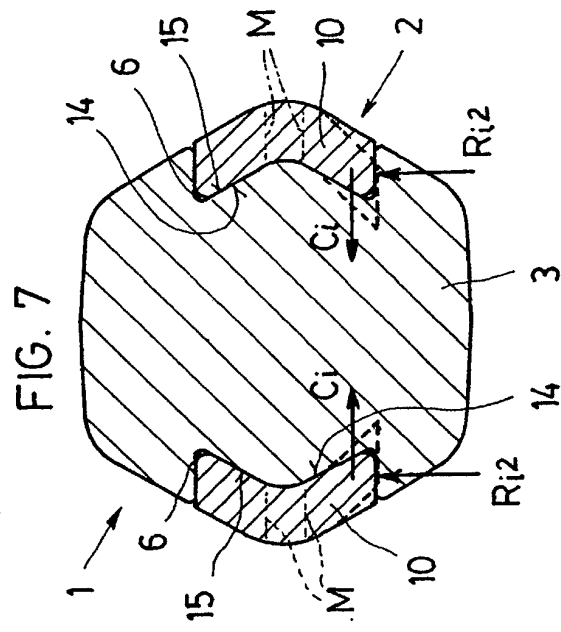
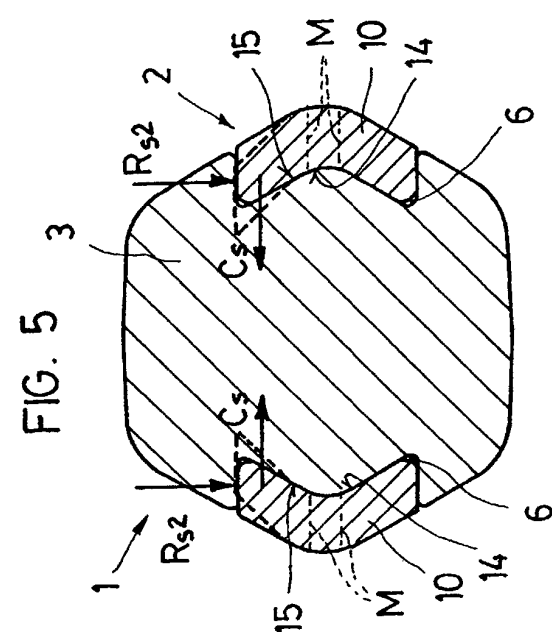


FIG. 8

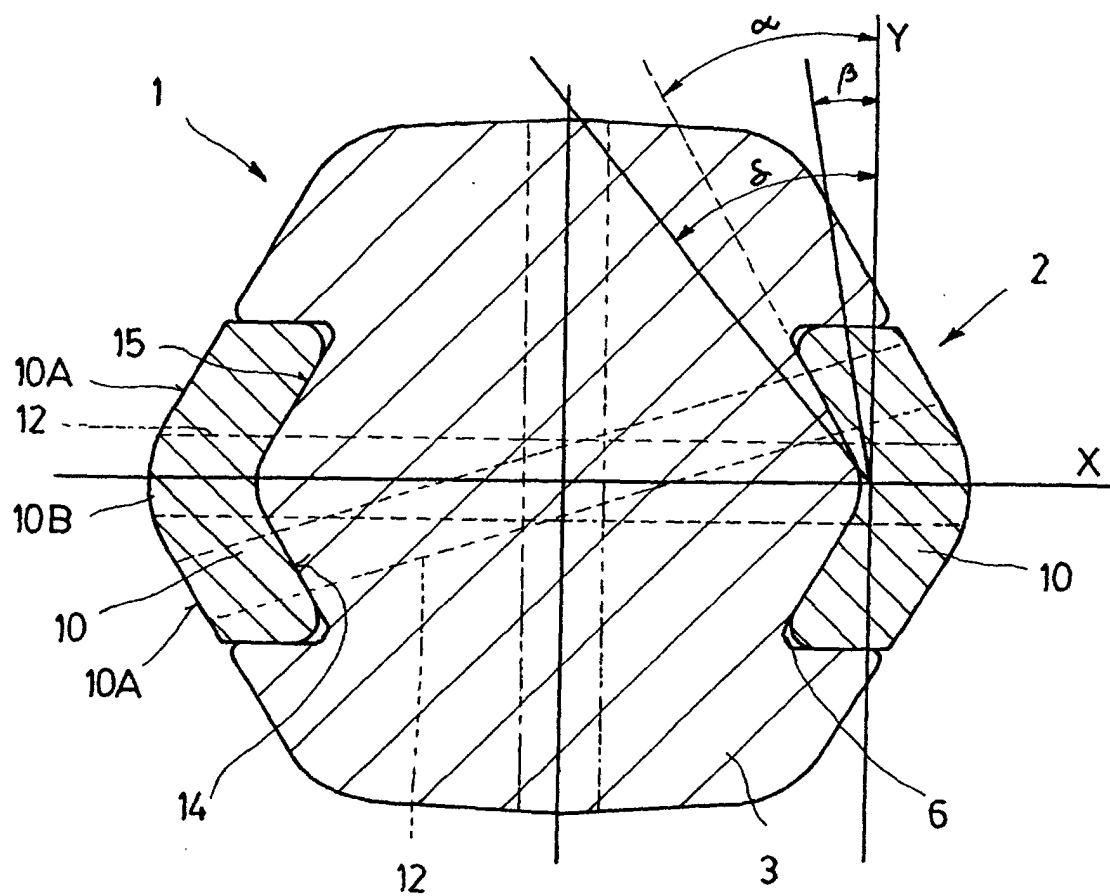


FIG. 9

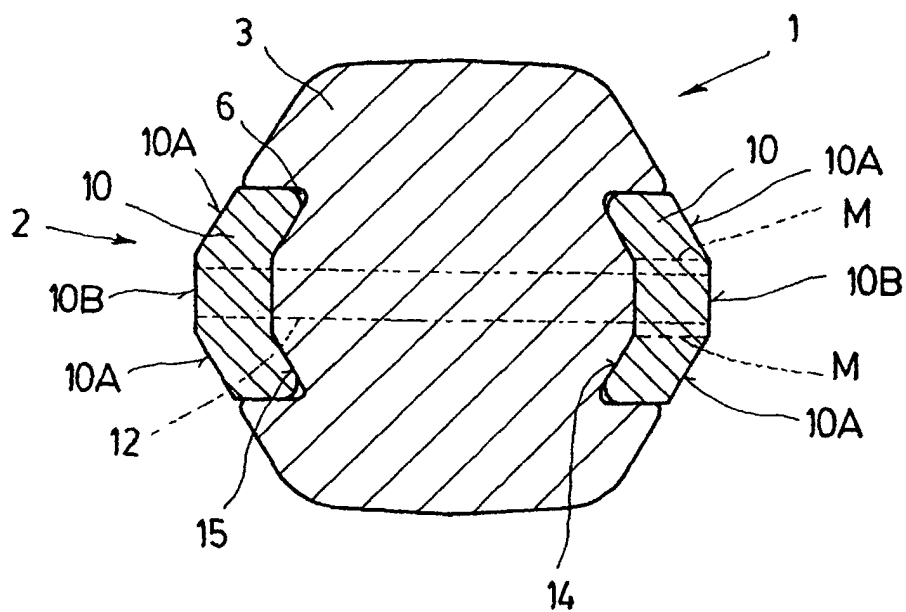


FIG. 10

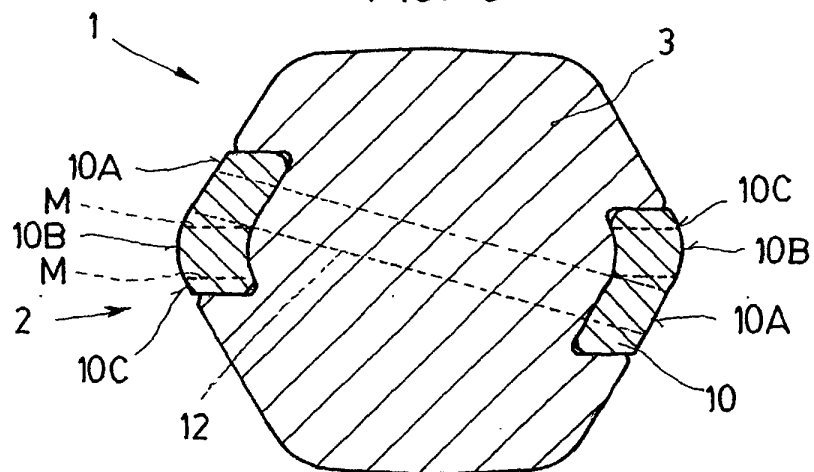


FIG. 11

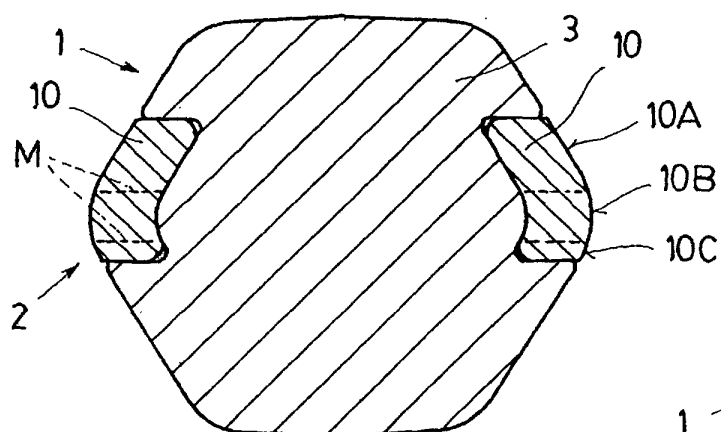


FIG. 13

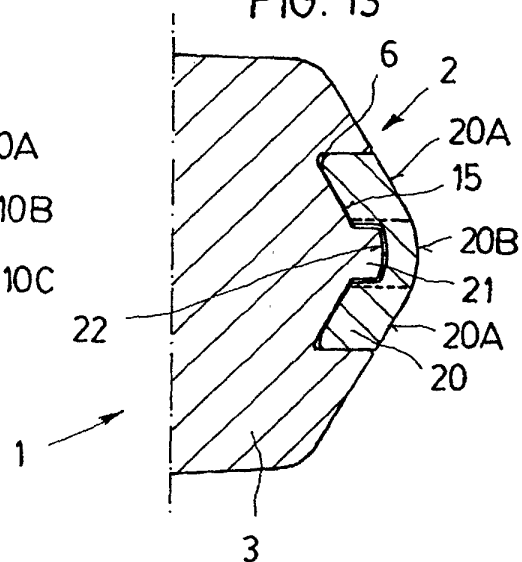
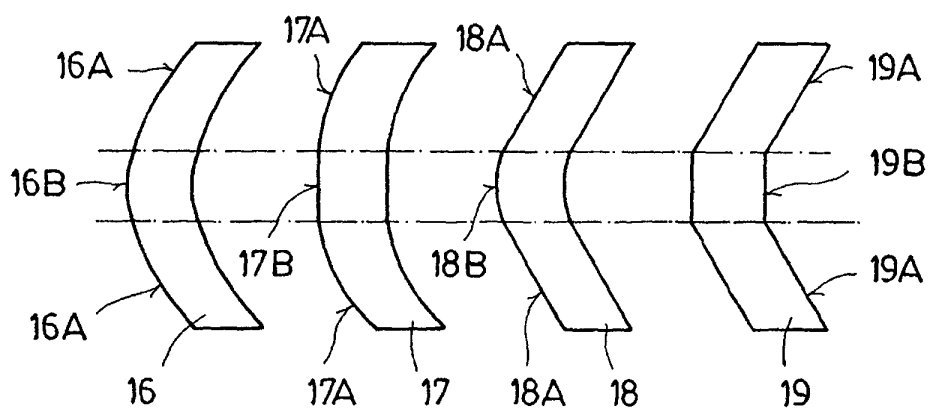


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES 01/00363

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E02F 9/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ES 2144519 T (CATERPILLAR) 16.06.2000. the whole document	1,5,8,14,16
A	ES 2138311 T (METALOGENIA S.A) 01.01.2000. the whole document	1,3,6,8,12,14

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
06 November 2001 (06.11.2001)Date of mailing of the international search report
29 November 2001 (29.11.01)Name and mailing address of the ISA/
S.P.T.O

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
 Information on patent family members

International Application No

PCT/ES 01/00363

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
ES 2144519 T	16.06.2000	WO 9428257 A	08.12.1994
		CA 2138531 A	08.12.1994
		AU 6557394 AB	20.12.1994
		MX 9404075 A	31.01.1995
		US 5386653 A	07.02.1995
		EP 0651837 AB	10.05.1995
		ZA 9402845 A	12.07.1995
		CN 1110060 AB	11.10.1995
		RU 2119998 C	10.10.1998
		DE 69422371 DT	03.02.2000
ES 2138311 T	01.01.2000	AU 2839197 AB	15.01.1998
		EP 0835963 AB	15.04.1998
		JP 10102548 A	21.04.1998
		BR 9703813 A	03.11.1998
		US 5918391 A	06.07.1999
		AT 184670 T	15.10.1999
		DE 69604293 DT	21.10.1999