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CA 2779503 C 2015/04/07

(11)(21) **2 779 503**

(12) BREVET CANADIEN / CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2010/10/13
(87) **Date publication PCT/PCT Publication Date:** 2011/06/03
(45) **Date de délivrance/Issue Date:** 2015/04/07
(85) **Entrée phase nationale/National Entry:** 2012/05/01
(86) **N° demande PCT/PCT Application No.:** AT 2010/000392
(87) **N° publication PCT/PCT Publication No.:** 2011/063435
(30) **Priorité/Priority:** 2009/11/27 (AT A 1892/2009)

(51) **Cl.Int./Int.Cl.** ***B23P 15/40*** (2006.01), ***B21H 7/10*** (2006.01), ***B27L 11/00*** (2006.01)

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(54) **Titre : PROCEDE DE FABRICATION DE LAMES REVERSIBLES**
(54) **Title: METHOD FOR PRODUCING REVERSIBLE KNIVES**

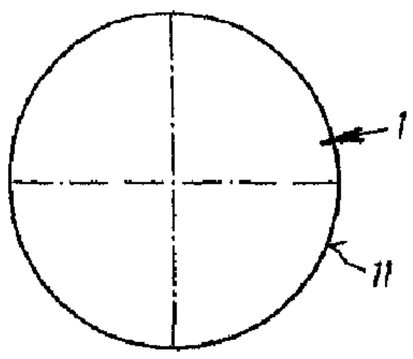

Fig.1

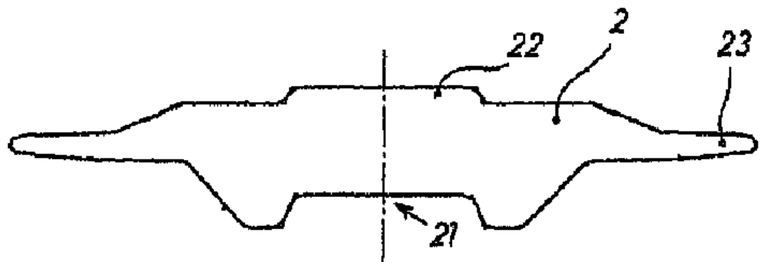

Fig . 2

Fig. 3

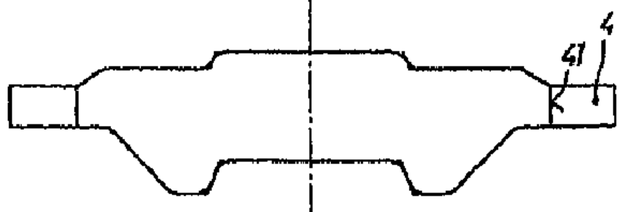

Fig. 4

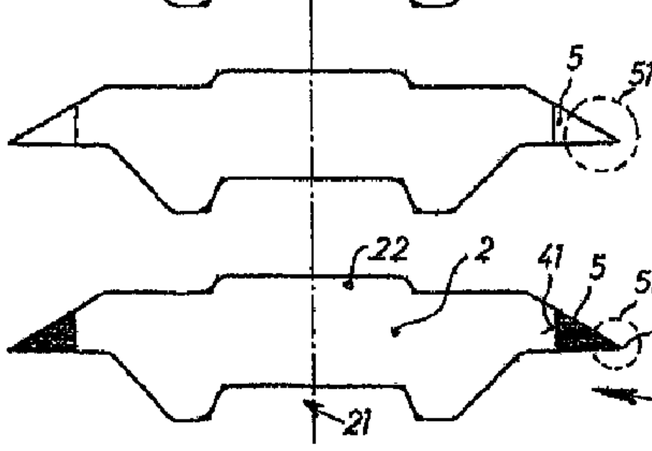

Fig. 5

Fig. 6

(57) **Abrégé/Abstract:**
A method is provided for producing reversible knives with profiled cross section composed of a proximal support part with at least one fitting means for fastening the knife and, on both sides of the support part, a distal chipping region containing cutting edges,

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(57) **Abrégé(suite)/Abstract(continued):**
wherein a preliminary material is subjected to a surface processing and a support profile is formed by rolling. Distal regions of the support part, worked in an overfilled rolling groove and having a large longitudinal extension, are removed in passage, respectively forming a bonding surface axially symmetrically in the longitudinal direction. Attachment parts of tool steel are attached to these processed surfaces of the support part, and from the attachment parts chipping regions with respectively one blade region and one cutting edge are shaped. At least edge regions of the chipping regions are treated with a thermal material treatment. Knives are then cut to a desired length.

Abstract

A method is provided for producing reversible knives with profiled cross section composed of a proximal support part with at least one fitting means for fastening the knife and, on both sides of the support part, a distal chipping region containing cutting edges, wherein a preliminary material is subjected to a surface processing and a support profile is formed by rolling. Distal regions of the support part, worked in an overfilled rolling groove and having a large longitudinal extension, are removed in passage, respectively forming a bonding surface axially symmetrically in the longitudinal direction. Attachment parts of tool steel are attached to these processed surfaces of the support part, and from the attachment parts chipping regions with respectively one blade region and one cutting edge are shaped. At least edge regions of the chipping regions are treated with a thermal material treatment. Knives are then cut to a desired length.

Method for producing reversible knives

The invention relates to a method for producing reversible knives with profiled cross section, in particular for a use in chopping machines for wood chipping, composed in cross section of a proximal support part with at least one fitting means for fastening the knife in a detachable and displacement-proof manner and on both sides on the support part a distal chipping region containing the cutting edges, wherein a preliminary material with large longitudinal extension is subjected to a surface processing and a support profile is formed therefrom by rolling.

The prior art includes reversible knives of the type described above in different embodiments. The embodiments mainly represent advantageous economical and/or technical innovations with respect to a special property profile of the knives.

EP 0 271 481 A, for example, discloses a method for producing in particular machine blades of hot-rolled flat steel, wherein a roll tab with homogeneous material structure in the cutting edge region is formed essentially on the side surface by overfilling the last groove.

From DE-OS-27 04 999 a method is known for producing strip-steel knives in continuous passage, wherein the strip is provided with a central groove or flute and the strip is guided on this groove or flute through the following work zones.

A reversible knife that can be used in a knife carrier in a predetermined position by projections or recesses interacting in terms of fit, and two welded-on working parts distal in cross section with blades of high-alloy tool steel, is disclosed by document AT 398 401 B.

Flat-steel knives with a rear end part optionally pressed on or a curved end part for attachment, which is positioned opposite the blade part, formed of tool steel, with a cutting edge are known from US 2009/021 7794 A1.

Reversible knives of the referenced type have economical disadvantages due to a complex production method and/or disadvantages of inadequate product quality or a lack of individual desired use qualities.

An object of the invention is now to disclose a generic method for producing reversible knives, by means of which the property profile thereof is optimized economically even with harsh stresses in use.

This object is attained with a method of the type mentioned at the outset in that the distal regions of the support part, worked in an overfilled rolling groove and having a large longitudinal extension, are removed in passage, respectively forming a bonding surface axially symmetrically in the longitudinal direction, after which respectively one attachment part of tool steel is attached to these processed surfaces of the support part by means of metallic bonding, and from the attachment parts chipping regions with respectively one blade region and one cutting edge are shaped by chip removal, on which edge regions a thermal material treatment and subsequently a cutting to length take place for reversible knives ready for operation.

According to an aspect of the present invention, there is provided a method for producing reversible knives with a profiled cross section that includes a proximal support part with at least one fitting for fastening the knife in a detachable and displacement-proof manner and distal chipping regions having cutting edges on the support part, the method comprising:

forming the support part by processing a preliminary material with a longitudinal extension;

removing distal regions of the support part to form processed surfaces axially symmetric in a longitudinal direction;

attaching attachment parts to the processed surfaces;

shaping the distal chipping regions from the attachment parts to form blade regions with the cutting edges;

treating at least edge regions of the distal chipping parts with a thermal material treatment; and

cutting the reversible knives to a desired length.

The advantages achieved with the method according to the invention are due to the fact that proximal fitting means and distal regions of the support part are simultaneously formed from the preliminary material by rolling in an overfilled groove, which distal parts far towards the longitudinal axis have a cold-worked, substantially unoriented structure and consequently a preferred strengthening of the material. These distal hardened parts, partially pressed out of the groove, are removed substantially at room temperature and a flat surface is formed, wherein it is ensured that the strength of the material achieved by cold working is retained in the flat region.

Attachment parts of tool steel are metallically connected to the surfaces of the support part formed in this manner, wherein the connection or welding is carried out in a high-energy manner, that is, without disadvantageous depth action. In this manner only an unimportant reduction in strength of the material of the support part hardened by cold working is achieved in the connection region, which produces a desired high mechanical stability of a fixing of the attachment part.

A forming of a chipping region with a cutting edge takes place respectively on the attachment part by means of cutting, optionally in combination with partial cold working, wherein a high-strength connection to the support part is maintained.

A thermal material hardening and tempering of the edge region is thereby provided such that no heat affecting of the zone with the metallic bond or welding without any additional materials takes place on the attachment part.

A final sharpening of the blade and a cutting to length of the knives can now take place in a simple manner.

In one embodiment of the invention it is advantageous if the preliminary material with large longitudinal extension, after a dimensionally exact processing of the surface thereof and before a rolling to form a support part, is heated by a rapid heating in a period of less than 50 sec., in particular of less than 15 sec., preferably by means of induction heating, in passage to a temperature of less than 900°C with the proviso that the structure of the material remains in a cubic body-centered atomic structure. In this manner, by means of a directly upstream dimensionally exact processing of the surface, an exact dimensioning of the preliminary material and thus a precise definition of the dimensions of the rolled product, on the one hand, and, on the other hand, a high quality non-scaling surface quality of the support profile, in particular the adjacent surfaces of the fitting means, take place. To avoid a disadvantageous oxide formation, it is advantageous for the preliminary material to provide a rapid heating in a period of less than 50 sec., which heating is preferably carried out by induction in passage. A maximum temperature for shaping the preliminary material is determined by the chemical composition or by the carbon content of the material. For a work hardening of the material during the shaping, at most a temperature is necessary at which a recrystallization of the structure is avoided and thus a forming of the part takes place in the temperature range with cubic body-centered atomic structure.

In order to achieve favorable conditions for a connection of the attached parts by fusion welding without any additional material with a small heat-affected zone, it can be advantageous with respect to a good adhesion and a precise consistence over the longitudinal extension if axially symmetrically distal regions are removed from the shaped support part during its guidance by the fitting means in passage with the formation of processed flat surfaces, wherein the width of the surfaces is more than 0.9 mm but less than 2.9 mm.

It is thereby advantageous in terms of bonding technology if with a shift in the longitudinal axial direction and with guidance of the support part by the fitting means, this is metallically fixed with attached parts of tool steel with a thickness of more than 0.9 mm but less than 2.9 mm and a width of 1.0 mm to 4 mm by fusion without any additional material, in particular by means of laser welding.

Advantageously, the carbon content of the usually low-alloy support part is to be oriented to the carbon activity of the attached parts established by alloying technology, in order to keep low or inactive a carbon diffusion to the high-alloy tool steel and thus a danger of a formation of a brittle region in the welding zone.

If the attached parts on the support part are further developed by cutting and/or by non-cutting shaping to form chipping regions substantiallytriangular in cross section with cutting edges, the mechanical stresses in the region of the connection zone can be minimized in a favorable manner and the material strength therein can be increased.

Advantageously, the blade regions with the cutting edges on the chipping part after a final machining to the axially symmetrical precise representation of the cutting edges in passage are subjected to a thermal material quenching and tempering by hardening and quenching the blade region of tool steel. In this manner desired properties and hardness values of the blade regions with respect to the field of use of the knives can be adjusted. However, it is necessary thereby to restrict the material quenching and tempering of the tool steel to the blade region and to avoid a disadvantageous heating of the chipping part in the region of the weld seam because an embrittling therein can lead to a breakage of the metallic bond.

It can be favorable for economic reasons if optionally from an intermediate storage a support part with great longitudinal extension after shaping of the distal chipping and blade regions and a thermal quenching and tempering of the regions with the dressed cutting edges is cut to length and finally formed to produce reversible knives ready for use.

In one aspect, there is provided a method for producing reversible knives with a profiled cross section that includes a proximal support part with at least one fitting for fastening the knife in a detachable and displacement-proof manner and distal chipping regions having cutting edges on the support part, the method comprising:

forming the support part by processing a preliminary material with a longitudinal extension;

removing distal regions of the support part to form processed surfaces axially symmetric in a longitudinal direction, wherein the distal regions are longitudinal extensions resulting from working the preliminary material in an overfilled rolling groove;

attaching attachment parts to the processed surfaces;

shaping the distal chipping regions from the attachment parts to form blade regions with the cutting edges;

treating at least edge regions of the distal chipping parts with a thermal material treatment; and

cutting the reversible knives to a desired length.

The invention is described in more detail below based on drawings which are intended to illustrate a production process for knives, and on exemplary embodiments, which show only one way of carrying out the invention.

The graphical representations show

Fig. 1 Preliminary material

Fig. 2 Shaped support part

Fig. 3 Processed support part

Fig. 4 Support part with attached part

Fig. 5 Support part with chipping region

Fig. 6 Reversible knife

Fig. 1 shows a cylindrical preliminary material 1 with a processed surface 11 with a rough depth R_y, (R_z ISO) of less than 45 µm.

Fig. 2 shows a support profile 2 shaped by means of rolling with an overfilled groove, which support profile in the distal regions respectively has a roll tab 23. During rolling fitting means 21, 22 with a concave shape 21 and a convex 22 shape have been worked proximally at the same time into the carrier body 2.

Fig. 3 shows diagrammatically a support profile body produced by separation 3 from the distal roll tabs 23 and provided with processed surfaces 3.

Fig. 4 shows in a schematic illustration respectively one attached part 4 fixed to the support part 2, wherein a metallic bonding 41 of the parts 2, 4 was carried out by fusing without any additional material, in particular by means of laser welding.

Fig. 5 shows respectively a chipping part 5 formed by processing an attached part 4, with a blade region 51 distanced from a bond or a weld seam 41.

Fig. 6 shows diagrammatically a knife W cut to measured length comprising a support part 2 with proximally positioned fitting means 21, 22 comprising a concave indentation 21 shaped in the knife axial longitudinal direction and a convex projection 22 lying opposite with attached parts 4 permanently attached to the support part 2 distally by metallic bonding 41, which attached parts are further developed to form chipping parts 5 and have thermally hardened blade regions 51 with cutting edges 52.

By means of practical tests so-called "trimetal" reversible knives of a support part 2 formed of high carbon steel and a chipping part 5 comprising a high-speed steel alloy EN/DIN material no. 1.3247 or AISI-M42 hardened and tempered to a hardness of 65 HRC in the blade region were examined and tested practically in a hard insert.

Test results showed that, above a certain carbon content of the support part 2 material, a carbon diffusion towards the tool steel part in the connection region 41 can take place

depending on temperature and time, whereby brittle regions formed in the weld seam can cause the chipping parts 5 to break loose.

Support parts 2 of carbon steels with a low C concentration of less than 0.35% by weight showed this danger to a much lower extent, wherein a prior strengthening of the material caused by cold working at a temperature in the alpha range of the alloy provides sufficient toughness and strength properties for extreme stresses of the knives even after an attachment by welding of an attached part 4.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for producing reversible knives with a profiled cross section that includes a proximal support part with at least one fitting for fastening the knife in a detachable and displacement-proof manner and distal chipping regions having cutting edges on the support part, the method comprising:

forming the support part by processing a preliminary material with a longitudinal extension;

removing distal regions of the support part to form processed surfaces axially symmetric in a longitudinal direction, wherein the distal regions are longitudinal extensions resulting from working the preliminary material in an overfilled rolling groove;

attaching attachment parts to the processed surfaces;

shaping the distal chipping regions from the attachment parts to form blade regions with the cutting edges;

treating at least edge regions of the distal chipping parts with a thermal material treatment; and

cutting the reversible knives to a desired length.

2. The method according to claim 1, wherein the reversible knives are structured for a use in chopping machines for wood chipping.

3. The method according to claim 1 or 2, wherein the attachment parts comprise tool steel.

4. The method according to any one of claims 1 to 3, wherein the attachment parts are attached to the processed surfaces by metallic bonding.

5. The method according to any one of claims 1 to 4, wherein the distal chipping regions are shaped by chip removal, cold forming or both.

6. The method according to any one of claims 1 to 5, wherein the processing of the preliminary material comprises a surface processing of the preliminary material and a rolling of the preliminary material.

7. The method according to claim 6, wherein after the surface processing and prior to the rolling, the method further comprises:

heating the preliminary material by a rapid heating in a period of less than 50 sec. to a temperature of less than 900° C, wherein the structure of the material remains in a cubic body-centered atomic structure.

8. The method according to claim 7, wherein the rapid heating period is less than 15 sec.

9. The method according to claim 7 or 8, wherein the heating of the preliminary material comprises induction heating.

10. The method according to any one of claims 1 to 9, wherein the removing of the distal regions occurs while the shaped support part is guided by the fittings and the formed processed surfaces are processed flat surfaces having a width of more than 0.9 mm but less than 2.9 mm.

11. The method according to any one of claims 1 to 10, wherein the formed support part is guided in a longitudinal axial direction, and, prior to attaching the attachment parts, a shift occurs in the longitudinal axial direction and the support part is guided by the fittings, and

wherein the attachment parts, having a thickness of more than 0.9 mm but less than 2.9 mm and a width of 1.0 mm to 4 mm, are metallically fixed to the support part when attaching to the processed surfaces.

12. The method according to claim 11, wherein the attaching comprises fusion without any additional material.

13. The method according to claims 11 or 12, wherein the attaching comprises laser welding.

14. The method according to any one of claims 1 to 13, wherein the shaping of distal cutting regions comprises cutting shaping, non-cutting shaping or both.

15. The method according to claim 14, wherein the distal chipping regions are shaped with substantially triangular cross-sections and cutting edges.

16. The method according to any one of claims 1 to 15, wherein the blade regions comprise tool steel, and wherein a final machining of the blade regions to an axially symmetrical configuration of the cutting edges occurs prior to the treating with the thermal material treatment, which comprises quenching and tempering at least part of the blade regions.

17. The method according to claim 16, wherein the thermal material treatment comprises quenching and tempering dressed cutting edges of the blade regions.

18. The method according to any one of claims 1 to 17, wherein the support part has a longitudinal extension from which the reversible knives are cut to a desired length after the shaping of the distal chipping regions and after the treating of the at least edge regions, whereby the reversible knives are ready for use.

19. The method according to claim 18, wherein the treating of the at least edge regions comprises thermal quenching and tempering of dressed cutting edges of the distal chipping parts.

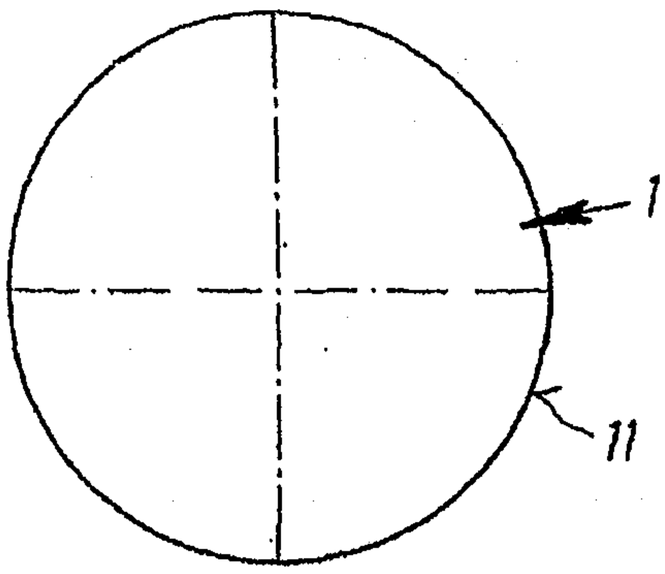

Fig.1

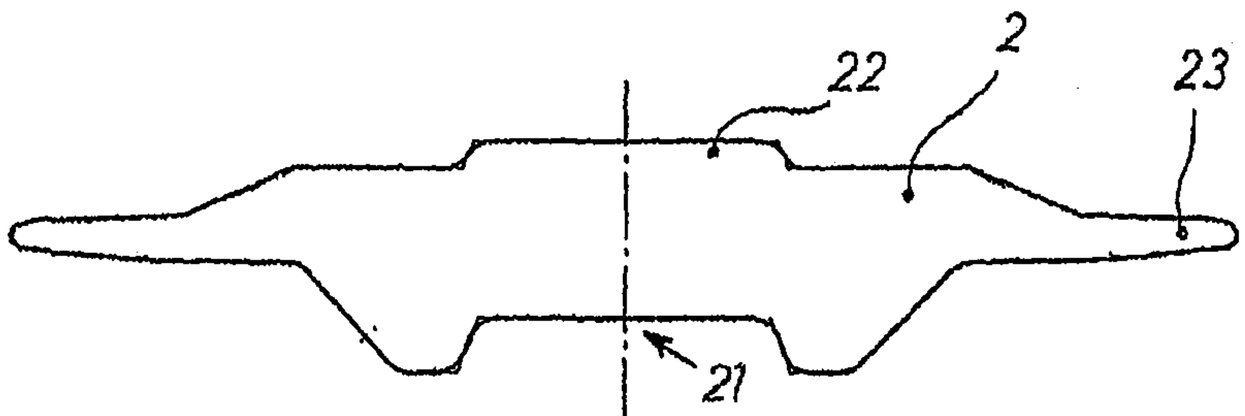

Fig . 2

Fig. 3

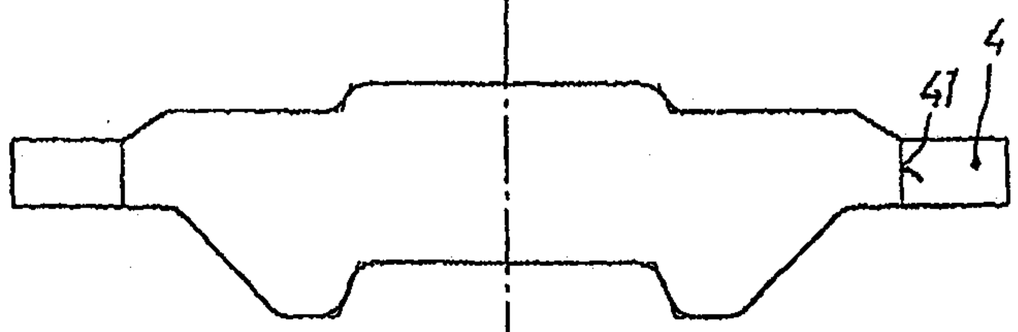

Fig. 4

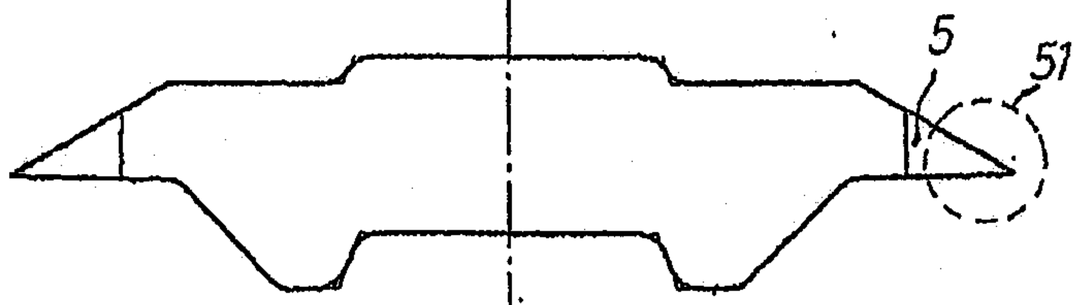

Fig. 5

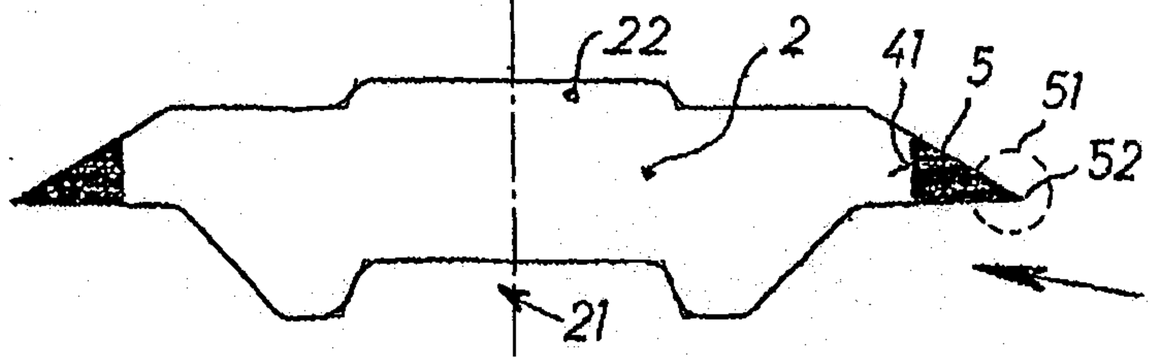

Fig. 6

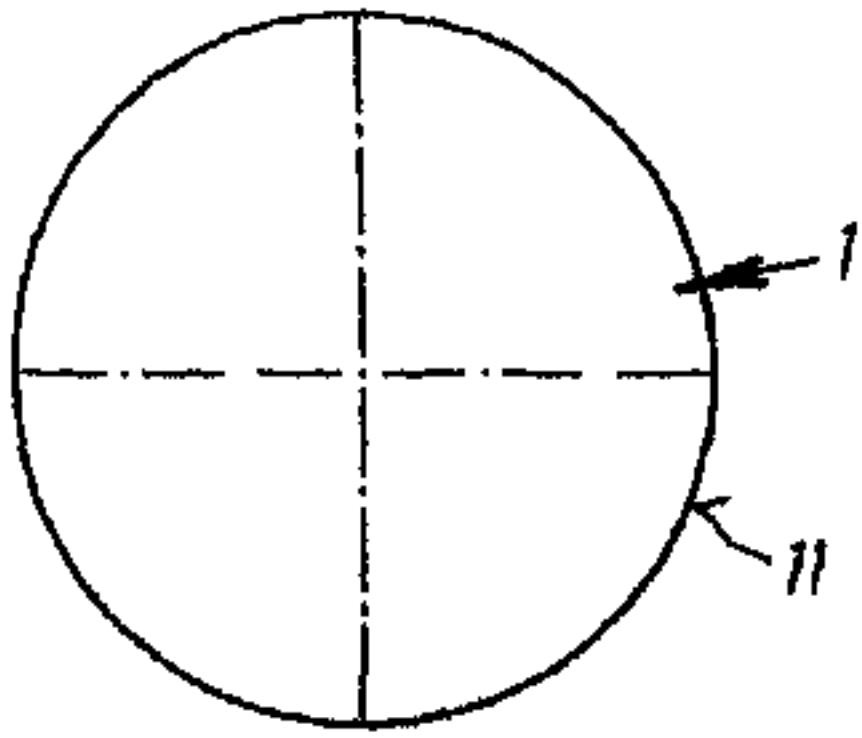

Fig.1

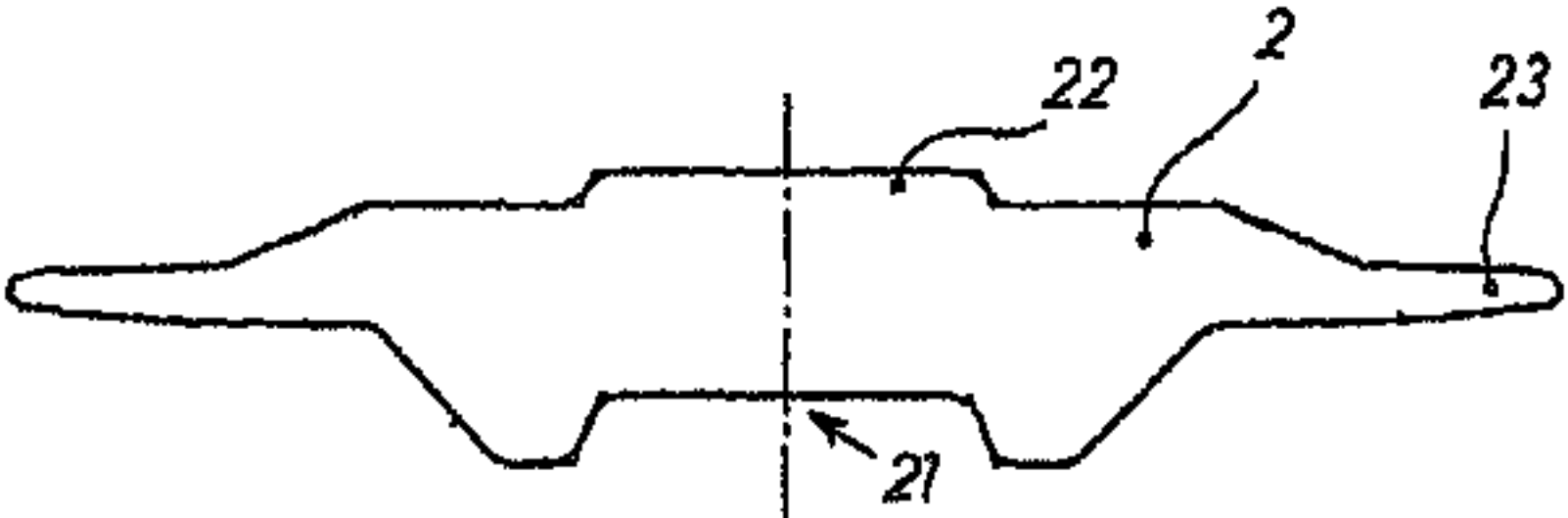

Fig . 2

Fig. 3

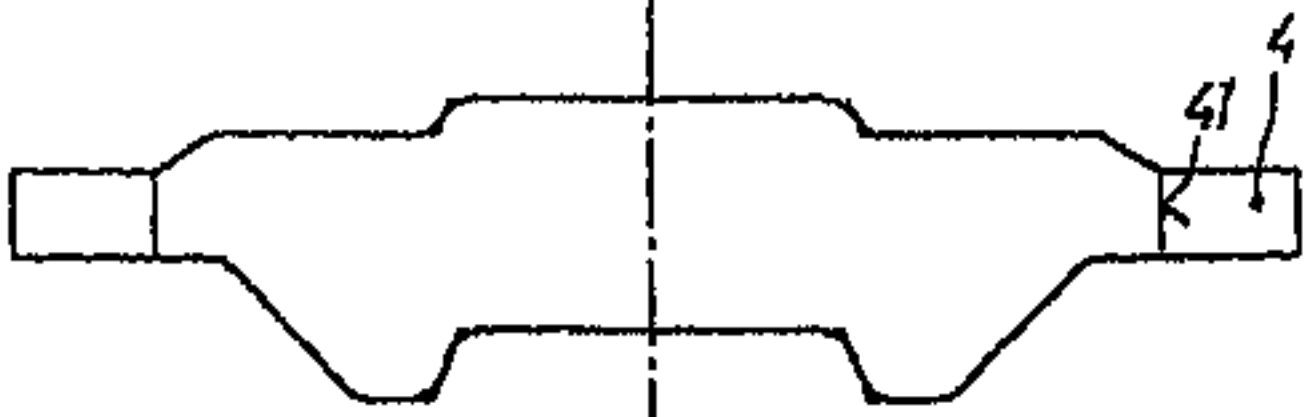

Fig. 4

Fig. 5

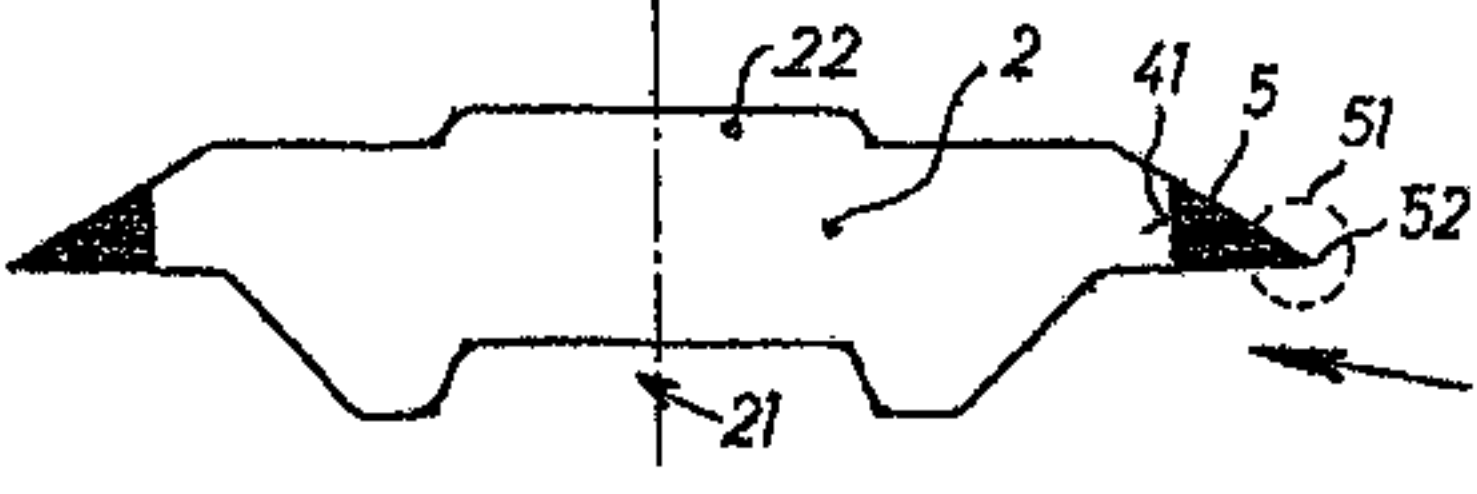

Fig. 6