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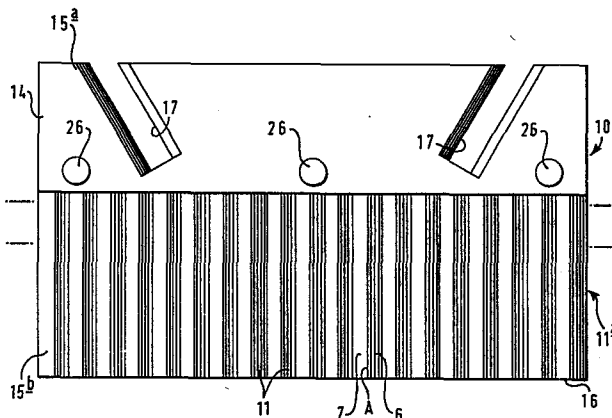
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⑤④ **Improved knife blade having a corrugated cutting edge.**

⑤⑦ A method of making a knife blade (10) having a zig-zag cutting edge (16) with sharp V-shaped apices (A) on at least one side, including the steps of taking a metal plate, forming said plate with a plurality of parallel corrugations (11) which extend from an edge thereof, each corrugation having a V-shaped apex, the forming operation including displacing metal at each apex into a region (20) outwardly of an arc of radius not less than the thickness of the plate in regions spaced from the associated apex and having a centre of curvature lying on a bisector of the apex.



Title: "Improved knife blade having a corrugated cutting edge"

This invention relates to a knife blade having a zig-zag cutting edge comprising a series of straight sections of which each adjacent pair are disposed at an angle to one another and meet at an apex, the apices being disposed alternately at one side and the other of a plane which passes through the straight sections and to a method of making such a knife blade.

Such knife blades are commonly used to form chevron -shaped cossettes of sugar beet. To produce cossettes of the desired shape it is necessary for the cutting edge of the blade to be sharp, in particular with each apex having a sharp V shape by which we mean having a radius of 0.2mm or less and preferably 0.1mm or less, more preferably 0.05mm or less and still more preferably not substantially more than 0.01mm.

Hitherto it has been necessary to machine such knife blades from solid blanks in order to provide the desired apex sharpness. However this method has the disadvantage that the blades are very costly to produce.

Of course corrugated knife blades with sharp V-shaped apices may be used for other purposes than cutting beet and the present invention relates to such knife blades irrespective of their intended use.

Objects of the invention are to provide a new or improved more economic method of making a knife blade having a zig-zag cutting edge with sharp V-shaped apices, and a knife blade made by such a method.

According to one aspect of the invention we provide a method of making a knife blade having a zig-zag cutting edge with sharp V-shaped apices on at least one side, including the steps of taking a metal plate, forming said plate with a plurality of parallel corrugations which extend from an edge thereof, each corrugation having a V-shaped apex, the forming operation including displacing metal at each apex into a region outwardly of an arc of radius not less than the thickness of the plate in regions spaced from the associated apex and having a centre of curvature lying on a bisector of the apex.

If desired, the apices on both sides of the plate may comprise sharp V-shaped apices.

The metal in said outward region may be machined to provide said sharp apex but alternatively, the displacing operation may form the metal in said region to provide said sharp apex.

Preferably however, the entire edge including the pair of straight portions and the apices, are machined to provide a sharp zig-zag cutting edge.

When the sharp apex is produced by machining, the displacing operation may provide sufficient metal in said outward region so that, after machining, the thickness of the blade at each apex is not substantially less than the thickness of the straight portions of the blade.

Previously it has not been possible to produce a blade having a zig-zag cutting edge using a forming operation, because the thickness of the blade at each apex has, due to bending, been thinner than the general thickness of the blade over the straight sections.

Thus when the edge has been machine sharpened, an uneven cutting edge has been produced. This is because the machining operation has tended to remove a greater proportion of metal from each thinned apex than from the straight sections resulting in the apex at the edge, being removed and the uneven cutting edge being produced.

Such an uneven cutting edge is unacceptable because it will not cut accurately and efficiently. However in a blade produced by the method according to the invention, a straight, even, sharp zig-zag cutting edge is produced easily and economically.

The plate may be bent along lines parallel to the cutting edge to provide a stepped shape and the stepped down part distant from the cutting edge, may be provided with apertures and/or other formations, whereby the blade may be attached for example to a slicing machine.

According to a second aspect of the invention we provide a knife blade having a zig-zag cutting edge when made by the method of the first aspect of the invention.

One way of carrying out the invention is described in detail below with reference to the drawings which illustrate two specific embodiments and in which:-

FIGURE 1 is a plan view of a knife blade in accordance with the invention;

FIGURE 2 is a side elevation of the knife blade of Figure 1;

FIGURE 3 is a cross-section on the line 3-3 of Figure 2;

FIGURE 4a is a diagrammatic illustration to an enlarged scale showing two straight sections and an apex of a first blade at a stage in manufacture;

FIGURE 4b is a diagrammatic illustration to an enlarged scale showing two straight sections and an apex of a second blade, at a stage in manufacture;

FIGURE 5 is a similar view to Figure 4a and Figure 4b showing a modification;

FIGURE 6a is a similar view to Figure 3, of two straight sections and an apex of a blade made by a process not according to the invention for comparison purposes;

FIGURE 6b is a plan view of the corrugation of Figure 6a.

Referring to Figures 1 to 5, a knife blade 10 for cutting beet into cossettes is illustrated. Such knife blades are used in either a vertical drum slicing machine or a horizontal disc slicing machine and in both machines alternate rows of knife blades are offset laterally by a half pitch across the blades so that cossettes of the desired shape are achieved. At least in the United Kingdom knife blades for the above application are of a standard dimension, namely a width of 137mm., a pitch of 7.2mm., and a height of 6mm.

It is usual to set the knife blade so that the top of each V-shaped corrugation is between 3.25mm. and 4.0mm. above the forelayer; the higher the knife the thicker the cossette achieved. In addition the distance between the cutting edge of the knife and the rear edge of the forelayer is set to be sufficient to permit the cossette to clear the cutting throat and normally the distance is set in the range 6mm. to 8mm.

The blade 10 illustrated conforms with these dimensions although it is shown to reduced scale.

Nevertheless the blade may be of any other dimensions when conformity with the above standard is not required.

In the present example, the blade 10 comprises a metal plate formed, as hereinafter to be described, to provide a plurality of V-shaped corrugations 11 over the entire plate.

Over a cutting part 11a thereof, each corrugation 11 has a pitch of 7.2mm. giving nineteen corrugations over the 137mm. width. In addition the plate is bent about lines 12, 13 to provide a stepped and inclined configuration and a stepped down part 15a being inclined relative to a front part 15b. Over the part 15a, the corrugations are flattened, for example in a pressing operation for the reason hereinafter explained.

The corrugated edge 16 of the part 15_b is sharpened to provide a zig-zag cutting edge afforded by the sharpened ends of the corrugations 11, as described below. The zig-zag cutting edge comprises a plurality of straight portions 8 adjacent straight portions, for example 6 and 7, being disposed at an angle to one another and meeting at an apex A. The apices A are disposed alternately at one side and the other of a plane P which passes through the straight portions 8, and shown only in Figure 3.

The part 15_a is provided with suitable apertures indicated at 17 to permit the blade 10 to be secured in position in the slicing machine.

The cutting edge 16 is also dressed to an appropriate angle depending upon the nature of the beet to be cut. The dressing and sharpening operations are performed to strict limits set out by the sugar beet processors but do not in themselves form part of the present invention and hence do not require detailed discussion.

As outlined previously, blades of the above described standard configuration have been made previously by machining from solid blanks. This has been necessary because it has not been possible to produce the zig-zag cutting edge 16 with adequately sharp V-shaped apices, i.e. with a radius of 0.2mm or less and preferably 0.1mm or less, more preferably 0.05mm or less and still more preferably not substantially more than 0.01mm except by this machining technique.

The present invention permits the production of a blade 10 of the above described standard type by a much more economical method which will now be described.

Initially a flat plate of the desired width, thickness, and length is taken, taking into account the extra length required for providing the corrugated configuration, and the extra width required for the stepped configuration. The plate is then passed through a series of forming rolls whereby the metal plate is roll formed to provide the above described nineteen corrugations 11, over the entire plate.

If desired, instead of taking plate of the desired size, strip or sheet may be drawn from roll stock and roll formed as described above and then blades of the desired dimensions cut from the rolled stock.

Referring to Figure 6_a, if it were attempted to produce a sharp radius on a plate by performing a simple bending operation, then the thickness t_1 of the metal adjacent the apex and the thickness t_2 at the apex A would be significantly less than the general thickness t of the metal straight portions

6, 7 of the edge 16. Thus when the straight portions 6, 7, and apex A of the cutting edge 16 are machine sharpened, a greater proportion of metal would be removed from the apex A than from the straight portions 6, 7.

Thus the cutting edge 16 produced would be uneven, the apex at the edge being removed, as shown in Figure 6b at 14. This problem would be aggravated when the straight portions 6, 7 of the edge are not perfectly straight over their entire length, because the machining tool, shown in dotted lines in Figure 6a, will as it rotates, remove metal along planes P1 and P2, and thus any metal lying outside those planes, would not be sharpened, whilst a large amount of metal in those planes, would be removed.

However with the method of the present invention the forming rolls are designed so that metal is displaced into a region 20, see Figure 4a and Figure 4b, outwardly of an arc, of radius r not less than t , which the plate would not adopt if subjected to a simple bending operation as described with reference to Figure 6a.

The desired sharp apex, i.e. an apex having a radius of 0.2mm or less and preferably 0.1mm or less, more preferably 0.05mm or less and still more preferably not substantially more than 0.01mm is preferably produced by designing the rolls so that the metal displaced in the region 20a is formed to the desired sharp radius as illustrated at 21a in Figure 4a wherein the straight sections continue up to the apex A, but may be produced by forming the metal in region 20b adjacent the apex into a bulge and subsequently machining the metal in the region 20 to produce the sharp radius as indicated at 22 in Figure 5. It will be noted that in this latter case the metal thickness in the region of the apex is not less than the thickness t of the straight portions 6, 7 but is greater than t . It is, of course, possible for the thickness to be slightly less than t if, for some purposes the apex requires machining which results in a slight reduction in thickness below t .

After thus forming the blades, the cutting edge is hardened and tempered by subjecting an edge region thereof to a conventional hardening and tempering sequence suitable for the particular alloy steel used and taking the usual precautions against distortion. The hardened and tempered steel should, for example, have a hardness lying in the range 50-54 Rockwell C (550-606 V.P.N.).

Although the particular case of knife blades for use for cutting sugar beet have been described hereinbefore, the invention may be applied to any blade having a zig-zag cutting edge with sharp V-shaped apices.

Although the method of manufacture described hereinbefore has been by way of roll forming, the corrugations and displacement of metal into the regions 20a and 20b at the apices may be by other forming operations such as by pressing between dies, or the corrugations may be formed to an intermediate configuration by any desired bending operation and the displacement of metal adjacent each apex being performed by a roll forming operation or a pressing or punching operation.

In the present example the blade 10 has been described as being of stepped configuration. So that the blade 10 can be secured to a slicing machine, apertures 17 are provided in the attachment part 15a of the blade 10, through which shanks of bolts can pass. However, it can be readily appreciated that if attachment part 15a is corrugated similar to the cutting part 16, then the bolt heads will not seat properly in contact with the corrugated surface.

Accordingly, preferably the corrugations are flattened by a pressing operation, over the attachment part 15a. This however presents a problem because the overall thickness of the blade 10 over attachment part 15a will thus be less than that required to provide the correct spacing between adjacent blades, secured to the slicing machine. Further, the bolt heads will stand proud of the attachment part 15a and interfere with the passage of cut beet over the surface of the blade 10.

Accordingly, a backing plate 25 is connected to the flattened attachment part 15a by rivets 26 or other fasteners, the backing plate 25 being of such thickness so that the overall thickness of the blade over the attachment part 15a, and the backing plate 25 together, is the same as the thickness of the blade 10 over the cutting part 16.

The backing plate 25 has apertures 17a aligned with apertures 17 of the blade.

Preferably the corrugations over attachment part 15a are flattened as much as possible so that the backing plate 25 can be as thick as possible and thus the edges of the apertures 17a can be rebated to provide a firm seating for a bolt head, and to ensure that the bolt heads lie flush, or nearly flush, with the surface of the backing plate.

Of course, if required instead of the backing plate 25, washers may be provided in the locality of the apertures 17 and the blade 10, to firmly seat the bolt heads. The washers may also have rebated apertures to allow the bolt heads to lie flush with the surface of the washers.

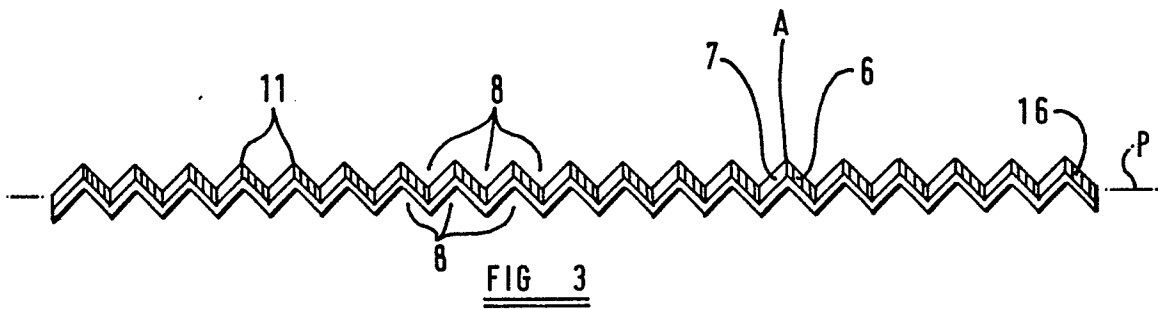
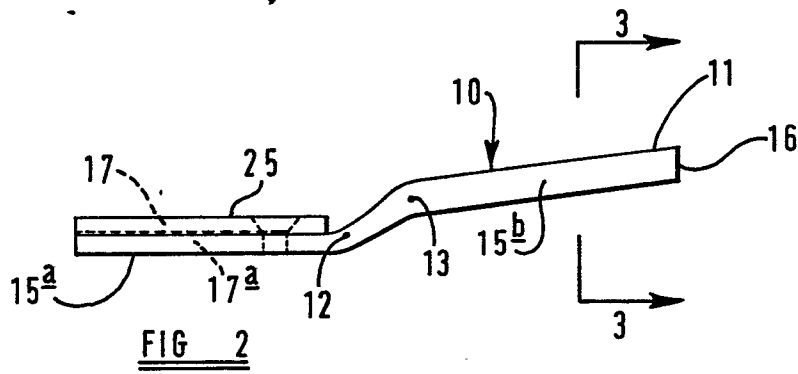
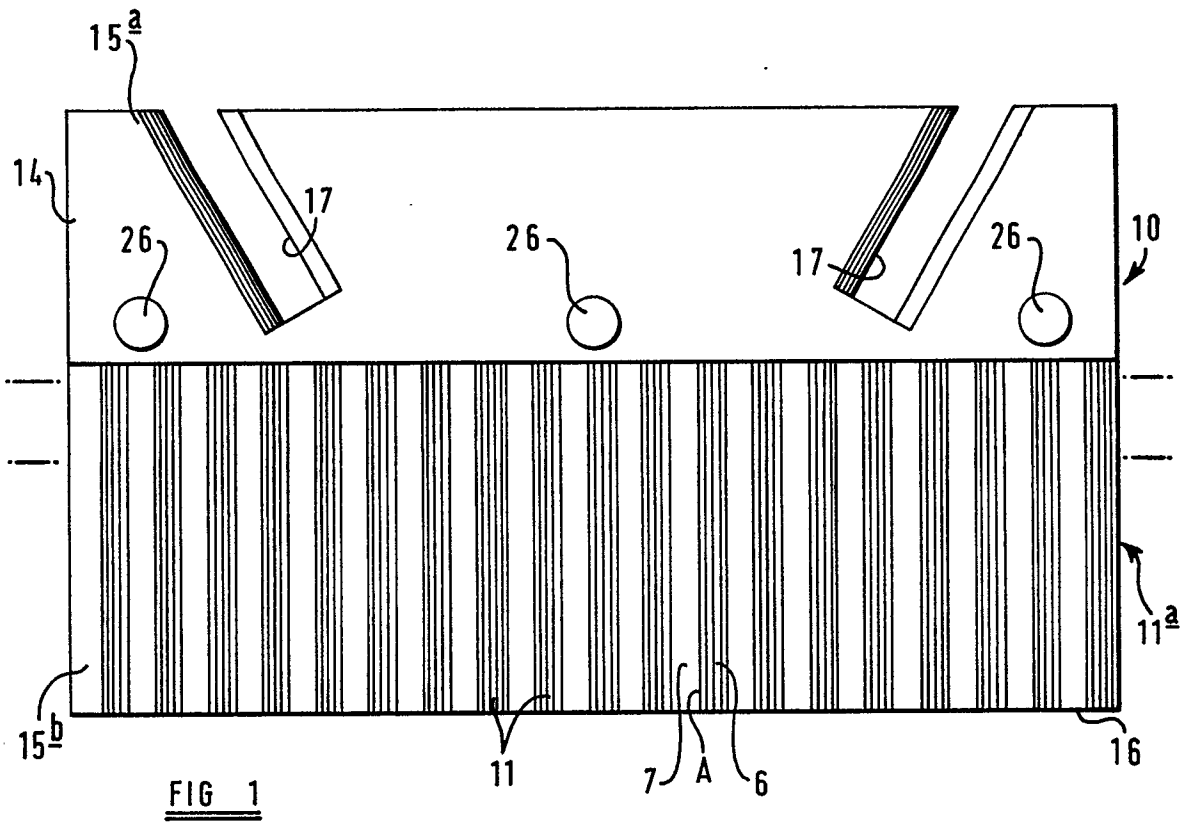
Particularly where washers are provided, the corrugations over attachment part 15a need not be flattened, but in this case, the additional thickness provided by the washer will not severely restrict the passage of cut beet over the surface of the blade, because such thickening occurs only adjacent the apertures 17 of the blade 10.

If desired to avoid the need to form either a step or a bend in the blade to provide a portion inclined to the attachment attachment part 15a, the blade 10 may be straight in a direction parallel to the corrugations 11 and secured in position with an intermediate angled plate to provide the desired angle of inclination.

CLAIMS:

1. A method of making a knife blade (10) having a zig-zag cutting edge (16) with sharp V-shaped apices (A) on at least one side, characterised in that said method includes the steps of taking a metal plate, forming said plate with a plurality of parallel corrugations (11) which extend from an edge (16) thereof, each corrugation (11) having a V-shaped apex (A), the forming operation including displacing metal at each apex (A) into a region (20) outwardly of an arc of radius (r) not less than the thickness (t) of the plate in regions spaced from the associated apex (A) and having a centre of curvature lying on a bisector of the apex (A).
2. A method according to Claim 1 characterised in that the apices (A) on both sides of the plate comprise sharp V-shaped apices.
3. A method according to Claim 1 or Claim 2 characterised in that the metal in said outward region (20) is machined to provide said sharp apex (A).
4. A method according to Claim 1 or Claim 2 characterised in that the metal in said outward region (20) is formed to said sharp apex (A) by the displacing operation.
5. A method according to any one of Claims 1 to 3 characterised in that the entire edge, including a pair of straight portions (6,7) which meet at the apices, are machined to provide the sharp zig-zag cutting edge (16).
6. A method according to Claim 3 or Claim 5 characterised in that the displacing operation provides sufficient metal in said outward region (20) so that, after machining, the thickness (r) of the blade at each apex (A) is not substantially less than the thickness (t) of the straight portions of the blade (10).
7. A method according to any one of the preceding claims characterised in that the plate is bent along lines (12,13) parallel to the cutting edge (16) to provide a stepped shape and the stepped down part (15a) distant from the cutting edge (16), is provided with formations (17) to permit the blade to be attached to another member.

8. A method according to any one of the preceding claims characterised in that the plate is cut to a desired size prior to forming said corrugations (11).
9. A method according to any one of Claims 1 to 7 characterised in that the plate (10) is cut to the desired size after forming said corrugations (11) in continuous stock material.
10. A knife blade having a zig-zag cutting edge when made by the method claimed in any one of the preceding claims.
11. A slicing machine having at least one knife blade according to Claim 10.



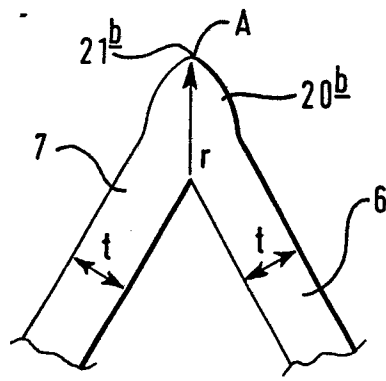


FIG 4^b

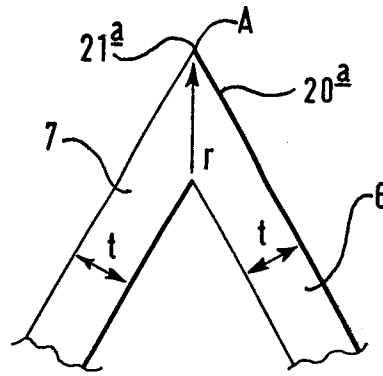


FIG 4^a

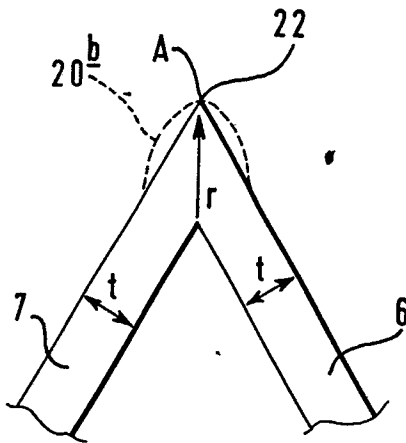


FIG 5

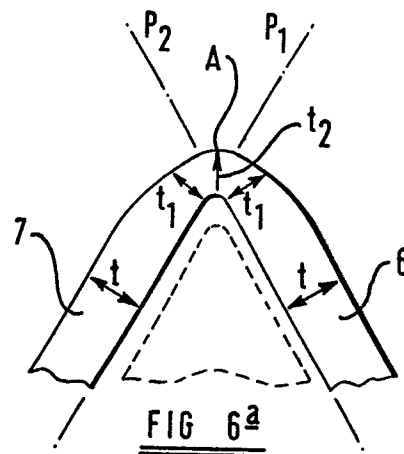


FIG 6^a

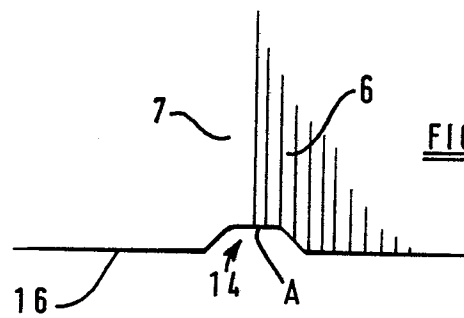


FIG 6^b



European Patent
Office

EUROPEAN SEARCH REPORT

0115555
Application number

EP 83 10 1190

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. 3)
A	DE-C- 459 970 (SEYDEL) * Claim 1; figures 1, 2 *	1	B 21 D 53/64
A	GB-A- 925 970 (MASSEY-FERGUSON)		
A	FR-A- 799 656 (STE INDUSTRIELLE DE FERBLANTERIE)		
A	US-A-2 590 024 (LIEBERMAN)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			B 21 D 13/00
			B 21 D 53/00
			B 21 H 7/00
			B 21 K 11/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 12-08-1983	Examiner SCHLAITZ J
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
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