WORKING EXAMPLE VC4: “ESSENTIAL FEATURES” BANDSAW BLADE AND METHOD OF MANUFACTURING A BANDSAW BLADE

[0001] The present invention concerns a bandsaw blade comprising a strip and teeth projecting therefrom, which teeth are arranged in recurring main groups, each main group comprising at least two recurring setting subgroups. The present invention also concerns a method of manufacturing a bandsaw blade.

PRIOR ART

[0002] Bandsaws have long been used for cutting of hard materials such as metal bars and profiles, their main advantage being that their thickness is lesser than for circular saws, thus wasting less material. They have disadvantages that have hitherto restricted their use, mainly due to the bandsaw blade loosing its torsional stiffness when the cutting force resistance against the tool edge is high. The result is that many tooth shapes and arrangements have been suggested with the purpose of reducing the cutting force required and other force components that might twist the blade. Well known such arrangements include having some teeth straight and longer than others to guide the blade laterally, and letting teeth with unequal height and width divide the cut in several thick chips with lesser width, known as the "Triple Chip" geometry.

[0003] One way of reducing the effect of the resulting lateral forces on the toothed edge of the sawblade is to let teeth that have large lateral forces occur in pairs with opposite setting. If the distance between them is small enough they will both be in the cut most of the time, and their individual lateral forces will counterbalance one another. However, small distances also mean that a larger number of teeth will be cutting simultaneously, with a large resulting feed force when cutting solid sections, which is not desirable, or a small feed force on each tooth, which means inefficient cutting and excessive wear.

[0004] Another problem is the low in-plane stiffness for many feed forces acting in unison, with a great risk of vibrations if many teeth at equal distances are cutting, causing vibration, noise, rough surfaces and reduced blade life. The reduced blade life is the result of damage to the tooth edge resulting from vibration. If only a few teeth are cutting simultaneously, the lateral forces will not be counterbalanced, which will result in corrugated surfaces on the workpiece finish. For this reason there has always been a "rule of thumb" that a minimum of three cutting teeth should be in contact with the workpiece.

[0005] These problems make it difficult to design an optimal bandsaw even for a well-defined task, and even more so if the bandsaw is to be used for a variety of materials involving different thickness, hardness, shapes of work pieces and bandsaw machines. Numerous tooth arrangements have been suggested for such situations. Differences in tooth height have been used not only for lateral guidance, but also to let a few longer teeth do most of the cutting in hard materials while still maintaining a reasonable cutting rate, and have all teeth actively cutting in soft materials.

[0006] Differences in tooth spacing is used to reduce vibrations and to locate teeth of equal height in pairs without getting too many cutting at the same time. Differences in setting, i.e. in bending the tooth outside the plan of the saw, are used to divide the kerf into more chips which are narrower and thicker for improved formation and lower cutting forces. Three set widths are traditional, right- unset-left, but five or more also occur, where lower teeth have larger set widths than higher teeth have.

[0007] For rational production, the teeth should be arranged in recurrent groups, corresponding to the widths of grinding, milling, punching and setting tools. Very long recurrent groups require larger tools and larger machines which are very expensive or not always available.

SUMMARY OF THE INVENTION

[0008] The purpose of the present invention is to create a bandsaw blade which is durable.

[0009] The invention thus comprises a bandsaw blade comprising a strip and teeth projecting therefrom, which teeth are arranged in recurring main groups, each main group comprising at least two recurring setting subgroups. The total set magnitude is the same for each one of the setting subgroups.

[0010] Each one of the said at least two recurring setting subgroups may comprise three teeth. The said unset tooth may have a top edge with two chamfered corners. The said at least one recurring geometrical subgroup may be the same as the said recurring main group. The said at least one recurring geometrical subgroup may comprise six teeth. The said at least one recurring geometrical subgroup may comprise nine teeth.

[0011] Each geometrical subgroup may comprise teeth of at least four different heights, and defining a height pattern repeating itself within the group.

[0012] Tooth heights and set magnitudes may be inversely related.

LIST OF DRAWINGS

[0013] Figure 1 shows, in a schematic cross section, a bandsaw blade according to the invention.

[0014] Figure 2 shows, in a side view, a part of the bandsaw blade according to figure 1, the part comprising two recurring setting subgroups of teeth.

[0015] Figure 3 shows, in a top view, the part according to figure 2.

[0016] Figure 4 shows, in a schematic cross section, a second embodiment of the bandsaw blade according to the invention.

[0017] Figure 5 shows, in a side view, a part of the bandsaw blade according to figure 4, the part comprising three recurring setting subgroups of teeth.

[0018] Figure 6 shows, in a top view, the part according to figure 5.

DESCRIPTION OF MODES OF EXECUTION

[0019] Figure 2 shows a part of a bandsaw blade 1a according to the invention with a recurrent main group of six teeth 1-6. The recurrent main group is combined with two short recurrent setting subgroups, a first one and a second one, of three teeth each, 1-3 and 4-6 respectively of five setting types, heavy left set (HL), light left set (LL), unset (0), light right set (LR) and heavy right set (HR) respectively the heavy set teeth being of substantially equal setting and the light set teeth being of substantially equal setting which is less than the setting of the heavy set teeth, see figures 1 and 3. Tooth heights and set magnitudes are inversely related. The first tooth 1 is of height h3 and light set to the right, the second tooth 2 is of height h1 and unset, the third tooth 3 is of height h4 and heavy set left, the fourth tooth 4 is of height h4 and heavy set to the right, the fifth tooth 5 is of height h2 and unset and the sixth tooth 6 is of height h3 and set light left. No two teeth in this group of six have the same setting and only tooth 2 is chamfered.

[0020] The overall set magnitude is the same for all setting subgroups, i.e. the total set magnitude for the teeth 1-3 (LR+O+HL) of the first setting subgroup is the same as the total set magnitude for the teeth 4-6 (HR+O+LL) of the second setting subgroup when the direction of set is disregarded. Thus the sum of one light right setting and one heavy left setting represents the same setting displacement as the sum of one heavy right setting and one light left setting.

[0021] The individual set magnitude for the first tooth 1 of the first setting subgroup differs from the individual set magnitude for the corresponding tooth 4 of the second setting subgroup. The individual set magnitude for the unset second tooth 2 of the first setting subgroup is the same as the individual set magnitude for the unset corresponding tooth 5 of the second setting subgroup, i.e. zero, but the tooth 2 is chamfered when the tooth 5 is non-chamfered. The individual set magnitude for the third tooth 3 of the first setting subgroup differs from the individual set magnitude for the corresponding tooth 6 of the second setting subgroup.

[0022] Figure 5 shows a part of a bandsaw blade 1a according to a second embodiment of the invention with a recurrent main group of nine teeth 1-9. The recurrent main group is combined with three short recurrent setting subgroups, a first one, a second one and a third one, of three teeth each, 1-3, 4-6 and 7-9 respectively of seven setting types, heavy left set (HL), medium left set (ML), light left set (LL), unset (0), light right set (LR), medium right set (MR) and heavy right set (HR) respectively, the heavy set teeth being of substantially equal setting, the medium set teeth being of substantially equal setting which is less than the setting of the heavy set teeth and the light set teeth being of substantially equal setting which is less than the setting of the medium set teeth, see figures 4 and 6. Tooth heights and set magnitudes are inversely related. The first tooth 1 is of height H4 and light set to the right, the second tooth 2 is of height H1 and unset, the third tooth 3 is of height H6 and heavy set left, the fourth tooth 4 is of height H6 and heavy set to the right, the fifth tooth S is of height H3 and unset, the sixth tooth 6 is of height H4 and set light left, the seventh tooth 7 is of height HS and set medium right, the eighth tooth 8 is of height H2 and unset and the ninth tooth 9 is of height HS and set medium left. No two teeth in this group of nine have the same setting and only teeth 2 and 8 are chamfered.

[0023] Also regarding this second embodiment of the invention the overall set magnitude is the same for all setting subgroups, i.e. the total set magnitude for the teeth 1-3 (LR+O+HL) of the first setting subgroup is the same as the total set magnitude for the teeth 4-6 (HR+O+LL) of the second setting subgroup and also the same as the total set magnitude for the teeth 7-9 (MR+O+ML) of the third setting subgroup when the direction of set is disregarded. Thus the sum of one light right setting and one heavy left setting represents the same setting displacement as the sum of one heavy right setting and one light left setting. Also the sum of two medium settings, one right and one left, represents the same setting displacement as the sum of one heavy and one light setting.

[0024] The individual set magnitude for the first tooth 1 of the first setting subgroup differs from the individual set magnitude for the corresponding tooth 4 of the second setting subgroup. The individual set magnitude for the unset second tooth 2 of the first setting subgroup is the same as the individual set magnitude for the unset corresponding tooth S of the second setting subgroup,i.e. zero, but the tooth 2 is chamfered when the tooth S is non-chamfered. The individual set magnitude for the third tooth 3 of the first setting subgroup differs from the individual set magnitude for the corresponding tooth 6 of the second setting subgroup.

[0025] Also the individual set magnitude for the first tooth 1 of the first setting subgroup differs from the individual set magnitude for the corresponding tooth 7 of the third setting subgroup. The individual set magnitude for the second tooth 2 of the first setting subgroup is the same as the individual set magnitude for the corresponding tooth 8 of the third setting subgroup but the tooth 2 is more chamfered than the tooth 8. The individual set magnitude for the third tooth 3 of the first setting subgroup differs from the individual set magnitude for the corresponding tooth 9 of the third setting subgroup.

[0026] By the present invention the concept of low teeth being set heavier than high teeth is utilized. In this way the load applied against each tooth becomes more uniform, so that uniform abrasion occurs, the saw blade is more resistant to veering from a straight cut, and the life of the blade is extended. The relative differences in height are evident from the figures 2 and S respectively.

[0027] For the first embodiment of the invention figure 2 shows that the straight raker tooth 2 of the first setting subgroup is the highest tooth in the main group. The second highest tooth is the straight raker tooth S of the second setting subgroup and the difference in height between the teeth 2 and S is a distance c. The third highest teeth are the light set teeth 1 and 6 and the difference in height between each one of these teeth and the tooth 2 is a distance 2c, i.e. twice the distance c. The fourth highest, and thus the lowest, teeth are the heavy set teeth 3 and 4 and the difference in height between each one of these teeth and the tooth 2 is a distance 3c, i.e. three times the distance c.

[0028] For the second embodiment of the invention figure S shows that the straight raker tooth 2 of the first setting subgroup is the highest tooth in the main group. The second highest tooth is the straight raker tooth 8 of the third setting subgroup and the difference in height between the teeth 2 and 8 is a distance d. The third highest tooth is the straight raker tooth S of the second setting subgroup and the difference in height between the teeth 2 and S is a distance 2d, i.e. twice the distance d. The fourth highest teeth are the light set teeth 1 and 6 and the difference in height between each one of these teeth and the tooth 2 is a distance 3d, i.e. three times the distance d. The fifth highest teeth are the medium set teeth 7 and 9 and the difference in height between each one of these teeth and the tooth 2 is a distance 4d, i.e. four times the distance d. The sixth highest, and thus the lowest, teeth are the heavy set teeth 3 and 4 and the difference in height between each one of these teeth and the tooth 2 is a distance 5d, i.e. five times the distance d.

[0029] The position of the unset tooth 2 and the position of the unset tooth 5 may be reversed and/or the position of the unset tooth 2 and the position of the unset tooth 8 may be reversed and/or the position of the unset tooth 5 and the position of the unset tooth 8 may be reversed.

[0030] The set magnitude of the medium set teeth is substantially half way between the set magnitude of the low set teeth and the set magnitude of the heavy set teeth.

[0031] The invention is not limited to the modes of execution shown here but may be varied in accordance with the following patent claims.

CLAIMS

1. Bandsaw blade (1a) comprising a strip and teeth (1-9) projecting therefrom, which teeth (1-9) are arranged in recurring main groups, each main group comprising at least two recurring setting subgroups, characterized in that the overall set magnitude is the same for each one of the setting subgroups.

2. Bandsaw blade (1a) according to claim 1, where each main group comprises at least one recurring geometrical subgroup, each tooth (1-9) is of one of at least five types, heavy left set, light left set, unset, light right set and heavy right set respectively, the heavy set teeth being of substantially equal setting and the light set teeth being of substantially equal setting which is less than the setting of the heavy set teeth and each setting subgroup comprises at least one tooth (1, 4, 7) which is set to the right, at least one unset tooth (2, 5, 8) and at least one tooth (3, 6, 9) which is set to the left.

3. Bandsaw blade (1a) according to claim 2, where each tooth (1-9) is of one of at least seven types, heavy left set, medium left set, light left set, unset, light right set, medium right set and heavy right set respectively, the heavy set teeth being of substantially equal setting, the medium set teeth being of substantially equal setting which is less than the setting of the heavy set teeth and the light set teeth being of substantially equal setting which is less than the setting of the medium set teeth and each setting subgroup comprises at least one tooth (1, 4, 7) which is set to the right, at least one unset tooth (2, 5, 8) and at least one tooth (3, 6, 9) which is set to the left.

4. Bandsaw blade according to any of the preceding claims, where each one of the said at least two recurring setting subgroups comprises three teeth (1-3, 4-6, 7-9).

5. Bandsaw blade according to any of the claims 2-4, where the said at least one recurring geometrical subgroup is the same as the said recurring main group.

6. Bandsaw blade according to claim 5, where the said at least one recurring geometrical subgroup comprises six teeth (1-6).

7. Bandsaw blade according to claim 5, where the said at least one recurring geometrical subgroup comprises nine teeth (1-9).

8. Bandsaw blade according to any of the claims 2-7, where each geometrical subgroup comprises teeth of at least four different heights, extra high, high, low and extra low respectively, and defining a height pattern repeating itself within the group, the extra high teeth being of substantially equal height, the high teeth being of substantially equal height which is less than the height of the extra high teeth, the low teeth being of substantially equal height which is less than the height of the high teeth and the extra low teeth being of substantially equal height which is less than the height of the low teeth.

9. Bandsaw blade according to claim 8, where tooth heights and set magnitudes are inversely related.

DRAWINGS

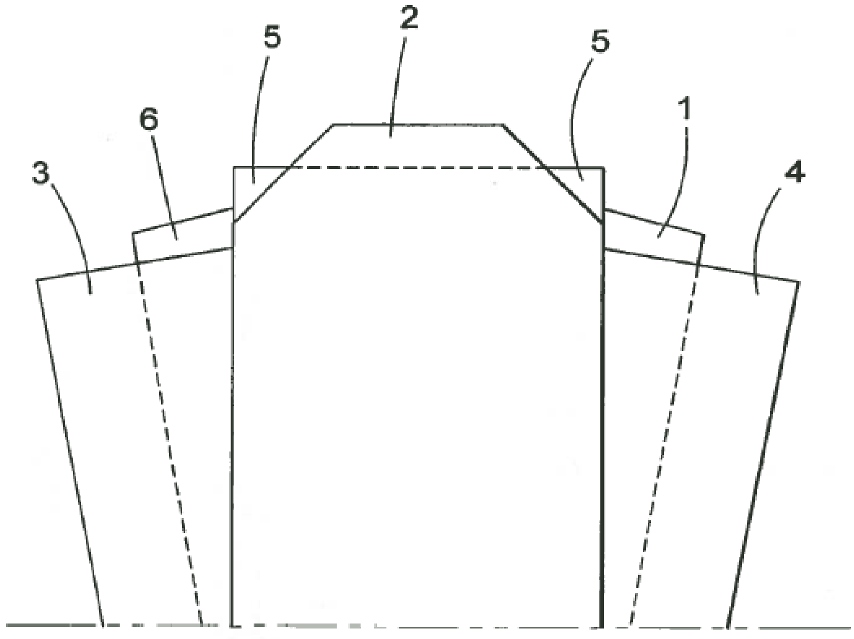

Fig. 1

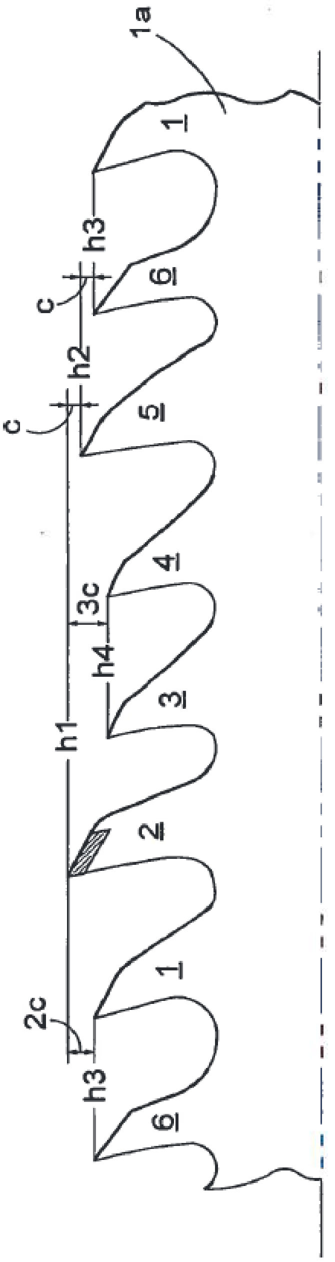

Fig. 2

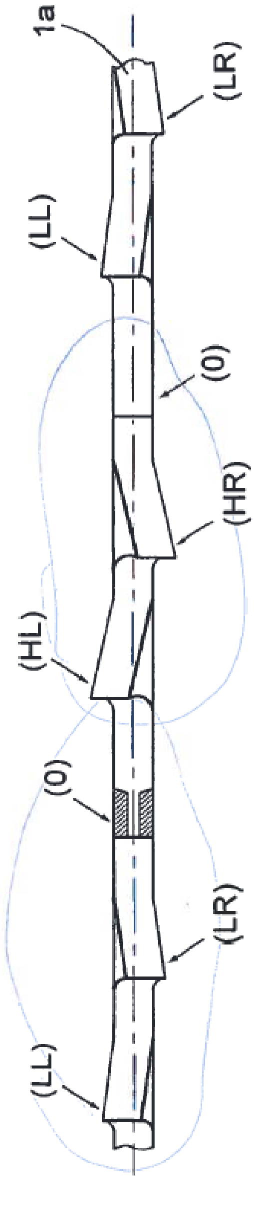

Fig. 3

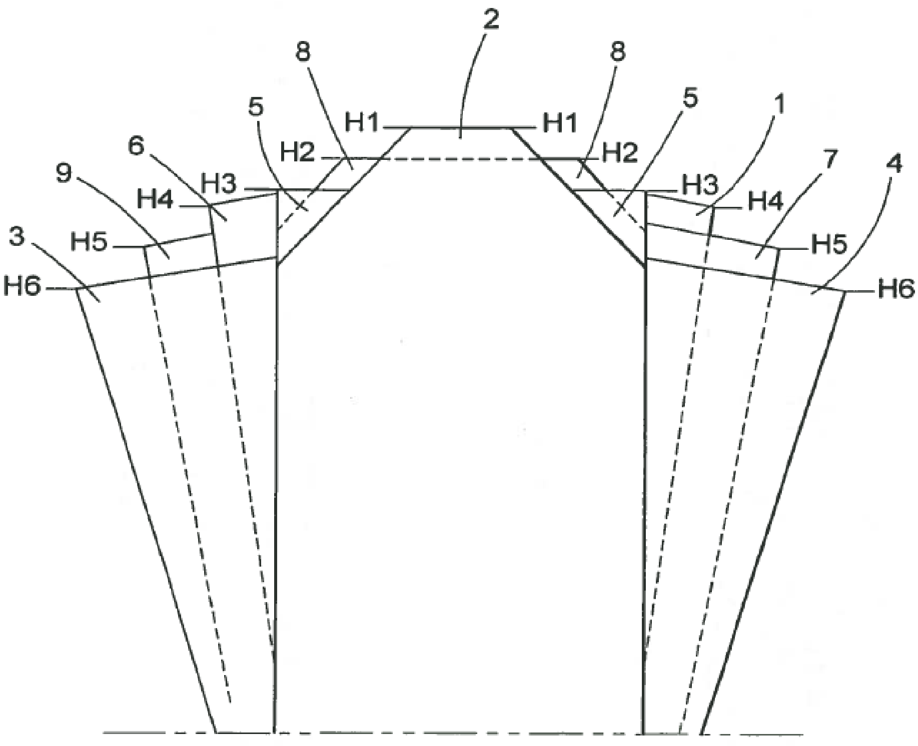

Fig. 4

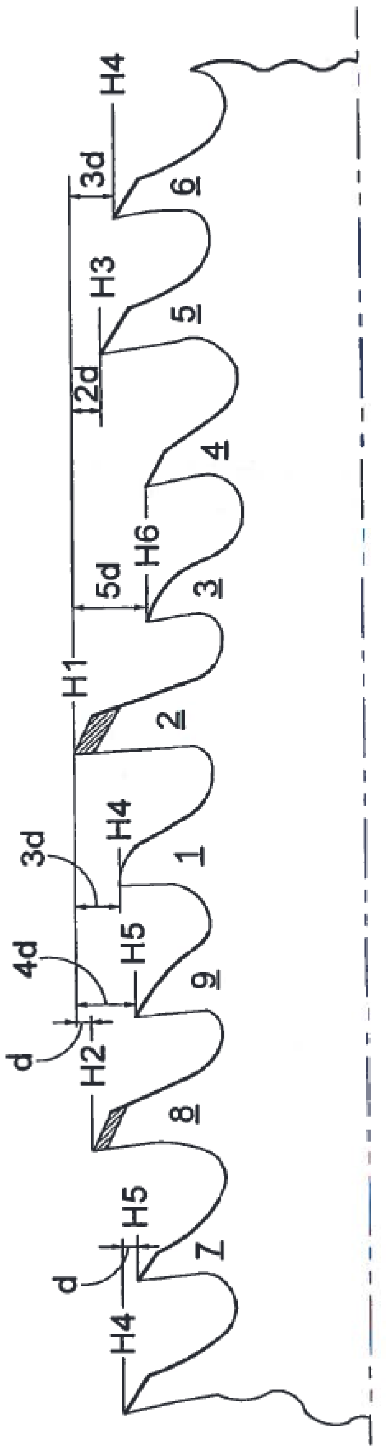
H4
3d
6
H3
5
2d
4
H6
5d
3
H1
2
H4
1
3d
H5
9
4d
d
H2
8
H5
7
d
H4

Fig. 5

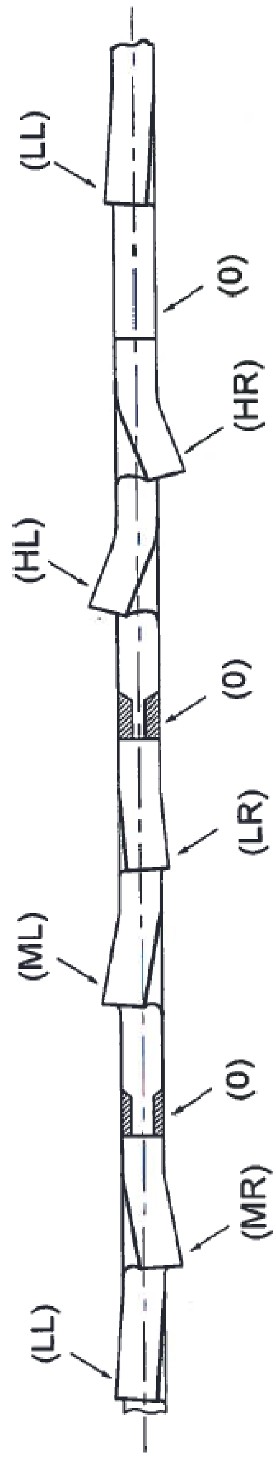
(LL)
(0)
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Fig. 6