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Nystrom et al.

[11] **3,732,907**

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[54] **DEVICE FOR SEPARATING SMALL PIECES FROM A WORK PIECE OF MATERIAL**

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[52] **U.S. Cl.** .....**144/176,** 144/219, 144/326 B, 241/28, 241/92

[51] **Int. Cl.** **B27l 11/02**

[58] **Field of Search** .....144/176, 326 A, 326 B, 144/218, 219, 118, 237, 172, 174; 241/28, 92; 83/906

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[57] **ABSTRACT**

The invention relates to a method for separating small pieces from blanks of material by using a device comprising a plurality of cutting elements, with short cutting edges as compared with the blank, said cutting elements being so arranged on the face of a rotating cutting element holding means with their edges pointing essentially in the direction of rotation, that always a plurality of said edges are in holding engagement with the blank during the rotation of said holding means when said blank is moved along a path intersecting said face. The feeding path has a projection, the direction of which is essentially parallel to the direction of the tangents of the orbits of the cutting elements in the place where said path intersects said face.

When applicated to a method of chipping timber the invention has the consequence that an elongated chip blank is cut from a sloping end face of the log by each cutting element, the width of said chip blank as determined by the length of said cutting edge being the same as the width of a separate chip, the length of each chip being determined by the angle between the direction of the fibers in the blank and the direction of the thickness of the blank.

The invention also relates to a device for separating small pieces from a blank of material, particularly a chipping machine for chipping timber to chips, said device comprising a plurality of cutting elements, with short cutting edges as compared with at least the next smallest dimension of the blank, said cutting elements being so arranged on the face of a rotating cutting element holding means at different distances from the axis of rotation of said holding means and with the edges pointing essentially in a direction of rotation, that always a plurality of said edges are in holding engagement with the blank during the rotation of said holding means when said blank is moved along a path intersecting said face.

The inclination of the back of the cutting element, i.e. the surface of the cutting elements directed towards the blank and the abutting the cutting edge, towards a plane including the rotational path of the cutting element is different between the cutting elements in such a manner that it increases with a reduced spacing between the cutting element and the axis of rotation of the holding means.

In another device for carrying out the method the cutting elements are arranged on a cylinder and the feeding path for the blank to be separated extends at a right angle to the cylinder axis.

14 Claims, 7 Drawing Figures

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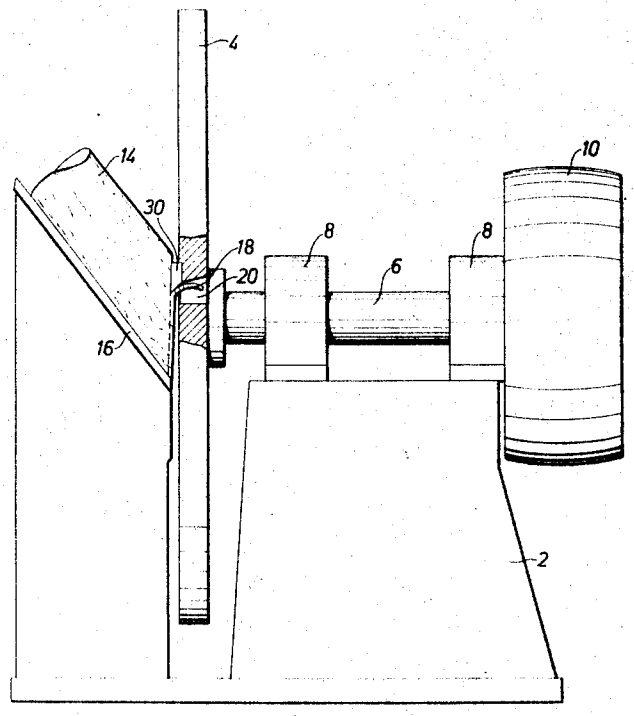


Fig. 1

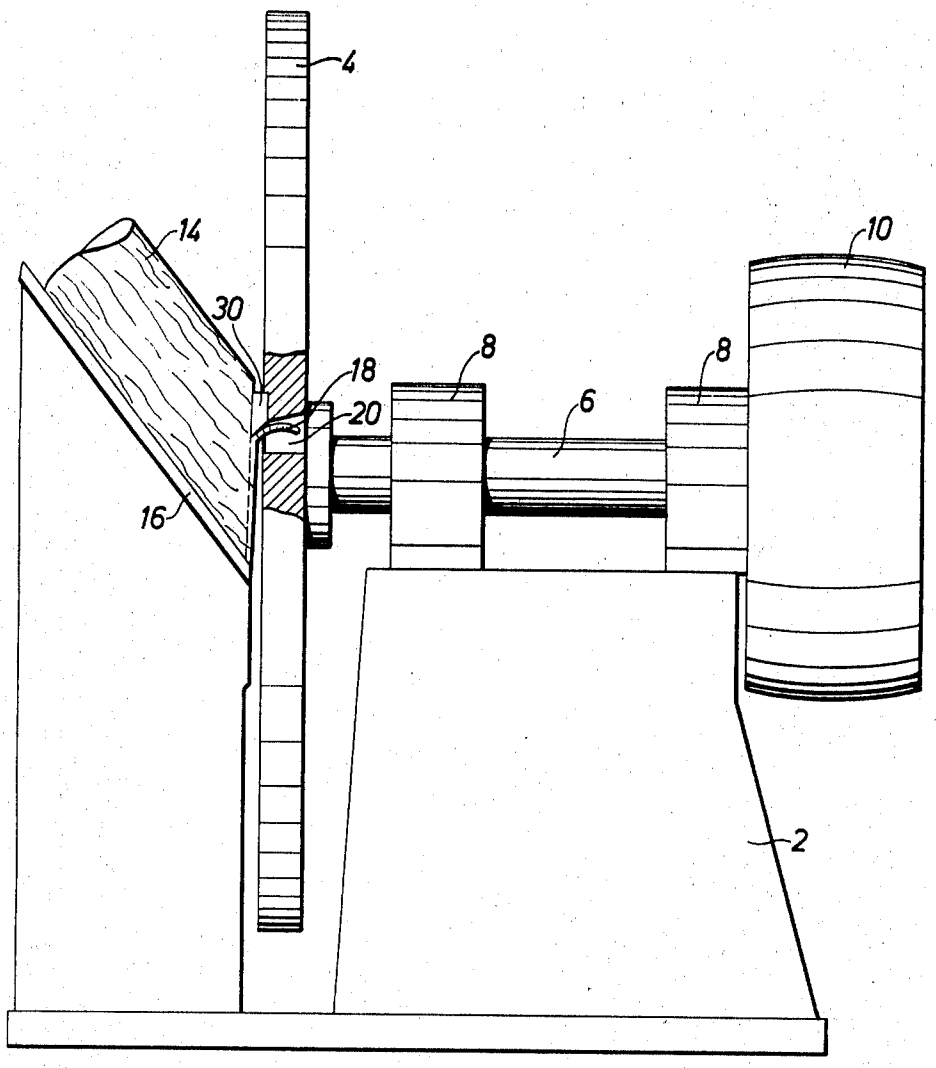


Fig. 2

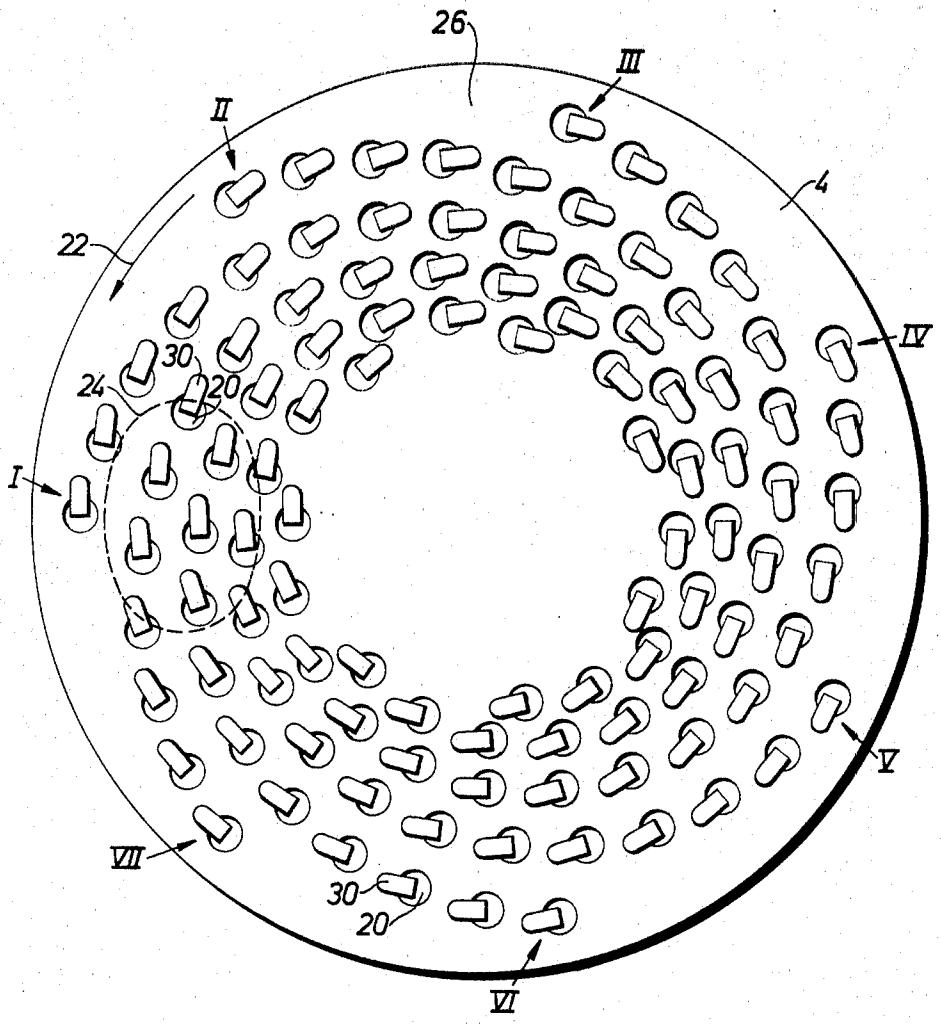


Fig. 3

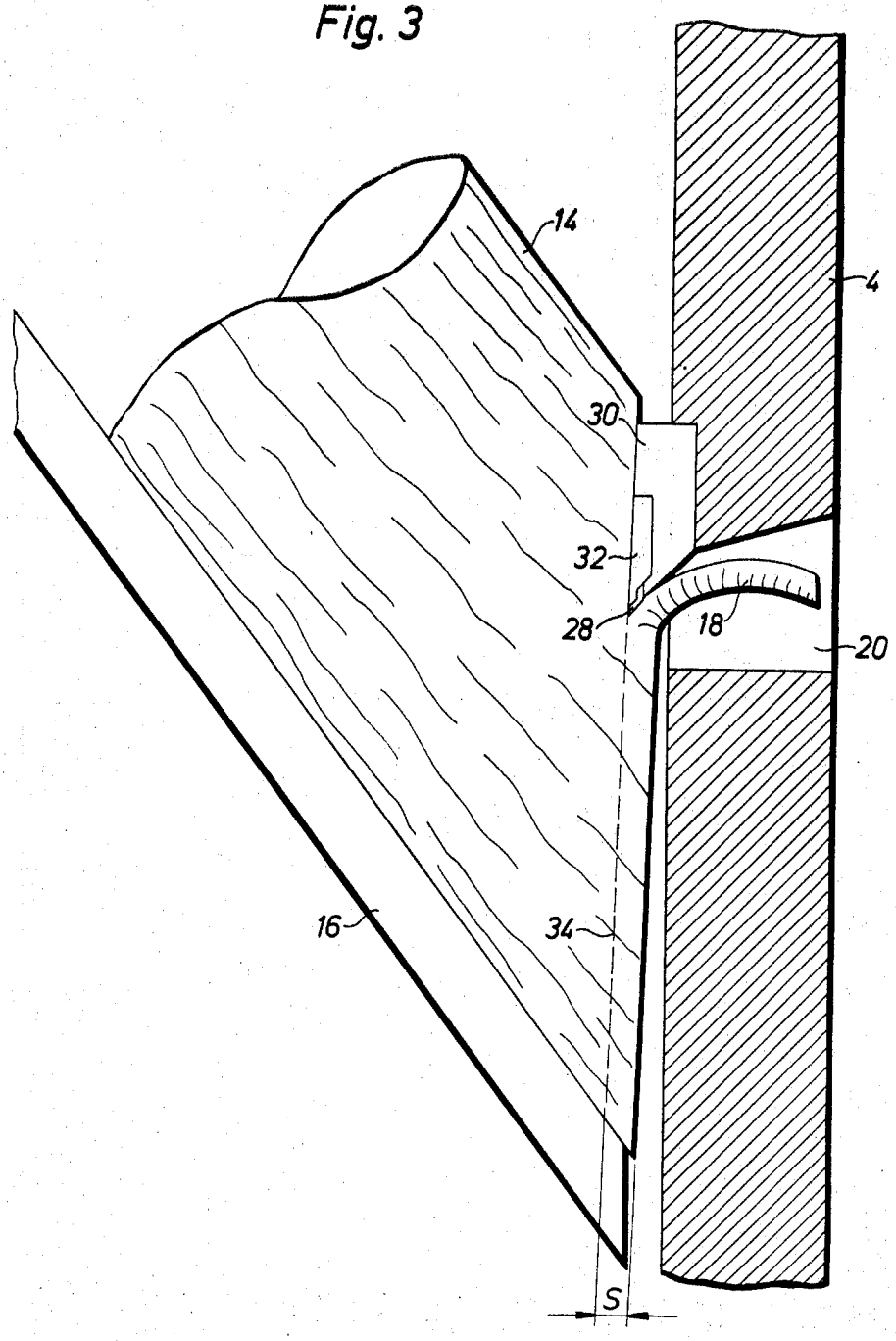


Fig. 4

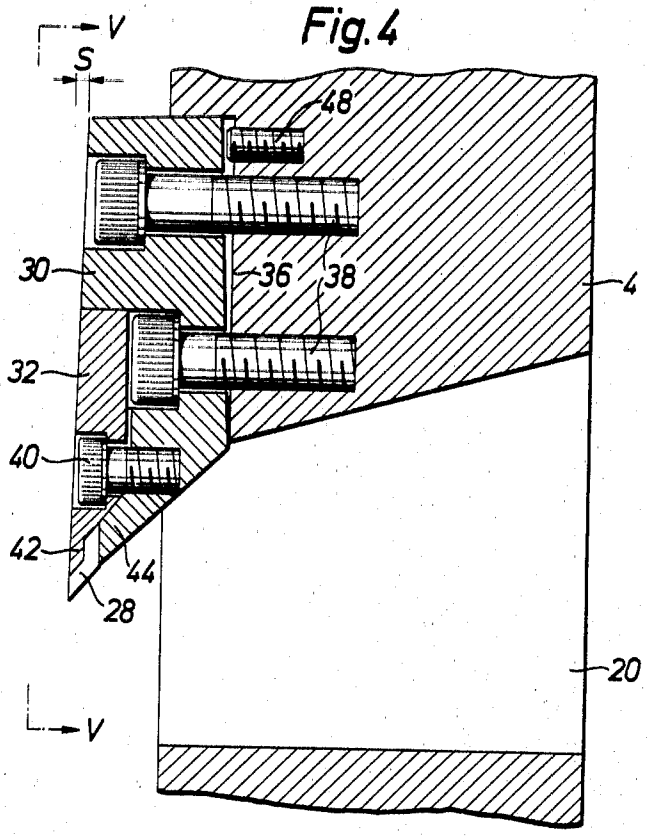


Fig. 5

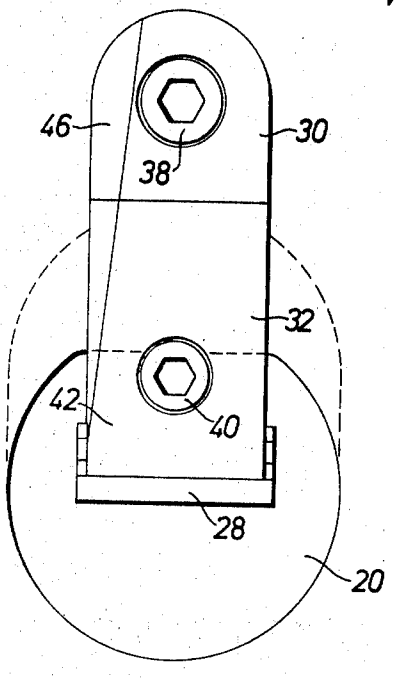


Fig. 6

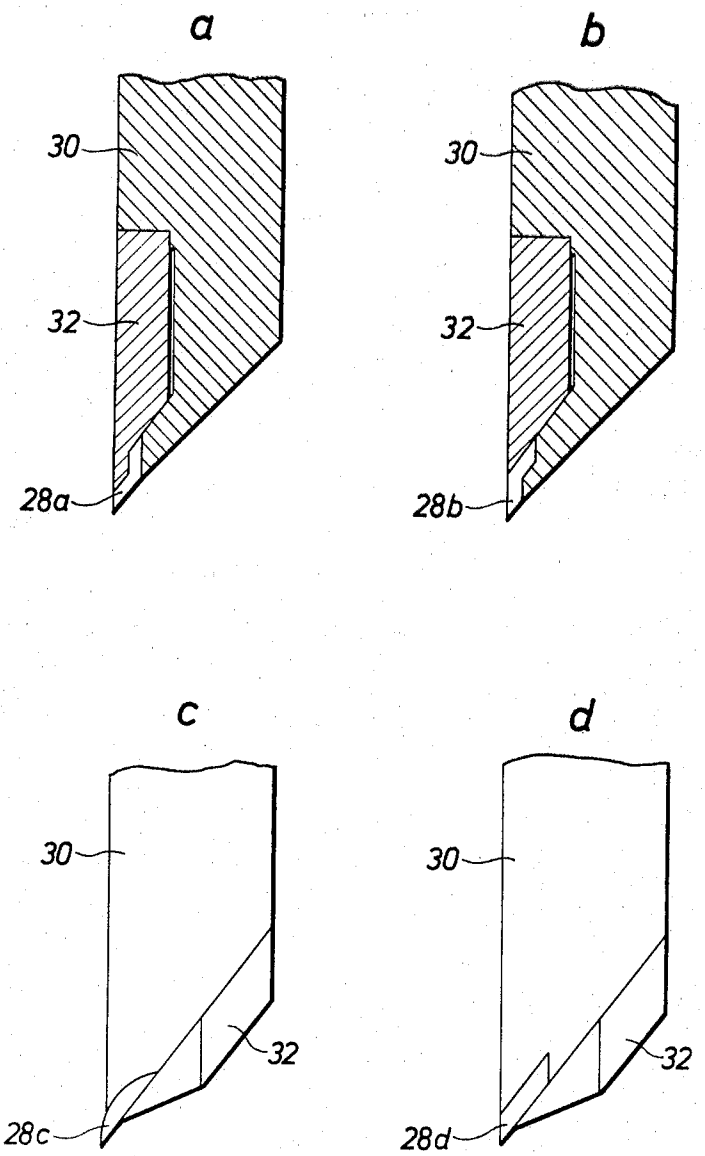
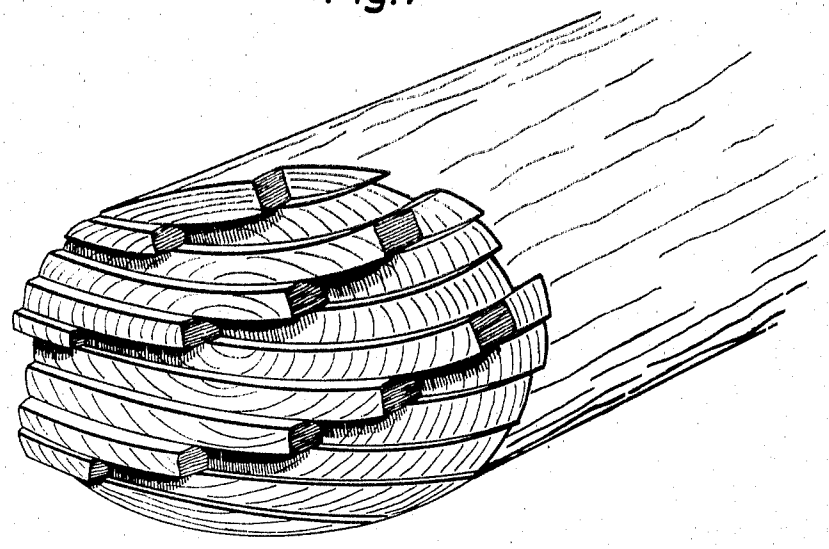


Fig. 7



DEVICE FOR SEPARATING SMALL PIECES FROM A WORK PIECE OF MATERIAL

In conventional chippers for chipping round timber to chips the tools are formed as knives of the same length as the largest round timber to be treated. The knives are arranged mainly radially on a tool holder in the form of a rotatable plane disc against which the log is moved with one end first. Hereby each knife cuts a piece from the cutting surface of the whole round timber. The thickness of this piece is defined by the distance between the knife edges and the plane of the chipper disc. This method, wherein the chipping depths are defined by the protrusion of the knives from the plane of the chipper disc, causes the round timber to be fed stepwise since, each time the round timber has been passed by a knife, it falls inwards towards the chipper disc with a heavy thud. The high noise levels caused by conventional chipping machines are known to be caused chiefly by the following factors:

Before each time the chipper knife hits the round timber the latter is located loosely in the steep or feeding device. When the chipper knife hits the working end of the round timber it is pressed downwards the abutment which is to support the round timber during the chipping. If the round timber is arcuate or when branch ends often protrude from the surface of the round timber the round timber is given an oscillating and hitting movement in the steep or the feeding device. The strong hits occurring when whole knives at once are to cut round timber ends and the oscillations of the round timber in the steep causes high noise levels. In addition the complete knives must be removed and reground if they are injured by contact with stones or steel details in the timber. This causes the further disadvantage that differently ground knives cause an unbalance in the chipper machine. Further, normal wear occurs mainly along a small portion of the whole length of the knives and knives with hard metal coating are excluded on account of the great risk for injuries mentioned above. The type of material of the chipper knives causes frequent exchanges for regrinding which brings about costly devices and equipment and requires skilled labor. Every exchange of chipper knives requires two men and each time attention must be paid to the balancing of the chipper disc. On account of the heavy hitting action mentioned above, when the knives in the chipper disc hit the timber, heavy stresses occur in the machine, the power transmission and the base. The impact charge, when the chipper knives hit the material, causes large power requirements. In order that the round timber should permanently be pressed in the direction of the chipper disc costly feeding devices are often required and the need that the round timber shall have time to be moved to abutment against the chipper disc between two knives causes a limitation of the number of the chipper knives and the rotational speed of the chipper disc. The quality of the chip produced is of great importance since all formation of splinters and irregularities in the chip material is of great disadvantage in the paper board and pulp industry. This forming of splinters is particularly marked when the light final end of the trunk, which is moved towards the vertically arranged chipper disc along a sloping plane, jumps and rolls about in this sloping plane or steep and thereby can hit the chipper knives so that the chipping is performed in the longitudinal direction of the round timber. However, even longer and heavier trunks can jump and roll about in the steep with the same disadvantages as a consequence. When the conventional machine is fed with waste timber and the like, small laths may be located between the chipper disc and the abutment in the steep and pass through the machine untreated. Due to the above-mentioned large disadvantages with the formation of splinters and irregularities in the chips the treated material must pass through expensive oscillating strainer devices where separation is performed.

Chipping machines are also known which in stead of the long knives are provided with short cutting elements arranged on a rotatable plane or conical disc or on a cylinder.

During chipping each cutting element works with two edges arranged at an angle to each other.

For several reasons these machines have in practice turned out to have very serious disadvantages and the conventional machines with long knives are still preferred, despite their disadvantages.

The object of the present invention is particularly to provide a machine and a method wherein all the above-mentioned disadvantages have been eliminated. However, the intention is also that such a method and a machine or a machine of a similar type can be used in the treatment of other material than round timber, slabs and the like, e.g. plastic.

According to one aspect of the invention a method for separating small pieces from blanks of material by using a device comprising a plurality of cutting elements, with short cutting edges as compared with the blank, said cutting elements being so arranged on the face of a rotating cutting element holding means with their edges pointing essentially in the direction of rotation, that always a plurality of said edges are in holding engagement with the blank during the rotation of said holding means when said blank is moved along a path intersecting said face, is characterized in that said path on said face has a projection, the direction of which is essentially parallel to the direction of the tangents of the orbits of the cutting elements in the place where said path intersects said face.

According to a further aspect of the invention a method for chipping timber to chips by using a chipping machine of the kind where a plurality of cutting elements with short cutting edges, as compared with the transverse dimension of the logs, are so arranged on the face of a rotating cutting element holding means with their edges pointing essentially in the direction of rotation that always a plurality of said edges are in holding engagement with the blank during the rotation of said holder, is characterized in that an elongated chip blank is cut from a sloping end face of the log by each cutting element, the width of said chip blank as determined by the length of said cutting edge being the same as the width of a separate chip, the length of each chip being determined by the angle between the direction of the fibers in the blank and the direction of the thickness of the blank.

According to a third aspect of the invention a device for separating small pieces from a blank of material, particularly a chipping machine for chipping timber to chips, said device comprising a plurality of cutting elements, with short cutting edges as compared with at least the next smallest dimension of the blank, said cutting elements being so arranged on the face of a rotating cutting element holding means at different dis-

tances from the axis of rotation of said holding means and with their edges pointing essentially in the direction of rotation, that always a plurality of said edges are in holding engagement with the blank during the rotation of said holding means when said blank is moved along a path intersecting said face is characterized in that the inclination of the back of the cutting elements, i.e., the surface of the cutting elements directed towards the blank and abutting the cutting edge, towards a plane including the rotational path of the cutting element is different between the cutting elements in such a manner that it increases with a reduced spacing between the cutting element and the axis of rotation of the holding means.

According to a fourth aspect of the invention a device for separating small pieces from a blank of material, particularly a chipping machine for chipping timber to chips, said device comprising a plurality of cutting elements being so arranged on the cylindrical face of a rotating cutting element holding cylinder with their edges pointing essentially in the direction of rotation, that always a plurality of said edges are in holding engagement with the blank during the rotation of said holding cylinder when said blank is moved along a feeding path intersecting the cylindrical face, is characterized in that said feeding path extends essentially at a right angle to the rotational axis of the cylinder.

Although the advantages reached by means of the present invention are particularly outstanding in chipper machines for the chipping of logs to chips similar advantages must be expected in the treatment of other materials. These advantages are based above all on the fact that a device, wherein always at least one cutting element is in a holding engagement with the material, permanently attracts the material and partly on the use of a plurality of small cutting elements instead of long knives. A chipping machine provided with a device according to the present invention is characterized by the following advantages as compared with a conventional chipping machine of the type described above. On injury of cutting elements only the one or those cutting elements that have been injured are replaced and since preferably turnable cutting elements are used only the turning of the injured cutting element is occasionally required. Since the wear of the different cutting elements is normally not equal, all cutting elements need not be replaced simultaneously. Preferably hard metal cutting elements or hard metal coated cutting elements are used, since the life of the cutting elements is considerably longer. Only one type of cutting elements and cutting element holders need to be used which is of great practical and economic importance since the advantages of mass production can be utilized both regarding the requirement of precision in the manufacture, lower manufacturing costs through long series and rational marketing by a small range. The cutting element which becomes an article of consumption is light and has small dimensions and thereby facilitates transport and storage in all stages. The turning or replacement of the cutting element requires no special skill and can be performed by one man with conventional, light tools.

A plurality of different factors contributes to considerably lower noise levels and thereby better work conditions. Among these factors may be mentioned that no oscillations occur, since the feeding will be even due to the fact that the material never comes into contact with the chipper disc. Further the machinery is always in balance on account of the utilization of turnable cutting elements. In addition the reduction of the noise level is also improved, since no noise occurs in the feeding device for the round timber, which is engaged by the cutting elements and cannot jump about. In the machine proper, the power transmission and the base there are small stresses on account of the smoother running and the power requirement will be less for the same reason. The feeding device for the round timber will be less expensive and simpler, since the timber is drawn to the treatment by the cutting elements. A better and more uniform division of the chip is obatained by means of a plurality of small cutting elements and chipping machines with a lighter and smaller chipper disc can be built and still give a production which is many times larger than has been possible up til now. Last but not least a great safety is obtained for the staff operating the machine. Further advantages are evident from the description of the drawings.

According to a further aspect of the invention there is also provided a turnable cutting element with an advantageous form for use in a device for separating small pieces from a blank of material, in particular in a chipping machine for chipping round timer to chips and a cutting element holder for holding the cutting element.

Further advantages of the invention and examples of embodiments will now be described in connection with the accompanying drawings, whereon FIG. **1** shows a chipping machine provided with cutting elements for chipping round timber to chips, FIG. **2** is a plane view of the tool holder for cutting elements used in the present machine in the form of a plane rotatable disc, the distribution of the cutting elements being shown, FIG. **3** is a view in a larger scale of a detail of FIG. **1**, showing the engagement of a cutting element with round timber, FIG. **4** shows in a large scale a section through a cutting element holder and the tool holder whereon it is mounted, FIG. **5** is a view in the direction of the arrows V—V in FIG. **4**, FIG. **6** *a–d* show a number of different cutting elements and cutting element holders that can be used according to the invention and FIG. **7** in perspective shows the end of a leg which has been in engagement with the disc of the machine according to FIG. **1–3.**

The chipping machine shown schematically in FIG. **1** comprises a machine frame **2** which supports a driving device for a tool holder in the form of a plane disc **4.** The disc is arranged vertically the end of a shaft, generally referenced **6,** which is supported by bearings **8** mounted in the frame **2.** The driving device comprises a pulley **10** mounted at the opposite end of the shaft **6.** On the side of the disc **4** directed from the shaft **6** there are cutting or chipping tools in the form of a plurality of cutting element holders of which only one, **30,** is shown in FIG. **1.** Round timber **14** intended for treatment is carried towards the disc **4** along an incline **16.** At the disc **4** the cutting elements of the cutting element holders **30** engage the round timber **14** and cut the round timber successively, each cutting element separating a chip blank **18** which passes through a hole **20** in the disc **4** provided adjacent each cutting element.

The arrangement of the cutting elements on the side of the disc **4** directed towards the round timber in the described embodiment is shown in FIG. **2.** An arrow **22** indicates the direction of rotation of the disc. Due to

the inclination of the incline **16** the projection of the cut surface of the round timber **14** on the disc **4** will have the form of an ellipse. This has been indicated by means of the dotted line **24.** As follows from FIGS. **1** and **2** the direction of the projection on the disc **4** of the path along which the timber is fed is essentially parallel to the direction of the orbits of the cutting elements in the ellipse **24.** This fact is essential and contributes to the advantages of the machine. The cutting elements and their cutting element holders **30,** which in FIG. **2** have the same reference number as in FIG. **1,** are arranged in a number of concentric circles part of which have been indicated in FIG. **2** and referenced **26.** The cutting elements in the described embodiment are arranged in a number, **7,** divisions I–VII in such a manner that each circle **26** comprises seven equally spaced cutting elements. In addition the cutting elements are arranged so that the paths of the cutting elements on adjacent circles **26** during the rotation of the disc **4** overlap each other slightly. In the direction from the circumference and inwards to the center of the disc **4** the cutting elements are arranged successively displaced forwardly relative each other on the different circles in an opposite direction to the arrow **22.** This provides a spiral path which the cutting elements on the same division follow. As shown in FIG. **2** in the described embodiment at least four cutting elements will always during the rotation of the disc **4** be located in a holding engagement with the round timber, the projection of which is indicated by means of the dotted line **24.**

FIG. **3** shows more clearly how one of the cutting elements provides a chip blank **18** through the hole **20** in the tool holder **4.** The cutting edge referenced **28** is secured in a cutting element holder **30** by means of a clamp plate **32.** The cutting line of the cutting element **28** in the round timber **14** has been referenced **34** and the distance between this line and the surface of the round timber directed towards the disc **4** has been referenced "s." This cutting depth s determines the chip length obtained, which is measured in the longitudinal direction of the round timber and is also greater than s. As shown in FIG. **3,** and more clearly in FIG. **4,** the back surface of the cutting element **28** directed towards the round timber and the corresponding surfaces of the clamp plate **32** arranged in the same plane as the above-mentioned surface, are inclined towards the plane of the disc **4.** The inclination angle is referenced α in FIG. **4.** The inclination α determines how long the round timber is drawn forwards by means of the cutting elements towards the disc for each revolution of the chipper disc. This feed per revolution is called pitch and this pitch divided by the number of cutting elements in each circle provides the cutting depth, The inclination α of the separate cutting elements varies in the embodiment described in such a manner between different cutting edges that it increases successively from the outer circular path to the inner. The different inclinations α of the cutting elements and the cutting element holders can be calculated according to the same method as propeller pitches. This different inclination of the cutting elements in the embodiments described provides the number of important advantages, completing the feature that at least one cutting element is always in holding engagement with the material during the rotation of the cutting elements. Thus, the influence that different angular velocity of the different cutting elements at different spacings from the axis of the rotation would have, if the cutting elements had the same inclination, i.e. in practice causing a stronger pressure of the material against those cutting elements that are closer to the rotational axis of the disc, is equalized. This fact in turn causes a smoother cutting by the cutting element and the surface of the cutting element holder in the same plane as said surface are always abutting the cutting surface in the material. In addition a screwing motion of the cutting elements into the material is obtained, whereby the cutting elements both hold, feed and cut the material.

In principle the disc according to FIG. **2,** provided with cutting elements with different inclination, can be regarded as a fan wheel with seven blades, wherein each blade corresponds to one of the division paths I–VII. The length of the edge of the cutting element, which length is preferably the same for all cutting elements, in a machine for providing wood chips for the production of pulp can be between **15** and 60 mm, preferably between 25 and 45 mm. In treating plastic, substantially shorter lengths of the edges can be used. The area of the tool holder which is occupied by the cutting elements can have a total width normally relative the direction of movement of the cutting edges between 300 and 1,200 mm, e.g. 500–700 mm, and the number of cutting elements per square meter of said area should mainly be at all locations as an average at least 30, preferably at least 60, e.g. 80–120.

IN FIG. **4** the cutting element, clamp plate, and the cutting element holder have been indicated **28, 32** and **30,** respectively as in FIG. **3.** The tool holding disc and the hole provided at each cutting element for the passage of the chip material has been indicated **4** and **20,** respectively, as in the other Figures. The cutting element holder **30** is mounted in a recess **36** in the disc **4** which translates into the hole **20** and is mounted at the disc by means of two fastening bolts **38,** the heads of which are both recessed into the material of the cutting element holder **30.** The head of the forward fastening bolt **38** is further covered by the clamp plate **32** which by means of a locking screw **40** which is screwed into the cutting element holder **30,** presses the cutting element between itself and the forward end **44** of the cutting element holder **30** which is key-shaped in longitudinal section. The cutting element **28** is V-shaped in the plane of the drawing, withan obtuse angle between the legs of the cutting element, and is formed as a turnable cutting element, i.e. the edge located between the parts **42, 44** can be turned outwards and serve as a working edge. As shown, the surfaces of the cutting element directed towards the abutment **42** and the end **44** are abutting closely the opposite surfaces. The cutting element holder and the clamp plate have a relief surface **46** along the side which is turned towards the periphery of the disc. The inclination of the cutting element holder and the cutting element is adjustable by means of an adjustment screw **48,** which is screwed into the material of the disc **4** from the recess **36** and against the free end of which the rear portion of the cutting element holder is abutting. Thus, the adjustment of the inclination of the cutting element holder is performed before the cutting element holder has been positioned in the recess **36,** by screwing the screw **48** inwards or outwards.

FIG. **6** *a–d* show a plurality of different useful forms of turnable cutting elements which in the different alternatives are referenced **28***a–d*. The cutting element

28*a* is the same as the one shown in FIG. 4, like the one shown in FIG. 6*b* but with a reversed mounting. The cutting element 28*c* in cross-section has the shape of a circular segment and the cutting element 28*d* is straight with a rhombical cross-section. The edge angle, which is determined partly by the fact that the cutting edge should pass as easily as possible in the material and partly by strength reasons cannot be made too small, is preferably 38°–40°. In practice this angle has proved to be a suitable compromise. Therefore, the angle between the legs of the V-shaped cutting edge 28*a*, 28*b* in the example shown is 140°–142°. The angle between the external surfaces of the cutting element holder and the clamp plate which, abut the cutting surfaces, is determined by the same factors as the edge angle, i.e. that it should be as small as possible while maintaining maximum strength. These requirements are best fulfilled by the device shown in FIG. 4 and 6*a* and has been made possible by the special V-shape of the cutting element.

It has previously been stated that in a chipping machine, provided with a device according to the present invention, it is possible to obtain a better and more uniform division of the chip as compared to prior chipping machines. A plurality of factors contributes to this improvement, among others the use of a plurality of small cutting elements which with small friction cut forwardly into the material. The drawing of the material towards the chipping disc described above also contributes to giving the chips a high uniformity and precluding the existence of splinters, slabs or the cutting of any portion of the material in the longitudinal direction of the timber. The length of the chips can be controlled easily be means of the adjustment screw 48 under the cutting element holder which provides the possibility of large variations in respect of chip lengths. Finally, the present invention provides large possibilities of variations in respect of the rotational speed of the tool holder.

The present invention is not limited to what has been described above and the embodiment shown on the drawings but a plurality of modifications are possible within the scope of the accompanying claims. Thus, the location of the cutting elements on the tool holder, the form of the tool holder, the angle of the cutting edge towards the direction of movement of the cutting element the form of the cutting elemeent etc. can be varied. Within the scope of the present invention a cylindric tool holder could also be used, on the mantle surface of which the cutting elements are arranged according to the invention in such a manner that always at least one cutting element is in a holding engagement with a material which is treated during the rotation of the cutting elements. The surface of the tool holder, provided with cutting elements, can also be conical or have the shape of an ellipsoid, hyperboloid, paraboloid or other rotation symmetric surface the generatrix of which is an arcuate line. The tool holder of the latter type is advantageous, since the removal of the separated material is facilitated.

What has been said above regarding the edge angle and the obtuse angle of the cutting elements is based on what is known about the conditions in chipping machines with long knives. In fact the invention implies that the edge angle of the cutting elements may be made considerably smaller than the 38°–40° mentioned above, e.g. 25°–35°. According to current experience such a reduction of the edge angle will result in a better chip quality.

Although in FIGS. 1 – 3 there is shown a chipping machine into which the log 14 is fed in a vertical plane, the log could equally well have been fed into the machine in a horizontal plane, thereby meeting the disk 4 above or below its rotational center under an angle to its surface. The only condition to be fulfilled is that the feeding path has a projection, the direction of which is essentially parallel to the direction of the tangents of the orbits of the cutting elements in the place where said path intersects the surface of the disk 4. However, this condition is also valid for other forms of the means carrying the cutting elements.

The view in FIG. 7 illustrates somewhat exaggerated the appearance of the end of a log, which has been engaged with the disk 4. At the moment of drawing the log back from the disk, the end was in engagement with 11 cutting elements. The diameter of the end surface of the log in FIG. 7 is quite small, about 10 cm and hence the "cutting element density" was about 15 cutting elements per dm^2.

We claim:

1. A device for chipping logs or the like into chips comprising
   a. a rotatable planar surface means,
   b. a plurality of cutting element holding means mounted on said rotatable planar surface,
   c. a cutting element mounted in each cutting element holding means,
   d. said cutting elements
      1. arranged in a plurality of concentric circles on said rotatable planar surface,
      2. being located at spaced intervals around the circumference of each concentric circle,
      3. having cutting edges that extend parallel to said surface means, and
      4. pointing substantially in the direction of rotation of said rotatable surface,
   e. means for guiding logs against said surface means so that there is an acute angle formed between the axis of said log and the plane of said surface means, and
   f. a plurality of holes in said rotatable planar surface means, each hole being located adjacent a cutting element so that any chips formed by said cutting elements may pass through said holes.

2. A device according to claim 1 wherein the spacings between the cutting elements are arranged closer together as the concentric circles progress inwardly.

3. A device according to claim 1 wherein the angle of inclination between the cutting element and the rotatable planar surface is different in one said concentric circle as compared to another concentric circle.

4. A device according to claim 3 wherein said angle of inclination of cutting elements in a given circle is greater than the angle of inclination of the cutting elements in the next exteriorly annular circle.

5. A device according to claim 3 wherein said inclination is adjustable by means of a cutting element holder arranged on said surface means, said cutting element holder having a surface in the same plane as the back of the cutting edge.

6. A device according to claim 5 wherein each holder is detachably arranged in a recess in said surface means, the underside of the holder abutting against an adjustment element in the bottom of said recess adja-

cent the end of the holder remote from the cutting element.

7. A device according to claim **1** wherein the cutting elements are arranged a radial distance from each other on the same order of magnitude as the length of cutting edges, an equal number of the cutting elements being arranged on each concentric circle.

8. A device according to claim **1** wherein said cutting elements are reversible, each cutting element in a section parallel to the sides of said element between which the two edges extend being V-shaped with an obtuse angle between the legs of the V-section and each cutting element being detachably secured in a cutting element holder by clamping the leg which is terminated by the unused edge.

9. A device according to claim **1** wherein the arrangement of said cutting elements on said rotatable planar surface appears as a number of lines extending substantially helically from the outermost to the innermost of said circles.

10. A device according to claim **8** wherein the angle formed by each cutting edge as viewed in cross-section is substantially equal to the complement angle of said obtuse angle.

11. A device for chipping logs or the like into chips comprising

a. a rotatable supporting surface,

b. a plurality of cutting element holding means mounted on said supporting surface,

c. a cutting element mounted in each cutting element holding means,

d. said cutting elements

1. being arranged in a plurality of concentric circles on said rotatable supporting surface,

2. being located at spaced intervals around the circumference of each circle,

3. having cutting edges that extend essentially parallel to said supporting surface, and

4. pointing substantially in the direction of rotation of said rotatable supporting surface,

e. means for guiding logs against said rotatable supporting surface so that the axis of said log extends essentially in a plane parallel to a tangent of a portion of said circles passing through the place on said rotatable surface where the log is brought into contact with said surface by said guiding means, and

f. a plurality of holes in said rotatable supporting surface each hole being located adjacent a cutting element so that any chips formed by said cutting elements may pass through said holes.

12. A device according to claim **11** for chipping logs into chips having two first essentially parallel sides intersecting the fibers of the chip, two second essentially parallel sides extending essentially perpendicular to said first sides, and two third sides intersecting said first and second sides, wherein the length of said cutting edges is at least approximately the same as the distance between said first sides.

13. A device according to claim **11** wherein said concentric circles are at different distances from the axis of rotation of said rotatable surface, and the angle of inclination of cutting elements in a given circle is greater than the angle of inclination of the cutting elements in the next exteriorly annular circle.

14. A device according to claim **11** wherein the concentric circles are at a distance from each other on the same order of magnitude as the length of cutting edges, an equal number of the cutting elements being arranged on each concentric circle.

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