Oct. 29, 1968 V. L. LINDBERG ET AL. 3,407,854

WOOD CHIPPING APPARATUS

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FIG-1

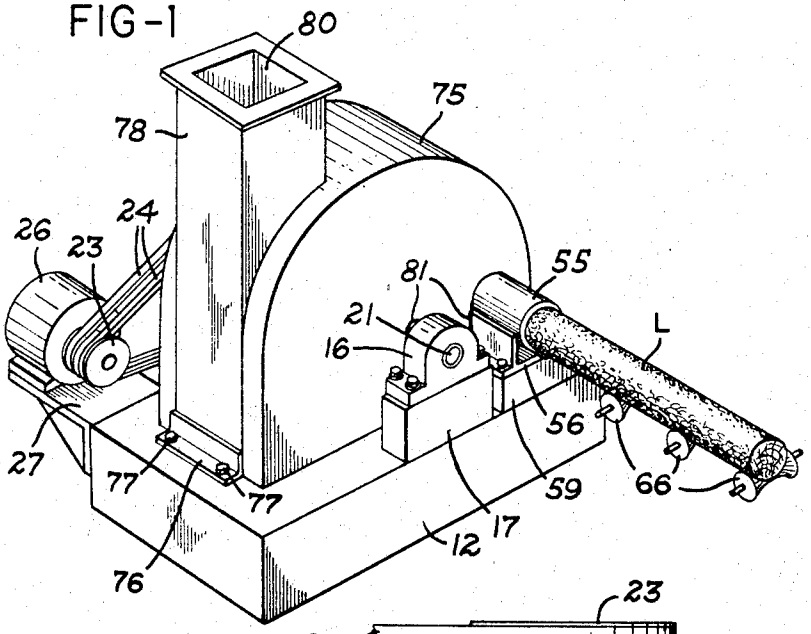
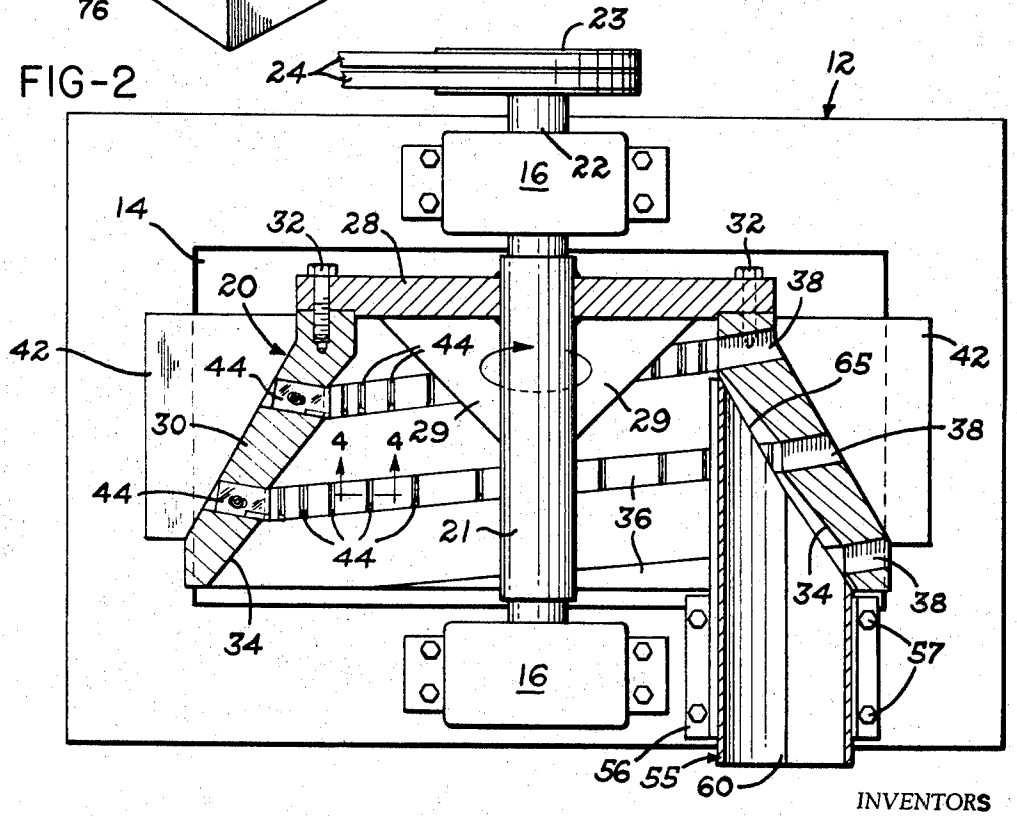



FIG-2




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FIG-3

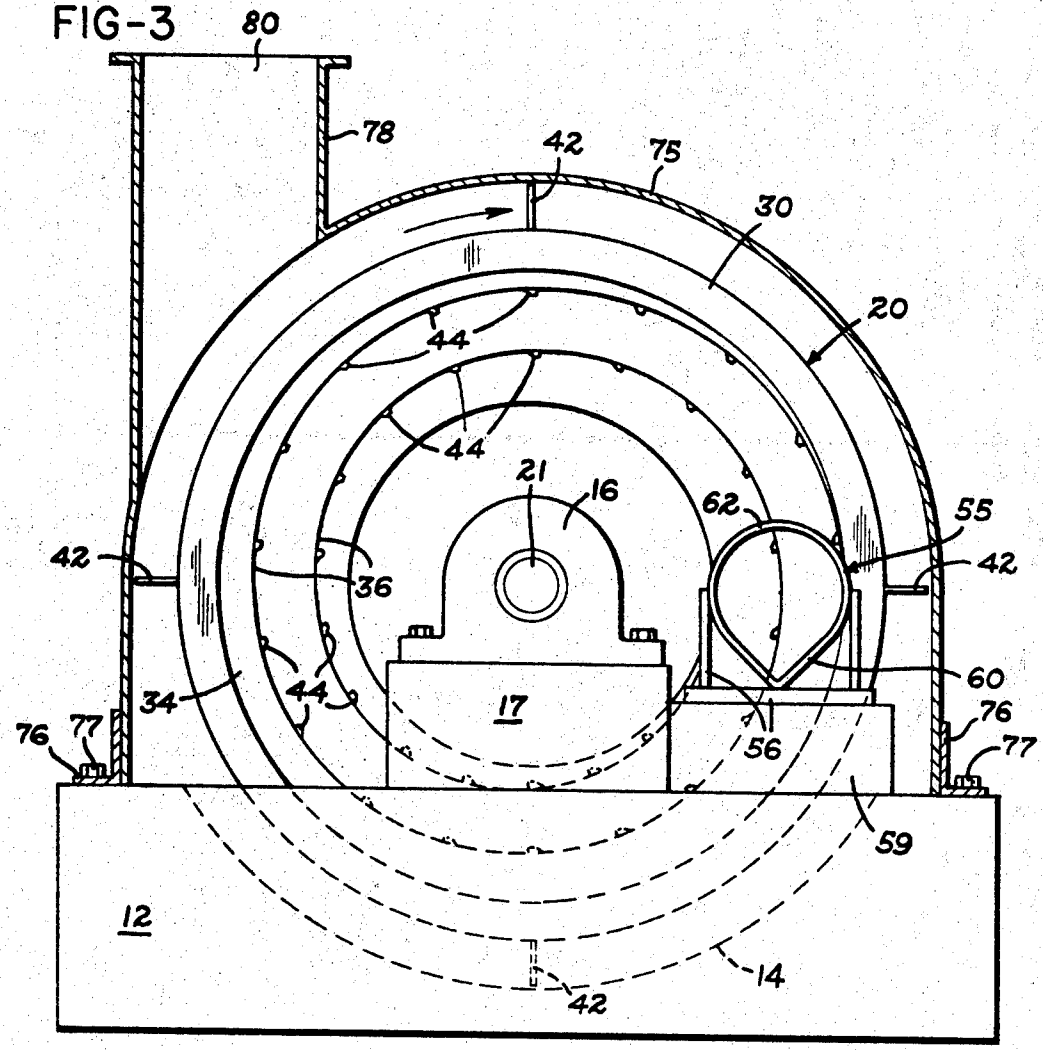



FIG-4

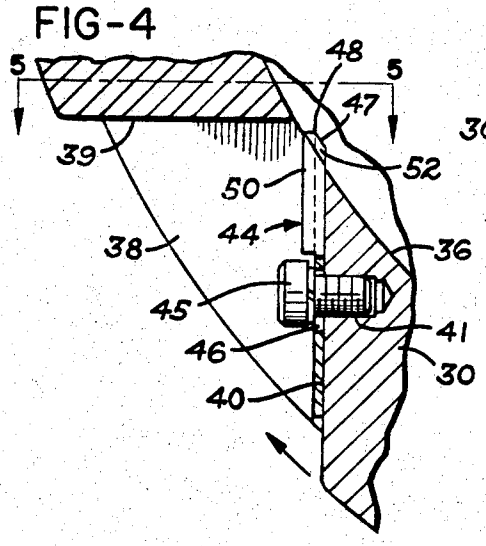
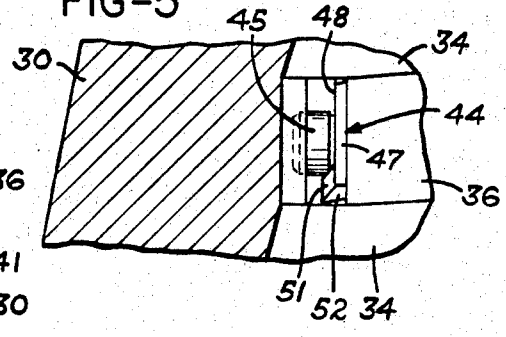



FIG-5



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FIG-7

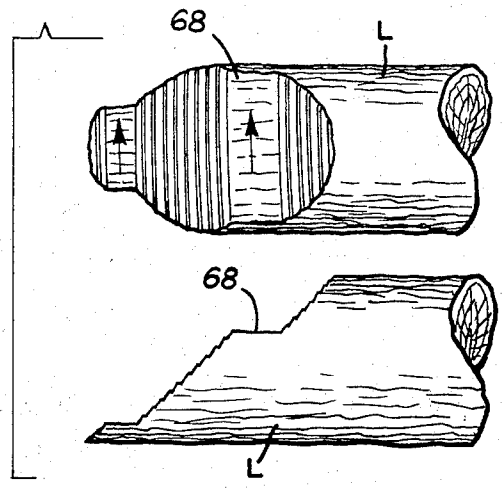



FIG-6

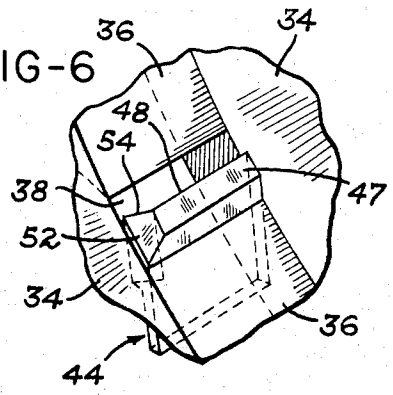



FIG-8

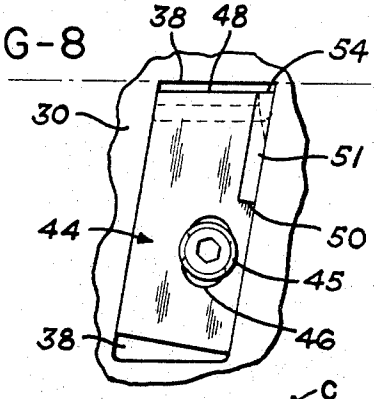



FIG-9

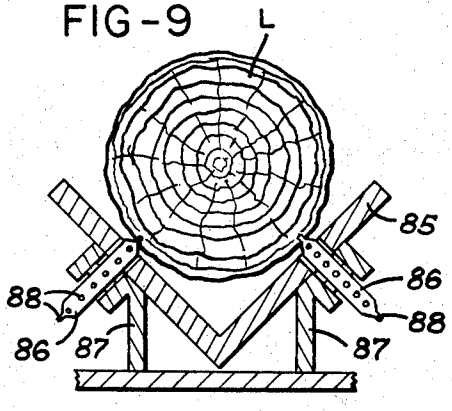



FIG-10

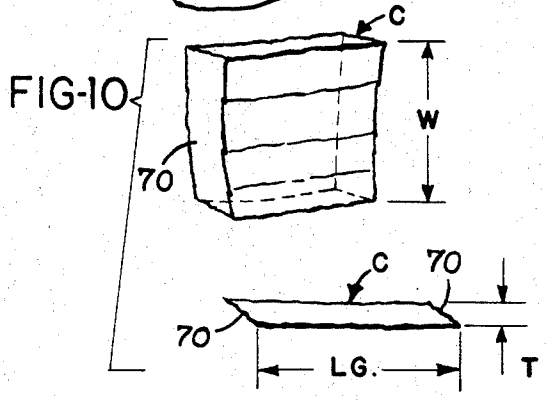



FIG-11

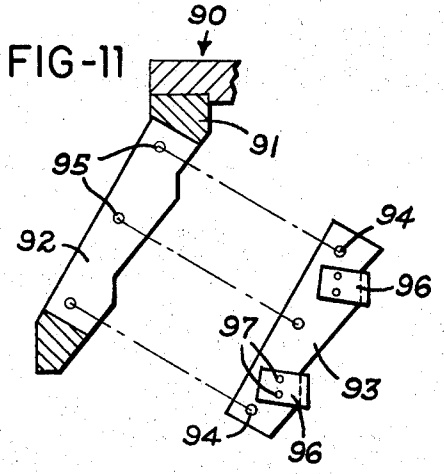
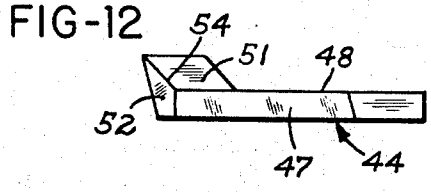



FIG-12



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# WOOD CHIPPING APPARATUS

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## ABSTRACT OF THE DISCLOSURE

A wood chipper has a rotor with a shaft member supporting a surrounding frusto-conical annular wall having peripherally spaced openings each receiving an inwardly projecting knife. Bearings rotatably support the shaft member on each end of the annular wall, and a guide spout extends axially into the annular space defined between the shaft member and the frusto-conical wall for directing the entire end surface of a log into engagement with the knives.

This invention relates to chip forming apparatus, for use in making pulp and paper, particle board and the like, and more particularly to improved apparatus for converting or reducing logs and wastewood such as sawmill waste, slabs and edges into small chips of generally uniform size.

It is well known in the art of wood cutting that substantially less force is required to split wood with the grain rather than to shear the wood across the grain. For example, less force is needed to drive an axe into the end of a log parallel with the grain to a predetermined distance than is required to drive the axe across the grain to the same distance. Furthermore, in the production of wood chips for making paper, it is desirable to have the grain or fibers extending the length of the chip rather than across its thickness in order to produce pulp having long fibers, which in turn result in a paper web having a higher tear strength.

It is also desirable, especially for use in the manufacture of particle board, to produce chips which are not compressed or damaged and are substantially uniform in width and constant in length and thickness. Such uniform chips without oversize chips are also desirable in the production of paper in that cooking liquor will penetrate uniformly into the chips and thereby produce a uniform pulp in a minmum time period. Furthermore, it is desirable to have fewer short fibers or fines within the pulp so that liquid will drain quickly from a mat formed from the pulp and the resulting paper web can be dried in a shorter period of time.

It is a primary object of the present invention to provide improved chipping apparatus which produces chips primarily by splitting the end of a whole log or wastewood pieces parallel to the grain so that the apparatus requires minimum power to operate, and in addition, produces chips of substantially uniform width and constant length and thickness with the fibers extending the length thereof.

As another object, the present invention provides improved chipping apparatus including a rotor having an annular frusto-conical inner surface incorporating a series of openings through which extend a series of knives, and which also includes a spout for feeding the wood into engagement with the knives in such a manner that the cutting edge of each knife remains generally parallel to the axis of the wood during the entire cut through the wood so that the chips are effectively split from the wood, thereby minimizing the horsepower for driving the rotor.

Still another object of the invention is to provide apparatus as outlined above wherein the rotation of the rotor



produces centrifugal forces on the chips to aid in discharging the chips through the openings formed within the rotor and thereby provides for controlled discharge of the chips and eliminates blowing chips out through the wood inlet spout.

It is also an object of the invention to provide improved apparatus as outlined above including a series of vanes extending outwardly from the rotor by which the chips thrown outwardly through the openings in the rotor are blown through a discharge conduit to a collecting or storage chamber.

Another object of the invention is to provide apparatus as outlined above wherein the spout is tubular in cross-section and has an annular end portion extending into the rotor and positioned closely adjacent the knives projecting from the inner surface of the rotor to assure that each log is completely reduced to chips and may further include means for preventing a log from turning while it is being split or parted into chips by the knives.

It is also an object of the invention to provide apparatus as outlined above wherein each knife includes a surface which tends to produce a self-feeding action of the wood into the rotor.

A further object of the invention is to provide apparatus as outlined above wherein the openings and knives are arranged in a helical pattern around the inner surface of the rotor to assure that the entire end portion of the wood is engaged by the knives and for enabling a plurality of knifes to engage the wood simultaneously.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

FIG. 1 is a perspective view of chipping apparatus constructed in accordance with the invention;

FIG. 2 is a view of the apparatus of FIG. 1 with the housing removed and the rotor shown in section;

FIG. 3 is an axial end view of the apparatus with the housing shown in section;

FIG. 4 is a fragmentary section of the rotor taken generally along the line 4—4 of FIG. 2;

FIG. 5 is a fragmentary section of the rotor taken along the line 5—5 of FIG. 4;

FIG. 6 is a fragmentary perspective view of the rotor and showing the projecting portion of a typical knife;

FIG. 7 is a view of a log end portion showing the end surface configuration as it is being formed into chips by the apparatus shown in FIG. 1;

FIG. 8 is a side view of a knife shown mounted on the rotor;

FIG. 9 is a section view of a guide chute formed in accordance with another embodiment of the invention;

FIG. 10 illustrates a typical chip shown in both perspective and plan views;

FIG. 11 illustrates a knife mounting arrangement in accordance with another embodiment of the invention; and

FIG. 12 is a top view of a knife.

Referring to the drawings, which illustrate preferred embodiments of the invention, the assembled chipping apparatus or chipper shown in FIG. 1 generally includes a base 12 in which is formed a semi-cylindrical cavity 14 (FIGS. 2 and 3). A pair of bearings 16 and spacing blocks 17 are mounted on the base 12 for rotatably supporting a rotor 20 by its shaft 21, which has a reduced end portion 22 extending through the rear bearing 16. A pulley 23 is mounted on the reduced end portion 22 of the main shaft 21 and is connected by V-belts 24 to a motor 26 supported by a bracket 27 mounted on the base 12.

Referring to FIGS. 2 and 3, the rotor 20 further includes a rear plate 28 which is rigidly secured to the

shaft 21 and reinforced by the ribs 29. An annular frusto-conical wall member 30 is rigidly mounted on the plate 28 by a series of screws 32 and defines generally an inner frusto-conical surface 34 which is interrupted by one or more spiral or helically formed lands 36. Preferably, each land 36 extends parallel to the axis of the shaft 21 and forms one or more revolutions on the surface 34. Formed within the wall member 30 and uniformly spaced around the spiral land 36 (FIG. 3) are a series of openings 38 (FIG. 4) defined by opposed surfaces 39 and 40. A threaded hole 41 is formed within the wall member 30 and extends from the surface 40. Also formed as a rigid part of the rotor 20 are a series of vanes 42 which project outwardly from the wall member 30 to act as fan blades.

A knife 44 (FIGS. 4 and 6) of stamped or drop forged construction is mounted within each of the openings 38 and is retained against the surface 40 by a cap screw 45 which extends through a slot 46 in the knife and is threaded into the hole 41. Each of the knives 44 is provided with a beveled surface 47 defining a straight cutting edge portion 48 which extends parallel to the axis of the shaft 21. In addition, each knife 44 includes an inclined forward side edge portion 50 (FIG. 8) of greater thickness than the balance of the knife and forming an inclined surface 51 (FIG. 12). A leading end surface 52 is beveled away from the beveled surface 47 toward the inner surface 34 of the rotor 20 to form a tapered leading cutting edge portion 54.

A tubular spout member 55 having a support frame 56 is mounted on the base 12 by a series of screws 57 extending through the support frame 56 into a spacing block 59. As shown in FIG. 3, the spout member 55 has an axis which is parallel to and spaced from the axis of the shaft 21. The spout member 55 includes an elongated V-shaped bottom portion 60 covered by a part cylindrical casing 62, and the inner end portion 65 (FIG. 2) of the spout member 55 is beveled generally parallel with the inner surface 34 of the rotor 20.

Conveyor means represented by a series of rollers 66 in alignment with the bottom portion 60 of the spout member 55 support and direct a log L into the spout member 55. Thus when the rotor is driven in clockwise direction (FIG. 3) and a log L is fed into the spout member 55, the log L is engaged and chipped by the successive knives 44, thereby forming on the log a sloping step-like end surface 68 (FIG. 7) extending on a bias across the log.

A typical small chip C (FIG. 10) which is formed by a knife 44 and thrown outwardly through an opening 38 has its grain or fibers extending along its length Lg which corresponds generally to the length of the knife cutting edge portion 48. This length is preferably approximately one inch long, but the chip length may be changed by changing the length of the cutting edge portion 48 and the width of the spiral land 36. The cutting edge portion 48 also projects inwardly from the spiral land 36 to provide a chip thickness T which is determined by the total number of knives.

As shown in FIG. 10, the end surfaces 70 of a typical chip C extend transversely or angularly across the thickness of the chip as a result of a cutting action produced by the leading cutting edge portion 54 of each knife 44, thus providing a parallelogram cross-sectional configuration. In effect, the knives 44 split or carve off different length strips from the log L, but it has been found that as the strips are thrown outwardly through the openings 38 and are engaged by the vanes 42 extending outwardly from the rotor 20, the strips are broken along the grain to form chips which are substantially uniform in width W.

While a bottom opening may be provided within the base 12 for discharging chips into a conveyor spaced below the apparatus, the chipper shown in FIG. 1 is provided with a semi-cylindrically shaped housing 75 which covers the rotor 20 and is removably mounted on the base 12 by a pair of flanges 76 and screws 77. A duct 78 extends upwardly from the housing 75 and defines a discharge outlet 80 through which chips are blown by the vanes 42. The chips may then be directed through a suitable conduit (not shown) connected to the duct 78 to a chamber for storage or treatment. For conveniently removing the housing 75, it is provided with suitable slots 81 (FIG. 1) for receiving the spout 55 and shaft 21.

FIG. 9 shows a trough assembly which may be used in place of the spout member 55 to provide additional resistance to rotation of a log L when it is being split by the knives 44. The trough 85 is slotted to receive portions of a plurality of wheels 86 rotatably supported by a frame 87. The wheels 86 are provided with circumferentially spaced teeth 88 which project into the log surface and thereby produce a positive grip on the log to prevent rotation while also reducing the frictional resistance of the trough to the feeding of a log L.

A modified form of the invention is shown somewhat schematically in FIG. 11 wherein a rotor 90 includes a frusto-conical wall member 91 having formed therein a series of peripherally spaced slot-like openings 92 which extend generally in an axial direction and have a cross-sectional configuration generally similar to the openings 38 shown in FIG. 4. A flat elongated bar 93 is mounted in each opening 92 by screws which extends through the holes 94 formed within the bar 93 and are threaded into the tapped holes 95 formed within the wall member 91. Each bar is positioned relative to wall member 91 on an inclined angle similar to the position of the knife 44 shown in FIG. 4.

The inner edge surface of each bar 93 is provided with a profile conforming to the internal configuration or contour of the wall member 91 and at least two axially spaced knives 96 are secured to each bar 93 by screws or rivets 97. Each knife 96 is constructed substantially the same as the knife 44 shown in FIGS. 8 and 12 and thus includes cutting edge portions which project inwardly from the inner surface of the wall member 91 in the same manner as shown in FIGS. 4 and 6 for the cutting edge portions of the knife 44.

The primary advantage of employing the bars 93 for supporting the knifes 96 is to provide for quick assembly and replacement of the knives to minimize downtime of the apparatus. That is, instead of replacing each knife individually when it becomes dull, it is only necessary to remove and replace the bars 93 which carry the knives. For example, it has been determined that from 12 to 16 bars 93 are sufficient to support approximately 36 knives. Furthermore, as mentioned above, the knives 96 are preferably either stamped or drop forged and may be disposable, when dull, thus eliminating the necessity of regrinding.

Thus it has been found that a log chipping apparatus constructed in accordance with the present invention provides several desirable features and advantages. Primarily, the apparatus is adapted to receive the entire end portion of one or more logs or wastewood such as sawmill slabs, edgings, or the like and progressively reduce the log or wastewood into chips of substantially uniform width and constant length and thickness, with the fibers extending the length of the chips. As a result, a paper web formed from the chips has longer fibers which produces higher strength and enables the web to be efficiently dried.

As an additional feature, the edge portion 48 of each knife 44 remains substantially parallel to the axis of the shaft 21 and the axis of the log L during the entire cut of the knife through the log. This has been found highly desirable for substantially reducing the power required for rotating the rotor 20 since the knives 44 are in effect splitting the chips from the log parallel with the grain rather than shearing them from the log across the grain. In addition, it has been found that the leading sloping cutting edge portion 54 of each knife 44 produces a clean

diagonal cut through the log along the ends of the chips, thereby preventing compression of fibers and minimizing the forming of undesirable short fibers or fines. Also, it has been found that the surface **51** of the knife edge portion **50** produces somewhat of a chisel effect which, in turn, produces a force component on the log in an axial direction tending to provide a self-feeding action on the log because of the inclination of the knife portion **50** to the axis of the rotor.

Other features of the invention are provided by the construction and arrangement of the spout member **55** and trough **85** which prevent rotation of the log L and also assure that the entire log or wastewood is formed into chips since the spouts extend into the rotor **20** adjacent the surface **34**. The spaced relationship of the openings **38** in relation to the shaft **21** provides the feature whereby rotation of the rotor **20** causes the chips formed by the knives **44** to be thrown centrifugally out through the openings **38** so that they will not blow back into the rotor **20** or out through the spout **55**. Furthermore, the vanes **42** extending from the rotor **20** provide for blowing the chips through the discharge outlet **80** and thereby transport them to a receiving chamber.

Another advantage of the chipping apparatus of the invention is provided by the spiral arrangement of the knives **44** on the rotor **20**. That is, the openings **38** and knives **44** are spaced on the spiral land or lands **36** so that as the cutting progresses towards the side of the log nearest the shaft **21**, simultaneous cutting begins on the outer side of the log. As a result, the knives exert forces on the log on opposite sides of the log axis and thereby tend to balance each other and reduce the tendency of the log to rotate.

The chipping apparatus of the invention also substantially eliminates the production of undesirable oversize particles or long slivers since such particles will be carried around the inside of the rotor until they are eventually cut to a correct length for passing through a slot-like opening adjacent a knife cutting edge. It has also been found that the centrifugal forces exerted on the chips as they are thrown through the openings **38** eliminates "carding" of the chips which is the tendency of chips to remain flexibly connected together by fibers extending between adjacent edges.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

**1.** Chipping apparatus for receiving the end of a log or like wood pieces and splitting the same into chips of substantially uniform width and constant length and thickness, comprising a rotor including an elongated shaft member, an annular concentric wall member surrounding said shaft member and having a generally frusto-conical inner surface cooperating with said shaft member to define an annular space therebetween, means rigidly connecting one end of said wall member to said shaft member, spaced bearings rotatably supporting said shaft member on opposite ends of said wall member, drive means for rotating said rotor, means defining a plurality of peripherally spaced openings within said wall member, a knife mounted in each said opening and having a cutting edge projecting inwardly of said surface, and spout means extending into said annular chamber between said shaft member and said inner surface of said wall for directing the entire end surface of the wood into engagement with said cutting edges of said knives so that the wood may be continuously fed into said spout means and be progressively formed into chips which are thrown outwardly through said openings.

**2.** Apparatus as defined in claim **1** wherein said spout means extends into said rotor substantially parallel to said shaft member so that wood is fed into said annular chamber in a direction substantially parallel with said shaft member.

**3.** Apparatus as defined in claim **1** including a housing for covering said rotor, means defining a discharge opening within said housing, and a plurality of vanes mounted on said rotor and projecting outwardly from said wall means for propelling the chips thrown outwardly through said openings within said wall member by centrifugal force through said discharge opening within said housing.

**4.** Apparatus as defined in claim **1** including means defining a series of peripherally spaced slot-like openings within said wall member, an elongated bar removably mounted in each said opening, and a plurality of longitudinally spaced knives mounted on each said bar to provide for quick replacement of said knives when said cutting edges become dull for minimizing the downtime of said apparatus.

**5.** Apparatus as defined in claim **1** wherein said means rigidly connecting said wall member to said shaft member comprise a support member mounted on said shaft member and positioned substantially perpendicular to the axis of said shaft member, and reinforcing means extending into said annular space and rigidly connecting said shaft member to said support member.

**6.** Apparatus as defined in claim **1** wherein each said knife includes a surface extending transversely relative to the axis of said rotor and positioned to effect a self-feeding action of the wood into said rotor.

**7.** Apparatus as defined in claim **1** wherein said spout means comprises a tubular spout having a V-shaped bottom portion.

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