April 2, 1957 P. G. BRUNDELL ET AL 2,787,304

MACHINE FOR REMOVING BARK FROM LOGS

Filed March 26, 1954 3 Sheets-Sheet 1

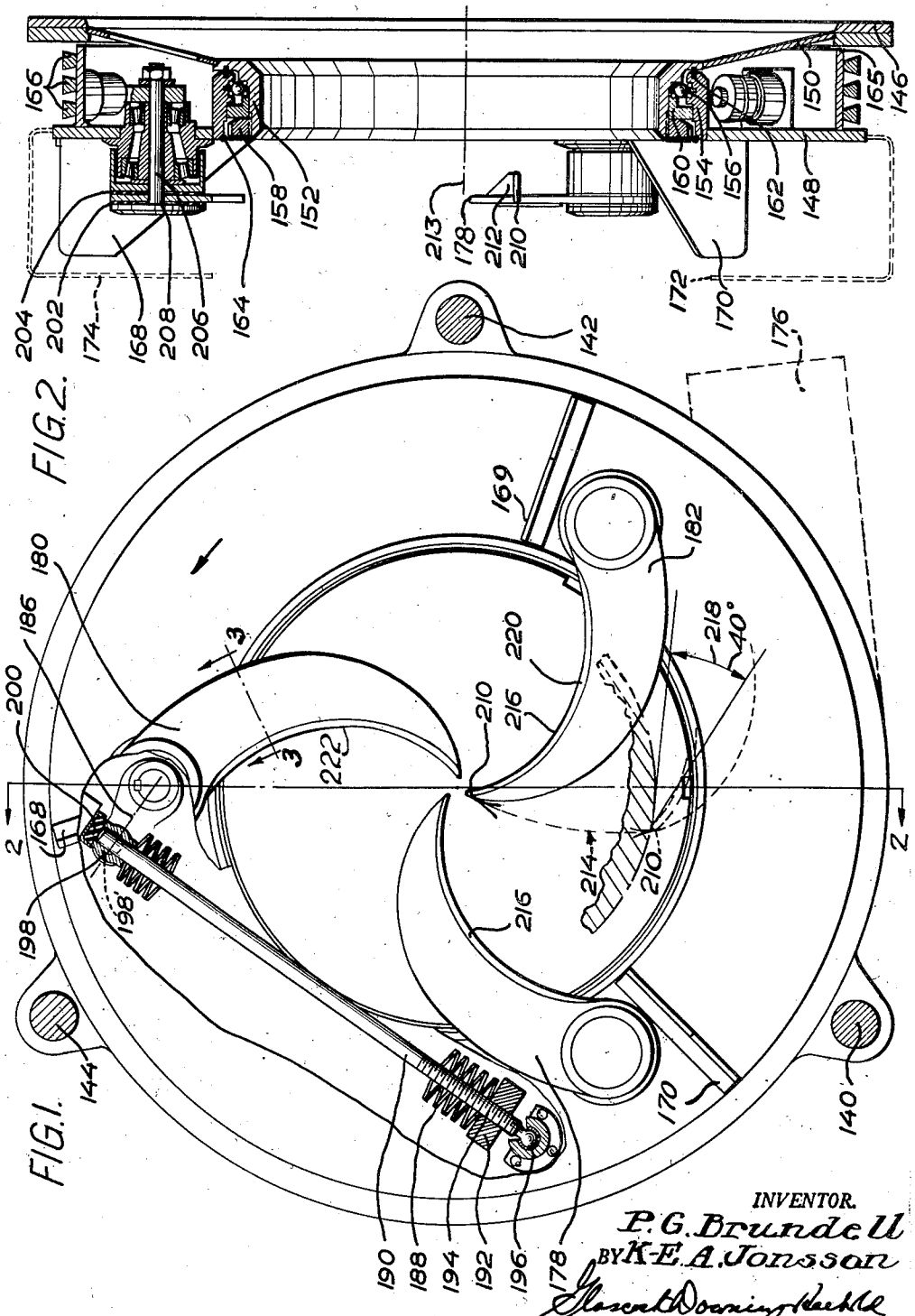


FIG. 2.

FIG. 1.

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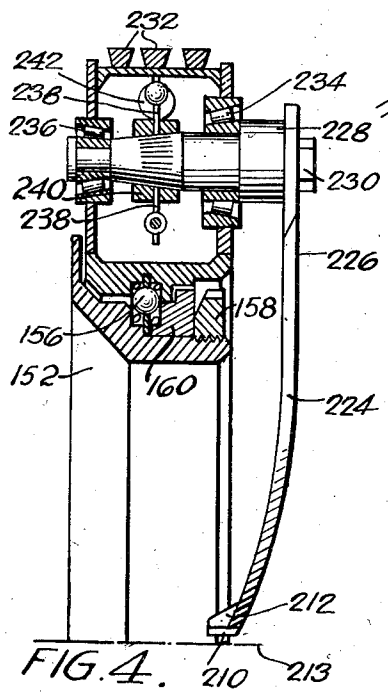


FIG. 4.

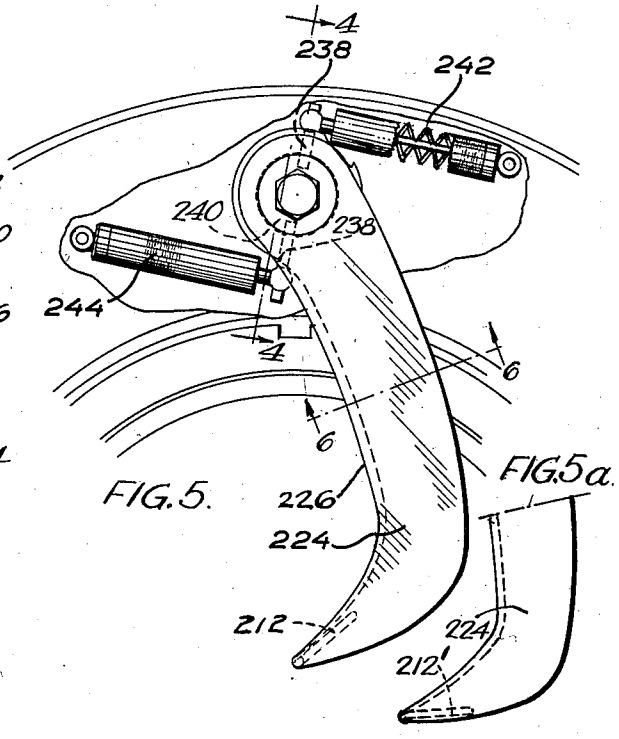


FIG. 5. FIG. 5a.

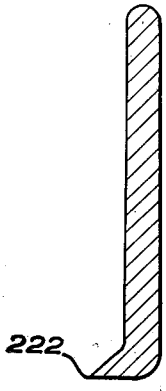


FIG. 3.

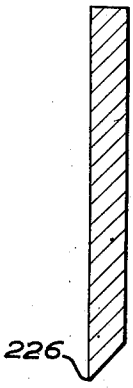


FIG. 6.

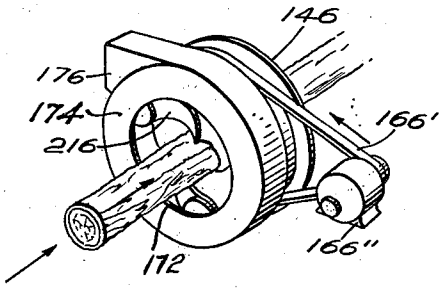


FIG. 7.

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MACHINE FOR REMOVING BARK FROM LOGS

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FIG. 8

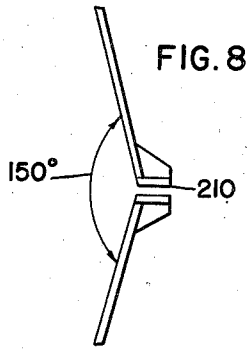


FIG. 9

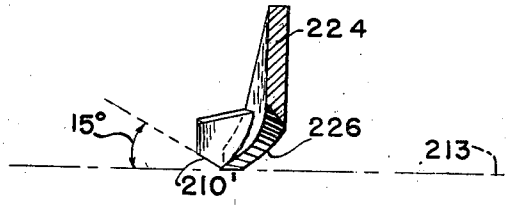
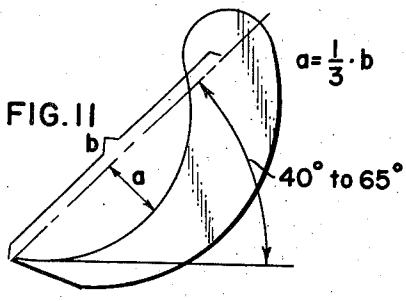


FIG. 11



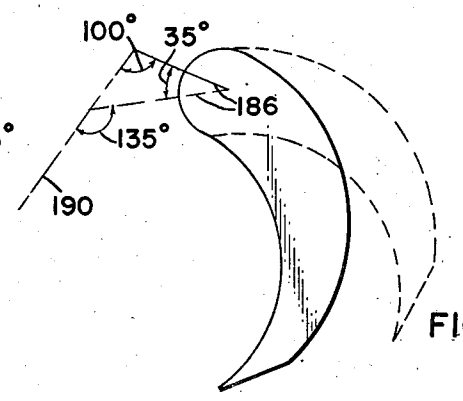
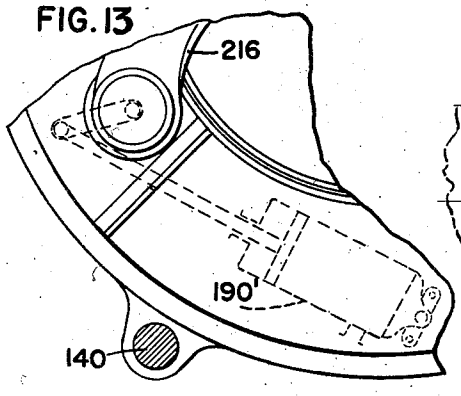


FIG. 12

FIG. 13



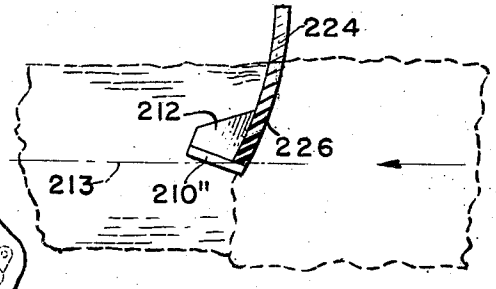


FIG. 10

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2,787,304

MACHINE FOR REMOVING BARK FROM LOGS

Per Gunnar Brundell, Gavle, and Karl-Erik Arnold Jonsson, Borlange, Sweden

Application March 26, 1954, Serial No. 418,854

Claims priority, application Sweden January 23, 1954

11 Claims. (Cl. 144—208)

The present invention relates to the art of removing bark from logs.

Specifically, this invention relates to improvements in debarking machines of the hollow-head type in which debarking tools are carried by a rotatable head or frame and the log is fed through the head during a bark-removing operation.

Still more specifically, this invention relates to a machine for debarking logs in which the tools are applied against the logs during the removal of bark by an elastic force of sufficient intensity to maintain the bark-removing portion of the tool in contact with the log regardless of irregularities in log contour and bark to disrupt the adherence of bark to underlying wood strata to remove the bark from the underlying wood without damaging the wood.

Therefore, the present invention is related to a debarking machine of the general type embodied in Patent No. 2,623,558 to Anderson, dated December 30, 1952, and of a debarking tool embodied in the U. S. patent application by Anderson, Ser. No. 273,212, filed February 25, 1952.

The construction and operation of the head of the hollow-head-type debarking apparatus is of considerable importance as regards the adequate removal of bark, since the debarking tools, of which a plurality are carried by the head, must be mounted on the head with due regard to the perpendicular contact with the log while it is passing through the head. Additionally, the axial extent of the head should be maintained at a minimum in order to adequately remove bark from logs that may be bent or crooked. Furthermore, elastic force-applying means must be embodied on the head to apply the perpendicular force to the tools to insure proper bark removal.

It is, therefore, a primary object of the present invention to provide a compact, hollow, tool-carrying head for a debarking machine and on which head is embodied improved debarking tools and means for applying the tools against the log during a bark removal operation.

It is a specific object to provide a hollow-head type bark-removing machine in which pivotally mounted arms are carried thereon and provided with debarking tools having a blunt edge and means for applying an elastic force to the tools so that as the head rotates with a log being fed therethrough each blunt edge is pressed against the log with sufficient intensity to penetrate the bark and slide on the wood surface of the log to remove the bark by a frictional shearing action exerted in a tangential direction.

A more specific object is to provide a unique spring arrangement for applying the elastic force to the tools.

A still more specific object is to embody the blunt edged tools as an integral part of the pivoted arms and to construct such arms in the form of crescent-shaped sheet metal members arranged in a plane substantially perpendicular to the axis of rotation of the head.

Another specific object is to incorporate a hood in association with the rotary head and to mount wings or vanes on the head that during rotation of the head function as fan blades to draw air through the head to entrain bark removed by the tools and to expel such bark circumferentially of the hood.

Specifically, the invention consists in the mounting of the tool-carrying arms on the head and in utilizing spring means, the force of which is adjustable, to apply the elastic force to the tools, and to arrange the springs so that they act on the tool-carrying arms in such a manner that the barking pressure of the tools will vary within permissible limits even when the logs being debarked have considerable differences in diameter, for example, from 1" to 16".

A further specific object is to provide debarking means consisting of a cemented carbide bit.

Further and more specific objects will be apparent from the following description taken in connection with the accompanying drawings illustrating suitable embodiments of the invention and in which:

Figure 1 is an elevation, parts being broken away and shown in section of the infeed face of the hollow head,

Figure 2 is a longitudinal sectional view and is taken along line 2—2 of Figure 1,

Figure 3 is an enlarged scale sectional view taken along line 3—3 of Figure 1 and illustrates a section of one of the crescent-shaped tool-carrying arms,

Figure 4 is an enlarged scale fragmentary longitudinal section of a modified form of mounting means for the tool-carrying arms, the plane of the section being indicated by line 4—4 of Figure 5,

Figure 5 is an enlarged scale fragmentary elevation, certain parts being broken away for clarity, and shows the embodiment of Figure 4 as viewed from the right,

Figure 5*a* is a fragmentary elevation of the inner portion of a modified form of tool carrying arm,

Figure 6 is an enlarged scale section through the modified tool-carrying arm shown in Figure 5 and taken along line 6—6 of Figure 5,

Figure 7 is a diagrammatic perspective view of a debarking machine in accordance with the invention with particular reference to the mounting of the fan housing and rotatable tool holder,

Figure 8 diagrams a cone of revolution of the inner end of a tool-carrying arm, assuming that a log moves from left to right.

Figure 9 corresponds to a horizontal section of the lower (inner) end of the tool-carrying arm shown in Figure 4, but shows a modified bark-removing tool.

Figure 10 is a fragmentary side elevation corresponding to the lower portion of Fig. 4, but showing a further modified bark-removing tool.

Figures 11 and 12 are schematic elevations of a tool-carrying arm and show various relationships of construction and mounting.

Figure 13 is a fragmentary view illustrating a modified arrangement for applying pressure to a tool-carrying arm.

In connection with the drawings, the rotatable head is supported in a stationary frame **146** that is connected by means of longitudinal tie rods **140**, **142** and **144** with the main framework of the machine on which are mounted conventional log-feeding means (not shown).

The conventional type of log-feed consists of knurled, fluted rollers arranged in pairs in front of and behind the rotatable head. The rollers are pressed against the log by any suitable means. The log-feed is not illustrated but can be of the type described in the aforementioned Anderson Patent No. 2,623,558 or preferably in the feeding mechanism disclosed in Figures 4 to 7 of U. S. patent application Ser. No. 378,738, filed September 8, 1953. It is to be understood, of course, that any

log-feed means well known in the art that will feed a log axially through the head while restraining it against rotation, can be utilized.

The frame on which the rotatable part of the hollow head is mounted includes a conical shield member **150** having an annular hub **152**, the inner diameter of which is large enough to accommodate the largest size log for which the machine is intended. The rotatable part of the hollow head includes an annular ring **148** having an internal hub **154**. The facing surfaces of hubs **154** and **152** are grooved to accommodate a single row of ball bearings **156**, preferably of the space-saving type as shown in the drawing.

The grooves are provided with circular rings made from hardened spring-steel wires, two of the circular rings being located on the rotating hub **154** and the other two on the stationary hub **152**. One of the circular wire rings on the stationary hub can be moved toward the other wire ring by means of a spacing ring **160** and an annular nut **158** which is threaded on the periphery of the stationary hub **152**. When this nut is tightened sufficiently the two wire rings on the stationary hub press the balls against the wire rings on the rotating hub **154** to such a degree that when the hollow head is forced around, the balls will by cold-rolling action impress geometrically correct running surfaces on the wire rings for the balls to roll on which the nut is somewhat loosened. The balls are spaced by suitable ball spacers. The ball bearing so described is easy to incorporate with a mild-steel or cast-iron construction, and gives excellent performance as far as low friction and running time is concerned. If the clearance in the bearing becomes too big due to wear this is easily compensated for by tightening the nut **158**. With this simple bearing all forces originating in axial and radial directions can be taken care of as well as bending forces. This bearing is sealed by labyrinths or by sealing rings **162**, **164** mounted between the hubs as shown in Fig. 2. The incorporation of the ball bearing described makes it possible to decrease the axial extent of the rotor to such a degree that pulp wood down to 3' length can be debarked when fed by feeding means disclosed in Figure 4 of U. S. patent application Serial No. 378,738, filed September 8, 1953.

Of course, it is obvious that the grooving arrangement in the facing surfaces of the respective hubs can be such as to accommodate ordinary type ball bearings. The rotatable frame further includes an annular ring **165** spaced outwardly of the hub **154** and extending from the rear face of the ring **148** and perpendicular thereto so as to cooperate with drive belts which may be V belts **166**, Figure 2, or a conventional drive belt **166'** illustrated in Figure 7. On the front face of the ring member **148** are mounted fan blades **168**, **169** and **170**, Figures 1 and 2, which draw air through the central opening **172** into a hood member **174**. This hood includes an outlet extension **176**. It is believed clear that the fan blades or vanes of which three are shown in Figure 1, establish an air stream when they rotate with the rotatable part of the hollow head and hurl the bark removed by the tools towards the circumference of the hood from which it escapes through outlet **176**.

The debarking tools of which three are utilized in the particular illustration, are designated **178**, **180** and **182**. These tools consist of crescent-shaped plate members that consist of plate members formed of a high-carbon-steel sheet or plate and are crescent shaped as viewed in the direction of log feed. These plate members are associated with shafts which are in turn supported preferably by conical roller bearings that are seated in bearing boxes bolted or otherwise rigidly connected to the rotatable holder. A lever **186** is provided and is adapted to be actuated by a pressure spring which is examplified in Figure 1 by a Belleville spring **188**. This spring consists of hardened, conical, steel washers mounted in facing relation in pairs on a hardened and ground rod **190**. One end of the rod terminates in a ball which is seated in a ball-shaped socket **196**. The portion of the rod adjacent the ball end is externally threaded at **194**, and a nut **192** threaded on this end constitutes one abutment for the Belleville spring packet. The opposite end of the rod **190** is slidable in a bushing **198** that is journalled on the free end of the lever **186** as at **198'**. The outermost position of the lever **186**, and therefore the innermost position of the debarking tool, is determined by an abutment formed by a rubber cushion **200** which is carried by the inner circumference of the V belt-supporting ring **165** and is disposed in position to intercept the lever **186**. It is therefore clear that when the lever **186** is rocked counterclockwise by outward swinging movement of its tool-carrying arm, the spring packet is further compressed. The tools **178**, **180** and **182** are clamped in place by clamping means preferably including rubber discs **202** and **204** mounted on opposite sides of the tool arms and a bolt **206** having an enlarged flat head **208**. The mounting is such that the spring packet, the tension and spring pressure of which can be adjusted to the desired value by manipulation of nut **192**, imparts clockwise movement to lever **186** (as viewed in Fig. 1) and thus inward or clockwise movement to the crescent-shaped tool-carrying arms. The outward movement of these tools is initiated by the logs as hereinafter described. In other words, the normal position of the tool arms is the inner position.

The tool arms **178**, **180**, **182**, **224** when viewed in the feeding direction of the logs have the shape of half crescents with the wide part attached to the pivoting shaft, the tip being provided with a transverse member **212** arranged at right angles or nearly at right angles to the plane of the crescent and extending backwards from same, a part **210** of said transverse member which contacts the log being blunt; and the tool arms as seen at right angles to the feeding direction appear thin and preferably have uniform thickness, see Figures 2 and 4. The tools are made by cutting them from a steel sheet or strip of high carbon content. The concave side **210**, **216**, **220** of the crescent-shaped tool faces an axis of rotation **213** of the rotor and or is provided with or shaped as a comparatively sharp edge **222** or **226**. When the log is pressed against the tool arms in an idle running machine or when a larger log is fed end to end after a smaller log each of these edges engages the peripheral corner at the end of the log and by means of the counterclockwise rotation of the rotor (as viewed in Figures 1 and 5) there arise, at the points of engagement, forces which counteract the elastic actuating force and turn the tool arms counterclockwise until their tips ride up over the butt end and onto the surface of the log and begin the debarking operation.

The planar surfaces of the crescent can extend perpendicular to the axis of rotation **213** of the rotor but preferably the crescent is bent so that it curves forward or in the direction of log feed so that the revolving tool arms generate a cone or a frustum of a cone which, however, has a comparatively great tip angle, for instance 150°, Figure 8. The barking blunt edge **210** extending from the tip of the crescent in the feed direction of the logs is preferably parallel to the axis of rotation of the rotor but for barking very dry wood it is preferable to use a tool in which a debarking edge **210'** tilts toward the exis of rotation so that said edge lies at an angle (for instance 15°) thereto (see Figure 9), whereby only a tip portion of the edge **210'** will contact the wood of the log; or it is possible to incline an edge **210''** (see Fig. 10) in a plane extending parallel to the axis of rotation and containing the pivot axis of the arm, so that the effective length of the blunt edge **210''** is reduced to the cosine of such angle of incline. Obviously, these modifications may be incorporated, either singly or in combination, in different tools. If with respect to the construction of the machine and torsional strength of

the debarked logs there is supposed a certain maximal total thrust by the blunt edge (for instance 220 lbs.), the obliquely directed debarking edge above described, due to the reduced area of contact and the resultant greater specific pressure, can penetrate and thereby remove considerably more difficult bark than a parallel edge. The degree of cleanness, however, will not be as good as that obtained with a parallel edge but will do for most kinds of kraft pulp.

The debarking edge **210** protrudes from the tip of the crescent and constitutes preferably one of the sides of a trapezoidal or triangular piece of metal **212** which is rigidly connected to a planer face of the crescent by means of riveting or welding. It is preferable to arrange this joint as shown by dotted lines in Figure 5 somewhat behind the concave edge of the crescent so that the tip portion of the concave edge can be made comparatively sharp. By doing this the bark will be cut or at least scratched along a helical path around the log and in advance of the blunt edge **210** so that the sharp tip portion does not contact the wood surface except when bark-free areas of the log are encountered. This results in a more efficient debarking, and at the same time counteracts the tendency of bark of certain trees to form long strips. Thus the bark is removed in small pieces which cannot fasten on the tool arms and which are easily removed through the opening **176** in the hood **174** by means of the fan blades **168, 169** and **170** connected with the rotor.

In order to obtain a machine which for a given maximum log dimension has the smallest possible external dimension the pivoting shafts of the tool arms have to be located relatively close to the axis of rotation of the rotor, wherefore the pivoting angles of the tool arms from inner position to outer position will be considerable (for instance up to 45°). The supporting member **212** of the debarking edge has two tasks: one is to create tangential forces against the bark encountered by the tool when the debarking edge slides on the wood surface, the other is to help the tool arm to ride over irregularities over which it is not lifted by the concave leading edge **210, 216, 220**. In order to avoid an unnecessary lifting force on the tool arm due to the pressure of the bark against the supporting member when the tool barks large diameter logs the supporting member **212'** is joined to the face of the crescent, see Figure *5a*, near the trailing or convex edge. But for small diameter logs the supporting member is preferably so located that it will contain a plane that also contains the axis of rotation **213**, this being the relationship of the supporting member **212** that is illustrated in Figure 5. In order to give the blunt edges a chance to go down into cavities on large diameter logs, the tip portion of the concave edge **210, 216, 220** of the tool arm should not form an angle less than about 40° with a tangent to the point of contact of the tip of the tool arm and the circumference of the largest diameter log (see angle **218** in Figure 1). In order to provide sufficient free space for the bark to escape and at the same time permit the lifting of the tool arm to be smooth, the concave edge of the crescent corresponds in shape to a circular arch, a tangent to which at the tip of the tool arm forming an angle of 40° to 65° with a line connecting the tip of the tool arm and its turning shaft (see Figure 11). The length of the circular arch is so chosen that the maximum angle of sweep (see arc **214** in Fig. 1) of the tool arm is between 20° and 40° and is preferably about 35° (see Fig. 12). The greatest depth *a* (see Figure 11) of the concavity will thus be equivalent to about ⅓ of the distance *b* from the tip of the tool arm to the turning shaft, it being understood that the depth *a* represents the perpendicular distance from the line *b* connecting the tip of the tool arm and the turning shaft.

The tool arms of the present invention have a comparatively small moment of inertia about their turning axis and consequently, without great variations in debarking pressure, can follow the surface of a very irregular log, even at high speeds of the rotor.

Good debarking is generally attained by using nose radii on the blunt edge of 1/48" to 3/8" but preferably 1/24" to 1/8". These curvatures with comparatively small radii are worn flat rather rapidly but by fastening to the supporting member **212** a thin cemented carbide bit which is ground to the nose radius desired the barking edge can be made to stand up for a very long running time.

The length of the spring packet **188** can be brought down to dimensions which are readily accommodated within the space available without causing too much variance in the torque exerted on the tool arm **180** to which the force exerted by the blunt edge **210** is proportional, as the tool arm swings between its innermost and outermost positions. This can be attained by arranging the longitudinal axis of the spring packet **188** (which coincides with the axis of rod **190**) so that the angle between this axis and the axis of the lever arm **186** when the arm **180** is in its outermost position is approximately 135° (see Figure 12). If the total pivotal movement of the tool arm is 35°, the angle between the axis of the spring packet and the lever will be approximately 100° when the blunt edge **210** is in its innermost position. When the spring force is the highest, that is when the tool arm is in its outermost position, the effective lever-arm length will be about 70% of the total length of lever **186**. When the blunt edge moves towards its innermost position, the rapid decrease in the force exerted by the expanding spring is largely offset by the increase of the effective lever-arm length to almost 100% of the total length of the lever **186**.

Figures 4 and 5 illustrate a tool-carrying arm of a more rigid type and made of steel plate provided with a permanent forward bend. The concave section of the tool arm **224** is provided with a relatively sharp leading edge **226**, Figure 6. This sharp edge engages an oncoming log so that the arm is lifted up onto the surface of the log by the rotational movement of the holder. Each tool arm of the type illustrated at **224** is mounted on a shaft **228** by a bolt means **230** without the interposition of any rubber cushions. The rotatable tool holder is made in the form of a hollow ring of generally rectangular cross section, front and rear sidewalls of the ring being provided with coaxial roller bearings **234** and **236** for the tool shaft **228**. Inside this ring are arranged two levers **238** having one end fastened in a ring **240** secured to shaft **228** and their other ends connected to Belleville type springs **242** and **244**. As the resulting force on the axis is negligible due to the fact that the spring packets counteract each other, in this respect, the spring pressure can be given higher values and consequently, very small degrees of travel. Thus, in this form of invention the springs are entirely enclosed and thereby protected from dirt.

In Figure 7 a diagrammatic perspective view of a barking machine shows the fan housing **174** and its outlet **176** and shows the rotatable tool holder driven by the belt **166'** operated by an electric motor **166''**.

Many advantages are to be derived by forming the debarking tools from plate members, such as economy in manufacture, sturdiness, and ease of replacement or substitution of tools. Additionally, by making the arms very thin in relation to their width there is ample space for the huge amounts of bark removed by the debarking tools to escape through the outlet **176**. A thin tool arm is not completely rigid with respect to bending forces perpendicular to the surfaces of the plate and thereby the blunt edge can adjust itself to make an even pressure along the whole extent of the blunt edge even when the wood portion of the log on which the blunt edge slides is not parallel with the axis of rotation.

Of course, other type springs can be utilized in lieu of the Belleville type illustrated.

It is believed clear, therefore, that the present invention provides a machine of the hollow-head type for debarking logs fed through the head by removing bark therefrom by a frictional shearing action. The hollow head includes a rotatable frame with movable tool means thereon that are directed inwardly of the head. Means are provided for continuously pressing the tool means against the logs. The tool-carrying arms engage the peripheral corner of an oncoming log and are automatically swung outwardly and onto the surface of the log being fed, and the bark-removing elastic force maintained on each tool is overcome, during such automatic repositioning of the tool, by energy supplied by the rotating frame member. Each of the tool means comprises a tip having a bark-removing blunt edge that preferably extends substantially parallel to the axis of rotation of the rotatable frame. The tip is supported by a crescent-shaped sheet metal member which has planar surfaces that stand substantially perpendicular to the axis of rotation, and which is pivotally mounted on the hollow head. The crescent-shaped sheet metal member, on the concave side thereof, is provided with or formed with a relatively sharp edge that faces in the direction of the oncoming log. The means for elastically and continuously pressing the tool body against the log is specifically constituted by a spring means in this disclosure. The spring means act on levers which in turn pivot the arms of the crescent-shaped sheet metal members.

It is also to be pointed out that pneumatic cylinders such as **190'**, Figure 13, can be utilized to apply the pressure on the tools, and in some instances balance weights could be used.

While there are above disclosed a limited number of embodiments of the structure of the invention herein presented, it is possible to produce still other embodiments without departing from the concept herein disclosed, and it is desired, therefore, that only such limitations be imposed on the appended claims as are stated therein or required by the prior art, so that the invention is to be understood as embracing all forms thereof that fall within the function and scope of the appended claims.

What is claimed is:

1. In a debarking machine of the hollow-head type in which a log is fed through the head so as to be debarked, a stationary frame, a rotatable hollow head rotatably supported by said frame; at least one tool means movably carried by the head; means mounting the tool means for movement towards and away from an axis of rotation of the head; means for elastically and continually pressing the tool means toward said axis and thus against a log passing through the head, with sufficient intensity, regardless of irregularities in log contour and bark, to disrupt the frictional adherence of bark to underlying wood strata so as to remove bark from such a log; the tool means having a blunt edge extending substantially parallel to the axis of rotation of the head so that bark is removed without damage to underlying wood, and the means mounting the tool means comprising a relatively thin metal member providing forward and rear planar surfaces and having its thin dimension connecting said planar surfaces and extending in the direction of the axis of rotation of said head, said planar surfaces appearing crescent shaped when viewed in the direction of the axis of rotation of said head and providing said metal member with a concave side facing said axis of rotation of the head, said concave side having a sharp edge facing in the direction of an oncoming log, and said mounting means including pivot means connecting said member to the hollow head.

2. In a debarking machine of the hollow-head type, a stationary frame, an annular head supported by and rotatable relative to said frame, tool means carried by the head, means mounting the tool means for movement

toward and away from an axis of rotation of the head, said tool means each comprising a relatively thin metal member providing forward and rear planar surfaces and having its thin dimension connecting said planar surfaces and extending in the direction of the axis of rotation of said head, said planar surfaces appearing crescent shaped when viewed in the direction of the axis of rotation of said head and providing said metal member with a concave side facing the axis of rotation of the head, each said metal member having a sharpened edge directed laterally of one of said planar surfaces and along said concave side and having a log-engaging blunt edge at its inner free end, said blunt edge extending substantially parallel to the axis of rotation of the head, the means mounting the tool means comprising pivot means connecting the crescent-shaped members to the head for swinging movement about axes parallel to the axis of rotation of the head, and means for elastically and continually urging the crescent-shaped members and thus the blunt edge toward the axis of the head whereby, when a log is fed toward the head from the side toward which the sharpened edge is directed, said crescent-shaped members are swung outwardly and then onto the surface of such log by the reaction of the revolving sharpened edge with the butt end of such log being fed, and whereby the means continually urging the crescent-shaped members inwardly, maintains the blunt edge against the surface of such log with sufficient intensity, regardless of irregularities in log contour and bark, to disrupt the frictional adherence of bark to underlying wood strata so as to remove bark from such log without damaging its underlying wood.

3. In a debarking machine as defined in claim 2, said planar surfaces of the metal member standing perpendicular to the axis of rotation.

4. In a debarking machine as defined in claim 2, the metal member being bent so that its planar surfaces curve forwardly or in the direction of log feed.

5. In a debarking machine as defined in claim 2, the blunt edge having greater axial extent than the thin dimension of the metal member and said member being sheet metal and having substantial flexibility so that the blunt edge can be pressed against such log even though its wood surface is not parallel to the axis of rotation.

6. In a debarking machine as defined in claim 2, the pivot means including roller bearings.

7. In a debarking machine as defined in claim 2, the pivot means including a shaft, at least one rubber disc on each side of each of the metal members, and means clamping said discs and member to the shaft.

8. In a debarking machine as defined in claim 2, a sheet-metal brace member being carried at the free end of each crescent-shaped member and extending perpendicularly from one of the planar surfaces thereof, said blunt edge being provided on said sheet-metal brace member, and said sheet-metal brace member serving to guide the blunt edge over knots on a log.

9. In a debarking machine as defined in claim 2, the blunt edge being inclined with respect to the axis of rotation of the hollow head.

10. In a debarking machine as claimed in claim 2, in which the annular head comprises interconnected inner and outer and infeed-side and outfeed-side walls to define a closed ring formation, the tool means being mounted externally of the infeed-side wall, the pivot means for each tool means including portions disposed between the infeed-side and outfeed-side walls, and the means for elastically and continually urging the crescent shaped members inwardly constituting resilient means housed entirely between said infeed-side and outfeed-side walls and interconnected with the pivot means.

11. In a debarking machine as claimed in claim 10, in which the resilient means comprise spring means.

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