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P. G. BRUNDELL ET AL
ROTARY DEBARKER HAVING PIVOTAL BARK-REMOVING
TOOLS BIASED BY ELASTIC RUBBER

2,786,499

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4 Sheets-Sheet 1

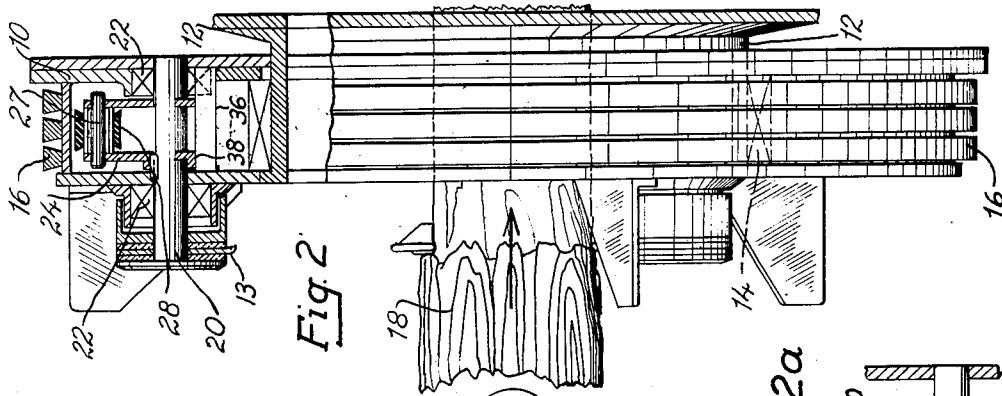


Fig. 2

Fig. 2a

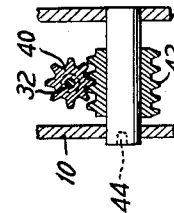
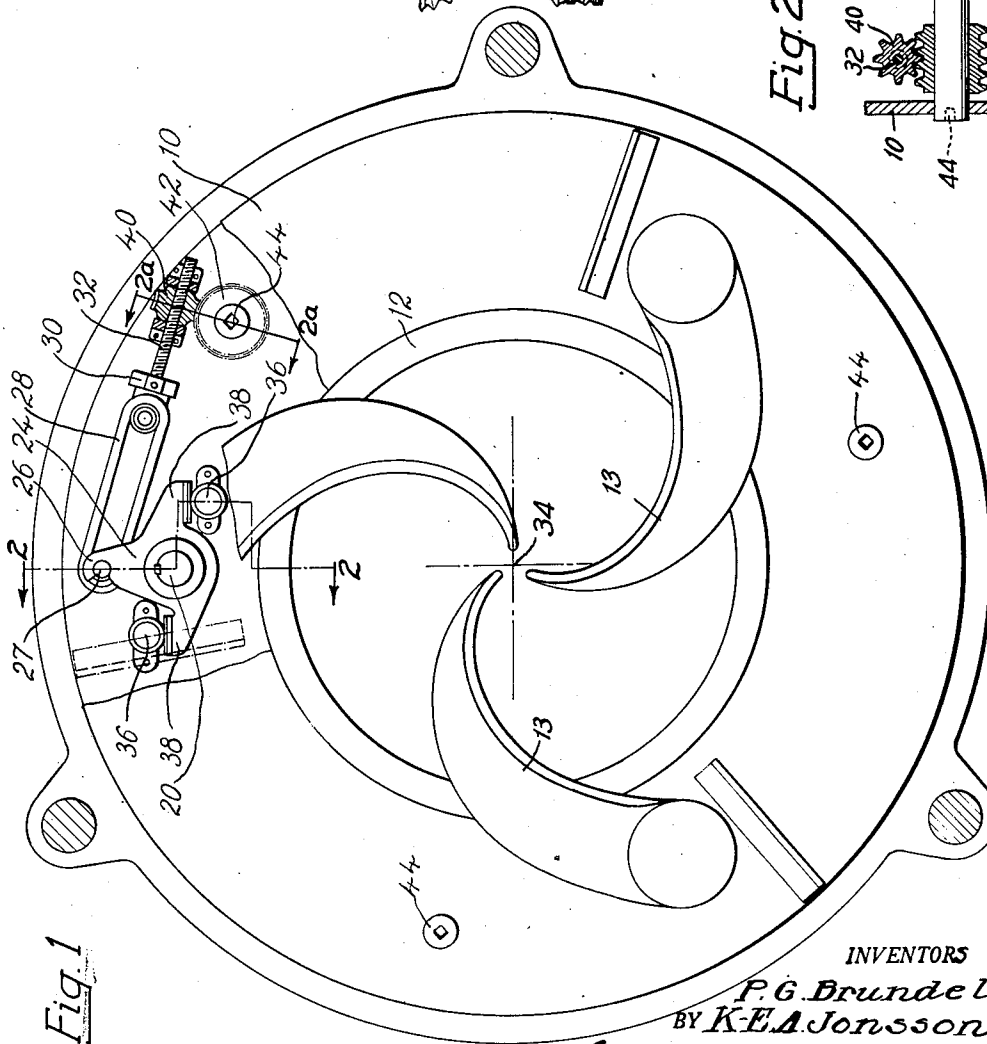


Fig. 1

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Fig. 1a

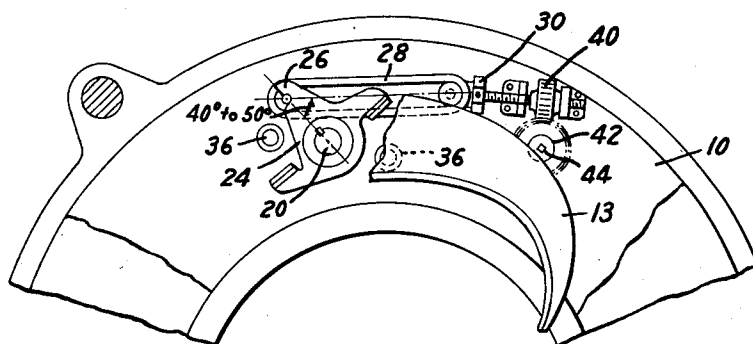
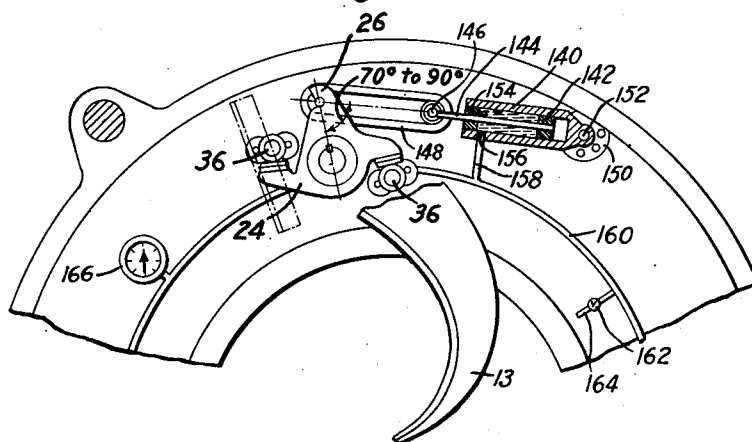


Fig. 1b



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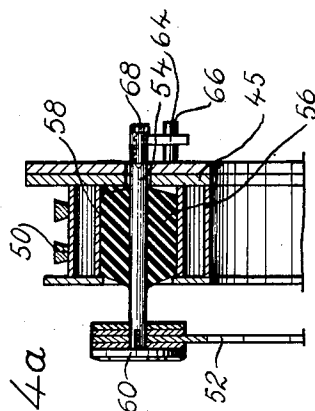


Fig. 4a

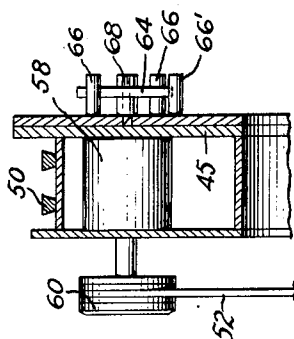


Fig. 4

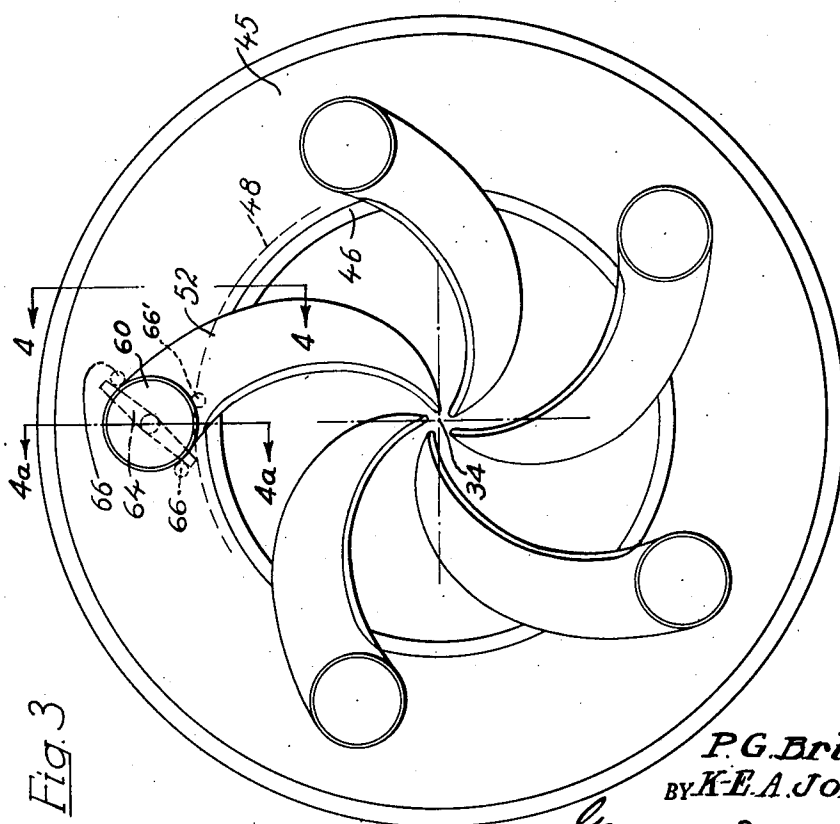


Fig. 3

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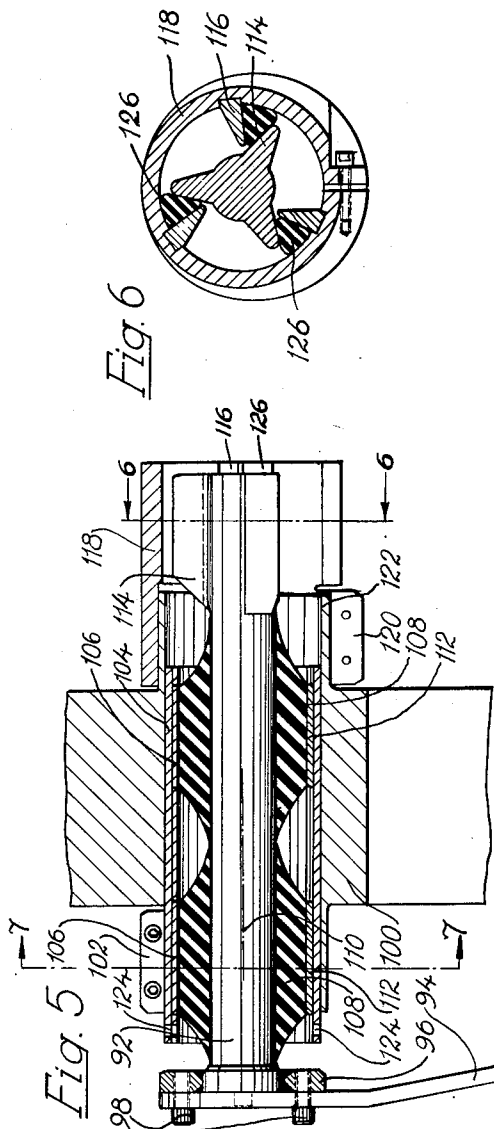
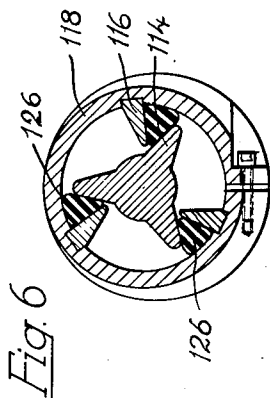
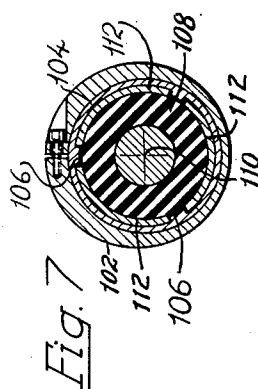
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4 Sheets-Sheet 4



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ROTARY DEBARKER HAVING PIVOTAL BARK-REMOVING TOOLS BIASED BY ELASTIC RUBBER

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14 Claims. (Cl. 144—208)

During recent years a number of debarking machines of the hollow-head type have been constructed for debarking pulpwood and timber. These machines are such that successive logs are fed through the hollow-head of the machine along a straight path and without rotation, while a plurality of tools, mounted in a frame or rotor which rotates around the path of travel of the logs, are resiliently pressed against a log with such force that the bark is removed along helical paths by a frictional or shearing action. The resilient force pressing the tools against the logs has hitherto been generated by means of compressed air, balance weights or steel springs.

The present invention is principally characterized by the use of solid elastic materials for the actuation of each tool, carried by a swingable arm, so that, if straight lines are drawn from the point or points of attachment of this material to the rotary frame to its point or points of attachment to the tool arm or to levers connected to pivot shafts of the tool arms, such straight lines will always lie within the elastic material. The actuating force thus is effected directly and without any special means such as spiral winding and the like, since either the stretching of elongate elastic material will produce tensile stress or the application of torque to a bushing of elastic material will produce shearing stress.

The resilient elastic force is generated by means of shearing or tension in a suitable elastomer, preferably natural rubber compounded with carbon black. The use of such material gives results comparable to the use of either steel springs or compressed air, but avoids the problems of leakage that always accompanies the use of compressed air. In comparison with steel springs the rubber provides a damping effect which prevents troublesome vibrations, whereas steel springs tend to oscillate longitudinally and also transversely when the tools ride over an irregular log surface. The actuation of the tool by rubber means is extraordinarily smooth which is particularly apparent in comparison with machines using balance weights for the actuation of the tools. The structure of the machine can be made much lighter due to the fact that it is not necessary to pay the same attention to fatiguing shock stresses as by machines using another form of actuation of the tools. Due to the light weight of the rubber member itself in relation to the desired actuating force, its small demand of space and the indirect decrease of weight due to the fact that the construction further can be made lighter it has become possible to produce a lightweight machine. Some different embodiments of the invention are shown as examples in connection with the following figures.

Figure 1 is a fragmentary view of a debarking machine with parts broken away for clarity as viewed from the direction of log feed and illustrating one form of the invention as regards means for applying the debarking tools to the logs,

Figure 1a is a fragmentary view diagrammatically illus-

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trating certain angular relationships of the parts shown in Figure 1,

Figure 1b is a fragmentary view similar to the upper portion of Figure 1 but illustrating a modified form of means for adjusting the force applied to the debarking tools,

Figure 2 is a fragmentary side view partly in elevation and partly in section with the section being taken on lines 2—2 of Figure 1,

Figure 2a is a fragmentary sectional view taken along lines 2a—2a of Figure 1,

Figure 3 is a view similar to Figure 1 but illustrating a modified arrangement of debarking tools and the means for applying force thereto,

Figures 4 and 4a are fragmentary views partly in elevation and partly in section of the upper part of Figure 3, as taken along lines 4—4 and 4a—4a, respectively, but omitting the stationary frame,

Figure 5 is a fragmentary view illustrating a modified form of mounting and force-applying means for the tools,

Figure 6 is a cross-sectional view taken along lines 6—6 of Figure 5, and

Figure 7 is a cross-sectional view taken along lines 7—7 of Figure 5.

In Figures 1 and 2, 10 designates an annular rotor rotatably journaled in a stationary frame 12 by means of a bearing 14. The rotational movement of the rotor 10 is effected by means of V belts 16. Logs 18 are fed serially through the center of the rotor in a straight path by any known feeding means. In the rotor are mounted three debarking tools carried by swingable arms 13, the tool-carrying ends of the arms 13 being continuously biased toward an axis of rotation 34 of the rotor 10. These tools may be of arbitrary type but preferably are made in such a manner that they remove the bark by means of shearing, the swingable arms being of such a shape that when they are contacted by an oncoming log, they are automatically swung outward as they ride over the butt end of the log, the tools thus being moved onto the peripheral surface of a log without making any change in the force that initially biases the arms toward the rotor axis. Shafts 20 of these arms are journaled in bearings 22 in the rotor 10. The shafts 20 are connected with levers 24 having outwardly extending arms 26, in each of which arms is a hold or pin 27 for one or several ring-shaped rubber members 28. This hold is preferably journaled on a needle bearing in order that the rubber will not become worn by sliding when the swingable arm and thereby also the hold or pin pivots. The pivoting angle of the arm generally amounts to about 30 to 40 degrees. It is preferable to arrange the arm 26 of the lever 24, when the tool is in its inner position, so that an interior angle between a plane containing the axis of the shaft 20 and the hold or pin 27 and the acting line of the tensile force of the rubber will fall within a range of about 70 to 90 degrees, Figure 1b. When the tool moves from the minimum to the maximum diameter of the log the increase of the tensile force of the rubber is compensated by a corresponding decrease of the effective lever, i. e. the perpendicular distance between the acting line of the tensile force and the axis of the shaft of the swingable arm. In this manner a much smaller rubber length is required for keeping the actuating force within permissible limits at the outer and inner position of the tool than if the lever is arranged so that said perpendicular distance remains constant. When the tool is disposed in its outermost position, the best relation is obtained when the plane containing the axis of shaft 20 and of hold or pin 27 forms an interior angle of about 40 to 50 degrees with the line of action of the tensile force, see Figure 1a. The rubber band 28 is at its outer end connected with a holder 30, which by means of a screw 32 can be displaced in relation to the rotor 10 so

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that the initial force that biases the barking tool can be varied for different barking conditions. Other ways to vary the initial biasing force, which can be combined with the displaceable holder 30 comprises removing or adding rubber bands 28, and selecting rubber bands having a different modulus of elasticity. The movement of the swingable arm 13 towards the rotation axis 34 of the rotor is limited by contact between stops 36, mounted on the rotor 10 and preferably provided with rubber cushions, and two arms 38 of the lever 24. The change in the tensile force of the rubber member 28 is initially effected when the screw 32 is displaced by rotation of a worm gear 40 mounted in suitable bearings and secured to the rotor, through the threaded center of which gear the screw passes. The worm gear 40 is in its turn rotated by a worm screw 42 which is also mounted on the rotor and which can be turned by a suitable key in the keyhole 44. As an example it may be mentioned that in a barking machine intended for logs having a diameter of 2" to 16", each tool required three rubber rings each having a square section of 2 cm.². The effective length of the rubber in unstretched condition was 80 mm. The weight of all rubber members for the setting amounted to about 0.35 kg. The modulus of elasticity of the rubber was 16 kg./cm.². As a comparison it may be mentioned that the weight for corresponding steel springs amounts to about 15 kg. The arrangement with balance weights and air-pressure cylinders respectively will be still heavier. Because of the small weight of the rubber used in the arrangement described, the influence of centrifugal force will be small in comparison with that obtained when using a steel spring.

Figure 1b illustrates a modified arrangement for regulating the tension of the rubber bands. In this figure an endless rubber band 148 has one end secured to the pivot or pin 27 while its other end is connected to a stud means 146 that is carried by the end of a piston rod 144 secured to a piston 142 displaceable in a cylinder 140. The cylinder is connected at one end to a pin 152 that is mounted in bearings or holding means 150 secured to the rotor whereby the cylinder 140 can rock about an axis parallel to the axis of the rotor. A stuffing box 154 closes the opposite end of cylinder 140 and the piston rod 144 passes therethrough. In order to introduce fluid into the cylinder 140 in front of piston 142 a flexible conduit 158 communicates with an inlet 156 in the cylinder. The flexible conduit in turn is connected to a circular conduit 160 carried by the rotor and in turn in fluid communication with other cylinders like 140 that are associated with the other tool arms, not shown. A pressure gauge 166 is in communication with the circular conduit 160 and to introduce fluid into the circuit a conduit 164 communicates with the circular conduit 160. A control valve 162 is mounted in the conduit 164. It is believed clear that liquid can be forced into the hydraulic system by hand pump, not shown, adapted for coupling with the conduit 164. Inasmuch as the liquid circuit is in communication with all of the piston cylinders, introducing the liquid under pressure at one point will place the same pressure in each cylinder so that the tension of the rubber bands 148 will be equal for each tool. Any differences between the rubber bands as occasioned by different settings will automatically be compensated for. The pressure gauge 166 will furnish a reading that is proportional to the actuating force of a tool against a log.

It is clear therefore that both in Figures 1 and 1b the endless rubber band constitutes an elastically deformable means for applying force to the tools during debarking and that by means of axial movement of the screw 32 or the piston 142 the amount of tension in the bands and thus the force applied to the tools can be adjusted to suit different debarking conditions.

Figures 3 and 4 illustrate a further modification in which an elastically deformable means is utilized. In this arrangement there is shown a further concept in the use of

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rubber in the construction of the barking machine as not only the biasing force but also the journaling of the swingable arms is effected by means of rubber. The barking machine according to Figure 3 is provided with five bark-removing tools and has a rotor 45, a stationary frame 46, a rotor bearing 48 and a driving device 50 in the same manner as described in connection with Figure 1. Shafts 54 of the swingable arms 52 are fixed by means of vulcanization in preferably cylindrical rubber sleeves 56 attached to the rotor 45 by means of tubular metal jackets 58. The shaft 54 of the swingable arm is provided at its front end with an enlarged end portion against which the swingable arm 52 is fastened by a flat head screw 60. A small lever 64 is mounted at its midportion on an opposite end of the shaft 54 and either engages a pair of stops 66 to limit the turning movement of the swingable arm towards the center, or engages a single stop 66' to limit outward swinging movement of the arm. The lever 64 can be fixed in different positions in relation to the shaft by means of a screw 68 in order to obtain the desired initial biasing force of the barking tool. This is effected by turning the shaft 54 by any suitable device, through such an angle that a torque proportional to the desired initial biasing force is obtained from shearing stresses set up in the rubber. The swingable arm of the tool and the stop levers are thereafter screwed tight in relation to the shaft. The machine is now ready to be used for its purpose. This embodiment of the invention is characterized by an utmost soft running as the barking tools are not in metallic connection with the rotor. Another reason for the smooth running is that the rubber bushing permits a comparatively great flexibility in all directions for the swingable arms so that the tools can adapt themselves along the log surface. The flexibility of the bushing in the longitudinal direction of the log is desirable when using swingable arms formed for automatic opening upon contact with the butt end of an oncoming log. Some further advantages include an extreme simplicity in construction by requiring a small number of parts, an insensibility to the climate, and operability under rough conditions in the forest. Furthermore ordinary bearing friction is avoided as well as lubrication, and in addition the rubber bushing does not require maintenance. Due to the small external diameter of the rubber bushing the dimensions of the rotor can be decreased to a minimum.

In Figure 5 a shaft 92 to which a barking tool arm 94 is attached by means of a flange 96 and bolts 98 is surrounded by a sleeve 104 attached to a hollow head 100 by means of a clamping ring 102. On the inner side of this sleeve there are three longitudinally arranged ridges 106, Figure 7. To the shaft 92 there are attached by vulcanization two rubber bushings 108 of the same size, and each having concave end walls which progressively decrease in diameter as they curve away from one another and toward the shaft 92. Preferably the lengths of any two lines which lie parallel to an axis 110 of the shaft 92 and which extend between said concave end walls and within said bushings, is made inversely proportional to their distances from said axis 110 of the shaft 92. By doing this the permissible turning angle for the barking tool in relation to the hollow head will be the greatest possible without causing any cylindrical section of the rubber to have less resistance to axial stresses along the axis 110 than the section closest to the shaft 92. The provision of two bushings coupled in parallel will result in an increased resistance against forces which tend to rock the shaft 92 out of its concentric relation with sleeve 104. To the outside of each of the bushings 108, are vulcanized three peripherally spaced sections 112 of a sleeve member. During manufacture the diameter of the bushings are such that they have to be pressed into the sleeve 104. By doing this the rubber can be given desired compression resulting in a better durability. The sleeve sections 112 fit between the ridges 106 and pre-

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vent relative rotation between the sleeve 104 and the periphery of the bushings when the shaft is turned. On the rear end of the shaft 92 are provided three wings 114 which have limited movement between ridges 116 provided in a surrounding sleeve 118, Figure 6. By means of a clamping device 120 this sleeve is attached to a collar 122 on the hollow head. The movement of the barking tool towards the axis 34 of the hollow head is braked by rubber members 126 provided between the ridges 116 and the wings 114. The end point of the movement of the debarking tool can be determined as desired by loosening the clamping device 120 and then turning the sleeve 118 until the desired position of the tool is reached. The desired initial actuating force on the tool is brought about by loosening the clamping ring 102 after which the sleeve 104 is turned by aid of a key that fits a key hole 124 until the desired actuating force is attained, after which the clamping ring is tightened. The above described construction is simple and easy to manufacture and very robust. The initial actuating force of the tool can easily be regulated within desired limits. The device is very compact especially in its radial dimensions. For example, a debarking machine for a smallest log dimension of 1" and a largest dimension of 11", the diameter of the shaft 92 was 1" and the inner diameter of the sleeve 104 2 1/2". The total greatest length of the rubber bushings 108 along the shaft 92 was 7". The torsion modulus of the elastomer used is preferably between 3.5 and 8 kg./cm.² (50 to 115 p. s. i.) and is preferably chosen to be between 5 and 6 kg./cm.² (70 to 85 p. s. i.). Turning angles from inner to outer position of the debarking tool can amount up to 45° without the resulting difference in actuating force exceeding permissible limits of variation.

It is therefore clear that the present invention provides a debarking machine of the type in which successive logs are fed end to end through a rotary annular frame while the logs are restrained against rotation. A plurality of arms are mounted on the frame for movement toward and away from the axis thereof and elastically deformable means are carried by the frame and operably coupled to the arms for exerting a resilient force thereon to apply debarking tools or bark removing portions of the arms against a log with sufficient intensity regardless of irregularities in log contour or bark to remove the bark from the logs as the frame rotates thereabout. The elastically deformable means is housed within the rotary frame in one form and constitutes at least one endless rubber band for each arm operable by tension. Means are provided for adjusting the tension exerted by the bands to suit different debarking conditions.

In another form of the invention the elastically deformable means constitute rubber bushings simultaneously supporting a shaft carrying each arm and placed under shear stress so as to apply force to the arm. In other words, the rubber bushings are vulcanized internally to a pin or pivot operably connected with the arms and externally either directly or indirectly to a portion of the rotary frame. In these forms, means are provided for adjusting the shear stress to thereby adjust the force applied to the arms.

What we claim is:

1. In a debarking machine, a rotatably mounted annular frame through which logs to be debarked are fed in end-to-end relation and while restrained against rotation, a plurality of debarking tools carried by the frame, turnable shaft means carried by the frame, extending parallel to the axis of rotation of the frame and mounting the tools for movement toward and away from the axis of the frame in paths containing a plane transverse to said axis, solid-elastic-rubber-material means adjustably connected between each shaft and the frame for applying a resilient turning and actuating force to each of the shafts to move the respective tool in the direction toward the axis of the frame with a force sufficient to remove bark

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from logs, and co-operable stop means respectively carried by the frame and shafts to limit the movement of said shafts and thus of said tools toward the axis of the frame.

2. In a debarking machine as claimed in claim 1, in which the solid-elastic-rubber-material means constitutes rubber strip means adjustably connected in tension between the frame and each shaft.

3. In a debarking machine as claimed in claim 1, in which the solid-elastic-rubber-material means constitutes at least one rubber bushing connected in shear between the frame and each tool.

4. In a debarking machine as claimed in claim 1, and the means mounting each tool including an arm, each arm having an outer end, a pin secured to the outer end and extending parallel to the axis of the frame and the solid-elastic-rubber-material means constituting for each arm at least one rubber bushing having its inner surface vulcanized to the pin and means including vulcanization fixing the outer surface of the bushing to the frame, and means for adjustably imparting shear stress to each bushing in order to initially adjust said turning and actuating force.

5. In a debarking machine as claimed in claim 4, in which each rubber bushing is of varying cross section with the width decreasing from the central portion thereof toward the opposite ends.

6. In a debarking machine of the type in which a succession of logs to be debarked are fed forwards in end-to-end relation while restrained against rotation through a rotary annular frame, the improvements comprising, a plurality of debarking tools carried by the frame, pivot means mounting the tools for movement toward and away from the axis of rotation of the frame, and solid-elastic-rubber-material strip means adjustably connected in tension between the frame and each of the tools for applying force thereto in a direction extending toward the axis of the frame so as to apply the tools to a log with sufficient intensity regardless of irregularities in log contour or bark to remove such bark.

7. In a debarking machine as claimed in claim 6, in which swingable arms carry the tools, the pivot means mounting the tools including shafts journaled on the frame and extending parallel to the axis thereof, said arms being mounted on said shafts, said shafts being equally spaced around the frame, each of said arms having substantial length, the solid-elastic-rubber-material strip means normally biasing the arms inwards in the direction toward the axis of the frame and stop means carried respectively by said shafts and said frame to limit the inward movement of the arms under the force generated by said strip means so that the tools carried by the respective arms are maintained out of contact with one another.

8. In a debarking machine of the type having a rotary annular frame through which a succession of logs to be debarked are fed forwards in end-to-end relation while restrained against rotation, the improvements comprising, a plurality of debarking tools, shafts journaled on the frame, said shafts extending parallel to the axis of rotation of the frame and corresponding in number to the number of tools, an arm mounted on each shaft so as to turn therewith, said arms carrying the tools, solid-elastic-rubber-material means operably connected with each of the arms for applying turning force thereto in a direction to move the tool carried thereby toward the axis of the frame and to apply the tool to a log with sufficient intensity regardless of irregularities in log contour or bark to remove such bark, lever means connected to each shaft, said solid-elastic-rubber-material means comprising at least one endless rubber band for each arm, means coupling one end of each band to each lever means in a manner to apply said turning force thereto and means mounting the other end of each band for movement toward and away from the associated lever means so as

to permit adjustment of the tension exerted by the bands on the levers and thus on the arms to thereby adjust the force applied to the tools to different barking conditions.

9. In a debarking machine of the type having a rotary annular frame through which a succession of logs to be debarked are fed forwards in end-to-end relation while restrained against rotation, the improvements comprising, a plurality of debarking tools carried by the frame, pivot means mounting the tools for movement toward and away from the axis of rotation of the frame, solid-elastic-rubber-material means connected between the frame and the tools to apply force to each of the latter in a direction extending toward the axis of the frame and to apply each of the tools to a log with sufficient intensity regardless of irregularities in log contour or bark to remove such bark, said solid-elastic-rubber-material means comprising at least one endless rubber band operably connected under tension to each tool at one end and means adjustably connecting an opposite end of each band to the frame for adjusting the tension of the band.

10. In a debarking machine as claimed in claim 9, in which the last-mentioned means includes a screw extending in line with an initial line of force applied by each band when the tools are disposed in their innermost or inoperative position, and means for axially displacing the screw to adjust the tension acting along the initial line of force.

11. In a debarking machine as claimed in claim 10, in which the last-mentioned means comprises for each band a piston, a cylinder for each piston, means mounting the cylinders on the rotor, and means for introducing fluid into each cylinder behind the piston therein in order to alter the position of the pistons and thus vary the tension of the bands.

12. In a debarking machine of the type having a rotary annular frame through which a succession of logs to be debarked are fed forwards in end-to-end relation while restrained against rotation, the improvements comprising, a plurality of debarking tools, pivot means mounting the tools for movement toward and away from the axis of rotation of the frame, elastically deformable means supported by the frame and operably connected with the tools for applying force to each of the latter in a direction extending toward the axis of the frame so as to apply each of the tools to a log with sufficient intensity regardless of irregularities in log contour or bark to remove such bark, each debarking tool comprising a swingable arm, said pivot means including a shaft for each arm journaled in the rotary frame and extending parallel to the axis thereof, said shaft being connected to one end of the arm, the opposite end of the arm constituting a log-contacting portion of the tool, lever means connected to each shaft and including a first lever arm extending in a direction radially outward from a journalling axis of the shaft and a pair of lever arms extending from opposite sides of a plane containing the axis of the shaft and said radially outward direction, the elastically deformable means comprising at least one endless rubber band, means connecting one end thereof to the first lever arm, means connecting the other end to the rotary frame so that an initial line of force of the rubber band makes an interior

angle of between 70° and 90° with an initial radially outward direction of said first lever arm, when the swingable arm is in its innermost position; stop means cooperating with the said pair of lever arms to limit the inward movement of the swingable arm to said innermost position and said first lever arm having a length such that when the swingable arm is in its outermost position an interior angle formed between a terminal line of force of the rubber band and a terminal radially outward direction of said first lever arm, is between 40° and 50°.

13. A debarking machine comprising a rotary annular frame through which successive logs to be debarked are adapted to be fed in end-to-end relation while restrained against rotation, a plurality of tool-carrying arms disposed for swinging movement in paths containing a plane transverse to the axis of rotation of the frame, a shaft for each arm, said shafts extending parallel to the axis of the frame and being distributed around and journaled in the frame, means connecting one end of each arm to its shaft, a tool at the other end of each arm, and solid-rubber biasing means adjustably connected between the frame and each arm and constructed and arranged to apply turning force to the shaft to urge the arm inwardly so as to urge the tool toward the axis of the frame and to apply the tool to a log being fed with sufficient intensity regardless of irregularities in log contour and bark to remove such bark.

14. A debarking machine as claimed in claim 13 and a lever means connected to each shaft, each said solid-rubber biasing means comprising an elongate rubber body, means connecting one end of each body to one of said lever means, means carried by the frame and mounting the other end of each body for movement toward and away from the associated lever means so as to adjustably tension each body, and stop means carried by the frame for limiting the movement of the lever means and thus of the tools toward the axis of the frame.

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