July 9, 1940. H. L. HASWELL 2,207,433

MEANS FOR SHARPENING A CIRCULAR KNIFE

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Fig. 1.

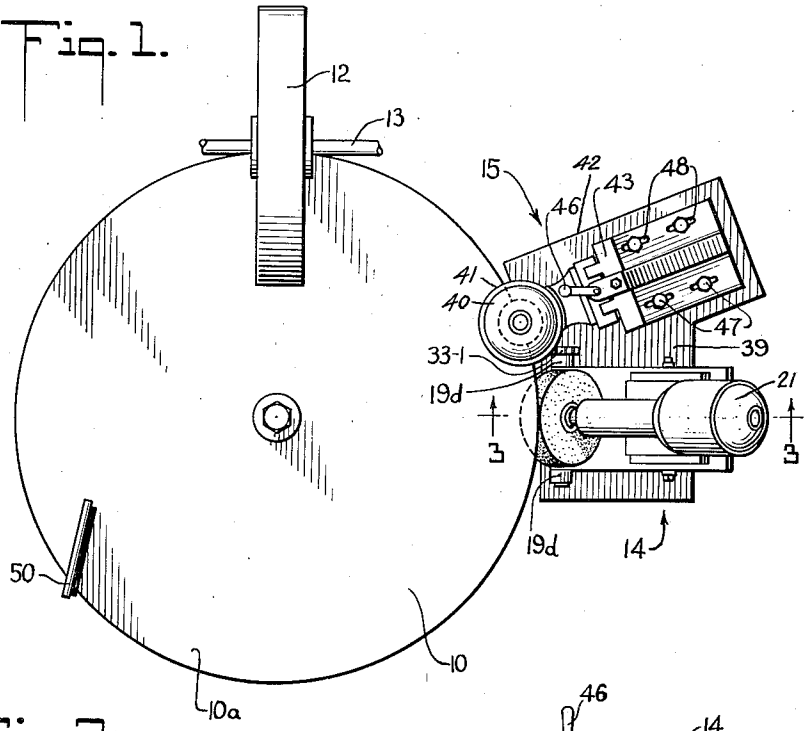
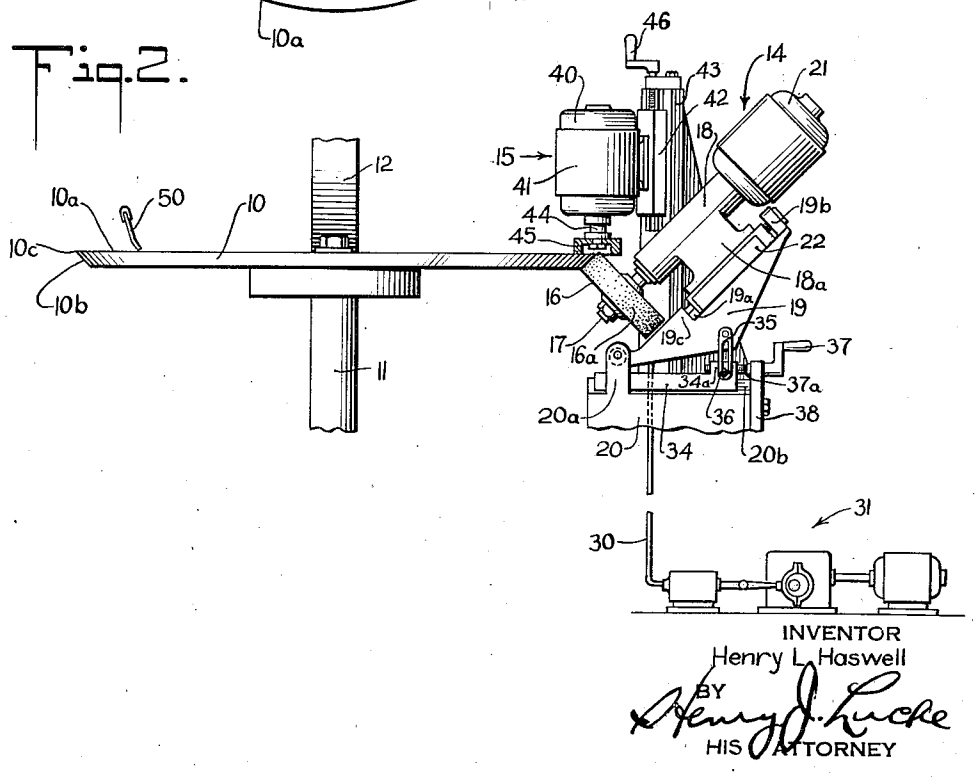


Fig. 2.



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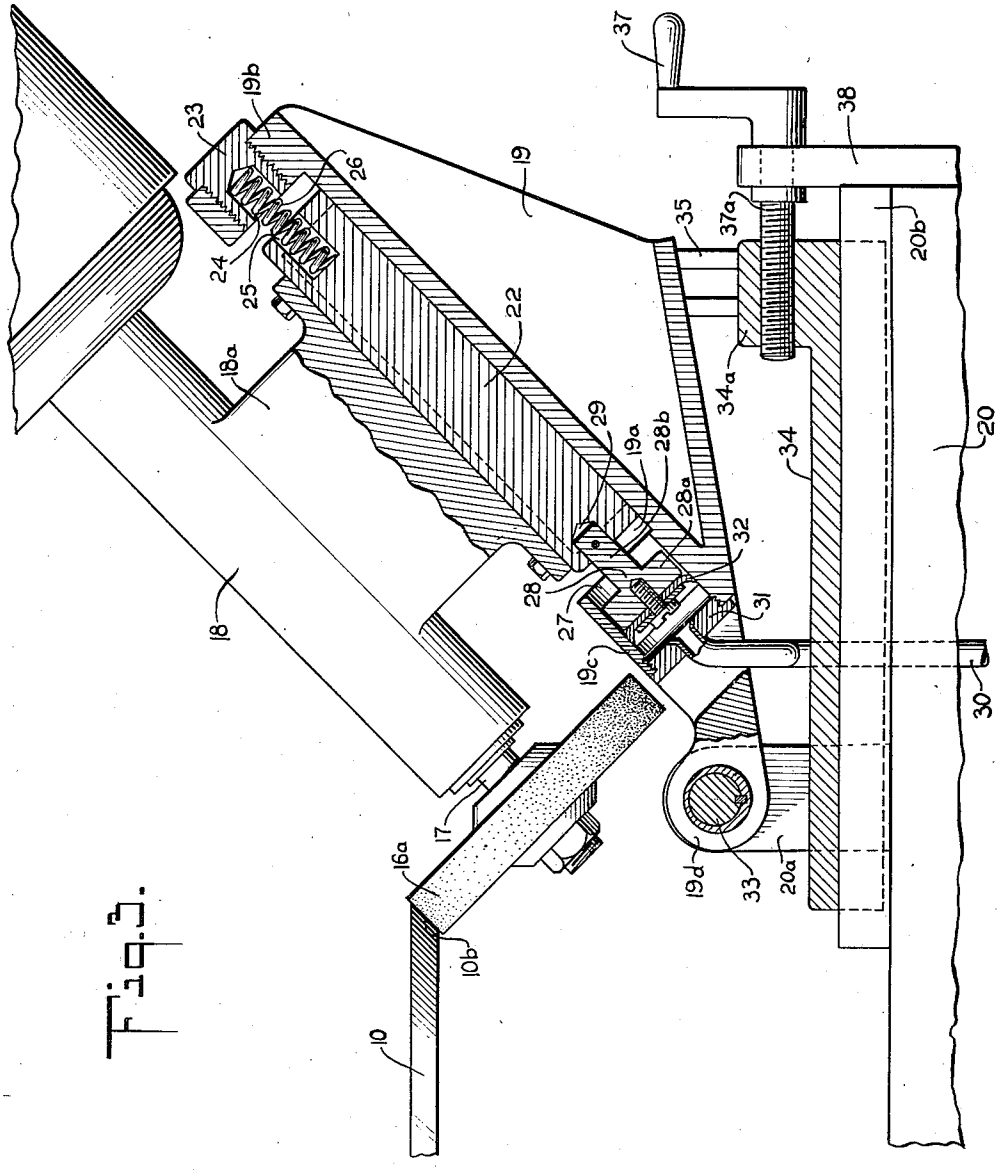

Fig. 2.

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MEANS FOR SHARPENING A CIRCULAR KNIFE

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2 Claims. (Cl. 51—247)

This invention relates to mechanism for sharpening a circular knife, particularly while the knife is in the course of an actual cutting operation.

Circular knives are employed in industry for cutting a variety of materials. Many of the materials require constant maintenance of an exceptionally keen edge on the knife during the entire cutting operation. When the operation is of extended duration, as in the cutting of a continuous length of material from a block of the material, maintenance of the knife edge at the required degree of keenness for efficiency of cut is a difficult problem.

In the latter instance, if the block of material operated upon is rubber, as is the case in the disclosures of United States Patents Nos. 2,064,508, 2,121,062, granted December 15, 1936, and June 21, 1938, respectively, to Enrique Vincke, an especially difficult cutting problem is presented. An extremely thin continuous rubber strip must be cut with micrometric nicety and without flutes from the circumferential surface of a rotating disk of rubber. Since rubber is a particularly difficult material to cut under any circumstances, it follows that special attention must be accorded the factor of knife sharpening.

The present invention has, therefore, as a primary object, the provision of and means for sharpening a circular knife continuously during its cutting operation in such manner that a super-keenness of knife cutting edge will be constantly maintained.

An outstanding feature of the invention is the operative relationship of the planes and axes of rotation of the circular knife and of a circumferential grinding surface, which is made to rotate against a circumferential blade surface of the knife, while holding the axis of rotation of the grinding surface fixed relative to the knife.

The planes of rotation of the circular knife and of the circumferential grinding surface are perpendicularly related to their respective axes of rotation, and the latter are so disposed with respect to each other that one deviates at but a small angle, if at all, from a single plane passed through the other parallel with its extension. This insures grinding along the circumferential blade surface of the knife, or at only a small angle thereto, thus precluding or greatly minimizing knife vibration.

In addition, provision is made for honing the other blade surface of the knife to remove the "wire edge" raised in the grinding operation. To prevent scoring of the particular blade surface concerned, and for achieving enhanced smoothness of the ground surface, it is advantageous that the circumferential grinding surface be made to oscillate along its axis of rotation during the grinding operation.

While the invention has been perfected and is here set forth primarily for use in connection with the production of rubber threads as described in the above referred to U. S. patents, its adaptation to the cutting of materials other than rubber is contemplated.

Further features and objects of the invention will be apparent from the following detailed description.

In the drawings:

Fig. 1 represents a top plan view of a circular knife together with sharpening mechanism pursuant to one embodiment of this invention, arranged for a continuous cutting operation.

Fig. 2 represents a front elevation of the structure of Fig. 1.

Fig. 3 represents an enlarged fragmentary view, partly in vertical section taken on the line 3—3, Fig. 1.

Referring to the drawings: The invention is illustrated as applied to a machine for cutting a continuous strip from a rotating disk of material. Only that structure of the machine per se which is sufficient to indicate the relationships important in the practice of the present method, is illustrated. The machine as a whole may take the form of that illustrated and described in the U. S. Patent No. 2,121,062 of Enrique Vincke.

In the present illustration, a circular knife 10 is secured on a shaft 11 for rotation therewith relative to a disk of cuttable material 12, which in turn, is secured to a shaft 13 for rotation therewith. The disk 12 is suitably mounted for rotation and for progressive approximately tangential feed of its circumferential surface into the cutting plane of circular knife 10. It is to be understood that the respective rotations of the circular knife 10 and of the disk 12, and the progressive feed of disk 12 into the cutting zone of circular knife 10 are suitably correlated to effect the cutting of a thin continuous strip of material from the circumferential surface of the disk 12.

In the cases of the disclosures of the aforementioned U. S. Patents Nos. 2,064,508 and 2,121,062, the disk 12 is made up of rubber and the continuous strip cut therefrom is extremely thin, and, for practical purposes, must be without flutes and other irregularities. Accordingly, to derive full advantage from the method and machine there disclosed, it is necessary that the

cutting edge of the circular knife be maintained in a constant state of super-keenness.

As illustrated, the particular type of circular knife preferably, but not necessarily employed has a plane surface 10*a* and a circumferential blade surface 10*b* which intersects the plane surface 10*a* at an acute angle to provide the cutting edge 10*c* of the knife. Thus the cutting edge of the circular knife is defined by the circumferential blade surface 10*b* and the circumferential margin of plane surface 10*a*, the latter itself forming one blade surface of the knife.

Sharpening means are associated with the circular knife for continuous operation on the blade surfaces thereof during the cutting operation. The sharpening means may comprise a grinding mechanism, indicated generally at 14, and a hone mechanism indicated generally at 15.

The grinding mechanism 14 provides a circumferential grinding surface adapted for rotation against the circumferential blade surface 10*b* of the knife, and advantageously comprises a grinding wheel 16 rigidly mounted on a shaft 17 for rotation therewith. Shaft 17 is journaled along the greater part of its length in a sleeve 18 provided with a supporting foot 18*a* which is mounted for reciprocation in slideway 19*a* of a supporting frame 19, the latter being, in turn, mounted on a supporting table 20 for adjustment in two dimensions relative to the circular knife 10. Shaft 17 is connected to a motor, indicted diagrammatically at 21, for rotation thereby.

The grinding wheel 16 is desirably of right cylinder formation having a circumferential grinding surface 16*a* of a width approximating, and advantageously slightly greater than, the width of the circumferential blade surface 10*b* of the circular knife; thus substantial uniformity of wear of the circumferential grinding surface 16*a*, and complete grinding coverage of the blade surface are assured.

It is to be noted that the shaft 11 on which the circular knife 10 is mounted, is perpendicularly related to the plane of rotation of the circular knife, and that the shaft 17 on which grinding wheel 16 is mounted, is perpendicularly related to the plane of rotation of the grinding wheel. Thus, the plane of rotation of circumferential blade surface 10*b* of the circular knife is perpendicularly related to its axis of rotation, and the plane of rotation of circumferential grinding surface 16*a* is perpendicularly related to its axis of rotation. The shaft 11, i. e., the axis of rotation of circumferential blade surface 10*b*, is, as illustrated, so disposed relative to the shaft 17, i. e., the axis of rotation of circumferential grinding surface 16*a*, that a single plane may be passed through both of the stated shafts, i. e., axes of rotation, parallel with the lengths thereof. Advantageously, the plane of rotation of grinding surface 16*a* is made to oscillate along its axis of rotation, i. e., the shaft 17, for preventing scoring of the blade surface 10*b* and for achieving smoothness of grind.

While it is usually preferred that the axis of rotation of the circular knife and the axis of rotation of the grinding surface be exactly so disposed with respect to each other that a single plane may be passed through both parallel with the lengths thereof, and while the illustrated embodiment discloses such relationship, it is contemplated that the axis of one might be set at an angle—desirably only a slight angle say 10 degrees or thereabouts, but in no case greater than 45 degrees—to a plane passed through the other parallel with its extension.

Where there is a definite though small angular relationship, as above explained, provision for oscillating the grinding surface across the blade surface of the knife may be dispensed with, since scoring of the blade surface will be substantially precluded by the slight cross-grind. It is to be noted that the degree of angular relationship must be determined for the particular case, since certain assemblies will withstand the tendency of the cross-grind to produce knife vibration better than other assemblies. Therefore, within the limits set forth the most advantageous disposition of the stated axes with respect to each other must be determined by the machine and knife construction, the type of material to be cut, and the degree of thinness of cut desired.

For accomplishing oscillation of grinding surface 16*a* transversely of blade surface 10*b*, the supporting foot 18*a* of sleeve 18 may be rigidly mounted on a carriage 22 for sliding reciprocation within the confines of slideway bed 19*a*.

Supporting frame 19 is configurated to provide the slideway bed 19*a* between limiting end members 19*b* and 19*c*. Carriage 22 fits into the slideway for sliding reciprocation between the respective end members. Desirably centrally located in the end member 19*b*, and extending therethrough, is a threaded plug 23 having a recess 24, whose end opens into the slideway. A recess 25 is coordinatingly located in the upper end of carriage 22. A coil spring 26 is positioned between carriage 22 and end member 19*b* with one end in recess 24 and one end in recess 25. The tension in coil spring 26 normally urges carriage 22 toward end member 19*c* of the supporting frame.

Formed desirably centrally in end member 19*c* is an open-ended cylinder 27, into which fits a piston 28 having a head 28*a* and a rod 28*b*, the free end of the rod being secured in a suitably placed bore 29 in the lower end of carriage 22. The piston 28 is adapted for upward actuation within cylinder 27 by the pressure of oil or other suitable fluid medium supplied to the cylinder through a conduit 30, the latter being secured in a cylinder head 31 threaded to the cylinder 27. Pressure impulses at suitably timed intervals are transmitted to the piston head 28*a* through the medium of the fluid in conduit 30, the pressure impulses being initiated by suitable means such as the motor driven piston-cylinder apparatus indicated generally at 31. For obtaining tightness precluding fluid flow past piston head 28*a* in cylinder 27, a cup leather 32 may be employed.

Fluid pressure impulses suitably timed by the piston-cylinder apparatus 31, and restoring pressure impulses effected by spring 26 accomplish reciprocation of carriage 22 within its slideway bed 19*a*, and thus oscillation of the plane of rotation of grinding surface 16*a* along its axis of rotation.

For attaining proper angular placement of grinding surface 16*a* relative to circumferential blade surface 10*b* of the circular knife, the grinding mechanism is preferably mounted for simultaneous two-dimensional adjustability in a single plane. Supporting frame 19 is eccentrically hinged on its supporting table 20, for pivotal movement in a single plane, through the medium of extending ears 19*d*, 19*d* which are journaled on an eccentric crank portion of a shaft 33, the shaft proper extending between and being journaled in upstanding supporting ears 20*a*, 20*a*, of table 20.

A slide 34, mounted for sliding reciprocation on a slideway bed 20b provided on table 20 and extending between the upstanding supporting ears 20a, 20a, has an upstanding boss 34a articulatively connected to an end of frame 19, which is remote from its location of hinge. The articulate connection is advantageously had by means of a slotted link 35 pivoted at one end to the frame 19 and adjustably secured at its other end to boss 34a by the nutted bolt 36 received in the link slot.

Manual adjustability is afforded by a crank 37 having a shank 37a threaded between an upstanding post 38, which is rigidly secured to table 20, and boss 34a of slide 34.

Rotation of crank 37 will effect raising or lowering of grinding surface 16a into or out of contact with knife blade surface 10b in the correct angular relationship.

The exact nature of the eccentricity of shaft 33 relative to the journaled ears 19d, 19d may be controlled by manually rotating the shaft slightly one direction or the other. A knurled thumbscrew 33—1, Fig. 1, is provided for the purpose.

The supporting table 20 may be adjustably mounted on a base 39, preferably supported independently of the cutting machine.

In the operation of the grinding mechanism relative to its particular blade surface of the circular knife, it is desirable that the grinding surface rotate against the direction of rotation of the circular knife.

The sharpening operation of circular knife 10 is completed by honing knife blade surface 10a for removing the "wire-edge" raised by the grinding of knife blade surface 10b. This may be accomplished by the use of honing mechanism as indicated generally at 15.

A motor 40 is mounted in a bracket 41 extending from a slide 42 mounted for vertical adjustment in the guide frame 43. An extension 44 of the rotor shaft of the motor depends above the blade surface 10a of the circular knife, and has secured thereto a hone wheel 45. When proper disposition of the hone wheel against knife blade surface 10a has been accomplished by adjustment of manually operable crank 46 for control of vertical reciprocation of slide 42 within its guideway frame, rotation of the rotor shaft of motor 40 accomplishes rotation of the honing surface of hone wheel 45 against blade surface 10a.

Guideway 43 may be adjustably mounted on the base 39 as for instance, by screws 47 cooperating with slots 48.

A wiper 50, preferably of resilient material such as rubber, may be mounted adjacent the blade surface margins of the upper plane surface of the circular knife for removing lubricant and debris incident to the sharpening operation, thus assuring a fresh clean blade surface for entry into the sharpening zone.

Whereas this invention has been illustrated and described by reference to specific forms thereof, it will be understood that many changes and modifications may be made without departing from the spirit of the invention as set forth herein and in the claims that follow.

I claim:

1. Adjustable grinding mechanism for a cutting blade mounted for substantially continuous cutting movement, the cutting blade having a blade surface inclined toward the cutting edge thereof, which comprises a grinding wheel mounted for rotation relative to said blade surface in such manner that the circumferential contact surface thereof extends substantially longitudinally with said blade surface, rigid supporting means independent of the mounting of said cutting blade, a supporting frame eccentrically pivoted adjacent one of its ends to said supporting means, the pivotal means being adjustable for varying the degree of eccentricity thereof, and said grinding wheel being mounted on said supporting frame, carriage means mounted on said supporting means for movement transverse to the oscillating axis of said pivotal means, means articulatively connecting said supporting frame with said carriage means whereby movement of said carriage means effects a two dimensional adjustment of said grinding wheel relative to said blade surface, and motive means for driving said grinding wheel.

2. Adjustable grinding mechanism, for a cutting blade mounted for substantially continuous cutting movement, the cutting blade having a blade surface inclined toward the cutting edge thereof, which comprises a grinding wheel mounted for rotation relative to said blade surface in such manner that the circumferential contact surface thereof extends substantially longitudinally with said blade surface, rigid supporting means independent of the mounting of said cutting blade, a shaft rotatably mounted on said supporting means, said shaft having an eccentric portion, a supporting frame journaled adjacent one end on said eccentric portion of the shaft and carrying the said grinding wheel and its mounting, a slideway formed on said supporting means, a slide mounted for sliding movement back and forth in said slideway, a link articulatively connecting said slide with said supporting frame at a location remote from said end thereof, means for rotating said shaft, means for moving said slide, and motive means for driving said grinding wheel.

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