May 31, 1938. J. B. ARMITAGE 2,118,912

CUTTER GRINDER

Filed Oct. 29, 1934 2 Sheets-Sheet 1

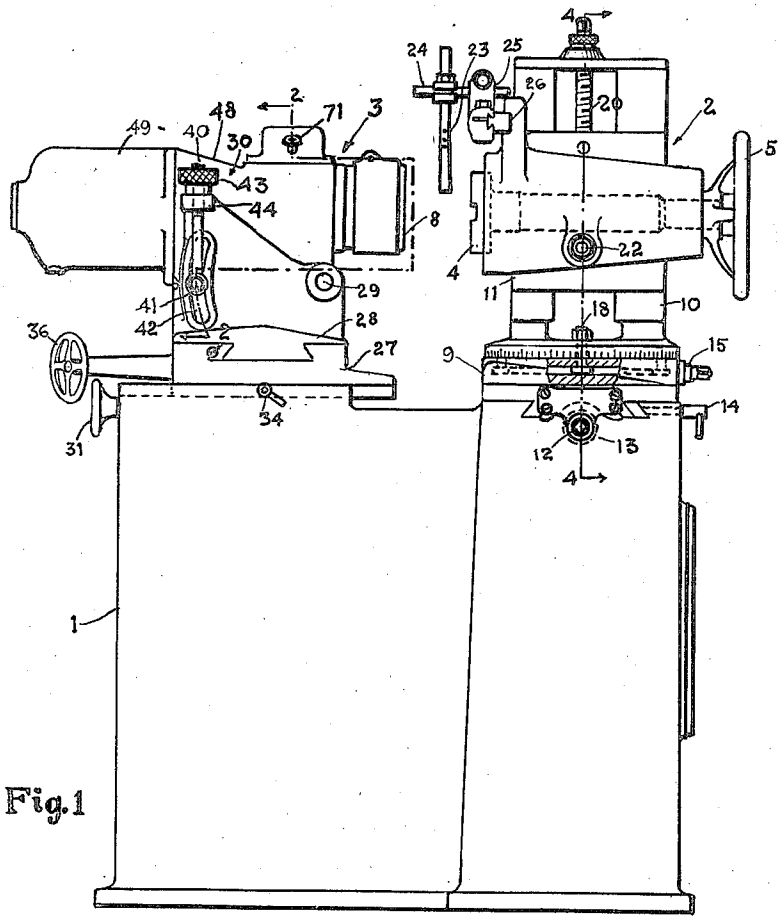

Fig. 1

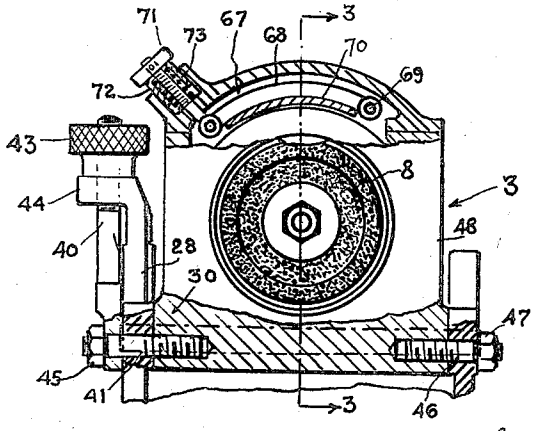

Fig. 2

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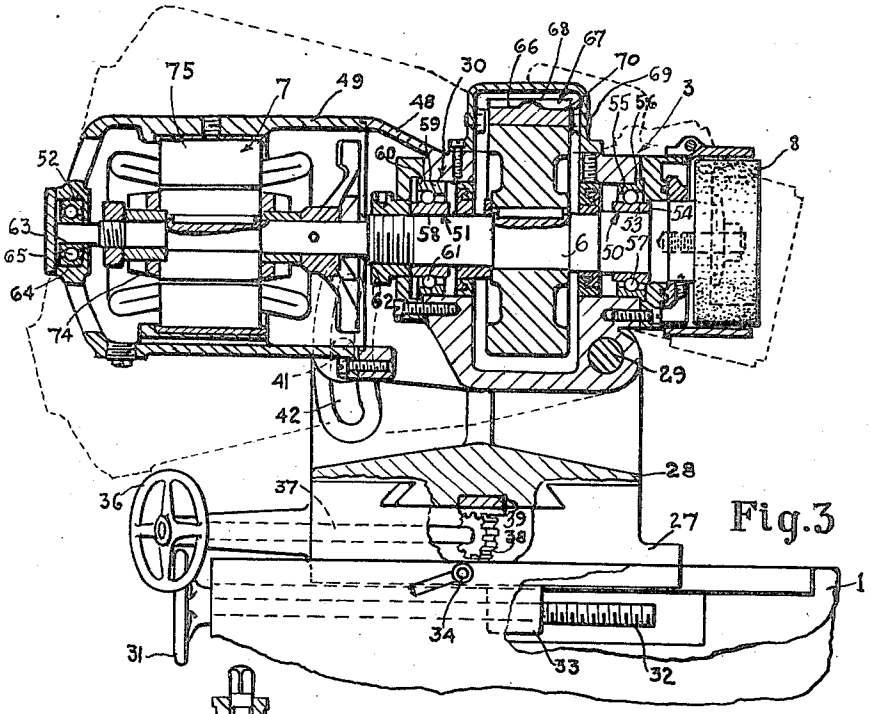

Fig. 3

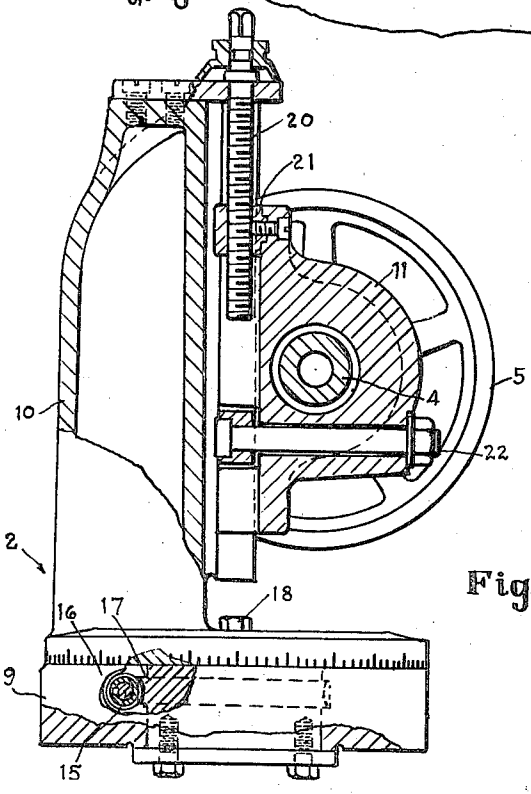

Fig. 4

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2,118,912

CUTTER GRINDER

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Application October 29, 1934, Serial No. 750,440

8 Claims. (Cl. 51—166)

This invention relates generally to machine tools and more particularly to precision grinding machines.

It is an object of the invention to provide a grinding machine of a type particularly adapted for grinding milling cutters having improved rigidity of support of the cutter to be ground and the grinding wheel and an improved relationship of supports for relative adjustment and for relative grinding movement of the cutter and wheel.

A further object is to improve the mounting of the grinding wheel and its driving means, particularly in a manner to avoid or minimize distortion or displacement which might disturb the desired relationship of the grinding wheel and the cutter during the grinding operation, and in a manner to avoid vibration or chatter.

Another object is to provide a driving transmission for the grinding wheel which will maintain a desired surface speed of the wheel substantially constant in spite of variations in load which occur as the wheel meets the cutter surface to be ground.

A further purpose is generally to simplify and improve the construction and operation of cutter grinders and especially the wheel driving mechanism and its associated elements, and still other objects and advantages will be apparent from the description and claims herein.

The invention consists of the construction and combination of parts as herein illustrated and explained, and in such modification thereof as may be equivalent to the structure set forth in and defined by the claims.

The same reference characters have been used to designate the same parts throughout the drawings and description.

In the drawings:

Fig. 1 is a view in right-hand side elevation of a grinding machine in which the invention is incorporated.

Fig. 2 is an enlarged partial section and elevational view of the same machine taken along line 2—2 in Fig. 1.

Fig. 3 is a view in longitudinal section taken along line 3—3 in Fig. 2, showing a portion of the lower structure.

Fig. 4 is a view in cross section taken along line 4—4 of Fig. 1.

The cutter grinding machine comprises a base 1 upon which is mounted a cutter supporting unit generally denoted by numeral 2, and a grinding wheel unit generally denoted by numeral 3. Supporting unit 2 provides a rotatable cutter carrying spindle 4 which at the one end is provided with a hand wheel 5 for rotation thereof, and at the other end is provided with an exposed portion upon which the cutter to be ground is mounted for rotation coaxial with the spindle. Wheel unit 3 provides a grinding wheel spindle 6 upon which is mounted the rotor of an electric motor generally denoted by the numeral 7, and an abrasive grinding wheel 8 fixed to the front end of spindle adjacent to the cutter support.

The cutter supporting unit 2 includes various relatively movable supports as follows: Slidably guided on base 1 for reciprocatory movement in a path transverse to the axis of wheel spindle 6 is a support 9 upon which a support 10 is mounted to be adjustable angularly about a vertical axis. Support 10 carries a support 11 slidably guided for vertical adjustment, in which the cutter spindle 4 is rotatably mounted. Support 9 may be moved by the means of a hand crank, not shown, applied to the squared end of screw 12 which engages a nut 13, and may be clamped in any position of adjustment by a clamp screw 14. Support 10 may be rotated by the means of a crank, not shown, applied to the squared end of a shaft 15, which turns a worm 16, engaging a worm wheel 17 fixed on the lower end of the support as best shown in Fig. 4, and may be clamped in any position of adjustment by the means of T-bolts 18. Support 11 may be adjusted vertically by the means of a hand crank, not shown, applied to the squared end of a screw 20, which engages with a nut 21, and may be clamped in any position of adjustment by the means of a T-bolt 22. The spindle 4 may be rotated, as previously noted, by the hand wheel 5. This serves to turn the cutter mounted at the other end of the spindle in a step-by-step motion to present the different teeth of the cutter to the grinding wheel successively for sharpening. To locate the individual teeth in the proper position of rotation there is provided a tooth rest 23 mounted for universal movement and adjustment about a rod 24 which in turn is pivoted in a member 25 slidably adjustable on a member 26 fixed with the support 11, the member 23 being clampable in any position of its adjustment by any suitable means such as the bolts and nuts shown.

Abrasive wheel unit 3 includes various relatively movable supports as follows: Slidably guided on base 1 for movement in a direction at right angles to the path of support 9 is a support 27 upon which a support 28 is slidably guided for movement in a path at right angles to the move-

ment of support 27. Pivoted on support 28 for movement about a horizontal axis on a pivot pin 29 is a grinding wheel spindle carrier or support 30. The support 27 may be moved by a hand wheel 31 fixed on a screw 32 engaging a nut 33 and may be clamped in any position of adjustment by the means of a screw 34 operating similarly to the clamp screw 14. The support 28 may be reciprocated by a hand wheel 36 fixed on a shaft 37 upon which is also fixed a spiral pinion 38 engaging a rack 39 on the lower surface of the support 28, as shown in Fig. 3. It is this hand wheel 36 which is normally used for traversing the grinding wheel 8 relative to the cutter mounted on spindle 4. The support 30 may be manually shifted about the pivot 29 by grasping the support and shifting it bodily, but for fine adjustments there is provided supplemental adjusting means best shown in Fig. 2 including a screw member 40 pivoted on a bolt or stud 41 fixed in the support 30 and which works in an arcuate slot 42 in the support 28. Screw 40 is threaded and is provided with a hand nut 43 bearing on an ear or lug 44 fixed with support 28. As the hand nut 43 is turned the support 30 is moved in the one or the other direction about pivot 29. Support 30 may be clamped in any position of its pivotal adjustment by a nut 45 on the stud 41, a similar clamp stud 46 and nut 47 being provided at the other side of the support. This improved supporting structure forms the subject matter of a co-pending application of Frank W. Curtis, Serial No. 748,630, filed October 17, 1934.

The support 30 is formed in two pieces, there being a main portion or member 48 and a removably attached motor housing portion or member 49. The portion 48 carries a front anti-friction bearing 50 and an intermediate anti-friction bearing 51. The portion 49 carries a rear anti-friction bearing 52. The front bearing 50 includes an inner race 53 shouldered against an enlarged portion of spindle 6 at 54, an outer race 55 shouldered against the support member 48 at 56, there being a plurality of interposed anti-friction ball elements 57, the bearing being adapted to restrain both rearward axial and lateral movements of the spindle. The intermediate bearing 51 includes an inner race 58 which is slidably fitted to spindle 6, an outer race 59 which is shouldered against support member 48 at 60, and a plurality of interposed anti-friction ball elements 61, this bearing being adapted to restrain both forward axial and lateral movements of the spindle. The inner race 58 may be adjusted along spindle 6 by the means of a nut 62 threaded on the spindle and the form of the various races and interposed anti-friction ball elements of the bearings 50, 51 is such that adjustment of nut 62 serves to remove all slack in both these bearings and thereby to fix the spindle 6 against axial movement in either direction and against lateral movement at either end. A slight further tightening of nut 62 sets up an initial or preloaded condition of each of the bearings 50 and 51, which serves to minimize or prevent any displacement of the spindle as the grinding load increases or decreases and to prevent chatter or vibration of the grinding wheel.

The rear bearing 52 includes an inner race 63 in which the spindle 6 is slidably fitted, an outer race 64 carried by the support portion 49, and interposed anti-friction ball elements 65. This bearing prevents lateral displacement or whipping of the rear end of the spindle 6.

A flywheel or inertia member 66 is fixed on spindle 6 at a point between bearings 50 and 51. It is a well known fact that a grinding wheel which is kept at proper speed and which is prevented from either torsional or lateral vibration or chatter will cut sharply and cleanly and with but little wear of the wheel. A relatively slight reduction in wheel speed, such as is ordinarily caused by the grinding wheel meeting the cutter tooth, or a relatively slight amount of vibration or chatter, will, on the other hand, result in relatively very rapid wear of the grinding wheel, particularly when the cutter blades being ground are of extremely dense and resistant material, such, for instance, as tungsten carbide. The form and location of the member 66, relative to the grinding wheel, the driving motor and the spindle bearings, has been found to very materially improve the action of the grinding wheel and to reduce the wear of the wheel to such extent that, even for cutters having a large number of teeth of the very hardest materials, the teeth may all be finish ground at one setting of the wheel, while still maintaining all the teeth of uniform size, thereby avoiding measuring the individual teeth to insure uniformity.

A spindle brake generally denoted by numeral 67 may be used for quickly stopping the spindle. Brake 67 includes an arcuate member 68 best shown in Fig. 2 having a pivot 69 supported from the member 48. A brake band segment 70 is fixed on member 68 in a position to frictionally engage the periphery of flywheel 66. A hand operable button member 71 is connected to the member 68 by a plunger member 72 and serves to permit the operator to engage the brake and quickly stop rotation of spindle 6 when desired, the brake being normally held disengaged by a spring 73.

The power for rotation of spindle 6 is derived from a power motor which may be of any suitable form or type including a rotor member 74 which is fixed on spindle 6 at a point between the intermediate bearing 51 and the rear bearing 52. The motor stator element 75 is fixed with the support portion 49 in manner to be removed to expose the rotor when the portion 49 is removed. The position and relationship of the motor members relative to the grinding wheel, flywheel and spindle bearings has also been found to be of material benefit in still further improving the action of the grinding wheel in the particulars previously pointed out in connection with the flywheel 66.

What is claimed is:

1. In a cutter grinder, the combination of a base, a cutter spindle and a grinding wheel spindle each rotatably supported from said base for adjustment of the one spindle relative to the other, a grinding wheel fixed on said wheel spindle, bearings for said wheel spindle including three anti-friction bearings spaced apart axially, said grinding wheel being axially outside said bearings, and drive means for said wheel spindle including a power motor having a rotating portion fixed with said wheel spindle and positioned axially between two of said bearings.

2. In a cutter grinder, the combination of a base, a cutter spindle and a grinding wheel spindle each rotatably supported from said base for adjustment of the one spindle relative to the other, a grinding wheel fixed on said wheel spindle at the front end thereof, bearings for said wheel spindle including a front anti-friction

bearing adjacent said grinding wheel and adapted to resist axial thrust of said spindle in the direction of the other end thereof and to resist lateral displacement of the front end thereof, a rear anti-friction bearing adjacent the other end of said spindle and adapted to resist lateral displacement of said other end, and an intermediate anti-friction bearing adapted to resist axial thrust of said spindle in the other direction and to resist lateral displacement of the spindle portions intermediate the ends thereof.

3. In a cutter grinder, the combination of a base, a cutter spindle and a grinding wheel spindle each rotatably supported from said base for adjustment of the one spindle relative to the other, a grinding wheel fixed on said wheel spindle at the front end thereof, bearings for said wheel spindle including a front anti-friction bearing adjacent said grinding wheel and adapted to resist axial thrust of said spindle in the direction of said other end and to resist lateral displacement of said front end, a rear anti-friction bearing adjacent said other end of said spindle and adapted to resist lateral displacement of said other end, and an intermediate anti-friction bearing adapted to resist axial thrust of said spindle in the other direction and to resist lateral displacement of the spindle portions intermediate the ends thereof, and means for initially preloading said front and intermediate bearings.

4. In a cutter grinder, the combination of a base, a cutter spindle and a grinding wheel spindle each rotatably supported from said base for adjustment of the one spindle relative to the other, a grinding wheel fixed on said wheel spindle at the front end thereof, bearings for said wheel spindle including a front anti-friction bearing adjacent said grinding wheel and adapted to resist axial thrust of said spindle in the direction of the other end thereof and to resist lateral displacement of said front end, a rear anti-friction bearing adjacent said other end of said spindle and adapted to resist lateral displacement of said other end, and an intermediate anti-friction bearing adapted to resist axial thrust of said spindle in the other direction and to resist lateral displacement of the spindle portions intermediate the ends thereof, and drive means for said wheel spindle including a power motor providing a rotor fixed with said spindle and axially between two of said bearings.

5. In a cutter grinder, the combination of a base, a cutter spindle and a grinding wheel spindle each rotatably supported from said base for adjustment of the one spindle relative to the other, a grinding wheel fixed on said wheel spindle at the front end thereof, bearings for said wheel spindle including a front anti-friction bearing adjacent said grinding wheel and adapted to resist axial thrust of said spindle in the direction of the other end thereof and to resist lateral displacement of said front end, a rear anti-friction bearing adjacent said other end of said spindle and adapted to resist lateral displacement of said other end, and an intermediate anti-friction bearing adapted to resist axial thrust of said spindle in the other direction and to resist lateral displacement of the spindle portions intermediate the ends thereof, a flywheel fixed with said wheel spindle axially between said front and intermediate bearings, and drive means for said wheel spindle including a power motor having a rotor fixed with said wheel spindle axially between said intermediate and rear bearings.

6. In a cutter grinder, the combination of a base, a cutter spindle and a grinding wheel spindle each rotatably supported from said base for adjustment of the one spindle relative to the other, a plurality of bearings for said wheel spindle and spaced apart in the direction of the spindle axis, a grinding wheel fixed at the one end of said wheel spindle and axially outside said bearings, a flywheel fixed to said wheel spindle between said bearings, and a spindle brake including a brake member frictionally engageable with the periphery of said flywheel.

7. A grinder for precision work, comprising a grinding spindle, a grinding wheel secured to one end of said spindle for rotation thereby, an anti-friction bearing disposed on said spindle closely adjacent to said grinding wheel and adapted to support said spindle radially and in manner to resist thrust axially in direction from said wheel toward said bearing, a flywheel secured to said spindle closely adjacent to said bearing at the side thereof opposite from said grinding wheel, a second anti-friction bearing disposed on said spindle closely adjacent to said flywheel at the side thereof opposite from said first bearing, said second bearing being adapted to support said spindle radially and in manner to resist thrust axially in direction toward said grinding wheel, means connected to said spindle at the side of said second bearing opposite from said flywheel for driving said spindle, and means on said spindle adapted for tightening said anti-friction bearings against each other in manner to preload them to effect rigid support of said spindle.

8. A grinder for precision work, comprising a grinding spindle, a grinding wheel secured to one end of said spindle for rotation therewith, an anti-friction bearing disposed on said spindle and operative to support said spindle radially and in manner to resist thrust exerted axially in direction from said grinding wheel, a flywheel secured to said spindle closely adjacent to said bearing at the side thereof opposite from said grinding wheel, a second anti-friction bearing disposed on said spindle closely adjacent to the other side of said flywheel and operative to support said spindle radially and in manner to resist thrust exerted axially in direction toward said grinding wheel, means on said spindle operative to tighten said anti-friction bearings against each other in manner to preload them to effect rigid support of said spindle, and means operatively connected to said spindle for rotating it.

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