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OUTBOARD WORK WHIPPING-INHIBITOR
FOR CENTERLESS GRINDERS

William Horberg, Bridgeport, Conn.

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11 Claims. (Cl. 51—103)

This invention relates to a method of inhibiting whipping of a long slender work piece that extends into outboard relation to the grinding throat of a centerless grinding machine while the work piece is being rotated rapidly in the grinding process. The present improvements further pertain to a newly devised accessory fixture that assists successfully in practicing the aforesaid method.

What may be termed the grinding throat of a conventional centerless grinding machine is a work-receiving space embraced between a grinding-wheel, a work-rotating or size regulating wheel and a work rest, all of which jointly border upon the grinding throat in positions to afford a three-point constraint for the periphery of the work piece that is being reduced in diameter by centerless grinding. When the work piece comprises a long and comparatively slender rod, shaft or spindle that projects some distance in outboard relation to the entrance of the grinding throat, the aforementioned three-point constraint of the work piece within the grinding throat is not sufficient to prevent vibrations which can deflect the outboard portion of the work piece away from true alignment with its axis of rotation. When this occurs, centrifugal force will promptly augment the initially slight deflections of the outboard portion of the work piece and set up a whipping action of the latter. This often disturbs the portion of the work piece that lies within the grinding throat to such extent that grinding it to accurate shape and size by the centerless grinding process becomes impossible.

It is the main object of my new method and newly devised accessory fixture to prevent whipping of the work piece by baffling initial deflections thereof before they can be augmented by centrifugal force or by resonance or become harmfully reactive upon that portion of the work piece that is being ground.

A further object is to provide an accessory fixture detachably usable with a conventional centerless grinding machine which will steady the outboard portion of a work piece without interfering with its bodily lowering in the grinding throat of the machine as its diameter becomes reduced in the grinding process.

A further object is to provide such fixture in a simple form that can be applied removably to a centerless grinder in outboard relation to its grinding throat and that incorporates a capacity for adjustive shifting of its bodily position as well as for independent adjustive shifting of component parts of the fixture, to enable the same to be set up in the grinding machine for cooperation with work pieces of differing lengths and diameters.

It is a particular object of the present improvements to provide a whipping inhibitor which at the beginning of the grinding operation not only will steady the work piece without obstructing its freedom to be lowered as its size becomes decreased by grinding but also in which at the conclusion of such size reduction there comes into play a V-type of more substantial furcate support for firmer steadying of the work piece in its final or "sparking out" stage of grinding.

These and other objectives will become clearer in greater particular from the following description of my improved method and of an apparatus, by which the method may be practiced, in which description reference is had to the appended drawings wherein:

Fig. 1 is an elevation of the front or work receiving side of a conventional centerless grinding machine equipped with my improved outboard fixture for inhibiting whipping of the work piece.

Fig. 2 is an isometric close-up view of the whipping inhibitor installed in outboard relation to the entrance to the grinding throat of the machine.

Fig. 3 is a plan view of the parts shown in Fig. 2.

Fig. 4 is a front view looking at Fig. 3 from the outboard end of the work piece shown positioned as at the time of beginning its grinding.

Fig. 5 is a fragmentary view taken in section on the planes 5—5 in Fig. 4 looking in the direction of the arrows.

Fig. 6 is an enlarged fragmentary view of a portion of the structure in Fig. 4 explanatory of the functioning set-up of the whipping inhibitor.

As conventional in centerless grinding machine, Fig. 1 shows a machine base 12 on which there is slidably supported a carriage 14 that affords rotary bearing for a power driven work regulating wheel 16, which by clockwise rotation rotates the work piece 18 counterclockwise in Fig. 4, at a speed, controlled by its rolling surface contact therewith. In a well known manner carriage 14 is shiftable to convey wheel 16 toward the left in Fig. 1 for thrusting work piece 18 against the grinding wheel 15. The latter is rotatably supported in the stationary head 17 of the machine and rotates clockwise at considerably faster peripheral speed than does the regulating wheel 16.

Carriage 14 is adjustable toward the right and left in Fig. 1, along ways 18 formed on a slidable slide 19, on which also is adjustably sta-
tioned at the grinding throat of the machine, the usual work rest 20 supported on a rigid machine standard mounted to be slidable adjustable forward and backward crosswise of slide 19. Work rest 20 has a top edge sloping downward toward regulating wheel 18. Carriage 14 may be fastened in any chosen position along ways 16 in relation to slide 19 by one or more of the usual gib tightening screw handles 22.

Also slide 19, itself, is adjustable along ways 15 formed on machine base 12 and may be fastened in any chosen positions threelong by one or more separate gib tightening screw handles 28.

A long and more or less slender rod, shaft or spindle 15 may comprise a work piece to be ground and is shown to project some distance forward in outward relation to the entrance to the grinding throat. That portion of work piece 15 that is within the grinding throat, while being rotated and ground, derives three-point constraint from work rest 20, regulating wheel 18 and grinding wheel 15 which jointly bound upon and define the grinding throat. Despite this adequate support for the work spindle within the grinding throat, high speed rotation of a long and slender work piece such as 15 can cause that portion of the work piece which remains in outward relation to the grinding throat to vibrate sufficiently to be deflected from true alignment with its axis of rotation. When this occurs centrifugal force will augment the initially slight deflections of the work piece and will set up a whipping action of the latter which so disturbs that portion of the work piece within the grinding throat that its accurate shaping or sizing becomes impossible.

I have discovered that this troublesome cause of work spoilage can be avoided in a very simple manner. In my new method in the early stages of the grinding operation there is presented to only the downward revolving side of the original peripheral of the work piece outside of the grinding throat a firm stationary slanting guide surface that can be tracked or contacted continuously by said periphery while the rotating work piece becomes obliquely lowered in the trough-like grinding throat owing to its diminishing size. Such guide surface is disposed in critical angular relationship to the degree of slope of the aforesaid top edge or seat of the work rest in the grinding throat. This method of inhibiting whipping will be explained in greater detail by reference to one successful form of my adjustable outboard work guiding fixture illustrated in Figs. 2 to 6, inclusive, and designated as a whole by 29.

The mounting base 30 of fixture 29 comprises a horizontal metal slab containing the elongated slot 31 through which freely extends the Shank of a fastener in the form of clamp bolt 32 that threads into the standard 21 of the work rest 20.

An adjustment holding clamp bolt 33 threads into the front edge of base 30 and extends freely through an elongated slot 34 in the thick right upstanding work guiding plate 35 whose slanting edge 35 alone contacts with the work in an outboard portion of the latter and steadies it against the aforementioned whipping action.

A separately adjustable auxiliary outboard work guiding surface 37 comprises one edge of a shoudered block 38 that slants oppositely to edge 35 and can adjustably be stationed to be contacted by the work only at the conclusion of the size reducing grinding of the latter, or during what is commonly referred to as the "spark out" or final stage of work rotation. Block 38 rests slidably on the top edge 39 of plate 35 and in part overlaps the latter. Block 38 is shown to be composed of an apron section and a rider section welded together. It could as well constitute an integral piece and will be fastened firmly in any chosen position along plate edge 29 by the clamp bolt 40 that extends freely through elongated slot 41 in block 38 and threads into plate 35.

Whereas block 33 is confined to adjustable movement in a straight direction parallel with plate edge 39, plate 35 is free to be adjustably mounted on the latter by its holding screw 33 pivoting when the latter is loosened, as well as shifted horizontally toward the right and left in Figs. 1, 2 and 4. This permits the degree of slope of plate edge 37 to be set at various angles with respect to work rests whose top edges such as 21 have different degrees of inclination. The angular setup of plate 35 can also be made to suit work pieces of different diameters.

For more easily executing a fine control over the adjustment of plate 35 while it is being moved toward the right into contact with the work piece 15, a thumb screw 45 is provided having threaded engagement with a spur bracket 46 that is secured on base 30 by screws 47 threading into the latter. For correspondingly fine control of the adjustment of block 33 while moving the latter initially toward the left into desired proximity to the test work piece, a thumb screw 48 is provided having threaded engagement with a spur bracket 45 secured on plate 35 by screws 49 threading into the latter.

The function and manner of use of the fixture 29 will have become largely apparent from the foregoing description. A centerless grinding machine utilizing the same will first be set up in the usual way with regard at first only to the proper relationship of grinding wheel, regulating wheel and work rest required by the initial and ultimate diameters of the work piece to be ground. If at the beginning of the grinding operation the work piece must protrude forward from the entrance to the grinding throat to a considerable extent in proportion to its cross sectional size and strength, the base 30 of my whippingLater will be firmly stationed on the front face of work rest standard 21 by means of bolt 32.

With an unground sample of the work piece 15 resting correctly in the grinding throat at the beginning of its grinding process and thereby serving as a position gauge, plate 35 will be placed so that its edge 37 just contacts such work piece, while sloping at an angle that is preferably parallel with a diametrical line D passing through the axis A of initial rotation of the work piece and bisecting the angle I formed by a projected straight line B, that is coincident with the slope of the top edge of work rest 20, and another projected line T that is in a plane tangent to the periphery of the regulating wheel 18 at its point of contact with work piece 16. Thumb screw 45 will afford fine control of plate edge 37 as it is pushed toward the right until it just contacts the test work piece 16.

After correct operating position of plate 35 has been attained by the aforesaid adjusting operation, clamp bolt 33 will be tightly set up to secure the plate firmly in place. At this time the supplemental work guiding surface 37 on block 38 remains well withdrawn from the work piece toward the right. The machine may now be started and a grinding operation performed at
the work piece such as is to be repeated in quantity production, after which the grinding will be allowed to "spark out." It will now be found that because of the reduction in diameter of the work piece, in the grinding throat of the machine the axis of rotation A of the work piece has dropped a little in a slanting direction along line D into the position A'. During this bodily lowering of the work piece the undiminished periphery of its outboard portion has gradually tracked along guide edge 35 while remaining in contact therewith until it comes to occupy the position A'. Block 35 will now be adjusted toward the left until auxiliary guide surface 37 just contacts the work piece. This can be done under very fine control if desired, by turning thumb screw 43 to push the block 35 toward the left. This adjustment of block 35 insures that at the conclusion of the size reducing grinding of the work piece, and during its "sparking out" rotation, the outboard end of the work piece will be supported and steadied in the furcate rest of V-formation that is formed jointly by both the work guiding surfaces 36 and 31. When once set up for the above described control of a test work piece of given size, any quantity of additional work pieces of that particular size may be ground with the advantageous aid of my improved whipping inhibitor without further adjustment of the latter.

It has been found that this inhibits all tendency of the rapidly rotating outboard portion of the work piece to disturb the designed alignment, true round grinding and accurate sizing of the portion of the work piece that is within the grinding throat. I have found it advantageous to set the plate 35 forward from the entrance of the grinding throat to a distance about equal to two-thirds of the outboard length of the work piece that projects from the grinding throat.

The regulating wheel 16 in Fig. 3 is shown skewed in a well understood way for automatically drawing the work piece lengthwise progressively into the grinding throat as it is being ground. In such case the outboard end portion of the work piece that is being steadied by the whipping inhibitor 29 is free to travel lengthwise across the plate 35 while rotating in constant contact with guiding edge 35 of the plate.

I may also station and use another fixture like 29 positioned as fixture 29 is positioned and used, except offset toward the rear from the discharge end of the grinding throat, viz. that end which appears at the extreme right in Fig. 2 and at the extreme top in Fig. 3. Such other fixture may be used concurrently with or may be used without fixture 29 and will be set up to engage with and steady the leading end of an elongated work piece as it proceeds outward from the grinding throat in the same manner that fixture 29 engages with and steadies the trailing end of such work piece as it approaches the grinding throat.

It will be appreciated that the mechanical principles underlying this invention can be embodied in a wide variety of specific shapes and constructions of fixtures that might be employed in outboard relation to the grinding throat of a centerless grinding machine, wherefofe the appended claims are directed to and intended to cover all substitutes and equivalents for the precise shapes and arrangements of parts herein disclosed that fall fairly within the broadest interpretation of the claim language.

I claim:

1. In a centerless grinding machine, the com-...
lying work rest, whipping inhibiting means as defined in claim 4, in which the said abutment comprises an upright plate having a horizontal slot therein, together with a mounting base fixed to said standard, and a releasable fastener on said base occupying said slot and holding said abutment in fixed relation to said base in a manner permitting the said work guiding surface to be adjustably swung relatively to the said sloping seat of the work rest in a plane crosswise said work piece thereby to determine and vary the slope of said surface.

8. The method of inhibiting whipping by the outboard portion of an elongated work piece while the work piece rotates in the tapered trough-like throat of a centerless grinding machine and tracks along the sloping seat of a work rest therein, which consists in blocking against lateral deflection in only one direction the non-ground revolving periphery of said work piece outside said grinding throat along the precise line of progressive advance of said periphery occasioned by the tracking of the work piece along said sloping seat of the work rest while said axis of the work piece remains exactly parallel with its original position.

9. The method of inhibiting whipping by the outboard portion of an elongated work piece while the work piece rotates in the tapered trough-like throat of a centerless grinding machine and tracks along the sloping seat of a work rest therein, which consists in blocking against lateral deflection in only one direction the non-ground revolving periphery of said work piece outside said grinding throat along the precise line of progressive advance of said periphery occasioned by the tracking of the work piece along said sloping seat of the work rest while said axis of the work piece remains exactly parallel with its original position, and ultimately blocking the outboard portion of the work piece against deflection in its seat tracking direction of movement during the sparking out period of the grinding operation.

10. A whipping inhibitor for steadying long work pieces in a centerless grinding machine having a grinding throat bordered by a work rest, comprising in combination, a work guiding surface adapted to be stationed in outboard relation to said grinding throat in a position to be trackable by the outboard periphery of a work piece rotating on said rest while being ground, means constructed and arranged to hold said guiding surface motionless in fixed relation to said work rest, a supplementary work engaging surface adjustably movable in relation to said work steadying surface and stationable in outboard relation to said grinding throat in a position to be reached and contacted by the said work piece after the latter has tracked along said guiding surface, and supplementary means constructed and arranged releasably to hold said supplementary surface motionless in fixed relation to said guiding surface.

11. A whipping inhibitor as defined in claim 10, in which the said supplementary holding means includes a releasable fastener permitting the said supplementary work steadying surface to be adjustably shifted with respect to the said work guiding surface.

WILLIAM HORBERG.

REFERENCES CITED

The following references are of record in the file of this patent:

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