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CENTERLESS GRINDING MACHINE AND METHOD

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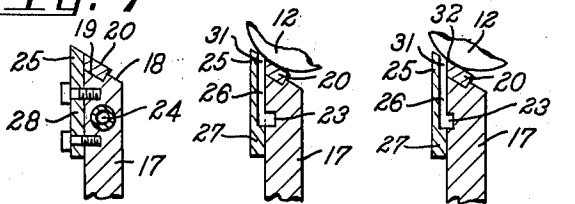
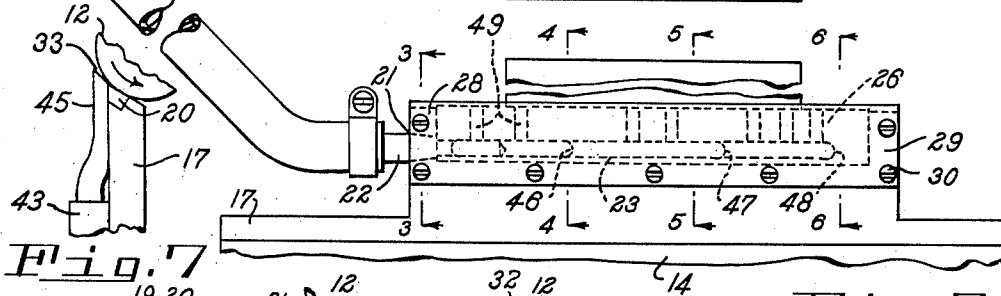
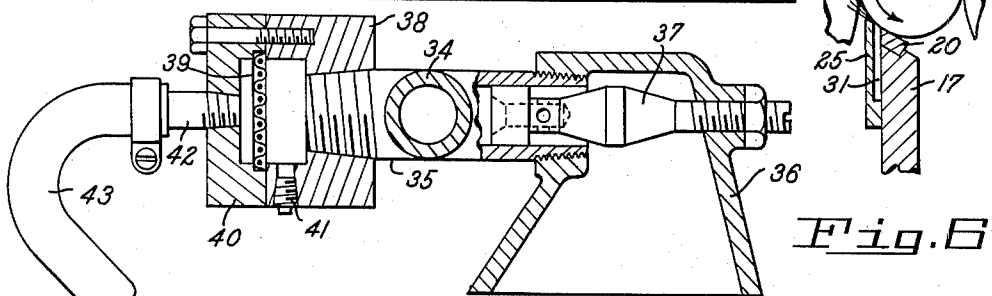
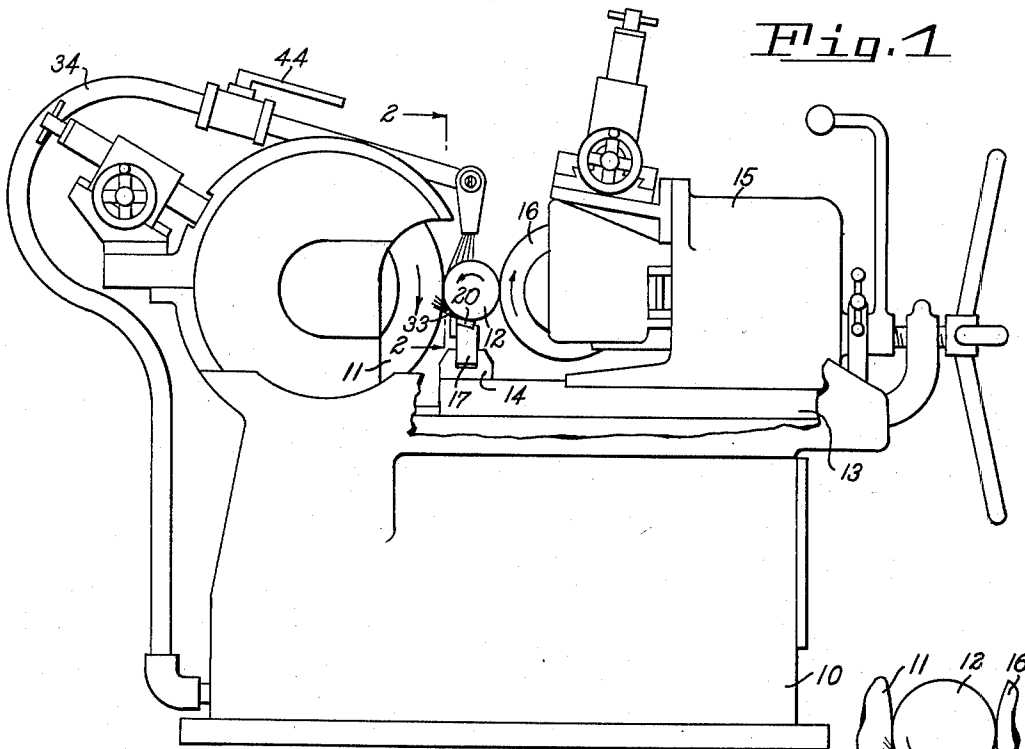


Fig. 2

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CENTERLESS GRINDING MACHINE AND METHOD

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7 Claims. (Cl. 51—103)

This invention relates to improvements in centerless grinders and has particular reference to an improved method of centerless grinding and structure for carrying out said method which will insure adequate coolant lubrication of difficult to grind work during the stock removing operation.

One of the objects of the invention is the provision of a novel structure of centerless grinder work supporting blade and coolant introducing mechanism for use in connection therewith which will improve the coolant lubricated action of the work piece and at the same time aid in maintaining a cleared condition of the surface of the grinding wheel, minimizing loading effects during the grinding operation.

A further object of the present invention is the provision of an improved method of an apparatus for centerless grinding of difficult to produce work pieces which will effect a greatly improved removal of grinding chips from the grinding wheel surface, preventing loading of the wheel or carrying around of loose chips to be rolled into the work piece during continuance of the grinding operation and which will at the same time clean, chill and lubricate the nascent ground surface of the work piece immediately after its formation and prior to its contact with the surface of the work supporting blade.

An additional object of the present invention is the provision of an improved structure for effecting a pressure chilling and clearance of freshly formed chips from the surface of a grinding wheel during a grinding operation to minimize adherence of the chips to the wheel surface or deleterious loading of said surface.

An additional object of the present invention is the provision of an improved structure which may be readily and effectively applied to existing machines.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification, considered in conjunction with the accompanying drawings forming a part thereof, and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

Figure 1 is a view of the front or work receiving side of a centerless grinder embodying improvements of the present invention.

Figure 2 is a fragmentary elevational view of the work supporting blade with portions of the coolant control mechanism in section taken substantially on the line 2—2 of Figure 1.

Figure 3 is a fragmentary vertical sectional view on the line 3—3 of Figure 2, and

Figures 4, 5, and 6 are corresponding sectional views taken on the lines 4—4, 5—5, and 6—6 respectively of said Figure 2.

Figure 7 is a similar section of an alternative embodiment of the invention.

In the drawings the numeral 10 designates the bed of

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the conventional type centerless grinder having rotatably mounted thereon the customary grinding wheel 11 driven in a clockwise direction for removal of material from the left hand side of the work piece 12 indicated in Figure 1. Mounted on the bed 10 is the transverse slide 13 bearing the work rest supporting bracket 14 and the supplemental slide 15 mounting the regulating wheel 16 which oppositely engages the work piece 12 in accordance with conventional centerless grinding practice.

Considerable difficulty has been experienced in the past in attempts to grind special materials as, for example, uranium parts, due apparently to loading of the grinding wheel, undue wear of the work rest blade, or roughness due to apparent alloying of the material with the blade. Vibration, noise, and unsatisfactory operation of the machine have resulted, as well as poor finish and frequent burning or otherwise damaging of the work pieces, accompanied by excessive wheel wear.

In elimination of these difficulties according to one embodiment of the present invention there has been secured to the work rest bracket 14 the main element or base portion of a centerless work rest blade 17. This blade has the inclined upper face 18 preferably recessed at 19 to receive a wear resisting insert 20 which in the present instance is preferably formed of a suitable hard sintered carbide or ceramic material to reduce the tendency of the work supporting portion of the blade member to alloy with uranium or similar type material work pieces.

Additionally, the rear portion of the blade 17 is drilled and tapped as at 21 to receive the coolant or lubricant conducting nipple 22. The blade itself is formed with slot 23 extending from the work discharge end of the blade toward the front or work receiving end of the blade as indicated in Figures 2, 4, and 5. At the rear, the slot is sufficiently deep to break into the drilled aperture 24 of the blade into which coolant flowing through the nipple 22 discharges. This slot is preferably made in stepped or tapered form from rear to front as shown to reduce the flow velocity of the coolant or lubricant under pressure and insure properly balanced discharge throughout the length of the blade. Secured on the back of the work rest blade 17 is a second blade element in the form of the closure plate 25 grooved or relieved in the upper area 26 so that its lower portion 27 and end portions 28 and 29 are tightly clamped against the rear of the blade as by the screws 30. As shown, the blade elements 17 and 25, together comprising the work supporting unit, are formed with an angled surface for rotatably supporting a work piece during a centerless grinding operation. The exact point of support or contact between the work piece and said angled surface is determined by the work diameter and relative adjustment of the regulating wheel and the blade as is conventional in centerless grinders. Preferably this contact is on the insert 20. The narrow elongated nozzle or discharge slot at 31 between the body of the plate and that of the work rest itself provides a porting interrupting the angled surface of the blade unit, which extends longitudinally of said surface and through which coolant is discharged immediately adjacent the normal point of contact at 32 between the lower portion of the work piece and the wear resisting insert 20 on the work rest supporting blade. By this construction adequate continuous supply of coolant in the nature of a knife-edge spray is directed against the full length of the work piece while within the grinding throat at a point directly ahead of the contact of the work with the work piece blade and in such manner that the grinding wheel-regulating wheel effected rotation of the work will tend to draw the lubricating coolant between the work and work rest blade. This action chills the hot, freshly formed chips and passivates the freshly formed nascent

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surface of the work, cooling and lubricant coating said surface prior to its sliding engagement with the supporting surface of the work rest blade. At the same time, both the work surface and wheel surface are cleared of loose grinding chips or abrasive particles. In this manner a continuous thin lubricating film may be maintained, reducing any tendency of the work to stick on or bond to the blade surface, as well as reducing wear on the work rest blade and irregularly or noisy action of the work due to possibly substantially dry surface contact between the work and blade.

By directing the spray of coolant at the particular point noted, there will be created a cleansing jet film reacting upwardly along the underside of the work piece and against the emerging wheel surface in the V at 33 formed by the beginning-to-separate arcuate surfaces of the work piece and grinding wheel.

It will be evident that the grinding has just been completed as these surfaces are separating, and it has been found that by forcibly directing the coolant to this point that it serves to chill the hot chips, and to clean off the freshly removed grinding chips from the surface of the wheel and prevent the loading of the surface of the wheel, which necessitates frequent retreating as has been the case when these chips were carried around by the wheel and additionally forced between wheel and work during the next bite taken by that particular portion of the wheel surface.

As is customary in centerless grinding machines, ordinarily a coolant supply is provided through the supply pipe 34. In employment of the present invention the pipe 34 has been indicated as extending into the transverse nipple or fitting 35 carrying the coolant discharge hood or nozzle 36, the volume of discharge through this nozzle to the top of the work and the work throat entering portion of the grinding wheel being controlled by a valve 37. In the present instance, there is additionally carried by the fitting 35 the block 38 supporting filter 39 retained in position by cap plate 40. Drain plug 41 communicating with the coolant chamber in the block ahead of the filter permits of ready cleaning of this area without removal of the cap. Threaded into the cap 40 is the nipple 42 connected by hose or conduit 43 with the nipple 22 of the work rest plate.

By the construction shown utilization may be made of the normal and existing coolant supply of the machine, the general flow being determined, if desired, by adjustment of the main control valve 44. However, a separate coolant supply may be provided, if desired, for the blade nozzle only. It has hitherto been customary that whatever coolant passed through the supply pipe 34 was generally discharged through a nozzle such as 36 onto the top of the work where it would splash over the work and adjacent the portion of the grinding wheel to lubricate and cool the work during the actual grinding. The contact of the wheel with the work and the relationship of the parts is such that the coolant was practically automatically excluded from the work rest at the point of contact of the work with the rest due to the backing up or squeezing out of the coolant by engagement between the work and the grinding wheel and the normal centrifugal action between the parts tending to disperse the coolant as respects the work rest area.

In the present instance, by provision of the valve 37, a desired distribution of the coolant may be attained so that proper and adequate amount for reaction on the work and wheel just prior to grinding will be supplied through nozzle 36 and at the same time a controlled condition will exist so that adequate amount of the lubricating coolant will be drawn down between the work and the supporting insert 20 on blade 17 at the contact line 32 to minimize friction and wear of the parts at this point.

At the same time the deflected coolant jet emerging from the slot 31 will be directed against the surface of

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the grinding wheel at the point 33, creating a hydraulic jet, washing away or removing the nascent chips just formed during the grinding operation and minimizing the objectionable loading of the wheel previously experienced in grinding of uranium or similar materials.

It will be noted that in the particular construction shown, a tapered effect is produced in the coolant supply channel to insure adequate supply of the coolant material across the entire face of the grinding wheel throughout the entire grinding zone.

A slightly different embodiment of the principles of the present invention has been illustrated in Figure 7. As there shown, there is secured to or adjacent the work rest blade 17 the discharge nozzle 45 extending along the blade in sub-tending relation to the V at 33 to provide the necessary jet washing, cooling, and lubricating action as respects the wheel and work surfaces. It will be understood that this nozzle may be suitably supplied with coolant through a housing connection 43 as in the previous form of the invention, extending to any suitable pressure supply source.

Reference has been made to the formation of slot 23 in a stepped or tapered form, best to control the localized supply of coolant to the grinding wheel and freshly ground or nascent surface of the work piece. In Figure 2, the general stepped nature of the groove has been indicated by dotted lines at the points 46, 47 and 48. Additionally, there has been there shown a plurality of vertical grooves 49 formed in the blade or in the inner face of the closure blade 25 to provide supplemental jet nozzles for discharge of the coolant or lubricant. These may vary in number and location, but it is preferable that a plurality be located as shown at the front or work receiving end of the blade to minimize the discharge restriction at this point and provide adequate surface lubrication of the work as it enters the grinding throat where the heaviest stock removal normally takes place. Also one or more such grooves are located at the rear or work discharge portion of the throat to adequate coolant discharge against the surface of the work as it emerges from contact with the grinding wheel and rotates toward and upon the work rest blade.

What is claimed is:

1. The method of centerless grinding consisting in mounting a workpiece in the grinding throat between the grinding and regulating wheels of a centerless grinder, peripherally supporting the workpiece for rotation in the throat on a work rest blade, and during grinding directing a fluid spray against the work as it disengages the grinding wheel and prior to its contact with the supporting blade for lubrication of the work surface and blade.

2. The method of centerless grinding consisting in mounting a workpiece in the grinding throat between the grinding and regulating wheels of a centerless grinder, peripherally supporting the workpiece for rotation in the throat on a work rest blade, and during grinding directing a fluid spray against the work and the grinding wheel in the receding portion of the grinding throat between the grinding wheel and the support blade just prior to the progressive rotational engagement of the freshly ground surface of the work with the support blade to clear the nascent work surface and passivate or lubricate the latter prior to its progressive engagement with the work rest blade.

3. A centerless grinder embodying a rotatable grinding wheel and an opposed rotatable regulating wheel, said wheels forming a grinding throat therebetween, a work rest having a work supporting surface projecting into the throat between the grinding and regulating wheels and extending transversely of the wheels for peripherally rotatably supporting the surface of a work piece during grinding, said wheels being disposed and rotatable to engage and rotate the work with its supported surface moving from the grinding wheel toward and across the work rest, and coolant supply means having a nozzle discharging

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coolant adjacent said work supporting surface of the work rest at a point between the grinding wheel and the rest to supply a coolant spray to the work surface in the area between the grinding wheel and the rest as the work rotates toward the supporting surface of the work rest to clean and chill said area of the work surface and maintain a lubricating film on said surfaces of the work and rest during a grinding operation.

4. A centerless grinder embodying a rotatable grinding wheel and an opposed rotatable regulating wheel, said wheels forming a grinding throat therebetween, a work rest having a work supporting surface projecting into the throat between the grinding and regulating wheels and extending transversely of the wheels for peripherally rotatably supporting the surface of a work piece during grinding, said wheels being disposed and rotatable to engage and rotate the work with its supported surface moving from the grinding wheel toward and across the work rest, and coolant supply means having a nozzle discharging coolant adjacent said work supporting surface of the work rest at a point between the grinding wheel and the rest to supply a coolant spray to the work surface in the area between the grinding wheel and the rest as the work rotates toward the supporting surface of the work rest to clean and chill said area of the work surface and maintain a lubricating film on said surfaces of the work and rest during a grinding operation, said coolant discharge means including a plate carried by the work rest and spaced therefrom to provide a narrow coolant discharge slit extending lengthwise of the work rest and transversely of the wheels at a point immediately adjacent said supporting surface.

5. A centerless grinder embodying a rotatable grinding wheel and an opposed rotatable regulating wheel, said wheels forming a grinding throat therebetween, a work rest having a work supporting surface projecting into the throat between the grinding and regulating wheels and extending transversely of the wheels for peripherally rotatably supporting the surface of a work piece during grinding, said wheels being disposed and rotatable to engage and rotate the work with its supported surface moving from the grinding wheel toward and across the work rest, and coolant supply means having a nozzle discharging coolant adjacent said work supporting surface of the work rest at a point between the grinding wheel and the rest to supply a coolant spray to the work surface in the area between the grinding wheel and the rest as the work rotates toward the supporting surface of the work rest to clean and chill said area of the work surface and maintain a lubricating film on said surfaces of the work and rest during a grinding operation, said coolant discharge means including a plate carried by the work rest and spaced therefrom to provide a narrow coolant discharge slit extending lengthwise of the work rest and transversely of the wheels at a point immediately adjacent said supporting surface, the plate having a portion projecting above the adjacent portion of the work rest supporting surface into proximity with the periphery of a supported work piece, whereby the discharge slit will be restricted by the work piece to confine the primary coolant discharge to the area of engagement of the work piece with the supporting surface.

6. A centerless grinder embodying a rotatable grinding wheel and an opposed rotatable regulating wheel, said wheels forming a grinding throat therebetween, a work rest having a work supporting surface projecting into the throat between the grinding and regulating wheels and extending transversely of the wheels for peripherally rotatably supporting the surface of a work piece during grinding, said wheels being disposed and rotatable to engage and rotate the work with its supported surface moving from the grinding wheel toward and across the work rest, and coolant supply means having a nozzle discharging coolant adjacent said work supporting surface of the work

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rest at a point between the grinding wheel and the rest to supply a coolant spray to the work surface in the area between the grinding wheel and the rest as the work rotates toward the supporting surface of the work rest to clean and chill said area of the work surface and maintain a lubricating film on said surfaces of the work and rest during a grinding operation, said coolant discharge means including a plate carried by the work rest and spaced therefrom to provide a narrow coolant discharge slit extending lengthwise of the work rest and transversely of the wheels at a point immediately adjacent said supporting surface, the plate having a portion projecting above the adjacent portion of the work rest supporting surface into proximity with the periphery of a supported work piece, whereby the discharge slit will be restricted by the work piece to confine the primary coolant discharge to the area of the work piece moving into engagement with the supporting surface of the work rest, and a plurality of means serially arranged at spaced points lengthwise of the work rest and plate structure forming resistances to vary pressure of the flow of coolant at different lengthwise areas of the discharge slit.

7. A centerless grinder embodying a rotatable grinding wheel and an opposed rotatable regulating wheel, said wheels forming a grinding throat therebetween, a work rest having a work supporting surface projecting into the throat between the grinding and regulating wheels and extending transversely of the wheels for peripherally rotatably supporting the surface of a work piece during grinding, said wheels being disposed and rotatable to engage and rotate the work with its supported surface moving from the grinding wheel toward and across the work rest, and coolant supply means having a nozzle discharging coolant adjacent said work supporting surface of the work rest at a point between the grinding wheel and the rest to supply a coolant spray to the work surface in the area between the grinding wheel and the rest as the work rotates toward the supporting surface of the work rest to clean and chill said area of the work surface and maintain a lubricating film on said surfaces of the work and rest during a grinding operation, said coolant discharge means including a plate carried by the work rest and spaced therefrom to provide a narrow coolant discharge slit extending lengthwise of the work rest and transversely of the wheels at a point immediately adjacent said supporting surface, the plate having a portion projecting above the adjacent portion of the work rest supporting surface into proximity with the periphery of a supported work piece, whereby the discharge slit will be restricted by the work piece to confine the primary coolant discharge to the area of the work piece moving into engagement with the supporting surface of the work rest, and a plurality of means serially arranged at spaced points lengthwise of the work rest and plate structure forming resistances to vary pressure of the flow of coolant at different lengthwise areas of the discharge slit, one of the slit forming members having irregularly spaced transverse grooves formed therein and providing outlet ports extending to the slit for effecting selected volumetric coolant discharge therealong.

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