United States Patent

Swenson

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[54] GRINDING WHEEL DRESSING APPARATUS

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[21] Appl. No.: **63,060**

[52] **U.S. Cl.** ..... **125/11 CD**

[51] **Int. Cl.** **B24h 53/14**

[58] **Field of Search** 125/11

[56] **References Cited**

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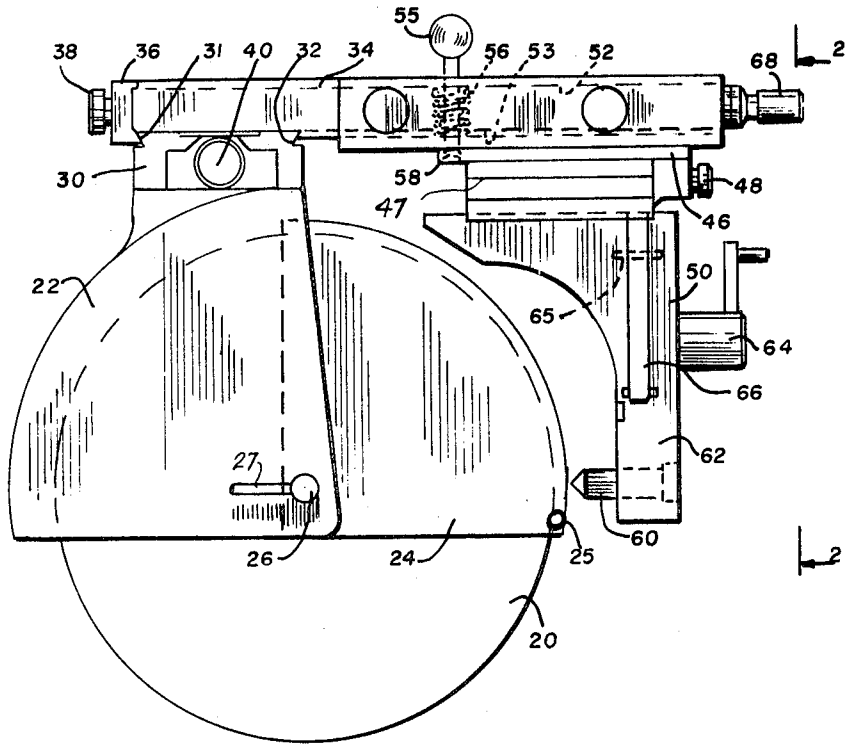
[57] **ABSTRACT**

A wheel guard or pedestal support is disposed for mounting on a grinding machine and provides a dovetail guide into which there may be removably mounted a diamond dresser; a contour forming device; an edge deburring support and like grinding wheel dressing apparatus. Precision lead screws are mounted in member portions of the support, said screws being disposed to be rotated to move a mounted dressing device into a desired precise position. A plunger pin is carried by a member and cooperates with an aperture in a mating member to permit a dressing device to be removed during grinding operations and to be reinstalled at the precise prior dressing position. In one embodiment a contour dressing mechanism is provided in which a diamond-surfaced precisely contoured wheel is rotated in the same direction as the grinding wheel is rotated but at a speed differential of about 400 surface feet per minute. This operation of the contour dressing mechanism provides a dressing of the grinding wheel whereby the wheels and dresser are kept at a relatively cool condition and the diamond wear is at a very low rate.

14 Claims, 10 Drawing Figures



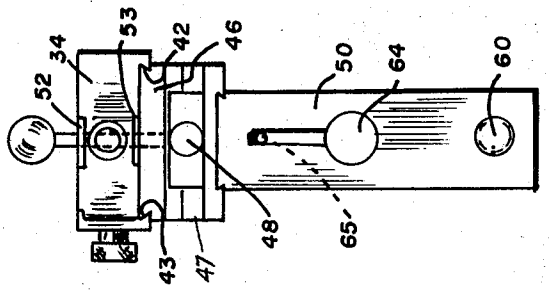


Fig. 2

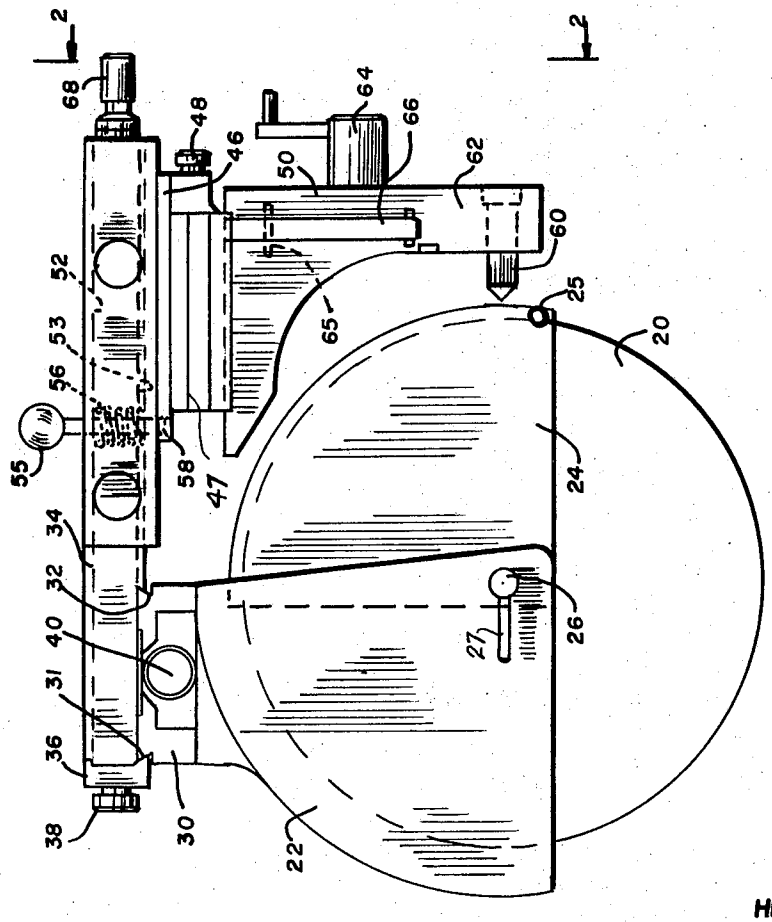


Fig. 1

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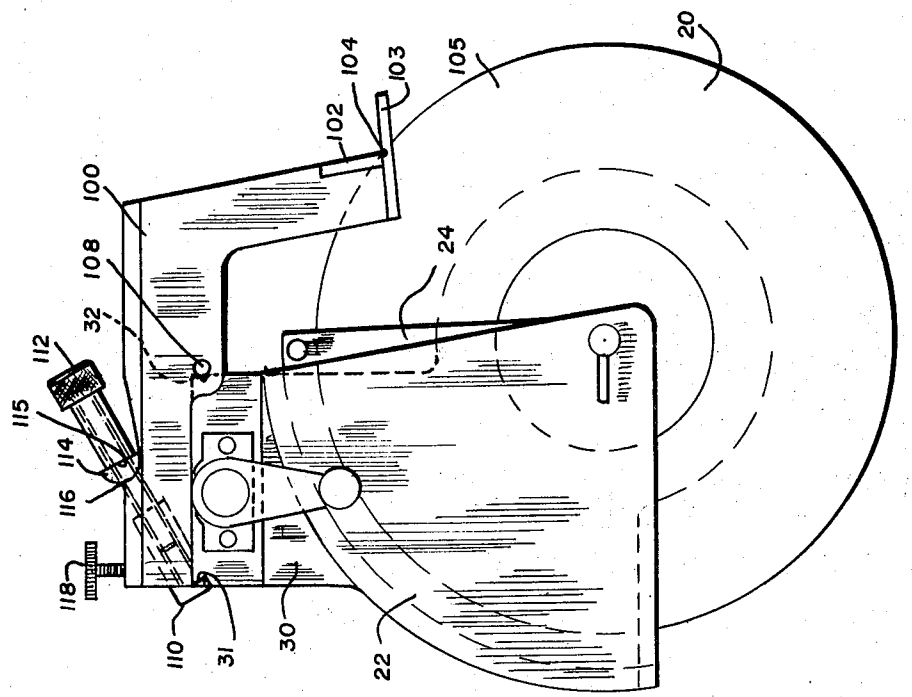

Fig. 4

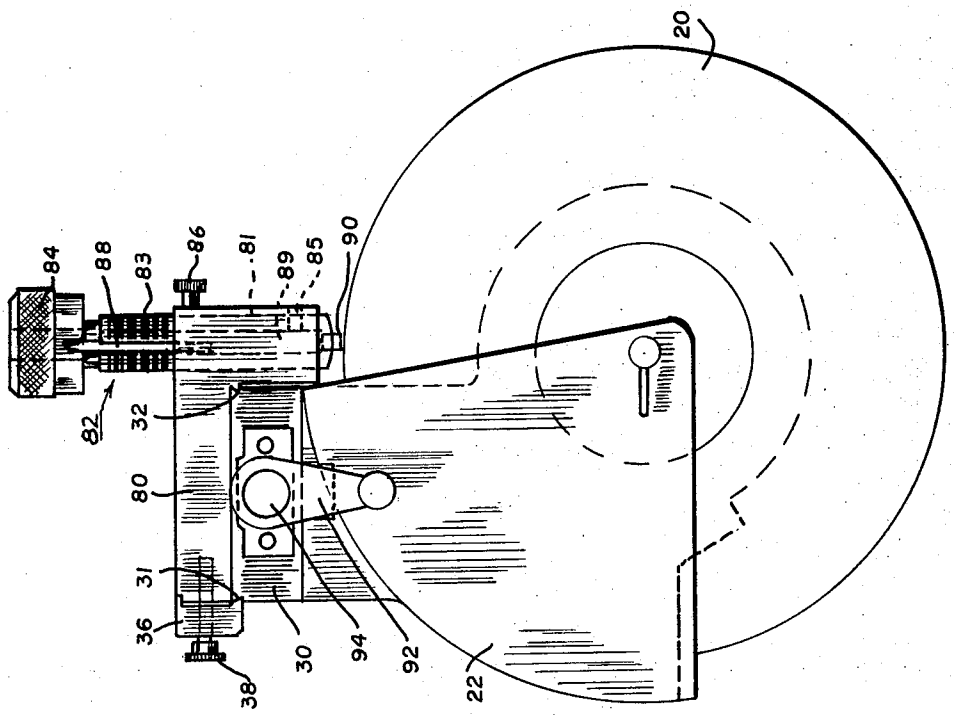

Fig. 3

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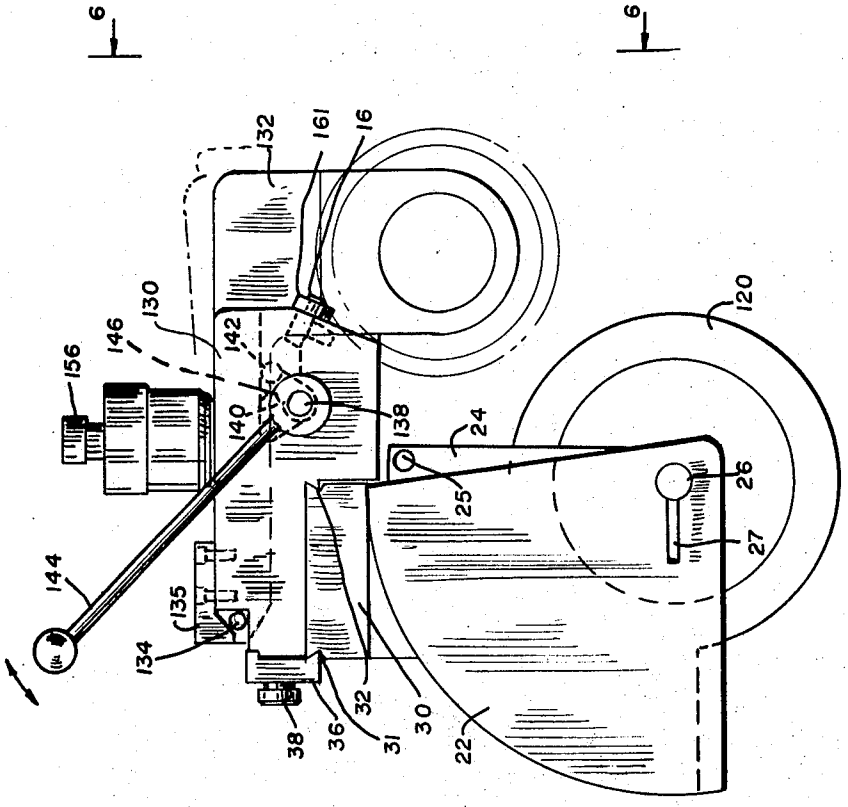

Fig. 5

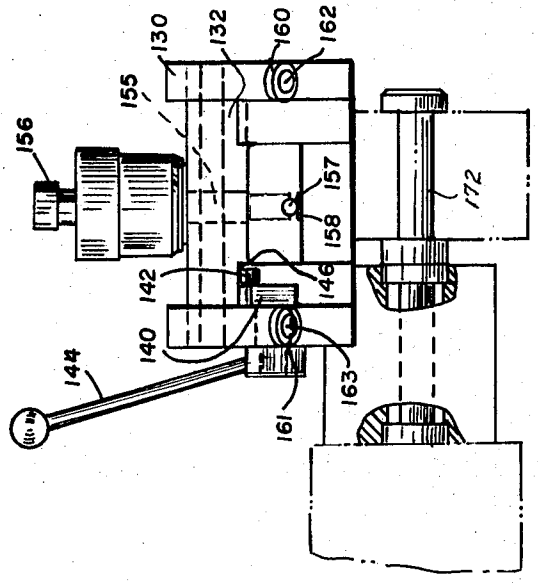

Fig. 6

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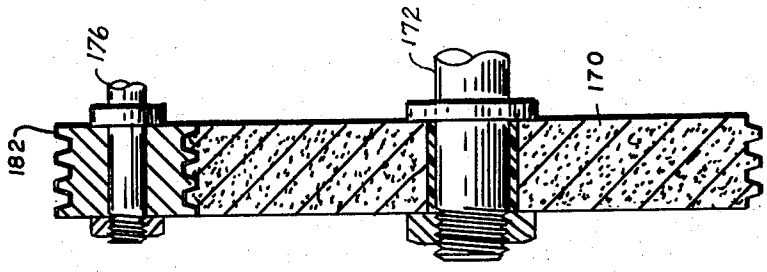

Fig. 8

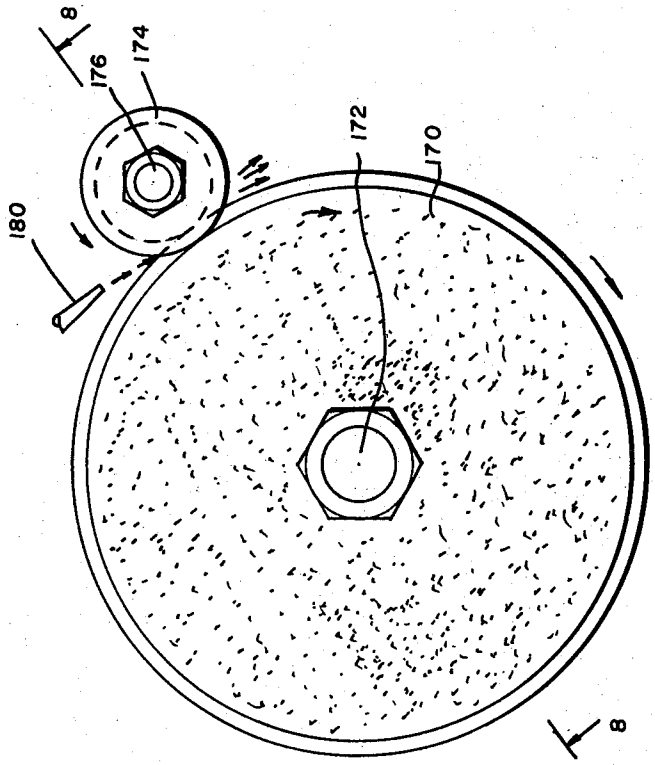

Fig. 7

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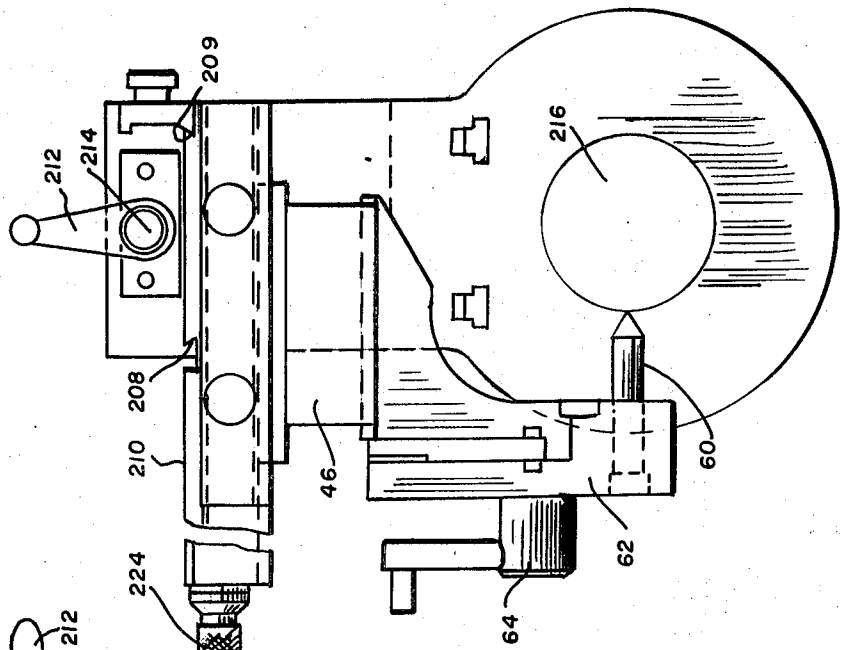

Fig. 10

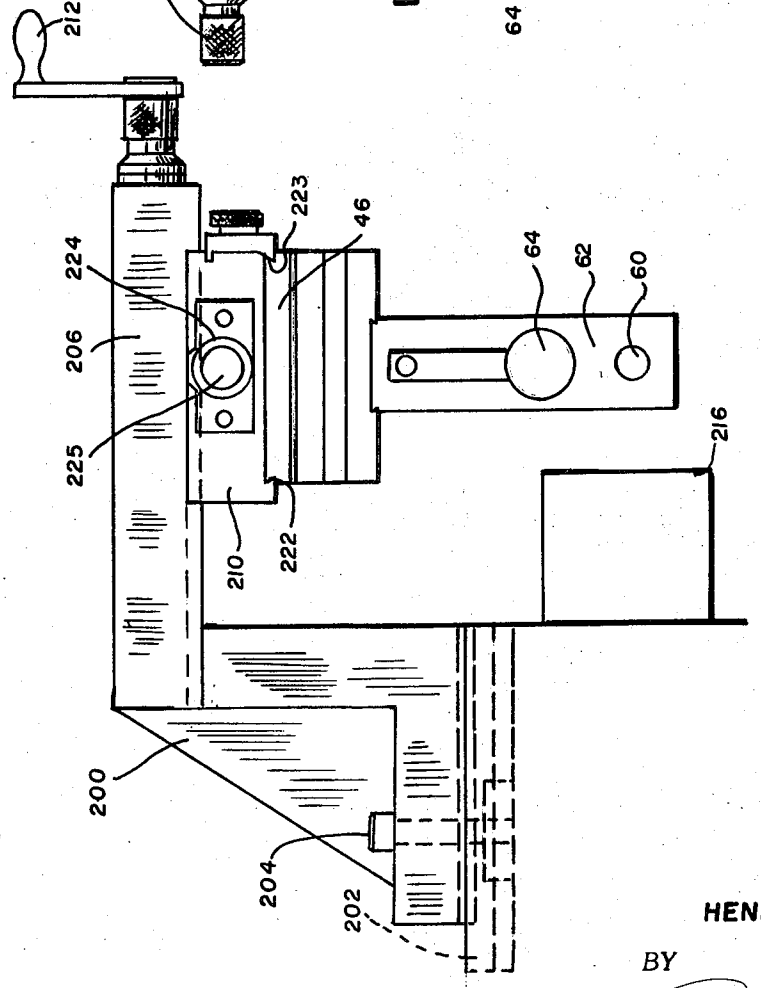

Fig. 9

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GRINDING WHEEL DRESSING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

In reference to the classification of art as established in the United States Patent Office this invention pertains to the general class of "Stone Working", and in particular to the subclass therein of "grinding wheel dressing". Other subclasses in this class which may be of interest are "tools" and particularly the one entitled "surface traversing" and the subclass pertaining to "-diamond" tools.

2. Description of the Prior Art

Grinding wheel dressing is a very well known art and has, in its development, been the subject of many United States and foreign patents. The apparatus provided for such grinding wheel dressing is usually either a wheel dressing means which is built in as a part of the grinding machine or is a removable mechanism which is only held temporarily in place while the grinding wheel is being dressed, after which it is usually removed from the machine. Re-establishment of the dressing position of the dressing means and its diamond or like dressing element to its previous dressing position is usually inaccurate or is time consuming. Many or most of the grinding machines used in present day machine job shops are multi-purpose and likewise the grinding wheel dressing and shaping apparatus for these machines is also multi-purpose. In the present invention it is contemplated that a wheel guard or fixed support member be provided to which or on which a dovetail carrier track is provided for the removable mounting thereon of a dressing means. After dressing the grinding wheel, the dressing means is or may be removed so that the grinding operation may be performed, after which the dressing means is remounted in the precise position from which it was removed. Onto this one dovetail carrier track various dressing devices may be mounted including a contour wheel dressing device which provides a diamond-faced contouring wheel which is contemplated to be run in the same direction as the grinding wheel and is driven so as to run at only a slight differential in surface speed. This dressing method provides means for contouring a grinding wheel with a minimum of heating and diamond wear or contamination.

Insofar as is known, prior to this invention no arrangement for the support of interchangeable grinding wheel dressing devices or apparatus has been provided, and in particular a support in which is provided a dovetail guide for the removable mounting of one of several dressing devices thereon. Of particular note is the novel grinding wheel contouring device wherein the diamond surfaced form is rotated at a speed of about 400 surface feet per minute differential than the speed of a new or full diameter grinding wheel. The form and grinding wheel at their point of engagement have the wheels rotating in the same direction and preferably a mist cooling is also provided.

SUMMARY OF THE INVENTION

This invention provides a guard or pedestal support upon which is mounted a support member provided with a dovetail guide. This support member is precisely movable in response to the rotation of a lead screw. At

right angles to the support block is another or second support member carried on another dovetail guide. This second support member may be removed and replaced by a like support member of another wheel dressing device. Some of these dressing devices are removably retained in still other dovetail guides and are disposed for precise repositioning by means of a plunger pin. Among the devices for removable mounting are a diamond dresser carried on a swinging arm; a diamond dressing end carried in a threaded holder; a support guard disposed to receive and provide a guide for a corner of a workpiece as it is passed over a rotating grinding wheel to be precisely deburred and a contour wheel dresser in which a diamond-faced form roller is driven at a determined surface speed and direction where at the engaging nip or contact of the form roller and grinding wheel they are both traveling in the same direction and at a surface speed differential of about 400 feet per minute. A spray mist is preferably used to assist in cooling the forming wheel and to insure that the removed residue is discharged from the backside of the nip of the inturning wheels.

INTENT OF THE DISCLOSURE

Although the following disclosure offered for public dissemination is detailed to insure adequacy and aid in understanding of the invention, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how it may later be disguised by variations in form or additions of further improvements. The claims at the end hereof are intended as the chief aid toward this purpose, as it is these that meet the requirement of pointing out the parts, improvements or combinations in which the inventive concepts are found.

There has been chosen a specific embodiment of a guide guard for mounting on a grinding machine and dressing attachments as adopted for use therewith and showing a preferred means for changing these attachments on the guide guard or on a fixed pedestal. This specific embodiment and an alternate embodiment thereof have been chosen for the purposes of illustration and description as shown in the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a side view of a grinding wheel dressing device removably mountable on a guide guard disposed for mounting on the spindle housing of a grinding machine;

FIG. 2 represents an end view taken on the line 2—2 of FIG. 1 and showing in particular the arrangement of the components of a removably mountable single-point dressing device;

FIG. 3 represents a side view of yet another embodiment in which a dressing diamond is disposed for mounting on the guide guard and provides means for dressing the top face of a grinding wheel of a cylindrical grinding machine;

FIG. 4 represents a side view of an edge deburring or grinding trough disposed to be mounted on the guide guard of FIG. 3, said trough providing means for precisely dressing the edge of a tool or the like as it is brought in way of the face of a rotating grinding wheel;

FIG. 5 represents a side view of a contour shaping mechanism for removable mounting on a guide guard and providing a novel means for contour forming the face of a grinding wheel with a diamond-faced master form;

FIG. 6 represents a fragmentary front view taken on the line 6—6 of FIG. 5 and showing a preferred arrangement of the grinding wheel contouring apparatus of FIG. 5;

FIG. 7 represents a somewhat schematic side view showing a grinding wheel as it is being contour-shaped by a diamond-faced contoured dressing form with the apparatus of FIG. 5;

FIG. 8 represents a schematic view taken on the line 8—8 of FIG. 7 and showing a representative contouring operation;

FIG. 9 represents an end view of a grinding wheel dressing device similar to that shown in FIGS. 1 and 2, but with the removably mounted dressing device mounted on a pedestal fixed to a grinding machine base or frame rather than on the spindle guide guard, and

FIG. 10 represents a side view of the grinding wheel dressing device and its pedestal support of FIG. 9.

In the following description and in the claims various details will be identified by specific names for convenience; these names, however, are intended to be generic in their application. Corresponding reference characters refer to like members throughout the several figures of the drawings.

The drawings accompanying, and forming part of, this specification disclose certain details of construction for the purpose of explanation of the broader aspects of the invention, but it should be understood that structural details may be modified in various respects without departure from the concept and principles of the invention and that the invention may be incorporated in other structural forms than shown.

DESCRIPTION OF THE EMBODIMENT of FIGS. 1 AND 2

Referring now in particular to FIG. 1, it is to be noted that a grinding wheel 20 is carried upon a spindle of a grinding-machine not shown. On the spindle housing of the grinding machine it is contemplated that mounted thereon is a housing guard 22 which has its top specially machined to provide a guide means. This housing or guide guard 22 provides the base or support for the several grinding wheel dressing devices to be hereinafter more fully described. Carried within this guard 22 is a movable guard cover 24 which is selectively moved in and out of wheel covering condition by means of a knob 25 shown on the right forward and lower end of the cover guard. A lock 26 has a lever portion 27 by which the lock 26 is rotated to clamp the guard cover in either an open condition as seen in FIG. 4, or in a closed condition as is seen in FIG. 1. Carried by an on the upper end of the housing 22 is a base member 30 which is formed with a pair of upwardly disposed left and right dovetail guides 31 and 32.

These guides are disposed to carry an upper housing 34 having formed on its underside a right-hand side dovetail recess disposed to mate with dovetail 32 while an outer or left-hand dovetail retaining means is provided by a removable clamp member 36. This clamp member is adjustably held in place by means of thumbscrews 38 which are tightened to adjust clamp plate 36 inwardly to provide the degree of sliding tension desired of upper housing 34 in the dovetails. A knurled knob 40 is attached to and drives a threaded lead screw, not shown, carried by and inside of the base 30. Thus lead screw is disposed to move the housing 34 toward or away from the operator as viewed in FIG. 1. Housing 34, as it is moved along the dovetails by this lead screw, is or may be moved with micrometer precision as it is contemplated that said screw is a precision screw and as it is rotated by knob 40, indicia on the knob is read by the operator to indicate the distance the member 34 is moved along said dovetails 31 and 32.

As seen particularly in FIG. 2 the underside of housing 34 is also formed with a pair of dovetails 42 and 43 in which is slidably and snugly mounted a support block 46. A rotary base 47 is carried by block 46 and is locked in a desired adjusted angle position by a knurled-headed screw 48. Block 46 is movable along the dovetails and carries with it a dresser base 50 mounted in dovetail guides formed in the lower member of the rotary base 47. The block 46 is slidable in dovetails 42 and 43 and is removably maintained in housing 34 by a latch means. This latch means includes upper and lower plates 52 and 53 which slidably retain and guide a plunger pin 55. These plates also are attached to a block moved by a screw carried in upper housing 34. Pin 55 is urged downwardly by a spring 56 seen in phantom outline in FIG. 1. The lower end of pin 55 is disposed to enter and snugly engage a recess or aperture 58 formed in block 46 and when tightly engaged to retain this block in the dovetails and in a determined relation to the screw moved block in housing 34. When the plunger pin 55 is lifted out of engagement of the recess 58, the block 46 may be slid from its support in dovetail guides 42 and 43 and be removed from the upper housing 34.

As shown in FIGS. 1 and 2 a diamond dresser 60 is carried by and at the downward end of a pivotally mounted arm 62 which is swung back and forth by means of a crank handle 64. Rotation of handle 64 causes the diamond 60 to be swung in an arc around a pivot pin 65. Spring arms 66 tend to keep arm 62 in a vertical condition and when left in this vertical position the carried diamond 60 may be moved across the face of the grinding wheel 20 by knob 40 after and when the guard 24 has been moved to its up position. The knurl-headed screw 48 may be loosened so that the rotary base 47 may be turned so that diamond 60, when swung by handle 64, dresses the grinding wheel at a determined angle to the axis of the wheel. With the rotary base 47 locked by knurl-headed screw 48 movement of the diamond 60 toward or away from the face of the grinding wheel is by a micrometer screw rotated by a knob 68. This screw as rotated by knob 68 causes upper and lower plates 52 and 53 and latch pin 55 to be moved as well as the block 46 when it is latched in position. Transverse motion of the diamond dressing point 60 across the face of the stone 20 when actuated by the rotation of knob 40 causes the upper housing 34 to be moved in dovetails 31 and 32.

DESCRIPTION OF THE EMBODIMENT OF FIG. 3

Referring next to FIG. 3, as shown therein, the housing or guide guard **22** carries upon its upper face a block or support member **80** which is retained in the guard dovetails **31** and **33** by means of the clamp member **36** and thumb screws **38** in the manner of FIG. 1. Carried in a threaded hole **81** formed in the right side of block **80** is an adjustable dressing holder **82** whose lower outer surface is formed with a precision thread **83**. Holder **82** is moved up and down as it is rotated by manipulation and rotation of a knurled knob **84** formed on the upper end of holder **82**. After adjustment of the holder it is snugly retained in the desired position by a nylon-tipped screw **85** adjusted to engage the threaded portion of holder **82**. A knurl-headed locking screw **86** is also carried in a threaded hole formed in support member **80**. This locking screw is adapted to engage and retain a pointer **88** which is slidable in a bore formed substantially parallel to the threaded hole **81**. The pointer, with the locking screw **86** in a disengaged condition, is slid to a desired height so that it will provide a reference for indicia inscribed on the barrel portion of knurled knob **84**. Carried within and extending below the lower end of holder **82** is a diamond dresser **90** which may be moved to a determined depth as by reading the micrometer type markings such as one thousandth of an inch on the barrel of knob **84** against the pointer **88**. The depth can also be estimated by counting a determined number of rotations of the knob **84**. This dressing end of the diamond **90** may be transversed back and forth over the face of the grinding wheel **20** by means of a crank **92** turning a screw **94** carried within the body **30** of the guard **22**. This screw engages a nut disposed to engage and support member **80** so that as crank **92** is rotated, the member **80** is moved along the dovetails **31** and **32**. In FIG. **3** as shown, the cover **24** has been omitted for the sake of more clearly showing the dressing device; however, it is contemplated that when a cover **24** is provided with the guard **22** the diamond **90** may be moved downwardly into dressing engagement with the face of the grinding wheel through a window in the guard and then by moving the support member **80** the diamond is traversed across the face of the grinding wheel **20** by the rotation of the crank **92**.

DESCRIPTION OF THE EMBODIMENT OF FIG. 4

Referring next to the guard mounting device of FIG. **4**, there is shown a grinding wheel **20** running within guard **22** in the manner of FIG. **1**. The guard cover **24** is shown in the open condition which permits the base **30** to carry an edge deburring support which in the preferred arrangement includes a main arm member **100**. This member is generally L-shaped and has its outer right-hand end turned downwardly to a lower level shelf portion, which includes a slide stop member **102** and a support plate **103** disposed at an angle of more than ninety degrees to each other. A small relief **104** is provided at their intersection. There is a small cutout formed from the rear of the shelf portion. This cutout extends into the intersection, permitting the outer surface or face **105** of grinding wheel **20** to project into the intersection a selected amount. A workpiece to be deburred or chamfered is supported on plate **103** and is brought against stop member **102** with the burr or sharp edge disposed in the relief **104**. The workpiece is then slid along this junction to bring the edge of the workpiece in way of the projecting grinding wheel **20** by which the edge of the workpiece is ground at about a 45° angle to its sides and at a determined small chamfer. In a like manner a hand-held wheel dresser may be slid along this junction and as it is brought in way of the face of the grinding wheel, said face **105** is dressed.

Arm member **100** is readily removed from base **30** by releasing the clamping action provided by a forward pin **108** seated in the dovetail **32** and by a hook member **110** which engages the dovetail **31**. A knurl-headed screw **112** is threaded into member **110** and is brought into engagement with the face of a swivel washer **114**. A sleeve or shoulder **115** is disposed below the knurl-headed end of screw **112** so that as screw **112** is tightened against said swivel washer **114**, the washer will be pushed against stop shoulders **116** formed on member **100** and cause the outer workpiece supporting end of the member **100** to be moved upwardly. When the screw **112** is loosened the outer supporting end of **100** is lowered to permit more of the surface **105** of grinding wheel **20** to project through the cutout and into the intersection of stop **102** and plate **103**. A lock screw **118** threadedly mounted in member **100** is disposed to be brought into engagement with the member **110** to hold member **110** in locking engagement on dovetail **31** and maintain a determined position of arm **100** with respect to grinding wheel **20**. To change the projection of surface **105** of the grinding wheel into the intersection of stop **102** and plate **103**, the lock screw **118** is loosened to permit screw **112** to be rotated to provide the desired adjustment of arm **100**. Screw **112** is also further loosened when it is desired that the assembly of arm **100** be removed from base member **30** so that other dressing devices may be mounted on said base member.

CONTOUR FORMING APPARATUS OF FIGS. 5 THROUGH 8

Referring next to FIGS. **5** through **8**, it is to be noted that guide guard **22** and movable cover **24** is shown as being carried on a grinding machine spindle housing by means of a collar clamp **120**. This is adapted for mounting as by clamping on the extended spindle housing of a grinding machine. A contour forming apparatus is disposed to be carried by and upon the upper portion of base **30** and is adapted for removable mounting in dovetails **31** and **32**. A block member **130** which is formed with a "U"-shape is retained on base **30** by clamp member **36** and thumb screws **38** as in FIG. **3**. Carried by block member **130** is a swing member **132** which is pivotally retained on one end by means of a through pin **134** which is held in a corner or notch by a pair of holding clamps **135**. Carried in block **130** is a shaft **138** which on its inner end has an arm **140** fixedly mounted thereto. The outer end of this arm carries a roller **142** by which swing member **132** is lifted. The shaft **138** is rotated by means of a lever arm **144**, and as the roller end of the arm is swung in an arc, the roller **142** is brought into engagement with surface **146** to cause member **132** to be lifted upwardly from the position of FIG. **5** to a position represented by the phantom

line. The shaft **138** is rotated counterclockwise until roller **142** reaches a stop shelf just to the left of a vertical line through the center of shaft **138**. At this condition the swing member **132** is at substantially the maximum lifted height while at the same time it is in a self-locking condition and is disposed to remain in this condition until arm **144** is moved to rotate shaft **138** clockwise.

The downward travel of swing member **132** is preferably adjustably determined and as seen in FIG. **6** this downward limit is provided by a micrometer screw **155** rotated by means of micrometer head **156** mounted on its upper end. On the lower end of this screw a ball end **157** or the like is provided. This end is disposed to rest on a support surface **158** formed in or mounted in block member **150**. When arm **144** is swung so that the swing member **132** is in the lowered condition of FIG. **5**, the ball end **157** establishes this lowered position of this swing member **132**. As seen particularly in FIG. **5**, roller **142** is disposed to be swung in a counterclockwise arc on the end of arm **140** to engage lifting surface **146** and in a smooth arc motion cause a lifting action to be provided to the member **132**. When and as arm **140** is moved to the determined back position the roller **142** engages the undersurface of swing member **132** to lift the member and as it lifts or lowers the outer end of swing member **132** passes between the side plates of member **130** and is guided by rollers **160** and **161**. These rollers are carried on like eccentric studs **162** or **163**, which are rotated so as to bring the peripheries of the rollers into a determined guiding control of the lateral movement or play of member **132** as it is moved up and down in the trough in member **130** by arm **140** and roller **142** mounted thereon.

Although a knurled nut **40** or crank **92** is not shown in FIGS. **5** and **6**, it is contemplated that block member **130** may be moved back and forth on base member **30** by rotating a lead screw in member **30** in the manner of FIGS. **1, 2, 3,** and **4**.

Referring next to FIGS. **7** and **8**, there is shown a form contouring means such as may be used for precisely shaping the face of a grinding wheel **170** carried on shaft **172** which is rotated in a clockwise direction as viewed in FIG. **7**. A shaping wheel **174** is carried on a shaft **176** and is rotated in a counterclockwise direction as seen in FIG. **7** so that when wheel **174** is brought into dressing engagement with grinding wheel **170** they are travelling in the same direction. A mist nozzle **180** is disposed above and to the left of the junction of the wheels **174** and **170**. From this nozzle a mist is directed to and at the junction line of the wheels so as to assist in lubricating and flushing the shaping wheel **174** and also to assist in keeping the shaping wheel **174** in a cooled condition. As reduced to practice and as a preferred embodiment, it is contemplated that shaping wheel **174** has its outer surface plated or coated with a layer of diamond grit **182** as seen in FIG. **8**. This layer **182** is applied after the metal core has been shaped or machined to determined contour. The diamond grit is applied in a determined thickness such as five to ten thousandths of an inch, after which, if necessary, the outer surface is further precisely finished as by lapping to the desired contour.

In the related shaping of the outer periphery of the grinding wheel **170** it is contemplated that a small controlled differential of speed will be provided between wheel **174** and wheel **170**. Preferably, the shaping wheel **174** is running at a surface feet speed just slightly in excess of the surface feet speed of the grinding wheel **170**. For example, assuming that wheel **170** is about 8 inches in diameter and spindle **172** is operated at a standard rotating speed of 3,450 rpm, this would result in a theoretical surface feet speed of the periphery of wheel **170** approximately 7,225 feet per minute. To contour the face of this grinding wheel it is contemplated that the shaping wheel **174** as carried on spindle **176** is rotated at a governed speed of 18,000 rpm. At this speed it is contemplated that the minimum diameter of wheel **174** will be 1⅝ inches in diameter. When an air motor is used, a pressure regulator may be used to establish a lesser speed by reducing the normal ninety pound air pressure supply to 60 or 70 pounds pressure. This intended governed speed results in a minimum surface feet of travel of 7,658 feet per minute for said shaping wheel. This results in a differential speed of the shaping wheel to the grinding wheel of 432 feet per minute. It is of course realized that in certain contoured areas the diameter of grinding wheel **170** is reduced from its original diameter, which results in a reduced surface feet per minute, increasing the differential speed. This condition is also found where the larger diameter of form wheel **174** changes the differential speed between it and grinding wheel **170**. The extending and reduced diameters provided by the contours on wheel **174** and the grinding wheel **170** change the differential of surface feet per minute so a compensating factor may be needed such as the reduced pressure suggested above.

In providing a compensated speed, it is contemplated that a desired differential speed of between 300 and 800 feet per minute be provided between wheel **174** and the grinding stone **170**. Within these limits, this low speed differential causes the grinding wheel **170** as it is shaped to remain in a cool condition and at the same time the shaping wheel **174** also remains in a cool condition. The spray mist fed by nozzle **180** assists in this cooling action and as the wheels rotate towards each other the mist increases the cleaning action so that there is no buildup of residue at the nip of the two wheels. With the wheels turning in the same direction there is no tendency for the removed material to be accumulated or piled up at the nip. This reduces, if not totally eliminates, distortion in the form being dressed into the wheel and also excessive abrasion of the diamond and the diamond matrix. As reduced to practice it has been found that with the wheels rotating at the speeds above-suggested, the removed residue is readily discharged from both wheels on the side opposite the nip of the two rollers. With the flinging discharge of the residue material the faces of the two wheels are kept relatively clean as they approach and pass through the nip. Keeping the shaping wheel **174** clean reduces abrasion of the matrix for the diamond surface. With a relatively low differential speed and little grinding residue at the nip, the completion of the forming of the grinding wheel finds that both wheels are in a cool condition and may be touched by hand. This result is contrary to that developed in the general

procedure used for shaping or contouring grinding stones by a contouring wheel. The diamond face of the shaping wheel **174** also remains in a sharp condition for a much longer period of service since the action of the diamond on the grinding wheel is more of a cutting action than an abrading action. The holding matrix, since it remains cool, also is maintained in a very good condition and as it is not excessively abraded or imbedded with accumulated removed residue from the shaping operation results in the life of the shaping wheel **174** being effectively lengthened. In the coating of the diamond on the shaping wheel it is contemplated that the diamond will be affixed by a precise plating process. The dressing or redressing, if required, may be accomplished by lapping.

USE AND OPERATION OF DRESSING DEVICES WITH THE GUIDE GUARD

It is contemplated that upon a grinding machine having a grinding wheel carried on the end of a spindle that the housing of the spindle is provided with a guard of a determined configuration. In the present instance the guard originally furnished on the machine is replaced with a guide guard like that shown in FIGS. **1** or **3**. This guard includes a fixed housing guard **22** and a movable guard cover portion **24** which is swung to an open condition to provide access for dressing the grinding wheel **20**. The upper portion of the fixed guard member **22** has slidably mounted thereon an upper housing **34** which is movable by means of a lead screw. This upper housing moves in a path whose axis is parallel to the axis of the grinding wheel **20**. This screw is rotated by a crank **92** or knob **40** so that housing **34** is moved a determined amount to bring said upper housing **34** and like members into a desired and determined position. Thumb-screws **38** are manipulated to cause clamp plate **36** to be tightened so as to permit housing **34** to remain in a sliding condition along dovetails **31** and **32** or the clamp plate **36** may be further tightened to lock upper housing **34** in a retained or clamped condition.

When it is desired to dress the grinding wheel **20** by means of a diamond point **60** as mounted in the dressing device of FIG. **1**, the plunger pin **55** is lifted and the diamond dressing assembly shown in FIGS. **1** and **2** is slid into the dovetails **42** and **43** so that support block **46** is brought to a determined mounting position in these dovetails. The plunger pin **55** is released from its lifted condition and is permitted to enter and engage aperture **58** to precisely position and lock support block **46** in said dovetail guide. The guard cover **24** is lifted to the condition of FIG. **5** and is locked so that the face of the grinding wheel **20** is exposed and available for dressing. The knob **68** is rotated to cause diamond **60** to be brought to the face of the wheel **20** to provide the desired facing engagements after which crank handle **64** is oscillated to cause the diamond **60** to be swung in an arc to give the desired precise face dressing to the rotating grinding wheel **20**. After grinding wheel **20** has been dressed to suit the workpiece to be ground, it is customary to cause the plunger pin **55** to be grasped and lifted permitting the diamond dressing assembly carried by support block **46** to be slid from dovetails **42** and **43**. With this diamond dressing portion of the apparatus removed from the housing guard **22** the movable guard cover **24** is swung to position of FIG. **1** and is clamped in covered condition by means of lock handle **26**, after which the grinding wheel **20** is moved towards and to the workpiece in the usual manner to grind said workpiece.

In FIG. **3** there is provided a face dressing means in the form of a group of diamonds held in a matrix disposed on the lower end of a screw **82**. This diamond matrix is provided as a dressing end **90** and, as above-described, is moved to the grinding wheel **20** by rotation of knob **84**. The traversing motion across the face of the grinding wheel **20** is provided by the rotation of screw **94** initiated by rotation of the crank handle **92**. Clockwise and counterclockwise rotation of the screw **94** causes the diamond **90** to be moved back and forth across the face of the grinding wheel. The micrometer screw **84** permits precise adjustment of the diamond **90** so that only a determined amount of dressing of the face of the wheel **20** occurs with each instance of dressing the face of the wheel.

Referring next to the operation of the edge deburring tool of FIG. **4**, it is to be noted that a grinding wheel **20** is used to break or chamfer the edge of a workpiece. This break edge is at a determined extent as established by the protrusion of the grinding wheel into the intersection of the grinding shelf. Main arm member **100** is mounted upon the dovetails **31** and **32** with forward pin **108** pivotally seated in the forward dovetail **32**. Hook member **110** engages the rear dovetail **31** so that arm member **100** is supported by and is retained by these two members. Screw **112**, with screw **118** in a loosened condition, is caused to be rotated forwardly or backwardly to engage the abutting shoulder of swivel washer **114** and cause the arm member **100** to be rotated around for ward pin **108** so that the shelf portion is raised or lowered a determined amount. When the determined adjusted height has been achieved, the lock screw **118** is caused to be tightened downwardly against hook member **110** to hold the arm member **100** in the adjusted position. It is to be noted that slide stop **102** and support plate **103** are preferably of hardened steel or carbide so as to provide a long wearing surface. These members are disposed at an included angle of 93° to 100° so that when a workpiece having the usual right angle corner is to be deburred and is seated upon the shelf, the two adjacent faces of the workpiece engage and seat on slide stop **102** and support plate **103** without either of these faces causing the part to be lifted from the intersecting point. Relief or undercut **104** is disposed to receive any sharp edge or burr on the workpiece while the faces of the workpiece are in engagement with stop **102** and plate **103**. The workpiece is slid along the shelf and as the edge which is to be deburred a small amount such as one, two or five thousandths of an inch is brought in way of the projecting outer diameter of grinding wheel **20** this desired amount is ground from the edge of the workpiece. This grinding device provides means for a precise edge deburring operation to be accomplished. The necessity of such an operation of deburring or chamfering often occurs in the manufacture of precision workpieces.

It is also to be noted that in FIG. **4** the stone **20** instead of being an abrasive wheel of aluminum oxide and the like may be a wheel having a diamond surface. The diamond wheel is preferred in the deburring of workpieces such as hardened tool steel, carbide and the

like. The precise setting of main arm member **100** enables a determined deburring or chamferring operation to be made on a workpiece in a rapid and precise manner.

With the housing guard **22** of this invention mounted upon the spindle housing of a grinding machine it is noted that said dovetail guide provides for the removable mounting thereon of many dressing devices which are used to provide the desired face or configuration of the grinding wheel **20**. For example, when the face of the grinding wheel **20** is to be straight dressed, either the dressing device of FIG. **1** or FIG. **3** may be utilized. When a contoured form is to be provided in the face of wheel **20**, the form apparatus of FIGS. **5** through **8** is mounted on this guard **22**. The contour forming operation is performed at the very low differential of speed noted above. It is to be noted that a differential of speed may be provided in the contour forming operation wherein the grinding wheel **170** is caused to travel at a slightly faster speed than the contour forming wheel **174**. This arrangement, of course, would produce the desired differential of speed but may cause a wear of the diamond which is greater than that where the contour forming wheel is the faster traveling wheel.

It has been found that the wheel contour forming as provided by the apparatus of FIGS. **5** through **8** results in a diamond loss at a rate which is one-tenth to one-twentieth the diamond loss found in conventional wheel dressing operation. This is attributed to the low heat resulting from the low differential of surface feet speed and also the lack of accumulation of residue at the nip of the two wheels. The counter directional movement of the wheels in the conventional shaping operation in addition to the high heat developed also causes the dressing residue to be driven into the matrix of the diamond surface. The high speed differential of conventional shaping also rounds the diamond's sharp cutting edges, further increasing the heat.

In the precise forming of the shaping wheel **174** the plating of the diamond layer is usually from five to ten thousandths of an inch in thickness. A lapping wheel or form running at a like low differential of surface speed is used to correct any inaccuracies in wheel **174**. This same lapping procedure may be used to reform the wheel **174** after it has been extensively used to shape wheel **170**.

It is further contemplated that power for shaft **176** may be provided by an electric motor having a speed sensing control enabling this shaft to be operated at substantially a constant speed no matter whether the contouring wheel **174** is under load or is at "no load". In like manner, a governor-controlled motor, either pneumatic or hydraulic, may instead be provided which drives the shaft **176** at a relatively constant speed with or without load. Such a drive of the contouring wheel **174** assures that when brought into engagement with the grinding wheel **170** the shaping or contouring is at the selected determined differential of speed which permits the operation to be completed with a minimum amount of heat developed in the contouring operation.

ALTERNATE MOUNTING OF FIGS. 9 AND 10

Referring finally to FIGS. **9** and **10**, it is to be noted that instead of the guide guard **22** of FIG. **1**, there is provided a support pedestal **200** which is mounted to the spindle housing **202** of a grinder by means of cap screws **204**. A top support member **206** has dovetails **208** and **209** disposed to carry movable member **210**. This member is precisely positioned by crank handle **212** as it rotates a screw **214** carried in top support member **206**. This movement of member **210** is parallel to the axis of the grinding wheel of a grinding machine which may be a tool and cutter grinder having a spindle housing **216**. Member **210** has dovetails **222** and **223** disposed to slidably retain support block **46** and the rest of the dressing device of FIG. **1**. Knob **224** rotates screw **225** to move movable member **210** in the dovetail guide.

OPERATION AND USE OF THE DRESSER OF FIGS. 9 AND 10

In the manner of the embodiment of FIGS. **1** and **2**, the dressing device of FIGS. **9** and **10** may or may not have a plunger pin **55** by which support block **46** may be readily removed from movable member **210**. Member **210** is moved along the axis of the grinder by means of screw **214** as it is rotated by crank **212** while support block **46** and the dressing device below is moved in dovetails **222** and **223** by means of knob **224** as it rotates screw **225**. Handle **64** is manipulated to cause diamond **60** to swing in an arc on arm **62** as described above for the embodiment of FIG. **1**.

When desired, the support block **46** may be removed from dovetails **222** and **223** and another dressing device be installed in its place. Such a device may be the form shaping apparatus of FIGS. **5** and **6** or the others above-shown. The embodiment of FIGS. **9** and **10** merely illustrates that the versatile support of housing guard **22** need not be confined to its attachment by clamp means to the spindle housing but the support may be provided by a bracket or the like attached by screws to the spindle housing of the grinding machine.

CONCLUSION

In each of the above devices it is contemplated that a dresser, preferably a diamond type, is provided to dress the face of a grinding wheel **20**. Whether the guard and cover of FIGS. **1–4** are used or the pedestal of FIGS. **9** and **10** is used, it is contemplated that the several devices may be used on the same support. If only one device is to be used, said device may be made a fixed part of the support.

Terms such as "left", "right", "up", "down", "bottom", "top", "front", "back", "in", "out", "clockwise", "counterclockwise" and the like are applicable to the embodiments shown and described in conjunction with the drawings. These terms, as used, are merely for the purposes of description and do not necessarily apply to the position in which the guide guard, support pedestal or the dressing attachments mounted thereon may be constructed or used.

The conception of the interchangeable grinding wheel dressing devices and their many applications is not limited to the specific embodiments shown but departures therefrom may be made within the scope of the accompanying claims and without sacrificing their chief advantages and protection is sought to the broadest extent the prior art allows.

What is claimed is:

1. Apparatus for dressing the face of a grinding wheel while said wheel is rotatably carried by the spindle of a grinding machine, said apparatus including: (a) a guide guard fixed to the spindle of a grinding machine; (b) a guide means provided on the support and disposed to removably receive and retain a grinding wheel dressing device; (c) a base member portion of said grinding wheel dressing device, said member portion removably mountable in and on said guide means; (d) dovetail guide means along which said base member and the dressing device portion thereof may be moved in a path substantially parallel to the axis of the grinding wheel, the rate and extent of said movement being at the discretion of the operator; (e) a deburring and dressing guide table which includes a main arm member having a through forward pin disposed to pivotally seat in and be retained in said dovetail guide means, said main arm having a depending outboard portion in which there is provided a workpiece supporting table portion which includes a slide stop and a support plate member, said members being in fixed relation to each other so that the workpiece supporting and engaging faces are at an included angle which is greater than 90°; (f) a relief formed at the intersection of the slide stop and support plate and extending the length of the guide table, and (g) a cutout formed in the table portion and disposed to receive the outer peripheral portion of the grinding wheel and permit the face of the grinding wheel to extend a determined extent into the intersecting area defined by the slide stop and support plate members, said extent providing means for deburring the edge of a workpiece as it is slid along the guide table and in way of and past the projecting face portion of the rotating grinding wheel, and also providing a guide means for a diamond dresser and the like when and as the dresser is slid along the table so as to be brought in way of and across the face of the grinding wheel so as to dress the face of said grinding wheel.

2. Apparatus for dressing the face of a grinding wheel while said wheel is rotatably carried by the spindle of a grinding machine, said apparatus including: (a) a guide guard attached to the spindle housing of a grinding machine, said guard including a guard cover disposed to be movable to an open position whereby the face of the grinding wheel is exposed for dressing, forming and the like, and in its closed condition the guard cover encloses the wheel to the extent normal for grinding a workpiece; (b) a base member portion of said grinding wheel dressing device, said member portion removably mountable in and on a pair of dovetail guides formed adjacent a top supporting surface of the base member, said base member being movable on the mounted guide guard in and along a path parallel to the axis of the spindle of the grinding machine; (c) means for moving said base member and the dressing device portion thereof along said guide means and in a path substantially parallel to the axis of the grinding wheel, the rate and extent of said movement being at the discretion of the operator; (d) a wheel dressing device which is a diamond dresser, said dresser carried in any by an arm pivotally mounted on a support block which is slidably mounted in a member having a guideway and in the mounted condition the guideway is disposed so as to be normal to the axis of the grinder spindle, said support block being removably retained in said guideway by a plunger pin; (e) means for moving said wheel dressing device to and into engagement with the grinding wheel so as to dress the face of said grinding wheel with the movement of said dressing device into engagement with the grinding wheel, and (f) a plunger pin carried by the upper housing and spring biased so as to be urged toward the support block, and in which there is provided an aperture formed in the support block and sized so as to snugly and removably retain the end of the plunger pin when urged thereinto by said spring.

3. Apparatus for contour dressing the face of a grinding wheel while said wheel is rotatably carried by the spindle of a grinding machine, said contouring apparatus including: (a) a support fixed to the grinding machine and including a block member; (b) a swing member pivotally carried by the block member; (c) a shaping wheel carried on and by a shaft rotatably mounted in the swing member; (d) an arm carried on a shaft rotatably mounted in the block member, said arm having a roller carried on its outer end, said roller disposed to engage an undersurface of the swing member as the shaft is rotated and as the roller engages this undersurface it lifts the swing member as the roller is swung in an arch of determined extent and when said arm is swung to disengage the roller the swing member is lowered to a supported condition; (e) motor means for rotating the shaping wheel in the same direction as the rotation of the grinding wheel so as to dress the grinding wheel with a small differential of surface speed whose average speed differential is not less than 100 surface feet per minute, and (f) means to precisely establish and maintain a determined dressing engagement of the shaping wheel with the rotating grinding wheel which includes a micrometer screw having a micrometer head, said micrometer screw being rotatably mounted in a threaded bore provided in the swing member, and with an anvil end of the micrometer screw disposed to engage a seating means on the block member.

4. A fixed support member disposed to be attached to a grinding machine and provide a guide means for the releasable mounting thereon of devices for use with the grinding wheel of the grinding machine, said support member including: (a) a base member having a pair of dovetail guides formed on the upper portion of the base member so that when the base member is mounted on the grinding machine the dovetail guides are substantially axially aligned with the axis of the spindle carrying the grinding wheel; (b) a deburring guide table having a main arm member having a through forward pin disposed to pivotally seat in and be retained in one of the dovetail guides, said main arm having a depending outboard portion in which is provided a workpiece supporting table portion which includes a slide stop and a support plate member which members are in fixed relation to each other so that the workpiece supporting and engaging faces are at an included angle which is greater than 90°; (c) a relief formed at the intersection of the slide stop and support plate and extending the length of the guide table; (d) a cutout formed in the table portion and disposed to freely receive the outer peripheral portion of the grinding wheel and permit the face of the grinding wheel to extend a determined extent into the intersecting area defined by the slide stop and support plate members,

said extent providing means for deburring the edge of a workpiece as it is slid along the guide table and in way of and past the projecting face portion of the rotating grinding wheel, and also providing a guide means for a diamond dresser and the like when and as the dresser is slid along the table so as to be brought in way of and across the face of the grinding wheel so as to dress the face of said grinding wheel, and (e) a clamp means for removably mounting on the dovetail guides said deburring guide table for use with the grinding wheel, said table while mounted on the base member further having means permitting the table to be selectively moved to and away from the face of the grinding wheel.

5. Apparatus for dressing the face of a grinding wheel as in claim 2 in which the member carrying the support block upon upon which is mounted the pivotally mounted arm and in which is formed the guideway for said support block, said member being an upper housing having mating dovetail engaging means for mounting on the dovetail guides of the base member, one of the dovetail engaging means comprising a clamp member which is adjustable to a tightened condition permitting the upper housing to be slidably moved along the dovetail guides, and which may be further tightened to clamp said upper housing to the base member, and with the clamp member in a loosened condition the upper housing and depending diamond dresser device may be removed from the dovetail guides of the base member.

6. Apparatus for dressing the face of a grinding wheel as in claim 5 in which the diamond dresser is traversed in axial alignment with the axis of the grinding wheel and across the face of the grinding wheel by means of a lead screw carried in the base member, said lead screw rotated by a crank and the like, the lead screw operatively connected to the support member so as to move it along the dovetail guides as the lead screw is rotated.

7. Apparatus for contour dressing the face of a grinding wheel as in claim 3 in which the shaping wheel is rotated so that it travels at the faster surface speed and in which there is provided a mist nozzle and a supply of pressurized cleaning and lubricating fluid disposed for discharge from said mist nozzle, mist being directed towards and to the nip of the shaping wheel and grinding wheel.

8. Apparatus for contour dressing the face of a grinding wheel as in claim 7 in which the shaping wheel is plated with a diamond treated dressing surface having a thickness of from five to twenty thousandths of an inch.

9. Apparatus for contour dressing the face of a grinding wheel as in claim 3 in which the distal end of the swing member carries the shaft upon which is mounted the shaping wheel, said distal end being movable in a prescribed arc as restrained in its side movement by adjustable guide means carried by the block member.

10. Apparatus for contour dressing the face of a grinding wheel as in claim 9 in which the adjustable guide means includes a pair of spaced apart rollers each carried on an eccentric stud which may be rotated so as to move the roller to a desired position in space disposed to engage a planar surface on the swing arm and guide and maintain the swing arm in a prescribed plane.

11. Apparatus for contour dressing the face of a grinding wheel as in claim 3 in which the block member is removably mounted in a guide means provided on the support and in which there is additionally provided means for moving said block member and the contour dressing apparatus along said guide means in a path precisely parallel to the axis of the grinding wheel.

12. Apparatus for contour dressing the face of a grinding wheel as in claim 11 in which the guide means is a pair of dovetail guides formed adjacent a top supporting surface of a base member and with said block member having a pair of mating dovetail guide engaging means, one of said dovetail guide engaging means comprising a clamp member which is adjustable to a tightened condition permitting the base member to be slidably moved along the dovetail guides and in which said clamp member may be further tightened to clamp the base member in the dovetail guides, and with the clamp member in a loosened condition the contour dressing device may be removed from the base member.

13. A fixed support member as in claim 4 in which the means for selectively moving the device to and away from the face of the grinding wheel includes a hook member disposed to engage the dovetail guide opposite the guide retaining the forward pin, said hook member having an aligned threaded bore in which an adjusting screw is mounted, said adjusting screw having a shoulder disposed to engage a swivel washer resting in a stop shoulder means provided on the main arm member, so that when the adjusting screw is rotated, the main arm member is pivotally moved around the forward pin to cause the guide table to be moved to and away from the face of the grinding wheel.

14. A fixed support member as in claim 13 in which there is provided a lock screw carried in a threaded bore in the main arm member, and by rotation of the lock screw one end of the lock screw is disposed to be moved into engagement with the hook member so as to lock the engagement of the hook member in the dovetail guide and the determined pivotal adjustment of the guide table.

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