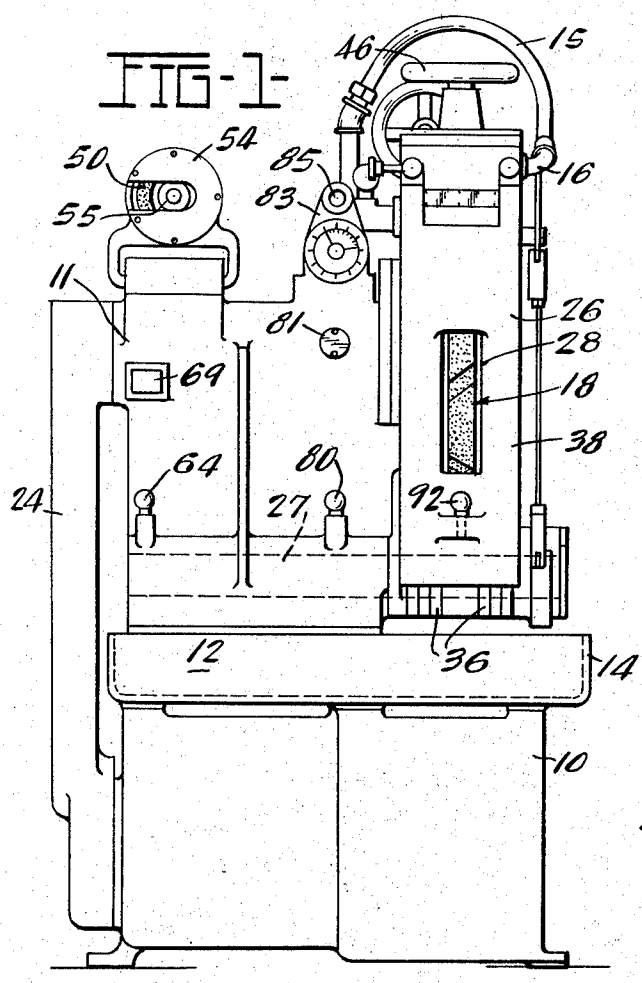
March 3, 1959 C. L. GARRISON 2,875,559

METHOD OF GRINDING AND GRINDING WHEEL THEREFOR

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FIG-1-



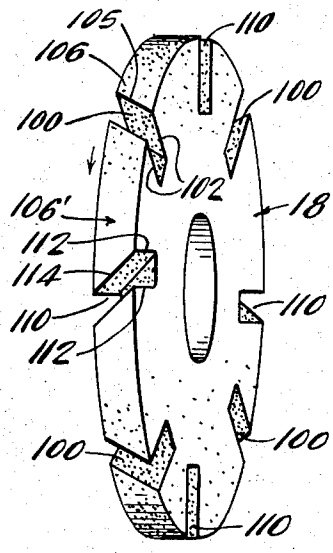


FIG-5-

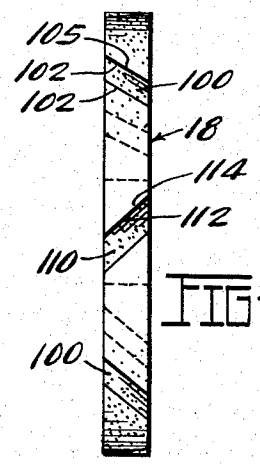


FIG-4-

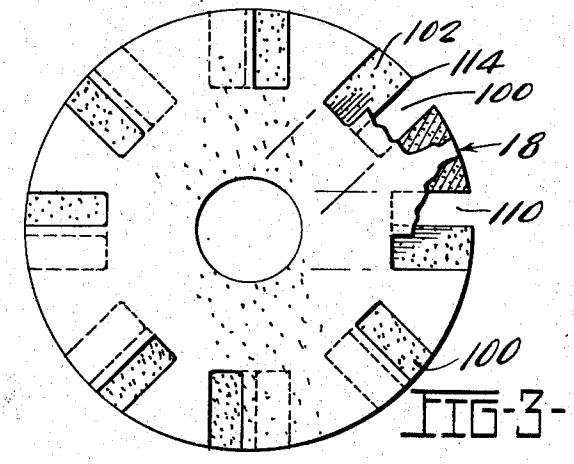


FIG-3-

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March 3, 1959 C. L. GARRISON 2,875,559

METHOD OF GRINDING AND GRINDING WHEEL THEREFOR

Filed Oct. 30, 1956 2 Sheets-Sheet 2

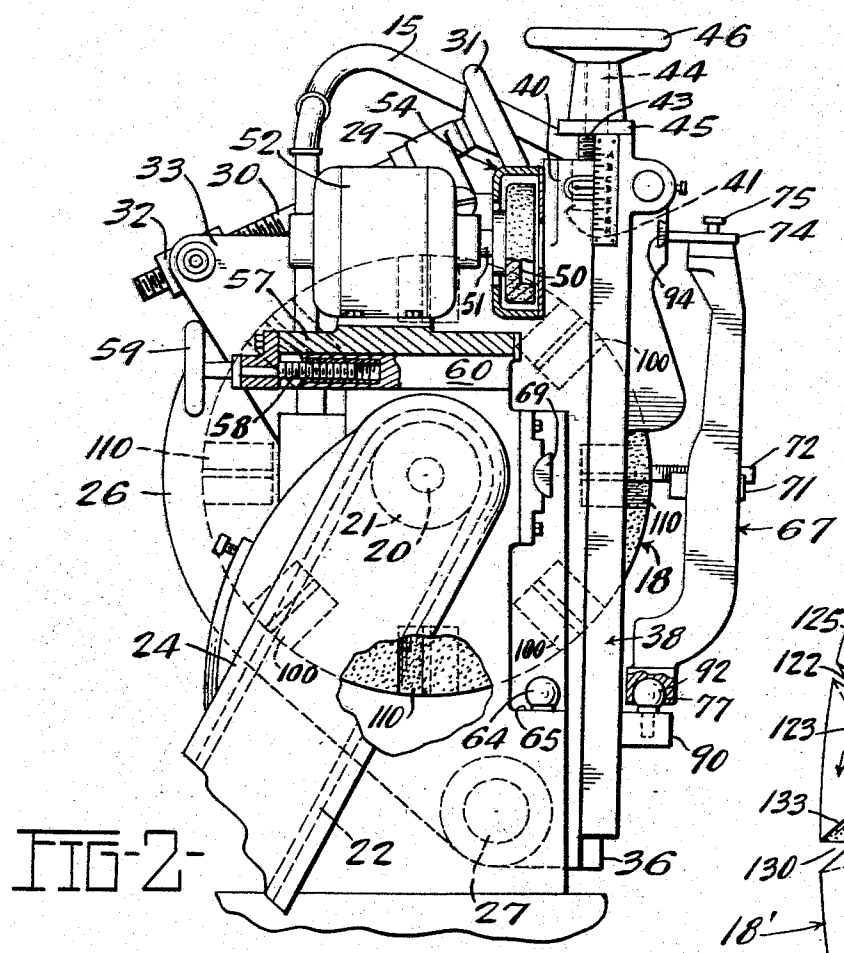


FIG-2-

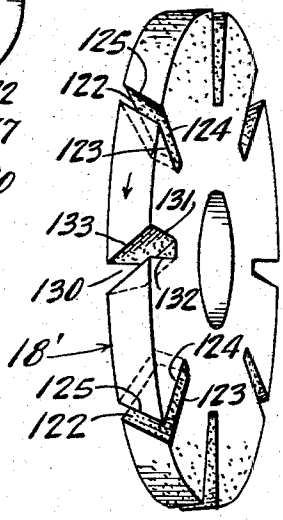


FIG-7-

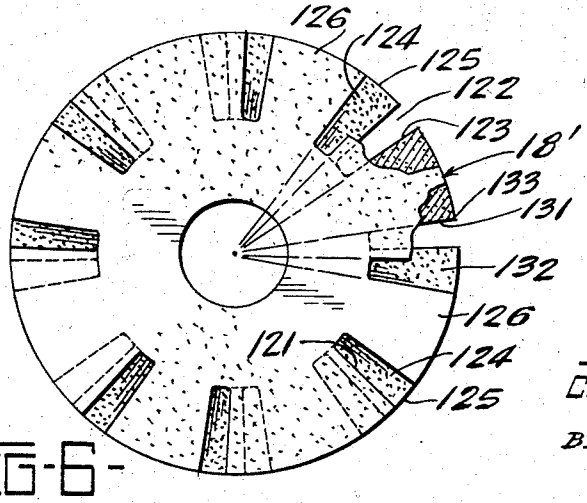


FIG-6-

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United States Patent Office 2,875,559
Patented Mar. 3, 1959

2,875,559

METHOD OF GRINDING AND GRINDING WHEEL THEREFOR

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Application October 30, 1956, Serial No. 619,292

4 Claims. (Cl. 51—206)

This invention relates to a grinding wheel and a method of forming, grinding, or sharpening metal objects or tools and more particularly to a method of configurating and sharpening form tools or form tool bits fashioned of comparatively hard materials and to a novel grinding wheel construction.

In the manufacture of cutting tools such as form tool bits of the character employed in machining operations for cutting metals and metal alloys, form tool bits have been made and utilized which are fashioned from materials which are extremely hard. One such material or alloy utilized for tools or tool bits is tungsten carbide.

Form tools or cutting tools made of tungsten carbide or similar hard materials must be ground or abraded to the proper shape or configuration for use in cutting operations, and by reason of the extreme hardness of the material, grinding methods heretofore used for shaping a tool to the proper configuration or resharpening a dull tool have not been very satisfactory or efficient.

When a tool bit formed of tungsten carbide or the like is brought into contact with a conventional grinding wheel having an uninterrupted circular grinding surface, the tool is not readily abraded or ground by the wheel and there is a tendency for the tool to be burned because of the high friction heat developed. Furthermore the cutting edge does not always become smooth and sharp but may be chipped or broken due to brittle characteristics of the hard material and the grinding wheel surface "glazed" by the contact of the hard material.

Applicant's Patent 2,607,173 granted August 19, 1952, discloses method involving the use of a grinding wheel having transversely arranged slots or interrupted zones at the periphery of the wheel to effect successive impacts of the spaced zones of the wheel against the region of the tool being shaped or sharpened whereby the tool is vibrated in directions toward and away from the wheel and the material of the tool removed by the successive impacts without burning the tool or glazing the wheel surface. The grinding wheel disclosed in applicant's patent for carrying out the patented method is provided with peripheral slots, the bounding walls of the slots being in planes parallel to the axis of rotation of the grinding wheel.

Applicant has found that in grinding form tools according to the invention forming the subject matter of applicant's patent where the upper surface of the form tool is disposed in a substantially horizontal position with respect to the grinding wheel rotating about a horizontal axis, the tool engaging edges or regions of the grinding wheel engage or contact the horizontally disposed tool surface throughout substantially the width of the tool surface in a substantial linear area.

The edge of the tool may not be sharpened to the desired degree of sharpness because of the cutting edges of the segments of the grinding wheel engaging the tool in a substantial linear area which may extend full width

of the tool depending upon the shape being formed on the tool.

The present invention embraces a method of grinding or sharpening a cutting tool of relatively hard metal or alloy in a manner whereby successive cutting regions of the wheel progressively engage the tool to be ground or sharpened in limited regions or areas so that contact between the wheel and the tool at any given instant is substantially a point contact so that successive impacts of spaced regions of the grinding wheel with the tool provides efficient grinding in a comparatively short time and a smooth cutting edge imparted to the tool.

Another object of the invention is the provision of a grinding method wherein spaced rectilinear regions of a grinding wheel disposed diagonally relative to the axis of the grinding wheel are successively engaged with a tool or other element to be ground or abraded so as to effect a progressive shearing action in abrading or cutting the tool whereby the grinding is effected at an increased rate without breaking or chipping the material of the tool at the zone of engagement of the wheel with the tool.

Another object of the invention resides in a method of grinding cutting tools or other hard metal objects wherein successive regions engaging the tool or other object are formed in alternately directed angular or diagonal positions in the grinding wheel periphery whereby successive impacts of the regions of the wheel adjacent the grinding or cutting region effect progressive shearing actions on the tool or object in alternately opposed directions whereby more uniform cutting or abrading of the tool is attained.

Another object of the invention involves a method of abrading tools formed of hard materials by engaging the tool with an instrumentality configurated to impinge upon the material in a manner imparting successive blows or impacts to the material effective in alternate opposed directions to set up vibration of the tool whereby increased efficiency of abrasion is attained.

Still another object of the invention resides in a method of engaging a body with a grinding instrumentality configurated to present body engaging regions extending in divergent directions which are arranged to engage the body in rapid successive impacts whereby the body is caused to vibrate or oscillate in longitudinal and transverse directions whereby grinding efficiency is greatly increased.

Another object of the invention resides in a method of grinding utilizing a grinding medium having an interrupted grinding area arrangement for cooperation with a cutting tool and support whereby the extent of movement of the cutting tool into engagement with the grinding medium is predetermined or restricted.

Another object of the invention is the provision of a grinding wheel configurated with spaced recesses or slots arranged in the peripheral zone of the wheel and extending in diagonal directions with successive recesses extending in alternate diagonally opposite directions.

Another object of the invention resides in a grinding wheel having a peripheral region configurated with slots disposed in askew positions with successive slots extending in divergent direction.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

Figure 1 is a front elevational view showing a form of

grinding or abrading apparatus adapted for carrying out the method of the invention.

Figure 2 is a side elevational view showing a portion of the apparatus illustrated in Figure 1.

Figure 3 is a side elevational view of a grinding or abrasive wheel embodying a form of the invention;

Figure 4 is a front elevational view of the grinding region of the wheel shown in Figure 3;

Figure 5 is an isometric view of the grinding wheel shown in Figures 3 and 4;

Figure 6 is an elevational view illustrating a modified form of grinding wheel of the invention, and

Figure 7 is an isometric view of the wheel configuration illustrative in Figure 6.

While I have illustrated an apparatus especially adapted to carry out the method of the invention utilizing novel forms of grinding or abrasive wheels for grinding or shaping form tool bits, it is to be understood that the principles of the invention may be utilized in forming, grinding or abrading other objects or articles.

Referring to the drawings in detail and particularly to Figures 1 and 2 thereof, the grinding apparatus illustrated is inclusive of a base **10** which supports an upwardly extending frame **11**. The base member supports a receptacle or trough **12** defined by a peripheral flange **14** which is adapted to receive cooling fluid that may be utilized to cool the grinding wheel and the object or tool being ground.

The base **10** encloses a fluid pump (not shown) which circulates fluid from a reservoir contained in the base through a flexible pipe **15** to a manifold **16** from which the fluid is directed onto the grinding region of a grinding or abrasive wheel **18**. The grinding wheel **18** is fixedly mounted upon a shaft **20** which is journaled in suitable bearings in the frame structure **11**. The shaft **20** is equipped with a pulley **21** driven by a belt **22** from a motor (not shown), the belt and pulley arrangement being enclosed within a casing or cover **24**.

The grinding wheel **18** is substantially enclosed within a housing or casing **26** and the member **38** is formed with a work access opening **28**, the casing **26** being mounted upon a shaft **27** and arranged for adjustment about the axis of the shaft **27**. The housing **26** of the machine is provided with a boss **29** which is bored to receive a shaft **30** which is equipped with a hand wheel **31** at one end, the opposite end region being threaded into a nut or bushing **32** which is pivotally supported upon a projection **33** formed on the frame **11**. Rotation of the hand wheel **31** and shaft **30** effects a pivotal movement or adjustment of the housing **26** about the axis of the shaft **27**.

The frontal portion of the housing **26** is formed with vertically disposed ways or tracks **36** of dove-tailed cross section which slidably support a member **38**. The upper portion of the housing **26** is formed with a boss **40** which is bored to snugly receive a bushing **41**. The bushing **41** is interiorly threaded to receive the threaded portion **43** of a shaft **44**. A plate **45** secured to the upper end of the slidable member **38** is bored to receive the unthreaded portion of the shaft **44** as shown in Figure 2.

Secured to the upper end region of the shaft **44** is a manipulating or hand wheel **46**. Rotation of the hand wheel **46** raises or lowers the slide member **38** dependent upon the direction of rotation of the hand wheel. In the operation of configurating or sharpening form tools or form tool bits of tungsten carbide or the like, a suitable tool holder **67** is equipped with a templet **74** of the configuration desired to be formed on the tool or tool bit.

The apparatus illustrated is inclusive of a templet shaping or grinding wheel **50** mounted upon a shaft **51** and driven by an electrically energized motor **52**. The grinding wheel **50** is enclosed within a suitable casing or housing **54** having an opening **55** to facilitate engagement of the templet **74** with the grinding wheel.

The motor **52** for driving the template shaping wheel is mounted upon a plate **57** adjustable in a direction axially of the motor **52** through the medium of a threaded shaft **58** equipped with a hand wheel **59**. The threaded shaft **58** is threaded into a sleeve inserted in a bore formed in a member **60** secured to the frame portion **11** of the apparatus.

A tool holder support or supporting means in the form of a semi-spherically shaped member **64** is secured to a ledge **65** formed on the frame of the machine. The member **64** is adapted to provide a universal support for a combined tool holder and templet carrying means **67**, which in Figure 2, is illustrated in tool grinding position.

Secured to the machine frame **11** is a gauge or abutment block **69** which, in forming a templet, is adapted to be engaged by a master form tool or bit of a predetermined configuration or shape which is to be imparted to the templet. The tool holder **67** is provided with a block or member **71** formed with a groove or recess of a dimension to receive and accommodate a form tool bit **72**. The block **71** and the tool bit **72** are adapted to be clamped to the tool holder **67** by suitable cam means (not shown).

The upper end of the tool holder **67** is arranged to support a templet **74** held in place by means of a clamping member or screw **75**. When the holder **67** is adapted to be utilized to shape or configurate a templet **74** to the shape of a master form tool for subsequent grinding or shaping of other tool bits or blanks, the templet forming operation is carried out in the following manner:

The master form tool is clamped to the tool holder in the supporting block **71** so as to securely lock the master form tool in the tool holder **67**. The lower end of the tool holder **67** is formed with a semi-spherically shaped recess or socket **77** which is adapted to snugly fit over the ball-shaped support **64** carried by the ledge **65**. The templet or template blank is secured to the upper end of the holder **67** by means of the clamping screw **75**. The templet is adjusted so that the shaped or configurated end of the master form tool is close to but not in engagement with the abutment block **69**, in which position the templet will engage the grinding wheel **50** so as to be shaped or ground to the proper configuration.

With the holder **67** mounted upon the ball **64**, the operator exerts pressure upon the holder **67** toward the grinding wheel **50** to bring the forward edge zone of the templet into contact with the wheel. The grinding continues until all portions of the master form tool carried by the holder contact or engage the abutment block **69**. When this condition obtains the shaping or profiling of the templet **64** is completed, the abutment block **69** cooperating with the master form tool as a limiting means for determining the extent of grinding of the templet **74**.

The apparatus is also provided with a gauging means for coordinating a form tool blank carried by the holder **67** in proper relation to the templet to limit or restrict the amount of metal to be ground or removed from the form tool blank at one grinding operation. As shown in Figure 1, the machine frame **11** is provided with another ball-shaped support **80** adapted to be received in the recess **77** formed in the end of the tool holder **67**. Positioned above the support **80** is a gauge plate **81** adapted to be engaged by a form tool blank carried by the holder **67**.

Also supported upon the machine frame **11** is an upwardly extending member **83** which has a threaded bore adapted to receive a threaded tenon formed on a rotatable gauge block **85**. The gauge block **85**, being threadedly supported in a bore in the member **83**, provides an arrangement forming a micrometer adjustment for the gauge block **85** whereby the block may be adjusted to a particular position for predetermining the amount

of metal to be removed from the form tool blank during a grinding operation.

In the use of the gauge, the gauge block is adjusted to proper position and the templet **74** is engaged with the face of the block. The form tool blank carried by the holder **67** is then adjusted in the supporting block or holder **71** with the end of the blank to be ground in contact with the positioning or gauge block **81** and the form tool blank locked in the tool holder **67**.

In this manner the form tool blank is preadjusted so that when the tool bit or blank is subsequently brought into engagement with the tool grinding wheel **18**, only a predetermined, comparatively small amount of metal will be removed from the tool or blank during one grinding cycle. This is an important feature of applicant's arrangement in the use of a slotted or mutilated grinding wheel as it is effective to prevent excessive movement of the tool bit or blank toward the grinding wheel which might result in fracturing peripheral regions of the slotted wheel.

The slidable member **38** is formed with a ledge **90** as shown in Figure 2 upon which is mounted a ball-shaped tool holder support **92** which, as shown in Figure 1, is arranged in a vertical plane passing through the central region of the grinding wheel or unit **18** and normal to the axis thereof. The upper portion of the member **38** is provided with a straight edge **94** which functions as a gauging or movement-limiting means for the tool holder in a direction toward the grinding wheel by reason of engagement of the templet **74** with the straight edge **94**.

In performing grinding operations upon a form tool blank or other metal objects **72**, after the position of the blank has been determined through the utilization of the gauge blocks or members **81** and **85** hereinbefore described, the tool holder **67** is placed upon the ball-shaped support **92** carried by member **38** and the operator exerts yielding pressure upon the tool holder in a direction toward the grinding wheel. As the form tool blank **72** engages the grinding wheel prior to engagement of the templet **74** with the straight edge **94**, grinding of the operative end of the form tool blank or object **72** will ensue until all portions of the forward edge of the templet **74** engage and contact the straight edge **94**.

It should be noted that through the use of a spherically-shaped support **92** for the holder engaging in a semi-spherically shaped recess **77** in the holder, the latter may be rotated through sufficient angles and oscillated about the center of the ball **92** so that any straight or convex form may be imparted to the blank **72** in accordance with the pattern provided by the shape of the templet **74**. The slidable member **38** is adapted to be adjusted in a vertical direction relative to the grinding wheel or unit **18** by manipulation of the hand wheel **46** to engage the form tool blank **72** at a zone above a horizontal plane through the axis of the grinding wheel in order to form a proper clearance or relief angle beneath and adjacent the cutting edge.

The present invention embraces an improved method of grinding form tool bits or other metal bodies and includes novel forms of grinding wheel or unit especially usable in grinding or configurating tools or bodies formed from tungsten carbide or other very hard metal alloys without "burning" the tool or body and without chipping of the tool engaging regions of the grinding wheel.

In my prior Patent No. 2,607,173, there is illustrated a grinding wheel configurated with radial slots bounded by walls which lie in planes parallel to the axis of rotation of the grinding wheel. In most shapes of form tool bits, the upper surface of the bit is substantially horizontal or is fashioned with a slight rake angle, the degree thereof depending upon the particular type of metal cutting operation for which the tool is to be used.

With types of tools or tool bits having substantially horizontal upper surfaces, the impact of the peripheral regions of the wheel defined by the radial slots sometimes results in chipping or flaking of the leading edges of the grinding zones which is apparently due to the impact of the transversely extending tool engaging region of a peripheral section of a grinding wheel throughout a line contact with the frontal edge or nose of the form tool.

The method of grinding disclosed herein and the novel forms of grinding wheel for carrying out the method effectively prevent or greatly minimize the tendency of the leading edges of peripheral sections or segments of the grinding wheel to become chipped as well as to greatly increase the speed of effective grinding or abrading of the tool through the provision of a progressive engagement of successive grinding wheel sections or segments with the work being ground.

The method of the invention more specifically provides for a shearing action of a grinding or leading edge of a wheel section with the tool being ground, and successive shearing actions against the tool may be effected in alternate, generally opposed directions. Such grinding action sets up a minute, though high-frequency, transverse oscillation or vibration of the region of the tool engaging the grinding wheel which augments or increases the effectiveness and efficiency of the grinding operation.

One form of grinding wheel for carrying out the method of the invention is illustrated in Figures 1 through 5. In this form the grinding wheel or unit **18** is of a generally cylindrical character having a circular periphery. The peripheral region of the wheel is formed with circumferentially spaced slots or recesses **100**, preferably equally spaced, which are angularly arranged with respect to the axis of the grinding wheel, each of the recesses **100** extending in the same general direction with relation to the axis of the grinding wheel. The recesses **100** may be defined as disposed in an askew, diagonal or oblique relation to the planes of the side walls of the grinding wheel.

In the form of wheel shown in Figures 1 through 5, the slots **100** are defined by parallel walls **102**, the width of the slots **100** being greater than the width of the form tool blank so that the end region of the tool blank may enter slightly into each recess in order to obtain the benefit of the impact of the tool engaging or impinging edges **105** formed at the intersection of a wall **102** with the adjacent peripheral region **106** of a grinding wheel section.

Formed in the periphery of the wheel is another series of slots **110**, each slot being substantially equally spaced between each pair of the slots **100**. The slots **110** extend in an angular direction generally opposite to the angular direction of the slots **100**. The slots **100** and **110** of each pair are in converging relation and are of equal angularity at each side of a plane through the zone of convergence and through the axis of the wheel.

Each of the slots **110** is defined by parallel walls **112** and, when the wheel is rotated in the direction indicated by the arrow in Figure 5, the leading edge **114** defined by a side wall **112** of a slot **110** and the adjacent peripheral surface **106'** of the grinding wheel forms an impinging region or zone on the periphery of the wheel which extends in an angular direction substantially equal and opposite to the angular direction of the impinging edge **105** of the grinding wheel.

Thus during grinding operations, the tool engaging or impinging regions **105** and **114** of alternately angular slots **100** and **110** progressively engage the form tool being ground or configurated in a transverse shearing action providing a progressive cutting or grinding impact or engagement of the edge regions **105** and **114** with the form tool being ground whereby at any single instant, the edge of the tool being ground is contacted by a cutting edge region of a grinding wheel segment in substantially a point contact.

Thus with a grinding or cutting action or engagement being intermittently effective upon the tool in generally opposite directions, a shearing action is effected in first one transverse direction followed by a shearing action in

a generally opposite direction so that the end thrust on the grinding wheel is in alternately opposite directions. This character of cutting action has the effect on the tool being ground of vibrating or oscillating the tool, or at least the end region of the tool engaging the wheel at high frequency in alternate transverse directions parallel with the axis of the grinding wheel.

This oscillating or vibrating action of the tool occurs in alternate transverse directions as well as in a direction longitudinally of the tool bit caused by the impacts and intermediate rebounds of the tool away from the wheel. Successive impacts of the cutting or impinging regions of the wheel engage the tool under the influence of the resilient or yielding pressure which the operator exerts upon the tool holder urging the holder toward the grinding wheel. The recesses **100** and **110** are of substantial depth in the wheel so that the segments between successive slots or recesses are usable until worn to the depth of the recesses. Thus the periphery of the wheel may be redressed many times before the wheel segments become worn to the bottoms of the recesses.

The grinding wheel or unit may be molded of an agglomerate of hard abrasive particles held together by a suitable cement or bonding agent. The slots in the periphery of the wheel may be of any desired angle depending upon the extent or degree of angular shearing action desired during the grinding operations. As shown in Figure 4, the slots are arranged at substantially an angle of 45° relative to a plane of a side face of the grinding wheel, but it is to be understood that other angular relationships may be established for the slots in order to secure most effective and efficient grinding operations upon particular materials to be ground.

The leading edges **114** of adjacent slots, due to the angularity of the slots, are arranged in converging relation. The widths of the slots in a plane through the wheel normal to the axis of rotation are greater than the vertical dimension of the tool as viewed in Figure 2 so that during grinding operations, the object or tool moves into each slot as the wheel is rotated to bring the slots into successive registration with the tool carried by the tool holder **67**.

The degree or extent of movement of the tool or object being ground into the recesses in the grinding wheel is determined by engagement of the template **74** with the straight edge **94**, the template having been preset as hereinbefore mentioned so as to permit the removal of a reasonable restricted amount of metal from the object or tool at any one grinding cycle.

When the amount of metal permitted by the predetermined positioning of the template **74** is removed from the tool, a resetting of the tool is required if additional metal is to be removed therefrom. To accomplish this resetting the tool holder is placed upon the ball support **80**, the template engaged with the micrometer stop **85** and the position of the tool bit **72** modified as herein fore described.

The method of grinding an object or tool with the grinding medium or wheel formed with diagonally arranged or oblique slots wherein successive slots extend in generally opposite or diverging directions, the leading edges of the slots successively engage the object or tool in a progressive shearing or slicing action so that at any given instant only substantially point contact or engagement obtains between a cutting edge of the wheel and the tool or work being ground.

Due to the relative high linear speed of the periphery of the grinding wheel, the leading edges of the wheel segments impinge upon the work with substantial impact and, due to the minimum area of contact through the progressive shearing action, friction is reduced to a minimum, avoiding "burning" of the tool and "glazing" of the wheel with a maximum efficiency in removing metal from the work or tool.

The efficiency of the cutting or grinding action is augmented or increased through the successive engagement of grinding edge zones extending in successive alternate directions. The successive entry of the work or tool into the slots sets up a compound vibration or oscillation of the work or tool operative in two directions. With particular reference to Figure 4 as an example, engagement of the leading edge **114** of the adjacent wheel segment, on impact with a tool entering the slot or recess **110** in the plane of rotation of the wheel, causes the tool to move a slight distance in a right-hand direction, as viewed in Figure 4, under the shearing action of the edge **114** engaging the tool.

At the same time, the impact of a grinding zone or edge **114** with the tool tends to push the tool away from the wheel in opposition to the yielding pressure exerted by the operator upon the tool holder **67** in a direction toward the wheel. After the wheel has rotated to bring the next succeeding slot **100**, arranged in a divergent relation to the slot **110**, into registration with the tool, the tool enters the slot **100** and is immediately impinged by the leading or cutting edge **105** exerting a shearing action in a generally opposite direction to that caused by the cutting edge **114** of the preceding slot.

The shearing action of the edge **105** is therefore in a generally opposite direction to that of the edge **114**, causing the work or tool to be moved slightly in a left-hand direction as viewed in Figure 4, and at the same time, the impact of the edge **105** with the work or tool tends to again push the work away from the wheel in a direction of the plane of rotation of the wheel.

Hence it will be seen that the engagement of successive leading edges **114** and **105** with the tool causes infinitely small movements of the tool, viz. the edge **114** moves the tool slightly in a right-hand direction and concomitantly moves the tool slightly forwardly away from the wheel, and the tool, upon registry with the next succeeding slot, is moved in a left-hand direction by reason of the shearing action of the edge **105** and concomitantly therewith the impact urges the tool out of the recess and away from the wheel in the plane of rotation of the wheel. It should be noted that these vibrations or oscillations imparted to the tool are opposed or resisted by the yielding pressure exerted by the operator upon the tool holder **67**.

The oscillations or vibrations in a plane normal to the axis of rotation of the wheel and in lateral directions greatly assist or augment the cutting or grinding efficiency by reason of the striking, impacting or impinging of the leading or cutting edges of the peripheral grinding zones with the tool whereby the speed of removing metal from the tool or other work is greatly increased over prior methods.

Figures 6 and 7 illustrate a modified form of grinding medium or wheel construction adaptable for carrying out the method of the invention. In this form of wheel construction, the alternate slots **122**, diagonally or obliquely arranged relative to a plane through the central region of the wheel and normal to the axis of rotation, are defined by radially converging walls **123** and **124** which lie in planes passing through the central axis or axis of rotation of the wheel as indicated in Figure 6. The leading or cutting edge **125** formed at the junction of the slot wall **124** and the peripheral surface of a grinding wheel segment or zone **126** engaging a tool exerts a shearing action from right to left upon the tool as viewed in Figure 7.

The next succeeding slot is diagonally or obliquely arranged in a generally opposite direction to that of the slot **122**, the pairs of slots being generally arranged in a converging direction or relation as illustrated in Figure 6. The walls **131** and **132** defining the slot **130** are disposed in radially converging relation as indicated in Figure 6 and lie in planes which at one point pass through the axis of the grinding wheel although the planes are not parallel to the axis of the wheel. The form of wheel

shown in Figures 6 and 7 is adapted to carry out the method in substantially the same manner as the wheel configuration shown in Figures 1 through 5.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

I claim:

1. A grinding medium formed with spaced grinding zones defined by recesses, and the leading edges defined by the junctures of walls of the recesses with surfaces of the grinding zones being diagonally arranged with successive leading edges extending in generally opposite directions, the leading edges of each of the recesses extending the full width of the grinding medium.

2. The method of grinding a tool which includes advancing the tool by yielding pressure against a rotating grinding wheel having grinding zones spaced apart circumferentially a distance greater than the dimension of the tool in the direction of rotation of the wheel and having successive leading edges disposed in alternate angular directions to cause the tool to engage the leading edges of the grinding zones and enter the spaces between the grinding zones in response to the yielding pressure whereby the leading edges by successive impacts with the tool vibrate the tool in directions radially of the wheel and in successive opposed directions transversely of the radial direction of vibration to remove metal from the tool by such impacts, and regulating the amount of metal removed from the tool by positively limiting the extent to which the tool is advanced in a direction radially of the wheel under the influence of the yielding pressure.

3. A grinding wheel of a diameter substantially greater than its width formed with circumferentially spaced grinding zones defined by recesses, and the leading edges defined by the junctures of walls of the recesses with surfaces of the grinding zones being diagonally arranged with successive leading edges extending full width of the wheel and in generally opposite directions, the walls defining each recess being disposed in substantially parallel planes.

4. A grinding wheel of a diameter substantially greater than its width formed with circumferentially spaced grinding zones defined by recesses, and the leading edges defined by the junctures of walls of the recesses with surfaces of the grinding zones being diagonally arranged with successive leading edges extending full width of the wheel and in generally opposite directions, the walls defining each recess lying in convergently arranged planes converging in directions toward the axis of the grinding wheel.

References Cited in the file of this patent

UNITED STATES PATENTS

278,608	Schrebler	May 29, 1883
888,129	Tone	May 19, 1908
909,913	Landis	Jan. 19, 1909
964,000	Deelen	July 12, 1910
1,029,406	Staynes	June 11, 1912
1,582,608	Hyde	Apr. 27, 1926
2,049,874	Sherk	Aug. 4, 1936
2,195,050	Wallace	Mar. 26, 1940
2,607,173	Garrison	Aug. 19, 1952

FOREIGN PATENTS

523,879	Great Britain	July 24, 1940