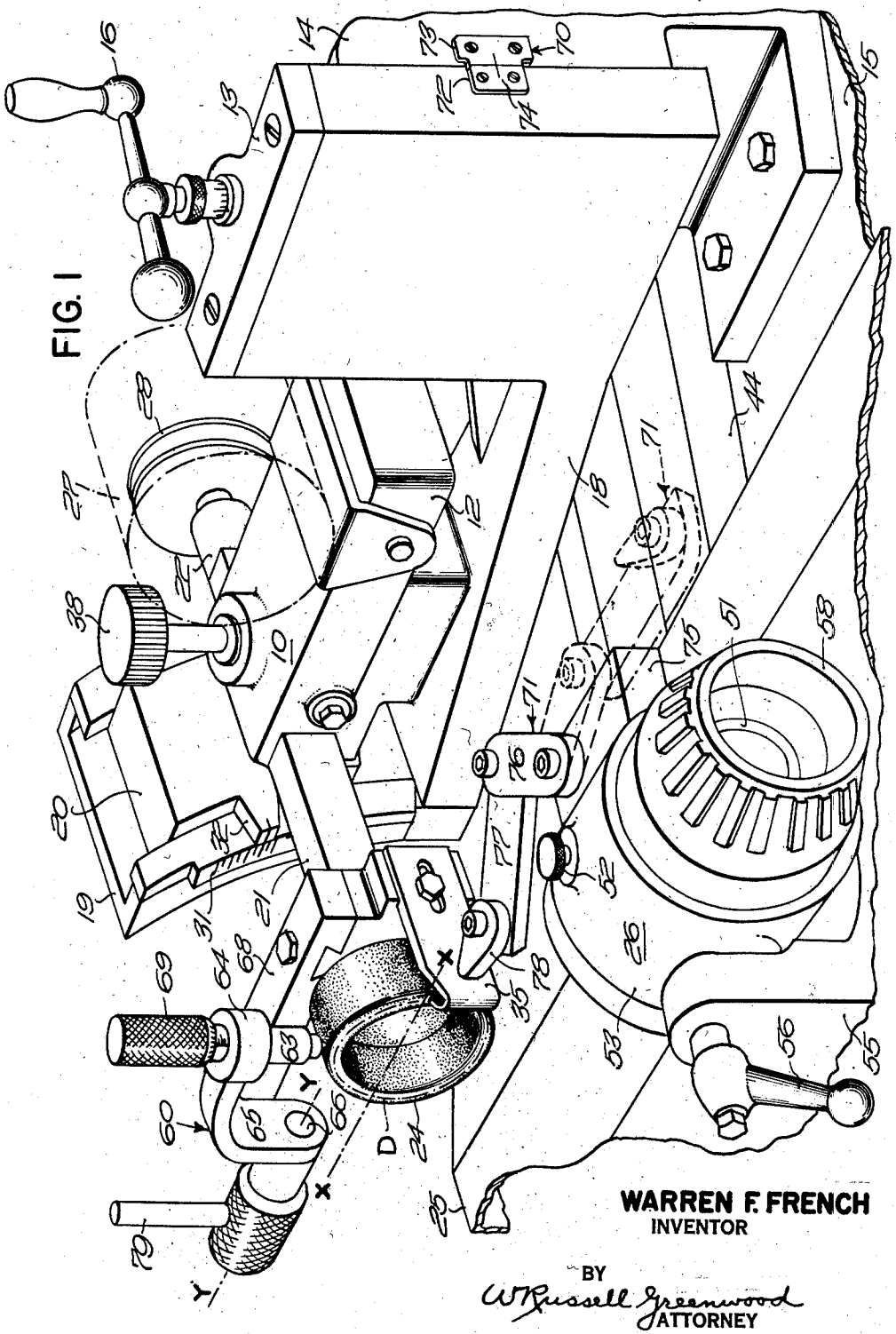
April 2, 1957 W. F. FRENCH 2,787,094

CUTTER GRINDERS

Filed Nov. 22, 1954 4 Sheets-Sheet 1

FIG. 1



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CUTTER GRINDERS

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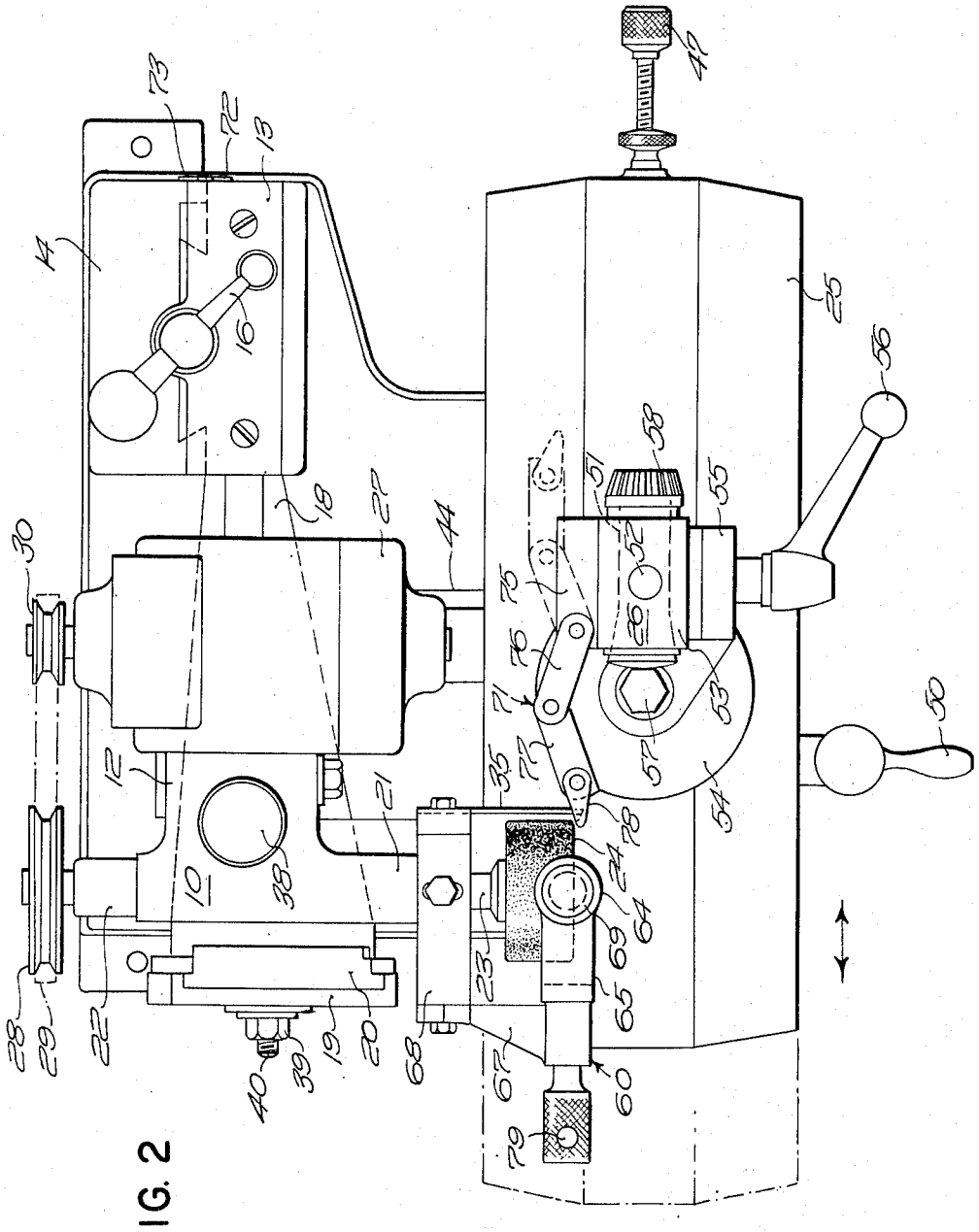


FIG. 2

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CUTTER GRINDERS

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FIG. 3

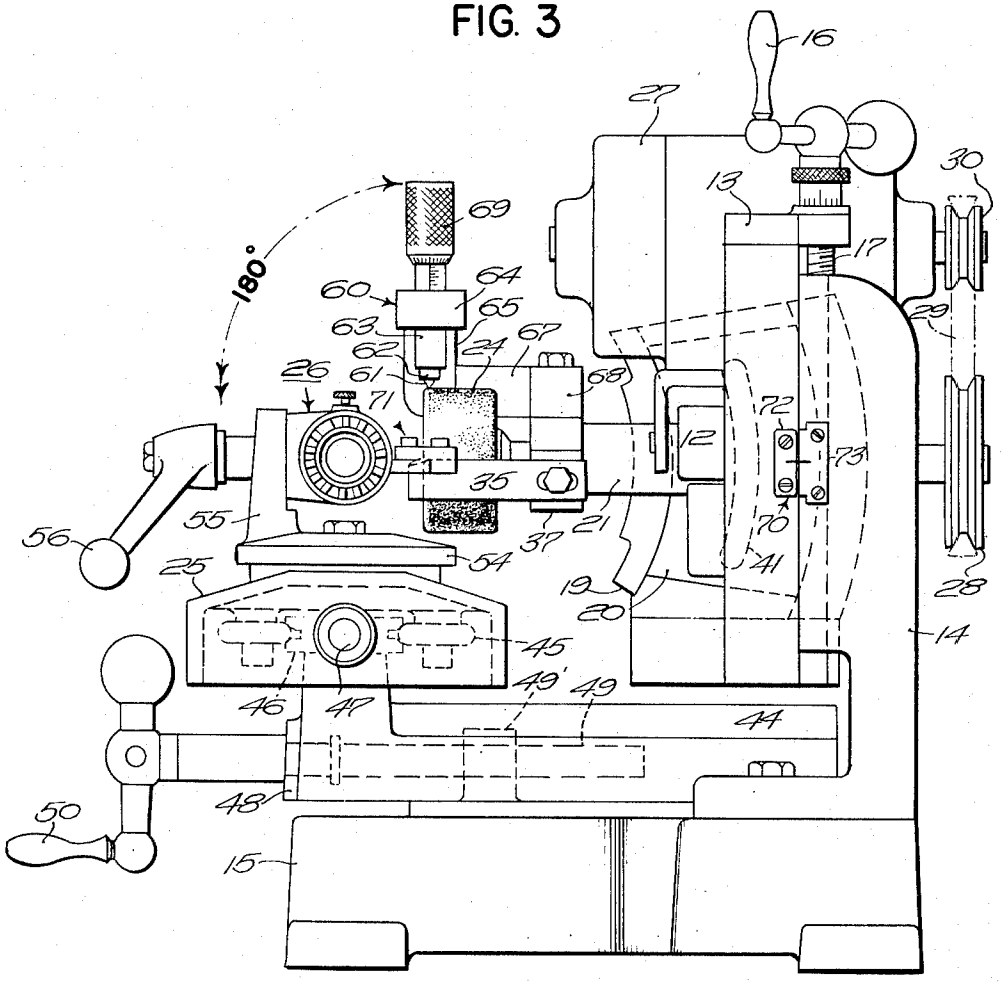


FIG. 6

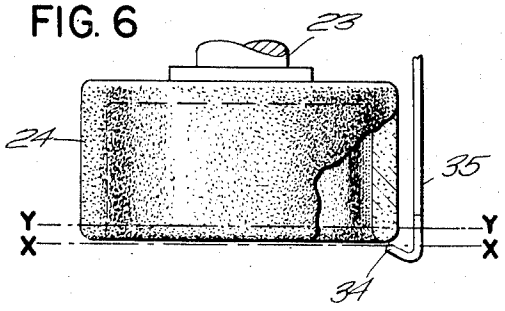
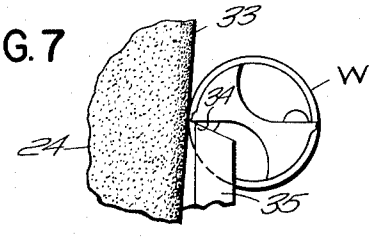


FIG. 7



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CUTTER GRINDERS

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FIG. 4

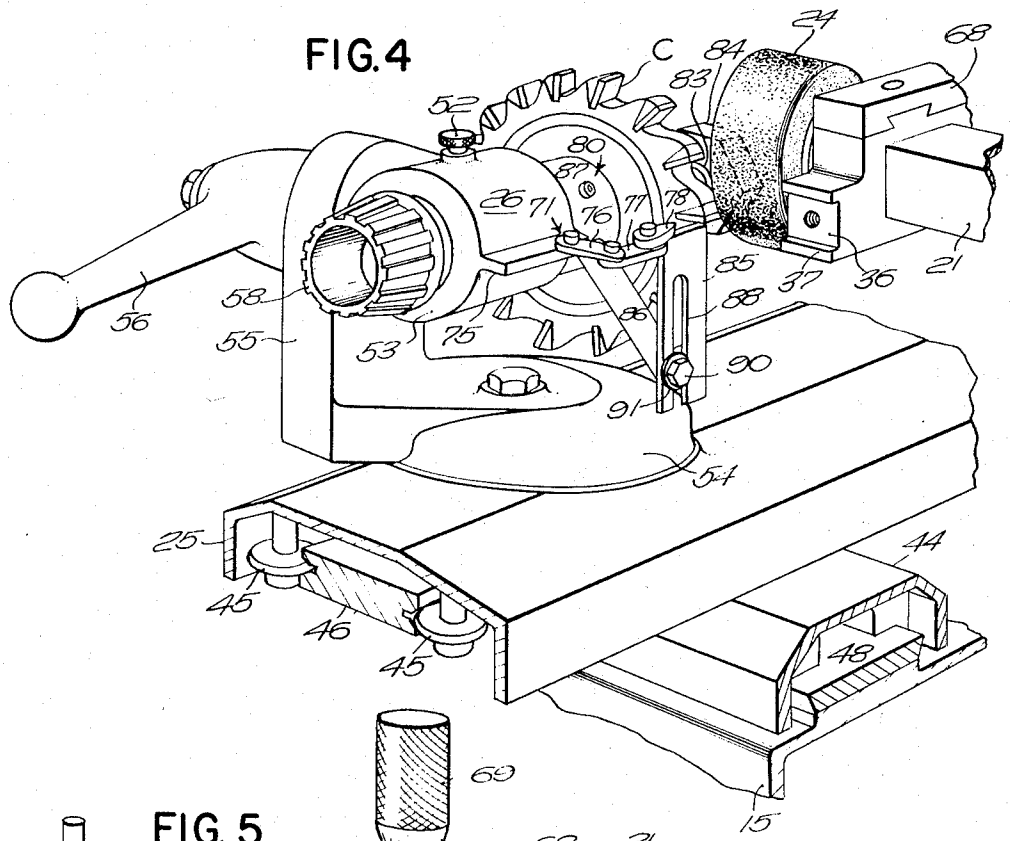
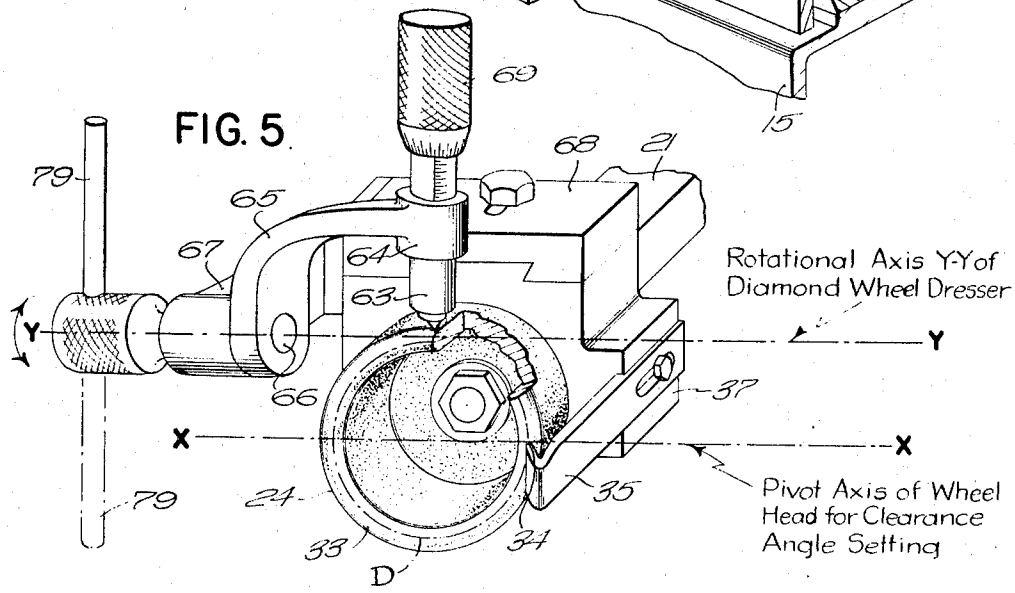


FIG. 5



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United States Patent Office 2,787,094 Patented Apr. 2, 1957

2,787,094

CUTTER GRINDERS

Warren F. French, Brockton, Mass., assignor, by mesne assignments, to William H. Field Co., Inc., Boston, Mass., a corporation of Massachusetts

Application November 22, 1954, Serial No. 470,207

10 Claims. (Cl. 51—123)

This invention relates to grinding machines, and more particularly to improvements in cutter grinders. More especially it relates to an improved cutter grinder for sharpening helical bits, cutters with helical flutes, and like cutting tools, as well as being adapted for use in sharpening the cutting edges of various cutters having straight flutes or teeth. The invention contemplates novel and effective positioning means for setting the height of the work supporting portion of a tooth rest accurately on center with the rotational axes of both the grinding wheel and a cutting tool in a work support. The invention further contemplates novel wheel dressing means whereby the annular end grinding surface of a cup-shaped grinding wheel employed to grind a cutting tool will be dressed or reshaped to vary accurate arcuate form or contour laterally of the wheel rim to provide a peripheral datum circle at the point of greatest convexity to which the work contact point of the cutter supporting tooth rest bears a substantially constant position regardless of the clearance angle being ground on the cutter.

In the particular form of the embodiment of the invention herein illustrated, the cutter grinding machine is provided with a longitudinally reciprocable and laterally adjustable work supporting means and an angularly adjustable elevatable or altitudinally positionable grinding wheel head including a cup-shaped grinding wheel having an annular end grinding surface provided with a convex periphery laterally of its rim made by dressing or shaping the same on a radius crosswise of the rim so that its convex grinding face is of substantially semi-circular contour. The grinding wheel head includes an angularly adjustable grinding wheel slide in a vertical plane and a vertically adjustable carriage on which the wheel slide is mounted. The grinding wheel slide is so arranged that its vertical angular adjustment is about a horizontal line or center lying forward of and parallel with the horizontal diameter of the operating grinding surface in a plane containing the rotational axis of the grinding wheel and also passing through the tip extremity of the work supporting contact point of a tooth rest which is fixedly mounted on the wheel head and movable bodily therewith during any altitudinal and angular adjustment of the wheel head. The wheel dressing means is mounted for 180° movement in a vertical plane passing through the rotational axis of the grinding wheel and also is fixed to the wheel head. The wheel dressing means is arranged to pivot or swing about a horizontal line or axis parallel with the aforementioned pivot axis of the wheel head and passing through the center of the radius of curvature of convex peripheral end of the grinding wheel rim.

Two forms of height setting or gauging means are provided on the machine, one being a hinged arrangement adapted for use in setting on center with the axis of the cutter to be sharpened the contact portion of tooth rests of either the fixed type fast on the wheel head or a blade mounted on a mandrel carrying the cutter to be operated on; and the other form being a pair of relatively movable plate members, one being adapted for use only with helical flute cutting tools and arranged for vertical movement with the wheel carriage and the other being stationary, and each bearing cross markings which are aligned when the wheel carriage is set at the correct height to place the contact point of the tooth rest on center with the axis of the cutting tool in the work supporting means.

The invention has for one of its objects to provide a cutter grinding machine wherein the setting of helical flute or straight fluted or toothed cutting tools is simplified and a predetermined lip clearance can be obtained which is uniform throughout the longitudinal extent of a particular cutting edge of the tool and can be duplicated upon each of the flutes or teeth thereof.

Another object of the invention is to provide a cutter grinding machine of simple and compact construction which can be used by a workman without previous experience, and without skilled labor, and by means of which helical or straight fluted bits and cutters may be rapidly and accurately ground and sharpened.

Another object of the invention is to provide a tooth rest for helical cutting tools fixedly supported on a grinding wheel head and adjustable only laterally thereof in relation to the annular end grinding surface of a grinding wheel.

A further object of the invention is to provide a tooth rest for helical cutting tools in which the contact point of the rest bears a substantially constant fixed relation with a datum circle formed on the grinding face of the grinding wheel and also is intersected by a diametrical plane containing the wheel axis and the axis of the cutting tool to be ground.

A still further object of the invention is the provision of accurate means of setting the height of the contact point of a tooth rest precisely on center with the axes of the wheel and the cutter to be ground and without being affected by changes in clearance angles.

Another object of the invention is the provision of radius wheel dressing means to generate a convex grinding surface on the wheel in which the point of greatest convexity lies on a peripheral datum circle around the grinding wheel face and to which the contact point of the tooth rest is fixedly positioned.

In the accompanying drawings:

Fig. 1 is a fragmentary perspective view, partly in section, of a cutter grinding machine according to the invention, and showing one of the height setting devices being used to set the contact point of the tooth rest employed in sharpening a helical cutter accurately on center with the cutter axis;

Fig. 2 is a top plan view of the cutter grinder shown in Fig. 1 but showing the articulated height setting device being used in a gauging position;

Fig. 3 is an end elevational view, partly in section, of the cutter grinding machine shown in Figs. 1 and 2 looking at the right end of Fig. 2;

Fig. 4 is a fragmentary perspective view, partly in section, of the cutter grinding machine shown in Fig. 2 but showing a milling cutter supported on a mandrel in grinding position and with the articulated height setting device for the tooth rest carried by the mandrel being swung into a gauging position;

Fig. 5 is a fragmentary pictorial view of the forward end portion of the grinding wheel slide showing more or less diagrammatically and in end elevation the cup-shaped grinding wheel partly in section, the tooth rest for helical cutters in operating position to the grinding wheel, and the axial disposition of the wheel dressing device to the grinding wheel;

Fig. 6 is a fragmentary top plan view of the cup-shaped grinding wheel and tooth rest as shown in Fig. 5 with the grinding wheel partly shown in section so as to illustrate the rim contour and also the operating po-

sition of the tooth rest to the convexed grinding surface; and

Fig. 7 is an enlarged fragmentary side elevational view showing the grinding operation in progress on a helical bit.

Referring to the drawings in detail, there is shown in Figs. 1, 2 and 3 a cutter grinding machine embodying the present invention in which the reference numeral 10 denotes, generally, a grinding wheel head assembly which comprises a grinding wheel slide 12 and a supporting carriage 13 therefor arranged for vertical movement along suitable dovetail slideways for altitudinal adjustment of the carriage on a bracket 14 upstanding from and fixedly mounted on a base member 15 for the machine. Vertical movement of the carriage 13 is by a manually-operated ball-crank machine handle 16 and a suitable feed screw 17. The grinding wheel slide 12 overhangs a laterally extending arm 18 of the carriage 13 and is supported for angular adjustment thereon in a vertical plane perpendicular to the plane of vertical altitudinal adjustment of the carriage by inter-engaging upright arcuately-shaped machine slide members 19 and 20 which are fixed to the outer end of the arm 18 and to the grinding wheel slide 12, respectively. The grinding wheel slide 12 is provided with overhung bearing portions 21 and 22 respectively, which extend forwardly and rearwardly of the slide and in which is journaled a spindle 23 having removably mounted on its forward end a grinding wheel 24 past which is reciprocated a horizontally reciprocable table 25 carrying a work supporting head 26. A V-belt drive is employed for driving the grinding wheel spindle 23 from an electric motor 27, the drive comprising a V-pulley 28 secured on the rear end of the spindle 23 and about which passes a V-belt 29 which is driven by a V-pulley 30 on the shaft of the electric motor 27. The arcuate slides 19 and 20 are provided respectively with a graduated scale 31 and a pointer 32 to facilitate the setting of the grinding wheel slide 12 angularly a predetermined amount for the wheel to grind the proper clearance angle on the cutter.

The grinding wheel 24 is of cylindrical cup-shaped form and, in the illustrated arrangement of the machine as shown in Figs. 1, 2 and 3 of the drawings, is formed with an annular convexedly curved end grinding surface 33 which is operatively arranged in proper relation to the work contact point 34 of a tooth rest 35 to grind the peripheral edge of the particular fluted portion of a helical bit or cutter herein designated by the letter W (see Fig. 7), as will be hereinafter described.

The tooth rest 35 for helically fluted cutting tools is attached to the wheel head 12 in an offset position alongside of the grinding wheel 24 and is adjustably mounted and clamped in a suitable channeled guideway 36 (see Fig. 4) formed in the side of an enlarged end portion 37 of the front bearing portion 21 for longitudinal adjustment only in the guideway 36 for setting of the contact point 34 of the tooth rest correctly to the end grinding surface 33 of the grinding wheel. It will be noted that the grinding wheel slide 12 is mounted for vertical angular adjustment on a horizontal line X—X lying in a plane at right angles to the rotational axis of the grinding wheel spindle 23 (see Figs. 1 and 5). For the purpose of so adjusting the grinding wheel slide 12, there is journaled in this slide a hand screw 38 having suitable pivotal connection (not shown) at its bottom end with the arm portion 18 of the carriage 13 whereby upon appropriate manual turning of the screw 38 the arcuate slide member 20 will be moved in the arcuate guideway of the slide member 19 and together with the wheel slide 12 will be angularly adjusted in any desired position in a radial line which is normal to the axis X—X about which the grinding wheel slide 12 is adjustable. The slide 12 is secured in place in its adjusted or operating position by a clamping nut 39 (see Fig. 2) cooperating with a threaded end of a stud 40 fixed in the arcuate slide member 20 and slidably passing through an arcuate slot 41 (see Fig. 3) in the arcuate slide member 19.

The table 25 is slidably mounted for longitudinal reciprocation upon a transversely adjustable slide 44 by means of free-moving, anti-friction rollers 45 engaging a V-edged plate or track member 46 which extends longitudinally beneath the table 25 and is mounted in a crosswise relation upon the slide 44, as shown in Figs. 3 and 4. The table 25 is hand-propelled by the machine operator past the annular end grinding surface 33 of the grinding wheel 24 in a direction at right angles to the axis of the grinding wheel spindle 23 during grinding of a bit or other cutting tool and returned to its initial position at the right end of the machine by means of a suitable spring (not shown) operatively connected with the table 25 and the slide 44 and adjustably tensioned by a hand screw device 47. The transverse slide 44, in turn, is operatively arranged for longitudinal sliding movement back and forth on suitable dove-tail ways of a guide member 48 by means of a suitable feed screw indicated at 49 turned in a threaded portion 49' of the guide member 48 by an operating handle 50. The work head 26 here shown is of a known construction and provided with an indexible work-supporting collet 51 which may be rendered freely rotatable by release of a pin plunger 52, and this collet is arranged in a known manner for longitudinal movement in a large hub member 53 overhanging a disc-like base member 54 of the work head. The hub member 53 is pivoted in the upper part of an upright arm 55 integral with the base member 54 of the work head and is adapted for angular adjustment on this arm in a vertical plane by means of an operating lever 56 as well as being adjustable angularly in a horizontal plane by rotary movement of the work head base member 54 about a vertical axis here shown as the central mounting stud 57 which secures the work head 26 to the top of the table 25. An enlarged hand-operated clamping nut 58 having operative connection with the usual threaded shank end of the collet 51 operates to draw it longitudinally with respect to the hub member 53 to effect tight clamping of either a bit shank or a cutter supporting arbor in the collet 51.

To properly shape the annular and convexedly curved end face 33 of the grinding wheel 24 so that it will be of the proper arcuate form with its crown opposite the contact point 34 of the tooth rest 35 and lying on a peripheral datum circle D around the end face of the wheel, it is necessary that the dressing or reshaping operation be carried out on an arcuate line lying in a vertical plane which includes the rotational axis of the grinding wheel 24 and which is generated about horizontal axis Y—Y about which the wheel dressing device revolves in forming the convexed end grinding surface 33 of the grinding wheel. In the present illustrative disclosure, the radius wheel truing or dressing means associated with the grinding wheel 24 and indicated at 60 is a micrometer device comprising a diamond 61 mounted in the end of a spindle and lead screw 62 threaded in a barrel 63 which is fixed in a hub portion 64 of a vertical swinging arm 65. The arm 65 has 180° pivotal movement by pin 66 on a bracket 67 attached to a dovetail slide 68 which caps the top of the enlargement 37 of the grinding wheel slide 12 and is arranged to be adjusted and clamped by a suitable stud in any adjusted position thereon. A beveled thimble 69 is rigidly fixed to the lead screw and spindle 62 and fits down over the barrel 63 but does not engage it. The beveled end of the thimble 69 is suitably graduated around its circumference, and one side of the barrel also is marked with suitable graduations in a longitudinal line for accurate adjustment of the position of the diamond point. The swinging arm 65 has a handle 79 for moving the point of the diamond 61 back and forth crosswise of the rim of the annular end face 33 of the grinding wheel 24 as indicated in Fig. 5 in order to true and/or dress the grinding surface

thereof and give it the desired semi-circular arcuate contour.

Means are provided for setting the height of a tooth rest on center with the axis of the work to be ground and for positioning a particular cutting edge to be ground in a horizontal plane passing through the axis of the cutting tool held by the work support **26**. In the illustrated embodiment, two distinct and separate height setting devices designated generally by the numerals **70** and **71** are provided on the machine as shown in Figs. 1 to 4 inclusive of the drawings to facilitate this positioning of the tooth rest and the lip of the cutter. The height setting device **70** is made up of two plates **72** and **73** of which the former is attached to the side of the carriage **13** and the latter fixed on the side of the bracket **14**, both being mounted close to the vertical parting line between the carriage and the bracket. Each plate is marked cross-wise with a centering line as indicated at **74** which lines are brought into horizontal alignment one with the other as depicted in Fig. 1 and indicate that the altitudinal adjustment of the grinding head **10** is correctly positioned to place the contact point **34** of the tooth rest **35** and the cutting edge of the cutter lip correctly on center with the axis of the cutter being sharpened. The second height setting device **71** herein illustrated is an articulated gauge arrangement which is pivotally mounted on the top surface of a flat plate-like projection **75** extending laterally outwardly from the side of the work support **26**, as shown in Figs. 1, 2, 3 and 4. The gauging device **71** comprises three pivotally connected horizontally disposed arm members **76**, **77** and **78** of which the arm **76** is pivotally mounted at its inner end on the top surface of the projection **75**, the arm **77** has swinging movement under the outer end portion of the arm **76**, and the arm **78** constitutes the feeler finger of the gauge and is positioned on top of the arm **77** at its outer end. The horizontally disposed gauging surfaces of the device, viz., the top surface of the projection **75**, the bottom surface of the arm **76**, the top surface of the arm **77**, and the bottom surface of the feeler arm **78** all are precision-ground or lapped absolutely flat surfaces throughout their entire extent. It should be noted that the flat top surface of the projection **75** exactly lies in a horizontal plane passing through the longitudinal axis of the work-supporting collet **51** and, consequently, the rotational axis of the cutter to be ground when held in the work support **26**. The arms **76**, **77** and **78** of the gauging device **71** are adjustable with respect to each other and the entire device **71** may be swung aside into an inactive position when not in use, as depicted in broken outline in Figs. 1 and 2.

In sharpening helical bits or helical flute cutters with the apparatus above-described, the grinding wheel slide **12** may be set first to the proper clearance angle, such as for example, ten degrees from vertical according to the scale **31** and pointer **32**. Then, the grinding wheel **24** is dressed by means of the radius wheel dressing device **60** to provide a convex grinding surface **33** on the annular end face of the grinding wheel. Prior to this dressing operation or at the completion thereof the proper size and hand of tooth rest **35** is mounted in position in the channel-shaped groove **36** of the portion **37** of the grinding wheel slide **12** and the work contact point **34** of the tooth rest adjusted to place it close to the convex end grinding face **33** of the wheel but without touching the wheel surface, i. e., approximately .010 of an inch, and also in juxtaposition with the datum circle D of the wheel. Then the height gauge **71** is swung around as indicated in Figs. 1 and 2 so that the flat bottom gauging surface of the feeler arm **78** of the height gauge **71** extends over and touches the tip of the contact point **34** of the tooth rest, the elevation of the grinding wheel **24** and the wheel head **10** being adjusted by appropriately raising or lowering movements of the carriage **13** on the bracket **14** by means of the ball-crank handle **16** and feed screw **17**. When thus set, the height gauge is swung aside out of the way as depicted in Figs. 1 and 2. If, however, it is desired to use the height setting means **70** in lieu of the articulated arm device **71**, then the contact point **34** of the tooth rest **35** is set on center in a horizontal plane with the axis of the cutting tool by adjusting the altitudinal position of the wheel head **10** by the ball-crank handle **16** and feed screw **17** until both cross centering lines **74** on the side plates **72** and **73** are longitudinally aligned thereby indicating that the tip of the contact point **34** of the tooth rest **35** is set on center in a horizontal plane passing through the axis of the cutter or bit. Regardless of which gauging or setting means is employed, the tip of the contact point **34** of the tooth rest **35** will lie in a plane containing the grinding wheel axis and the line X—X about which the grinding wheel slide **12** is angularly adjusted.

During the grinding operation on cutting tools, such as helical bits and cutters having helical flutes, it is merely necessary to insert the shank of the cutting tool to be sharpened in the work-supporting collet **51**, after which the traverse slide **44** together with the table **25** and the work head **26** is fed inwardly by appropriate movement of the operating handle **50** until the lip of a particular flute of the cutting tool engages over and is supported by the contact point **34** of the tooth rest **35**. The cutting tool then is moved longitudinally past the grinding wheel **24** while in engagement with its rounded end grinding face by manual reciprocation of the sliding table **25** while holding the tool revolved and pressed against the contact point **34** of the tooth rest by means of the collet clamping nut **58**. In this way, as the cutting tool is moved lengthwise the helical lead of its cutting edge or lip will turn the cutting tool about its own axis in the work support **26**, since it is now freely turnable therein due to previous releasing movement of the pin plunger **52**, and thereby will bring successive portions of the helical flute being operated by the grinding wheel into the proper grinding plane while thus supported by the tooth rest and until the cutting tool stops turning when the end of the particular helical flute is reached. This procedure may be repeated several times for each flute and until all the lips of all of the cutting tool have been ground and sharpened. The helical bits or cutting tools to be ground can be any length, four inches being usually the maximum limit for router bits. The size, angle and hand of helix of the contact point **34** of the tooth rest **35** will, of course, depend upon the hand and angularity of the twist or lead of the helical cutting edge of the particular cutting tool to be ground and, in practice, many possible combinations of helix and hand of cut are possible so that a number of appropriate hands of tooth rests are used to meet the various requirements of helical flute bits and cutters operated upon by the grinding machine.

In the event that a straight fluted cutting tool, such as a milling cutter C is to be sharpened, reference is made to Fig. 4 of the drawings in which a milling cutter C having the cutting edges of its straight teeth to be ground by the cup wheel **24** is mounted for free rotation upon a suitable shaft portion (not shown) of a mandrel herein designated generally by the reference numeral **80** which is supported in the horizontally extending overhanging fashion hereshown by a shank portion (not shown) held fixed in the collet **51** of the work support **26**. A spring **83** acting between the rear side of the cutter C and a clamping nut **84** exerts a restraining force against the cutter C to prevent it from turning too freely on the mandrel during indexing of the cutter teeth as well as serving to keep the cutter C square with the cylindrical face of its supporting shaft portion of the mandrel **80**. A flexible tooth rest **85** consisting of a blade member made of flat sheet spring stock is adjustably mounted in a laterally extending position on the outer end of a bar member **86**, which in turn is slidably mounted in and adjustable

radially of a hub portion 87 of the mandrel 80. The tooth rest blade 85 is longitudinally slotted as indicated at 88 to permit its height to be set relative to a particular tooth of the cutter C on the mandrel after which the tooth rest is clamped in place in its set position by means of a stud 90 and washer 91. The specific construction of this cutter grinding mandrel 80 with tooth rest 85 forms no part of the present invention since its structure forms the subject matter disclosed and claimed in my copending application, Serial No. 445,003 which was filed July 22, 1954 and has since led to Patent No. 2,725,690, granted December 6, 1955.

From the above description it will be apparent that I have provided a novel cutter grinder adapted to grind helical flute bits and like cutting tools as well as milling cutters having straight peripheral teeth in a simple and accurate manner, the grinder being of compact form adapted to be mounted upon a bench and to be operated by a comparatively unskilled workman or one without previous experience in cutter grinding. It will also be apparent that by reason of the novel mounting arrangement of the grinding wheel head 10 the whole grinding wheel slide 12 including the grinding wheel 24 itself is angularly adjustable to grind desired clearance angles on the cutting tool and the angular movement of the grinding wheel slide is about a line or axis passing substantially through the contact point of a tooth rest which remains in fixed height relation and on center with the work axis when once set in this position by use of either of the height setting devices 70 or 71 which constitute one feature of my invention. Thus by my improved mounting arrangement of the wheel head I have obviated the prior general procedure of separately making adjustments to bring the center of the wheel and the work as well as the contact portion of the tooth rest all into the same plane and then raising or lowering the wheel head (or the table) the proper distance to give the desired clearance angle since with my machine the tooth rest contact point position is fixed by its mounting on the wheel slide 12 and maintained in a predetermined relation to the grinding surface 33 of the grinding wheel 34 where it remains unaffected by clearance angle adjustments by reason of the angular positioning of the grinding wheel slide 12.

While I have described a preferred form of my invention, it is to be understood that various modifications and changes in form and details of construction may be made therein within the range of engineering skill without departing from the spirit and scope of the invention as defined in the appended claims, and it is therefore my intention not to limit my invention in any manner whatsoever except by the terms and scope of the appended claims.

What is claimed is:

1. In a machine for grinding helical cutting tools the combination of a grinding wheel head adjustable for altitudinal movement in a vertical plane and also angularly in a lateral direction in a vertical plane perpendicular to said vertical plane of altitudinal adjustment of the wheel head, a grinding wheel spindle rotatable on said wheel head, a grinding wheel carried by said spindle, a work support for supporting a cutting tool to be sharpened and provided with a gauging surface fixedly positioned in a horizontal plane containing the axis of said work support, said work support being movable longitudinally past the grinding surface of said wheel and also adjustable laterally toward and from said grinding surface, a tooth rest mounted on said wheel head and having a tooth contact point set close to but clear of the grinding surface of said wheel, the tooth contacting tip of said tooth rest point coinciding with a horizontal line normal to the wheel axis and lying in a diametrical plane containing the axes of said spindle and the grinding wheel, and also including the axis of said work support, and height setting means for the tooth rest movably arranged on said gauging surface and including a feeler element to be brought from an inactive position into a position coincident with said diametrical plane to establish an accurate placement of the tip of the contact point of said tooth rest exactly on center with the axis of a cutting tool in said work support as the vertical altitudinal adjustment of the wheel head is made in the appropriate direction, said tooth rest having bodily movement with said wheel head during adjusting movements thereof both altitudinally and angularly in their respective vertical planes during which the tip of the work contact point of the tooth rest maintains a constant position in relation to the grinding surface of the wheel unaffected by predetermined changes in clearance angles.

2. In a machine for grinding helical cutting tools the combination of a grinding wheel head adjustable for altitudinal movement in a vertical plane and also angularly in a lateral direction in a vertical plane perpendicular to said vertical plane of altitudinal adjustment of the wheel head, a grinding wheel journaled in said wheel head, a cup-shaped grinding wheel carried by said spindle, a rotatable work support for holding a cutting tool to be sharpened and provided with a flat gauging surface fixedly positioned in a horizontal plane containing the axis of said work support, said work support being movable longitudinally past the end grinding surface of said cup wheel and also adjustable laterally toward and from said grinding surface, a tooth rest mounted on said wheel head and having a tooth contact point set close to but clear of said grinding surface of the wheel, the tooth-contacting tip of said tooth rest point coinciding with a horizontal line normal to the wheel axis and lying in a diametrical plane containing the axes of said spindle and the grinding wheel, and also including the axis of said wheel support, and height setting means for the tooth rest movably arranged on said gauging surface and including a feeler element to be brought from an inactive position into a position coincident with said diametrical plane to establish an accurate placement of the tip of the contact point of said tooth rest exactly on center with the axis of a cutting tool in said work support as the vertical altitudinal adjustment of the wheel head is made in the appropriate direction.

3. The combination claimed in claim 2 in which the height setting means consists of a series of articulated elongated arm members, one of the end arms being pivotally mounted on the cutter holding work support and supported by said flat gauging surface thereof placed exactly on center with the work support axis and the distal end arm having a flat undersurface accurately aligned with the first-named surface to serve as a gauging surface for the setting of the tooth-contacting tip portion of said tooth rest on exactly center with the axis of a cutter to be ground.

4. The combination claimed in claim 2 in which the cup wheel has a convex grinding surface transversely of its rim and with the crown of said surface opposite the tooth contact point of the tooth rest and lying on a peripheral datum circle around the end face of the wheel, and a radius wheel dressing device is provided in which the dressing tool moves in an arcuate path lying in a vertical plane which includes the rotational axis of the grinding wheel and which is generated about a horizontal axis about which the wheel dressing device is arranged to revolve so as to form said convex grinding surface on the wheel with said crown portion thereof correlated to said tooth contact point of the rest.

5. In a cutter grinding machine, the combination of a grinding wheel having an annular grinding face, elevatable support means for said grinding wheel including a spindle on one end of which said grinding wheel is secured, means for rotating said grinding wheel spindle, a work support reciprocable past said annular grinding face of said wheel and adjustable laterally toward and away from such wheel face, and height gauge means pivotally mounted on a lateral extending portion of said

work support and which forms a perfectly flat gauging surface thereon fixedly positioned in a horizontal plane containing the axis of said work support, said gauge means further having a feeler member the underside of which is perfectly flat and disposed in a horizontal plane that exactly coincides with said horizontal plane containing the rotational axis of the cutter to be sharpened, said height gauge means also being articulated and arranged to be swung from an inoperative position into an operating position to place the feeler portion of such gauge opposite the end grinding face of said wheel to engage the tooth contact point of a tooth rest and thereby position it accurately on center with the rotational axis of a cutter when the grinding wheel support means is manually adjusted vertically to effect such engagement of the contact point of such tooth rest with the underface of the feeler member.

6. In a grinding machine, the combination of a cup-shaped grinding wheel, vertically elevatable and vertically angularly adjustable support means for said grinding wheel including a spindle on one end of which said grinding wheel is removably secured, means for rotating said grinding wheel spindle, a tooth rest mounted on said grinding wheel support means and having a tooth contacting portion placed in predetermined fixed relation to the annular end grinding face of the annular end grinding wheel, a work support reciprocable past the grinding face of said wheel and adjustable laterally toward and away from such wheel face, and height gauge means pivotally mounted on a lateral extending portion of said work support and which forms a perfectly flat gauging surface thereon fixedly positioned in a horizontal plane containing the axis of said work support, said gauge means further having a feeler member the underside of which is perfectly flat and disposed in a horizontal plane that exactly coincides with said horizontal plane containing the rotational axis of the cutter to be sharpened, said height gauge means also being articulated and arranged to be swung from an inoperative position into an operating position to place the feeler portion of such gauge opposite the end grinding face of said wheel to engage the tooth contact point of the tooth rest and thereby position it accurately on center with the rotational axis of a cutter when the grinding wheel support means is manually adjusted to effect such engagement of the contact point of the tooth rest with the underface of said feeler member.

7. In a grinding machine, the combination as set forth in claim 5 in which the end cutting face of the grinding wheel is convexedly curved in a semi-circular arc to form a convex grinding surface whose crown faces opposite the tooth contact point of the rest and lies on a peripheral datum circle around said end wheel face and a radial wheel dressing device is provided in which the dressing tool moves in an arcuate path lying in a vertical plane which includes the rotational axis of the grinding wheel and which is generated about a horizontal axis about which the wheel dressing device is arranged to revolve so as to form said convex grinding surface on the wheel with said crown portion thereof correlated to said tooth contact point of the rest.

8. In a cutter grinding machine of the character described, a base having an upstanding support member; a carriage mounted upon said support member for vertical sliding movement into desired altitudinally adjusted positions, said carriage having a laterally extending arm; an arcuate member affixed to said carriage arm and disposed laterally thereof in a vertical plane, said arcuate member having a longitudinal arcuate guideway; a movable wheel slide including an arcuate support member engaging in and guided by said arcuate guideway when moved longitudinally therein to adjust said wheel slide angularly in a vertical plane or to position it horizontally; a cup-shaped grinding wheel rotatable on said wheel slide and disposed in overhung relationship thereto; a tooth rest mounted in an offset position on said wheel slide and adjustable thereon for placement of a cutter tooth contact portion of said rest in a predetermined fixed position to the annular end grinding surface of said wheel; a table mounted on said base below said grinding wheel and arranged for movement longitudinally past said end grinding surface of the wheel and also adjustable laterally toward and from such wheel surface, said table including work support means provided with a laterally extending portion having a perfectly flat horizontal gauging surface fixedly positioned in a horizontal plane passing through the longitudinal axis of said work support means; and height gauge means composed of a plurality of pivotally articulated members including an end feeler element having a perfectly flat undersurface portion, said height gauge means being pivotally mounted by the articulated member distal from said feeler element against the flat horizontal gauging surface portion of the laterally extending portion of said work support means, said height gauge means being arranged to be swung from an inoperative position into an operating position to place the feeler element of such gauge opposite the end grinding surface of said wheel and above the contact point of said tooth rest for engaging such contact point and position it exactly on center with the axis of said support means when the grinding wheel slide is manually adjusted in elevation to bring about engagement of the contact point of said tooth rest with the undersurface of said feeler element of the height gauge.

9. The combination as claimed in claim 8 in which the cup-shaped grinding wheel has an annular end grinding surface which is convexedly curved in a radial direction of the grinding wheel and presents a convex grinding surface whose crown faces opposite the tooth contact point of the rest and lies on a peripheral datum circle around said end wheel face, and a radius wheel dressing device is provided in which the dressing tool moves in an arcuate path lying in a vertical plane which includes the rotational axis of the grinding wheel and which is generated about a horizontal axis about which the wheel dressing device is arranged to revolve so as to form said convex grinding surface on the wheel with said crown portion thereof correlated to said tooth contact point of the rest.

10. In a cutter grinding machine of the character described, a base having an upstanding support member; a carriage mounted upon said support member for vertical sliding movement into desired altitudinally adjusted positions, said carriage having a laterally extending arm; an arcuate member affixed to said carriage arm and disposed laterally thereof in a vertical plane, said arcuate member having a longitudinal guideway; a movable wheel slide including an arcuate support member engaging in and guided by said arcuate guideway when moved longitudinally therein to adjust said wheel slide angularly in a vertical plane, or to position it horizontally; a cup-shaped grinding wheel rotatable on said wheel slide and having an annular end grinding surface convexedly curved in a radial direction; means operatively arranged for adjusting and securing said wheel slide in a desired adjusted position to support said grinding wheel in a predetermined operating position; a table including work support means mounted on said base below said grinding wheel and arranged for movement longitudinally past said end grinding surface of the wheel and also adjustable laterally toward and from said wheel surface, said work support means having a flat gauging surface fixedly positioned in a horizontal plane containing the axis of said work support means; and height setting means for a tooth rest movably arranged on said gauging surface and including a feeler element arranged to be brought from an inactive position into a position aligned with said gauging surface to engage and to establish an accurate

placement of the tooth contact portion of such tooth rest exactly on center with the axis of a cutter supported by said work support means and as the vertical altitudinal adjustment of said carriage is made in the appropriate direction.

References Cited in the file of this patent

UNITED STATES PATENTS

727,981	Lomasney	May 12, 1903
1,193,295	Perkins	Aug. 1, 1916
1,917,504	Curtis	July 11, 1933
1,918,951	Anderson	July 18, 1933
2,381,150	Wildhaber	Aug. 7, 1945

FOREIGN PATENTS

359,612	Great Britain	Oct. 29, 1931
704,028	Great Britain	Feb. 17, 1954