July 19, 1949. C. PETERS 2,476,322

INVOLUTE FORM DRESSER

Filed April 24, 1946 4 Sheets-Sheet 1

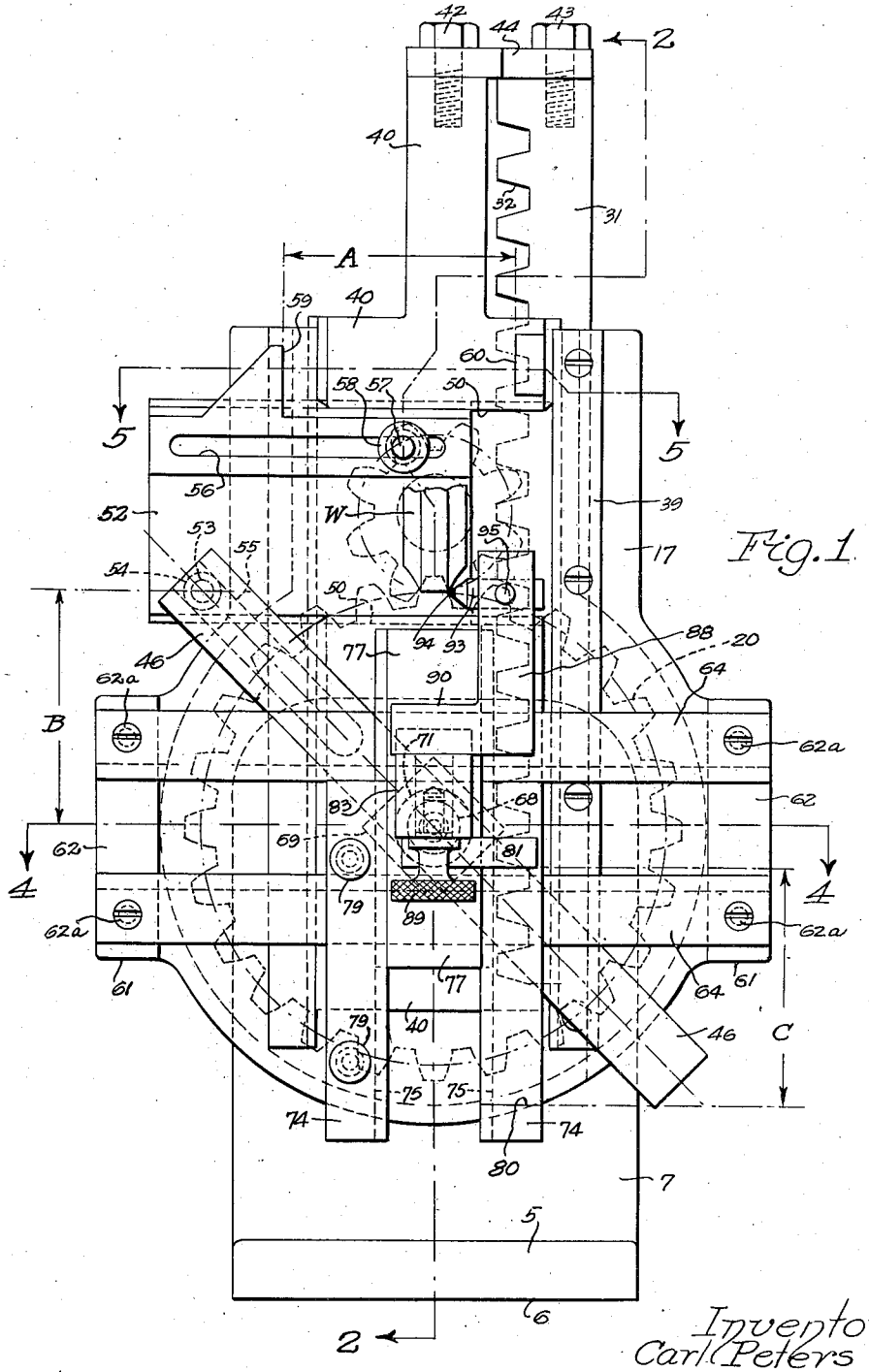


Fig. 1

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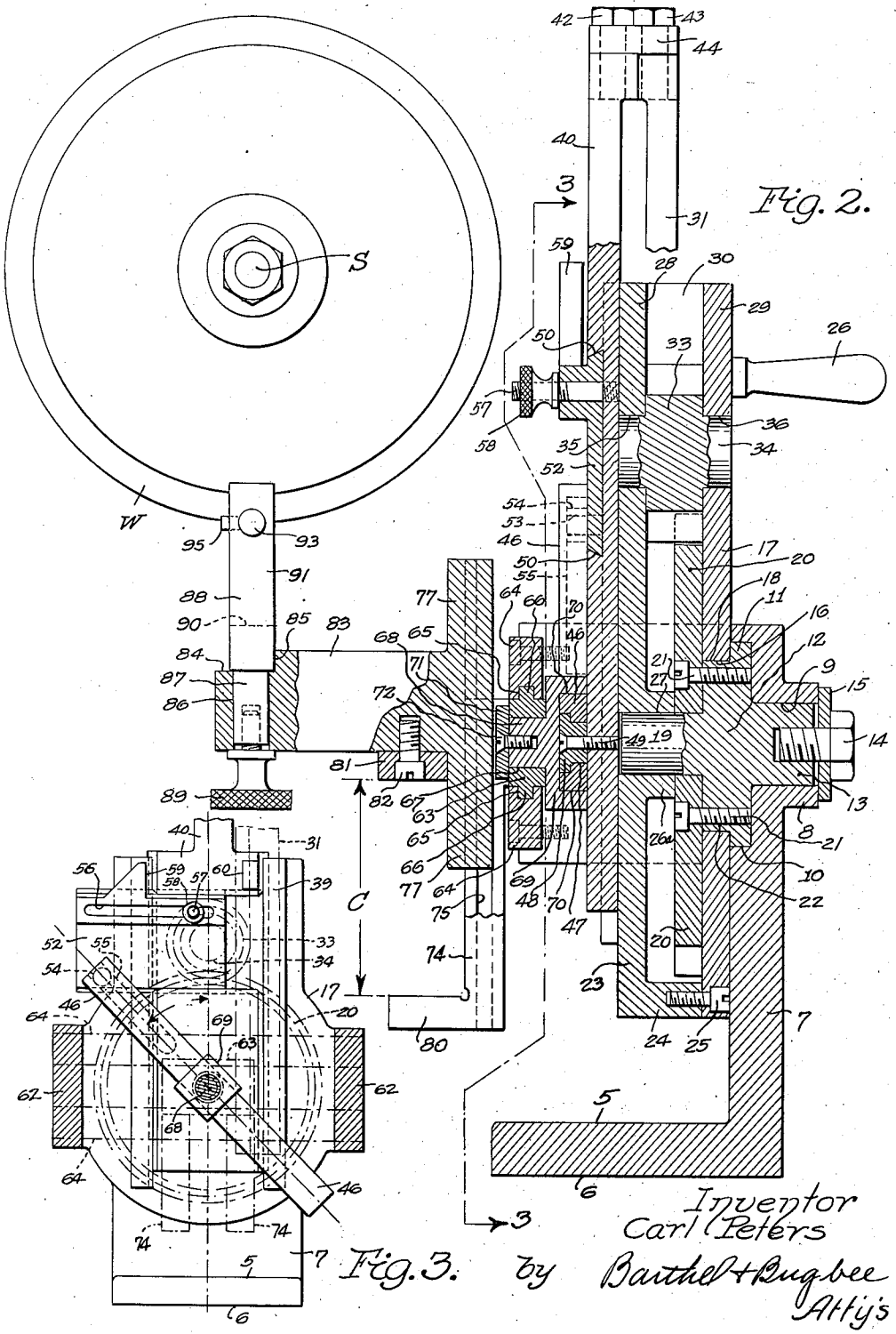


Fig. 2.

Fig. 3.

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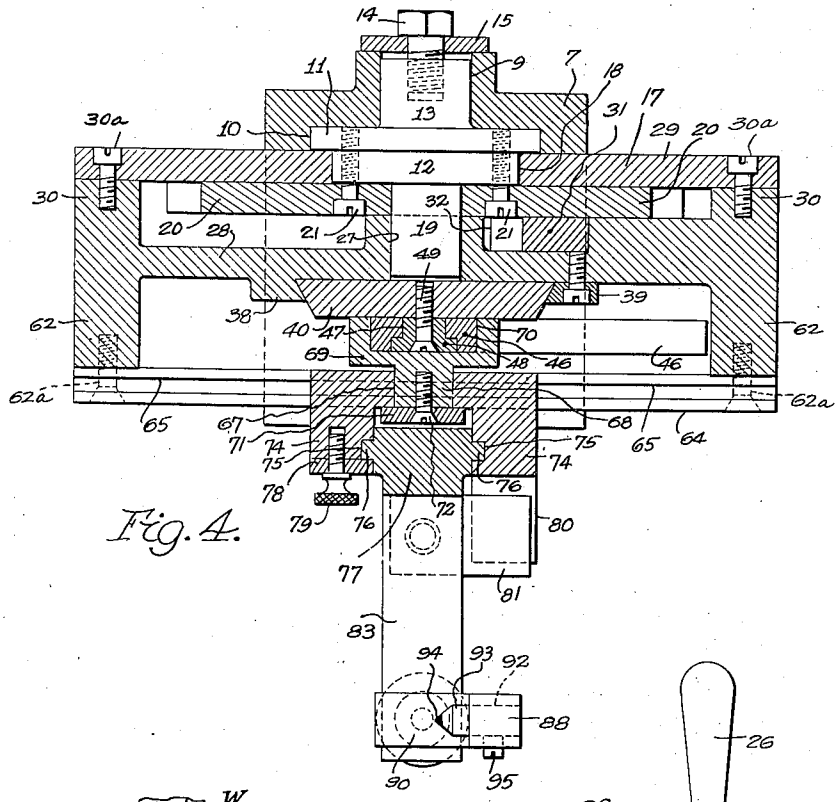


Fig. 4.

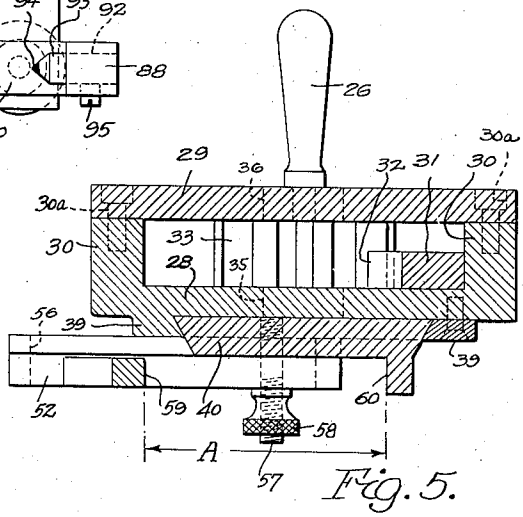


Fig. 5.

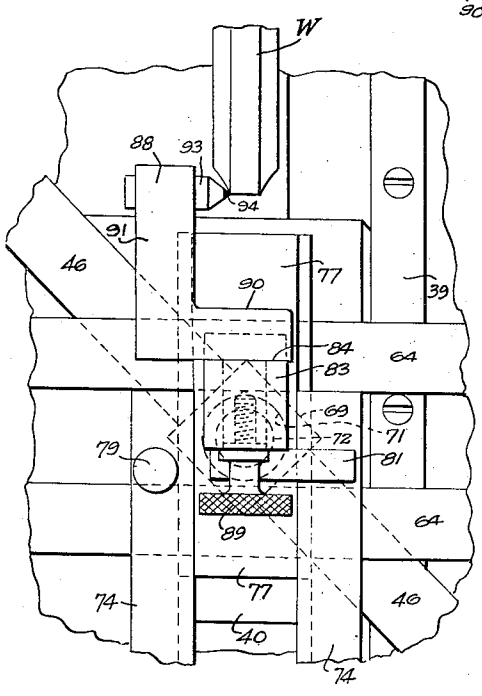


Fig. 7.

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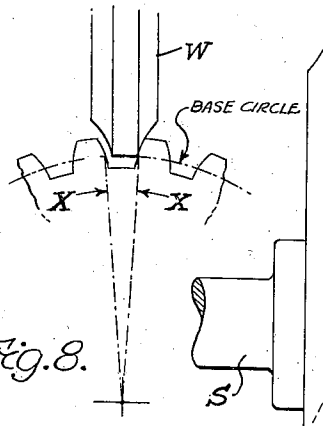


Fig. 8.

Fig. 6.

BASE CIRCLE

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UNITED STATES PATENT OFFICE

2,476,322

INVOLUTE FORM DRESSER

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Application April 24, 1946, Serial No. 664,629

12 Claims. (Cl. 125—11)

1

This invention relates to grinding wheel dressing tools, and in particular, to a dressing tool for forming an involute contour on the edge of a grinding wheel.

One object of the invention is to provide a grinding wheel dressing tool which is so constructed and arranged as to impart a true involute form to the grinding wheel of a gear grinding machine.

Another object is to provide a grinding wheel dressing tool in which the involute curve or path of the cutting member is generated indirectly through a pinion and rack so that the periphery will be developed from the pitch line of said rack.

Another object is to provide a grinding wheel dressing and surface cutting tool in which the acceleration of the cutting member or diamond point is accomplished through the use of tangent trigonometric functions, thus eliminating the considerable computations otherwise required in correctly setting the dressing tool to cut a particular involute curve.

Another object is to provide a grinding wheel dressing tool in which the slide frame is arranged for vertical to and fro translatory movement, thereby providing a dressing tool which is compact and consumes only a small amount of space.

Another object is to provide a grinding wheel dressing tool which is so constructed as to enable the same to be set by simple computations involving only division and multiplication, in an easy manner to cause the dressing tool, such as a diamond point cutter, to move along a path, all points of which are on a true involute curve.

Another object is to provide a grinding wheel dressing tool which will develop an involute form between the peripheral and radial walls of a grinding wheel in substantially the same manner as the involute gear tooth profile is generated, thus producing as nearly as possible the correct form on the grinding wheel for a prescribed tooth profile.

Other objects and advantages of the invention will become apparent during the course of the following description of the accompanying drawings, wherein:

Figure 1 is a front elevation of the grinding wheel dressing tool, with the various parts in neutral position and the accelerating member set at an angle of 45°;

Figure 2 is a vertical section through the dressing tool, taken on the irregular line 2—2 of Figure 1;

Figure 3 is a vertical section taken on the line 3—3 in Figure 2 and showing how the accelerating member is angled and held in a predetermined adjusted position;

Figure 4 is a horizontal cross-section taken on the line 4—4 in Figure 1;

Figure 5 is a horizontal cross-section taken on the line 5—5 in Figure 1;

Figure 6 is a front elevation similar to Figure 1 but showing the position attained by the dressing tool when the rotatable frame is turned through a partial revolution;

Figure 7 is an enlarged fragmentary view showing the position of the diamond cutting member reversed to dress the opposite edge of a grinding wheel; and

Figure 8 is a diagrammatic view showing the angle $x—x$ of tooth space formed between the involute profiles of a gear at the base circle.

Referring to the drawings in detail, Figures 1 and 2 show a preferred embodiment of the grinding wheel dressing tool as comprising a base 5 having a perfectly flat bottom wall 6 which is adapted to be mounted on the bed of a gear grinding machine. The gear grinding machine is of any conventional type having a shaft S carrying a grinding wheel W.

Extending upwardly from the base 5 and formed integral therewith is an upright 7 having a bearing boss 8 at its upper end provided with a bore 9 surrounded by an annular recess 10. Seated in the annular recess 10 is the flange 11 of a pintle 12, one end 13 of which is mounted in the bore 9 and is held therein by means of a retaining bolt 14 and washer 15. Adjacent the flange 11 is a reduced diameter portion 16 upon which is journalled the bearing bore 18 of an oscillatable frame plate 17. The pintle 12 terminates in a reduced diameter end portion 19 upon which is fitted a fixed gear 20 secured to the pintle 12 by screws 21 threaded into holes 22 therein.

Secured as by the screws 25 to the circular portion of the frame plate 17 is the annular flange 24 of a circular housing 23 (Figure 2). The latter has a central boss 26a with a bearing bore 27 journalled on the end portion 19 of the pintle 12 so that the housing 23 and frame plate 17 may be rotated thereon by means of a handle 26 mounted thereon. Extending radially upward from the frame plate 17 and housing 23 respectively are plate-like projections 28 and 29. The projection 29 has flanges 30 along its edges to which the projection 28 is secured as by the screws 30a. The passageway thus formed slidably receives a rack bar 31 having teeth 32 meshing with and drivingly engaged by a pinion 33.

The pinion 33 is formed with integral hub portions 34 which are journalled in aligned bearing bores 35 and 36 respectively in the frame plate extension 28 and the housing extension 29. Thus rotation of the frame plate 17 and housing 23 about the pintle 12 causes the pinion 33 to roll on the fixed gear 20 and reciprocate the rack bar 31.

The housing 23 and its extension 29 carry dovetail guides 38 and 39 in which is mounted an elongated dovetail slide 40. Secured by the screws 42 and 43 to the upper ends of the slide 40 and rack bar 31 is a bridge piece 44. Pivotally mounted on the lower portion of the slide 40 is an accelerator 46. For this purpose the latter is provided with a stepped bore 47 journalled on a pivot pin 48 secured to the slide 40 by a screw 49.

The slide 40 above the accelerator 46 is provided with a dovetail guideway 50 with a reciprocable adjusting slide 52 (Figure 6) carrying a pin 53 and a roller 54. The latter engages a longitudinal slot 55 in one end of the accelerator 46. The adjusting slide 52 is provided with a slot 56 through which projects a threaded stud 57 seated in the slide 40 and carrying a clamping thumb nut 58. The slide 52 is also provided with a jaw 59 (Figure 1) which cooperates with a jaw 60 carried by the slide 40 to receive precision gauge blocks therebetween.

The frame plate 17 (Figure 1) is provided with transverse projections 61 with forwardly extending arms 62 (Figure 4). Secured as at 62a to the arms 62 are parallel guide bars 64 having guide grooves 65 receiving the corresponding ribs 66 of a cross slide 63. Mounted in a bore 67 in the cross slide 63 is a pivot pin 68 secured thereto by a retaining washer 71 and screw 72 (Figure 2). The pivot pin 68 projects forwardly from a swivel slide 69 having a groove 70 slidably engaging the accelerator 46.

Formed integral with and depending from the cross slide 63 are two spaced parallel guide rails 74 (Figures 1 and 2) having opposed guide grooves 75 (Figure 4). The latter slidably receive the lateral ribs 76 of a diamond tool bracket 77 held in place by a retaining strip 78 which is secured to one of the depending guide rails 74 by thumbscrews 79. One of the depending guide rails 74 is provided with an arm forming a jaw 80 cooperating with a jaw 81 secured to the slide bracket 77 by screws 82. These serve to receive precision gauge blocks (not shown) for positioning the diamond tool as described below.

The slide bracket 77 has a bracket arm 83 which is cut away at its end to form a seat 84 and a vertical shoulder 85. The arm 83 is bored as at 86 to receive the short shaft portion 87 of an L-shaped bracket 88 held in place by a thumb screw 89 threaded therein. The horizontal portion 90 of the bracket 88 is offset relatively to the axis of the short shaft portion 87 to permit it to be turned to either side of the grinding wheel W, whereas the upstanding portion 91 is provided with a transverse bore 92 for receiving a cutting tool 93 held in place by a set screw 95 and having a diamond point 94.

Operation

In the operation of the invention, the various parts of the grinding wheel dressing tool are adjusted so that the axis of rotation of the housing 23 is in alignment with the center of the opening 67 in the cross slide 63. Next, the accelerator 46 is set to the proper angular position for the base circle diameter of the gear to be cut by inserting between the jaws 59 and 60 a precision gauge block having a length A equal to one-third of the base circle diameter, the distance B (Figure 1) being fixed. For example, to set the accelerator 46 to grind a gear having a base circle diameter of six inches, a two inch precision gauge block is inserted between the jaws 59 and 60. The thumb screw 58 is then tightened to lock the block in this position.

After the accelerator 46 has thus been angled and locked in position to give the proper acceleration to the cross slide 63, the diamond point 94 is then properly located so that the cutting point will trace an involute curve starting from a point on the base circle of the gear to be ground. This is done by inserting between the jaws 80 and 81 another precision gauge block having a length C (Figure 2) equal to the radius of the base circle of the gear to be ground multiplied by the cosine of one-half of the angle (x—x in Figure 8) of tooth space formed between the flanks of the involute profiles thereof at the base circle. With the proper precision gauge block thus located between the jaws, the thumb screws 79 are then tightened in place to securely hold the slide bracket 77 in its thus adjusted position. The distance of the diamond cutting tool point 94 from the axis of the shaft portion 87 is then calculated by multiplying the sine of one-half of the above angle of tooth space at the base circle (x—x in Figure 8) by the radius of the base circle.

When the grinding wheel dressing tool is set as above described, it is placed on the bed or other support on the grinding machine with the diamond tip 94 in vertical alignment with the axis of the grinding shaft S. The handle 26 is then moved in a clockwise direction to cause angular displacement of the housing 23 in a clockwise direction looking at Figure 6. In so doing, the slide 40 (which carries the accelerator 46) will move downwardly, causing the cross slide 63 to move along the guide rails 64 through the action of the angularly-positioned accelerator 46 in the swivel slide block 69. The three movements combine to cause the diamond point 94 to cut an involute curve on one edge of the grinding wheel periphery.

The mechanism of the present invention reproduces the mathematical condition that the involute tangent equals the developed circumference of the arc which is unwound from the base circle. In the simplified case of the involute problem, shown in Figures 1 and 6, where the base circle of a gear to be ground equals the pitch circle of the fixed gear 20, and where the accelerator 46 is inclined 45 degrees, the movement of the diamond point 94 equals the movement of the accelerator 46 which is being actuated by the rack bar 31. This results from the fact that the movement of the rack bar 31 equals the developed circumference of the fixed gear 20, this movement being projected at right angles thereto by the accelerator 46 and imparted to the diamond point 94, thereby following the successive involute tangents corresponding to the successive arcs as the angular displacement of the housing 23 is occasioned by the movement of the handle 26.

By the use of the device of the present invention, all involute problems down to zero base circle diameter are resolved with great fidelity when diamond setting C and accelerator 46 setting A conform to the formulations as hereinafter set forth. The accelerator 46 is the agent which measures the involute tangents that correspond to the arc through which the housing 23 is moved,

The angular setting of the accelerator 46 is accomplished through similar triangles, the base of one of which always equals the fixed distance B in Figure 1; the distance A will always be

$$\frac{A}{B} \text{ equals } \frac{\text{Base circle of the required gear}}{\text{Pitch circle of fixed gear}}$$

For example, let the pitch circle of the fixed gear 20 be 6 inches, let the base circle of the required gear be 3 inches, and let B equal 2 inches. Then by the above formula,

$$\frac{A}{B} \text{ equals } \frac{3}{6}$$

or A equals 1 inch. Thus in this example we find the A value to be ⅓ of the base circle.

After one edge of the grinding wheel has been dressed or cut to impart an involute form thereto, the position of the cutting tool supporting bracket arm 91 may be reversed to dress the other peripheral edge of the grinding wheel W. This is accomplished by merely loosening the thumb screw 89 a sufficient distance to permit the bracket block 88 to be unseated from the base surface 84 and shifted 180°, whereupon the thumb screw 89 is again tightened. After the grinding wheel has been used for grinding a number of gear teeth sufficient to cause wear in excess of the tolerances being observed, it is dressed from time to time to retrue its inaccurate surfaces.

While I have shown and described my invention in detail, it will be understood that various changes may be made therein without departing from the spirit and scope of my invention.

What I claim is:

1. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame for movement diametrically and substantially through the axis of rotation thereof, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable angularly relatively to said slide, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide.

2. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, a gear fixedly connected to said support, a rack reciprocably mounted on said frame and connected to said slide, a pinion rollable on said gear and meshing with said rack whereby to reciprocate said slide in response to the rotation of said frame, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable angularly relatively to said slide, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide.

3. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a reciprocable adjusting member slidably mounted on said slide, a coupling element interconnecting said accelerator member and said adjusting member, a locking device for securing said adjusting member in its adjusted position, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide.

4. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a reciprocable adjusting member slidably mounted on said slide, a coupling element interconnecting said accelerator member and said adjusting member in simultaneous sliding and swinging relationship therebetween, a locking device for securing said adjusting member in its adjusted position, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide.

5. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a reciprocable adjusting member slidably mounted on said slide, a coupling element interconnecting said accelerator member and said adjusting member, a locking device for securing said adjusting member in its adjusted position, cooperating opposed projections on said adjusting member and slide respectively for receiving precision gauge blocks therebetween, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide.

6. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame for movement diametrically and substantially through the axis of rotation thereof, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide, said accelerator member being pivotally mounted on said slide for angular adjustment relatively thereto.

7. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame for movement diametrically and substantially through the axis of rotation thereof, a gear fixedly connected to said support, a rack reciprocably mounted on said frame and connected to said slide, a pinion rollable on said gear and meshing with said rack whereby to reciprocate said slide in response to the rotation of said frame, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to

said slide, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide.

8. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, a gear fixedly connected to said support, a rack reciprocably mounted on said frame and connected to said slide, a pinion rollable on said gear and meshing with said rack whereby to reciprocate said slide in response to the rotation of said frame, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide, said accelerator member being pivotally mounted on said slide for angular adjustment relatively thereto.

9. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a reciprocable adjusting member slidably mounted on said slide, a coupling element interconnecting said accelerator member and said adjusting member, a locking device for securing said adjusting member in its adjusted position, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide, said accelerator member being pivotally mounted on said slide for angular adjustment relatively thereto.

10. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a reciprocable adjusting member slidably mounted on said slide, a coupling element interconnecting said accelerator member and said adjusting member in simultaneous sliding and swinging relationship therebetween, a locking device for securing said adjusting member in its adjusted position, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide, said accelerator member being pivotally mounted on said slide for angular adjustment relatively thereto.

11. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame for movement diametrically thereof, a gear fixedly connected to said support, a rack reciprocably mounted on said frame and connected to said slide, a pinion rollable on said gear and meshing with said rack whereby to reciprocate said slide in response to the rotation of said frame, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide, said accelerator member being pivotally mounted on said slide for angular adjustment relatively thereto.

12. An involute form dresser for grinding wheels comprising a support, a frame rotatably mounted on said support, a slide reciprocably mounted on said frame, mechanism responsive to the rotation of said frame for reciprocating said slide, a cross-slide reciprocably mounted on said frame at right angles to said slide, an accelerator member mounted on and adjustable relatively to said slide, a reciprocable adjusting member slidably mounted on said slide, a coupling element interconnecting said accelerator member and said adjusting member, a locking device for securing said adjusting member in its adjusted position, cooperating opposed projections on said adjusting member and slide respectively for receiving precision gauge blocks therebetween, a dressing tool holder connected to said cross-slide, and mechanism responsive to the motion of said accelerator member bodily with said slide for reciprocating said cross-slide, said accelerator member being pivotally mounted on said slide for angular adjustment relatively thereto.

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