May 13, 1952 N. HOGLUND 2,596,555

WHEEL DRESSING AND FORMING APPARATUS

Filed Aug. 16, 1946 3 Sheets-Sheet 1

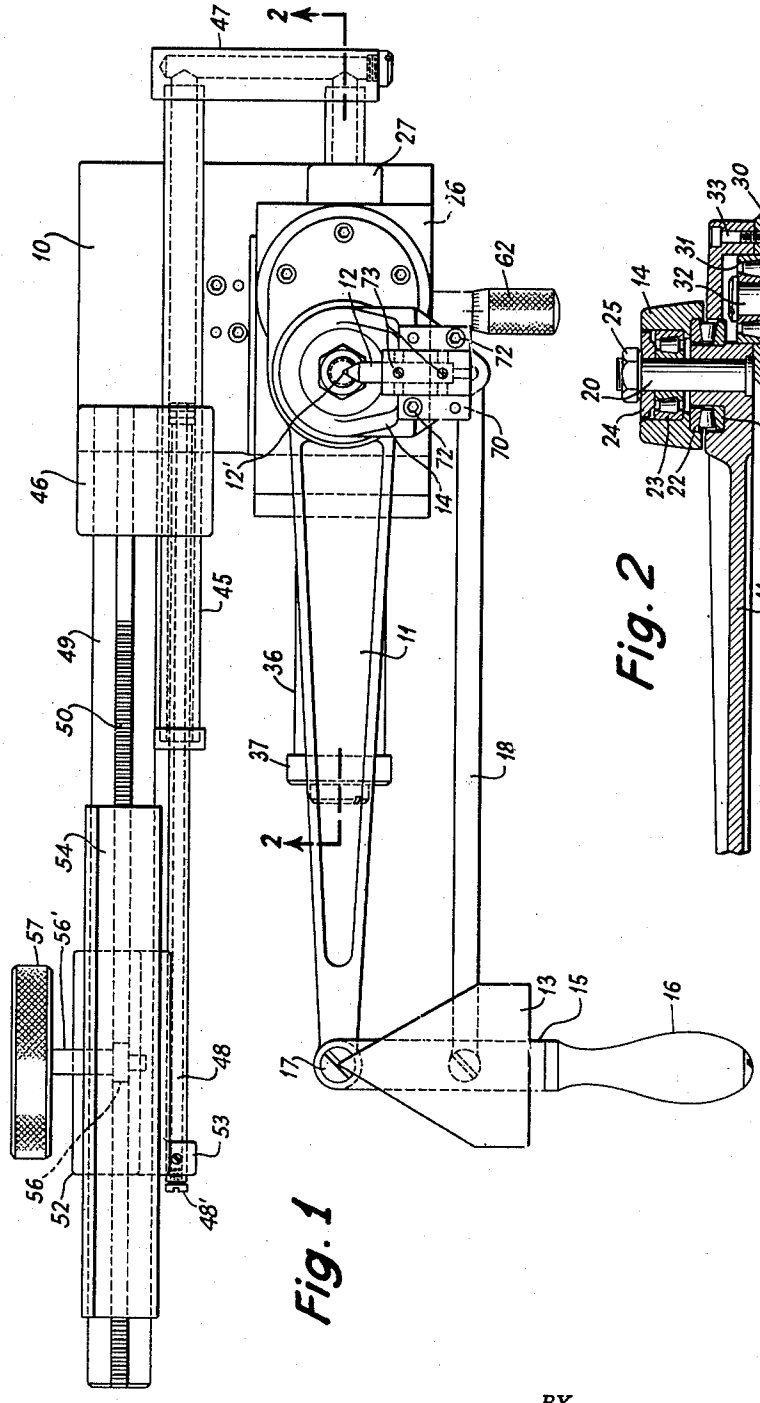


Fig. 1

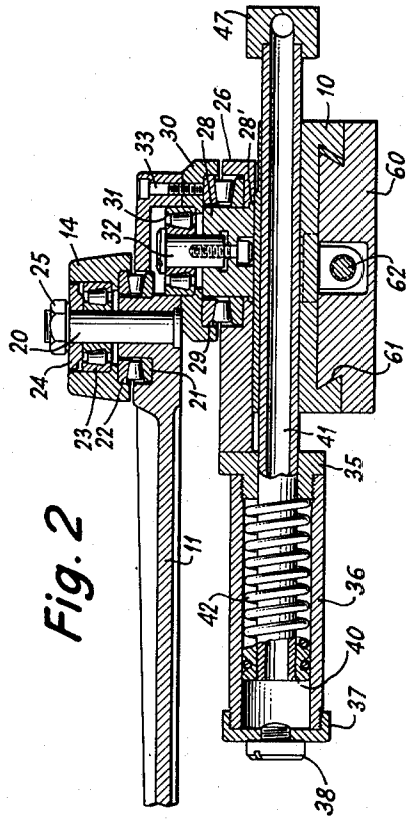


Fig. 2

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Fig. 3

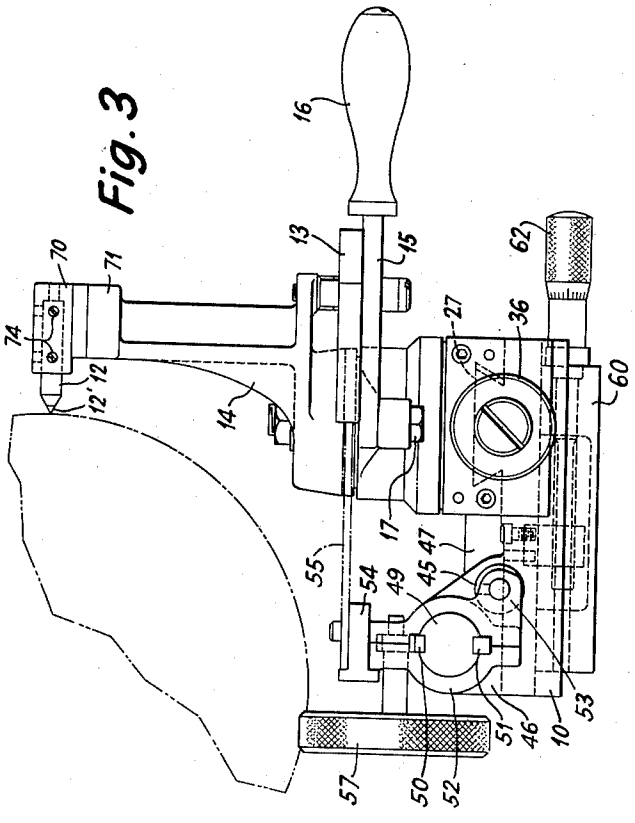
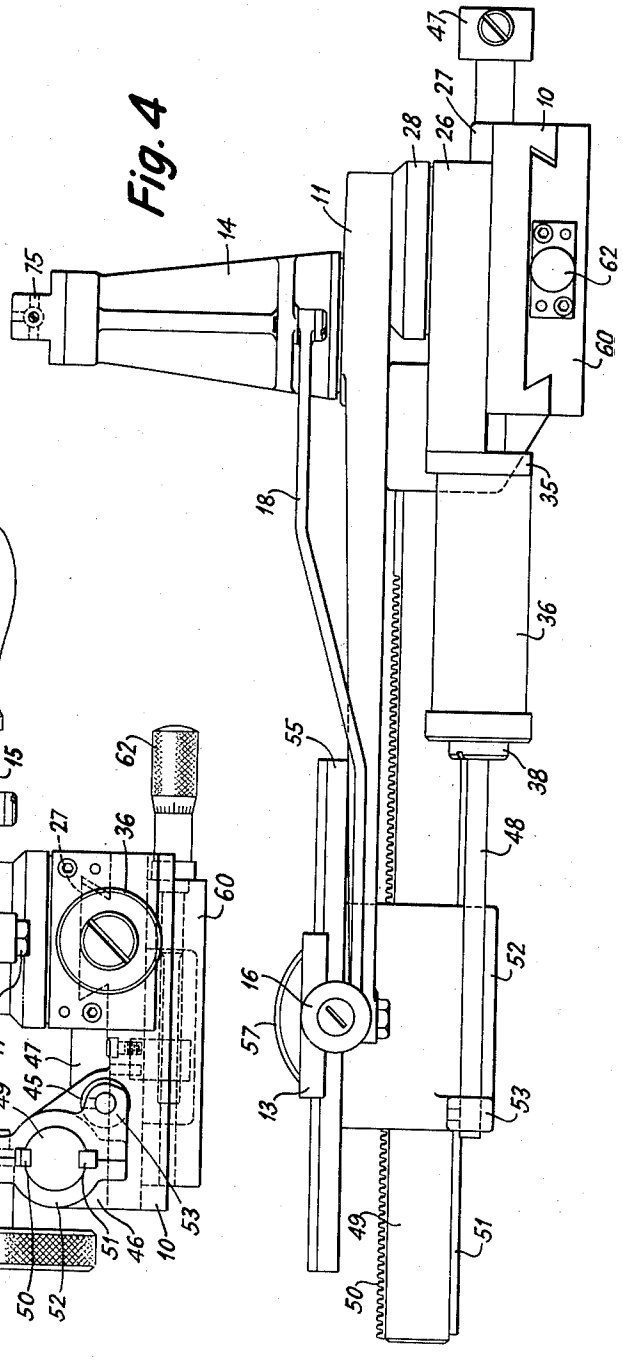


Fig. 4



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3 Sheets-Sheet 3

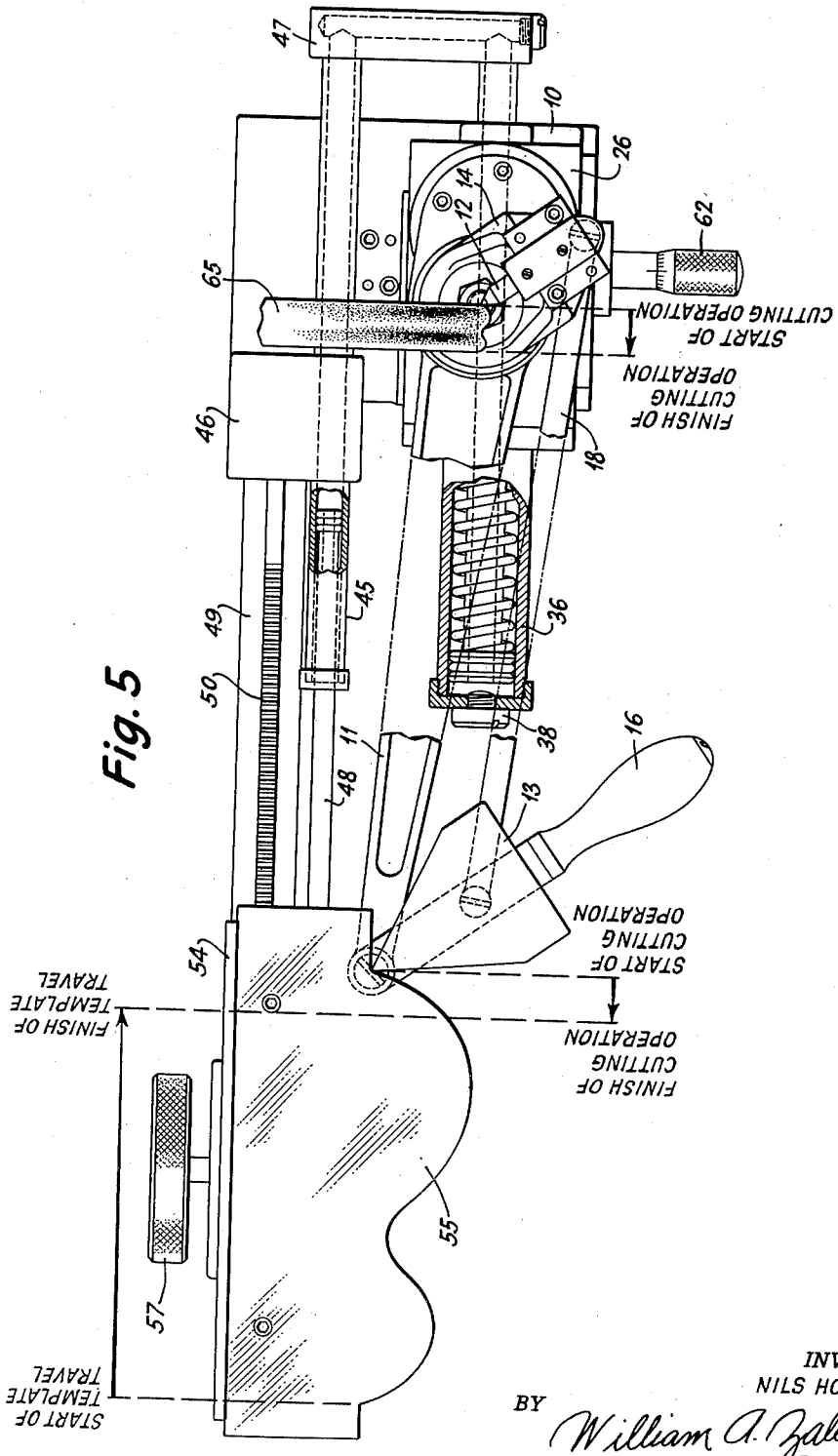


Fig. 5

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WHEEL DRESSING AND FORMING APPARATUS

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13 Claims. (Cl. 125—11)

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My invention relates generally to wheel dressing devices, more particularly to devices for dressing, truing and forming desired profiles on grinding wheels.

In one form of conventional dressing equipment where the contour of a templet is reproduced on the grinding surface of a grinding wheel on a reduced scale, a pantograph arrangement of complicated design is normally employed so as to transfer the contour from the templet to the surface of the wheel being dressed as the tool is moved across the surface of the wheel. This usually involves complicated link mechanism for this purpose. Normally wheel dressing devices are permanently fixed to the grinding equipment and are heavy and bulky. With the conventional dressing equipment it is difficult to provide contours where sharp or undercut contours are desired on the grinding wheel. Controls for these devices in the past have not been as simple and effective as desired and thus required the use of skilled labor to produce the desired contour on a grinding wheel.

In addition to this, wear on the tool, usually a diamond, caused inaccurate reproduction of the contour from the templet. In present devices great difficulty is encountered in replacing or substituting a dressing tool when set into the tool holder since it requires considerable skill to centralize the diamond. This consumes considerable time in changing diamonds after they are worn and have to be replaced. Even skilled mechanics have difficulty in replacing the diamonds accurately so far as proper centering is concerned. This is a cause for inaccurate work being done and cannot be tolerated where close limits are a criterion. It is also difficult in devices available to dress to sharp angles and in some cases to dress more than a one radius contour.

A principal object of my invention, therefore, is to provide a simple and effective wheel dressing and forming device of improved design.

Another object of my invention is to provide such a device which dispenses with the need of a pantograph arrangement for reproducing on a reduced scale the contour of a templet on a grinding wheel.

Another object of my invention is to provide such a device which may be easily and quickly moved from machine to machine and quickly set up.

A further object of my invention is to provide such a device in which the dressing tool can be manipulated to produce contours of small

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radius or arcs and having sharp angles or breaks and of more than one radius.

A further object of my invention is to provide such a device which can be easily and effectively controlled and operated by an unskilled operator.

A still further object of my invention is to provide such a device providing for predetermined accurate setting and centering of the dressing diamond when removed for sharpening and resetting in the tool holder, or for inserting a diamond for roughing or another diamond for finishing.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure 1 is a plan view of a wheel forming or wheel dressing device employing my invention, Figure 2 is an enlarged detailed section taken along the line 2—2 of Figure 1, Figure 3 is a left hand end view of Figure 1, Figure 4 is a side elevation of Figure 1 and Figure 5 is a plan view showing apparatus made according to my invention in one stage of operation and with a templet in place.

Briefly, my apparatus comprises a tool supporting unit or assembly for providing longitudinal and transverse movement of the tool with respect to the workpiece or wheel being dressed or formed. This assembly is mounted on a base which also supports the mechanism for causing the longitudinal and lateral or transverse movement of the tool under accurately and finely controlled operating conditions. The base, the tool supporting assembly and the operating mechanism are all mounted for movement toward and from the workpiece under micrometer controlled movement.

The tool supporting assembly comprises an arm pivoted at one end on a slide and pivotally supports a dressing tool, usually a diamond, and at its free end a templet follower or tracer connected by a link to the dressing tool so that the templet and tool may be rotated simultaneously about parallel vertical axes parallel to the axis of rotation of the supporting arm. The assembly and slide are moved along a longitudinal path by hydraulic means.

A manually operated means is provided for controlling the hydraulic driving mechanism. Mounted on the base adjacent the manually operated means and controlled thereby is a slide guide supporting thereon a slide. The slide carries a templet which is engaged by the templet

follower or tracer, so that as the dressing tool is moved along a longitudinal path it is also caused to have a traversing movement by maintaining the templet follower in contact with the surface of the templet for reproducing the contour of the templet on the grinding wheel.

In order to reproduce the form of the templet on the surface of the grinding wheel on a reduced scale, the relationship of the parts is made such that a ten to one reduction or any other ratio reduction may be obtained while at the same time accurately controlling the movement of the dressing tool.

Referring to the drawings in Figure 1 there is shown base 10 on which the tool support assembly and manually controlled operating means is mounted. The tool support assembly comprises the arm or lever 11 pivoted at its right hand end in a manner to be described in detail below and supporting the dressing tool 12, usually a diamond, adjacent the pivot of the arm. The templet follower or tracer 13 is supported pivotally at the free end of the arm, the templet follower being provided with an arm 15 and a handle 16, the unit being pivoted by means of the pivot stud or screw 17. A link 18 connects the templet follower and the tool so that rotation of the templet follower through a predetermined arc will work a like rotation through an equal arc of the diamond dressing tool.

As best shown in Figures 2, 3 and 4, the bracket 14 for supporting the tool is mounted on a stud 20 extending through the arm 11 adjacent its pivoted end. The arm is provided with a recess 21 for receiving the supporting bearing 22. The bearing 22 supports the lower end of bracket 14 which receives within it and between it and the stud a tapered roller bearing 23 retained in place by washer 24 and nut 25. This provides a good strong rigid support which is capable of withstanding the stresses and strains on the tool during dressing operations.

The arm 11 on which the tool support and its associated elements are mounted is pivotally supported as best shown in Figure 2 in a manner comparable to that of the diamond tool holder. A slide 26 mounted for movement on the slide guide 27 on base 10 is provided with a stud-like element 28 of enlarged diameter having a retaining flange 28' at its lower end. Surrounding this stud-like element and mounted within a recess in slide 26 is a roller and support bearing 29. A collar 30 in the form of a cover is mounted for rotation on this bearing and supports between it and the retaining stud 32 a tapered roller bearing 31. Screws 33 hold the arm 11 on the rotatable collar 30. Thus the arm 11 is securely and firmly fixed to the slide 26 for rotation about a vertical axis on this slide.

From what has been described it will be apparent that the arm 11 may rotate about a vertical axis to cause transverse movement of the diamond dressing tool 12 and templet follower 13. The ratio of the arcs or arcuate paths travelled by tool 12 and the templet follower 13 can be determined by the relationship of the distance of the point of the tool 12 from the axis 32 of the arm 11 and the distance of the point of the templet follower 13 from the axis 32 of the lever arm. The greater the distance of the tool from the pivot of the arm 11 the larger the arcs in which it travels and the less the reduction of transverse movement with respect to the movement of the templet follower.

To provide longitudinal movement of the dressing tool across the surface of the wheel being dressed, fluid responsive means are provided for moving the slide 26. This includes a flange 35 fixed to one end of slide 26 and supporting thereon and closing one end of the movable cylinder 36 closed at its other end by cylinder head 37. Cylinder head 37 is provided with an aperture closed by a screw member or plug 38. Fluid, such as oil, may be introduced into the system through the aperture. Mounted within the movable cylinder is piston 40 having a hollow stem or piston rod 41 through which fluid may be introduced into the space between the end of the piston 40 and the cylinder head 37. The piston is immovably fixed on the base 10. A biasing spring 42 is positioned between the end of the cylinder and one side of the piston and is placed under compression when the slide 26 and cylinder 36 are moved from right to left. This spring of course insures the return of the slide and dressing tool assembly when the manual operating means to be described is operated to permit the flow of fluid from the movable cylinder back into the operating mechanism.

A manually operated fluid pressure generating mechanism is provided for causing longitudinal movement of the dressing tool and its associated elements. As shown in Figures 1, 3 and 4, this includes a cylinder 45 fixed to the base 10 by means of a bracket 46. This cylinder communicates with the movable cylinder 36 through a conduit 47. Received within the cylinder 45 is an elongated hollow piston 48 which forces fluid under pressure from cylinder 45 into cylinder 36 when the piston is forced into the cylinder 45. This piston is provided with an aperture closed by a screw plug 48' which is removed to permit entrapped air to be expelled from the fluid containing system when filled. Mounted parallel to and supported by bracket 46 is slide guide 49 of circular cross section. Mounted in the upper surface of this slide guide is rack 50 and in its under surface a key 51 as best shown in Figures 3 and 4. A collar-like slide 52 is mounted on and slides along the slide guide 49. This slide 52 is fastened to one end of the piston 48 by means of the lug 53 and has a templet supporting plate 54 for supporting a templet 55 for purposes to be described. A pinion 56 rotatably mounted on shaft 56' in the slide 52 is manually operated and can be finely adjusted by means of the knurled knob 57. It contacts and cooperates with rack 50. The key 51, of course, insures that the slides travel a linear path.

Thus when the knurled knob 57 is rotated, the pinion 56 travels along rack 50 forcing the slide 52 and the piston 48 from left to right to force fluid from cylinder 45 through conduit 47 into movable cylinder 36, the fluid passing through the hollow stem 41 into the space between the piston 40 and the cylinder head 37. This forces the slide 26 from right to left along the slide guide 27, thus causing the dressing tool to traverse a path from right to left. When the knurled knob is rotated in the opposite direction it permits the spring 42, which was placed under compression by movement of the cylinder 36 from right to left to return the slide 26 and the dressing tool to retracted initial position.

Inasmuch as it is desired to produce a reduction of movement of the dressing tool so as to accurately reproduce a templet pattern on a smaller scale, the cylinder 45 and piston 48 are made with a smaller transverse cross section than piston 40 and cylinder 36 so that there is a smaller volu-

metric displacement per unit of linear travel of the piston **48** as compared to linear travel of the movable cylinder **36**. This can be made in any ratio desired. In this way a reduction of any ratio can be accomplished.

As best shown in Figure 5, when a wheel **65** is to be dressed to have a certain contour, a templet **55** of the desired form is mounted on the templet support **54**. By rotating the pinion driving wheel **57** the slide **54** with its templet **55** is moved to the right and the slide **26** with the diamond tool and tracer is moved to the left during the dressing operation, the tool and tracer being manipulated by the handle **16**. The follower or tracer **13** is maintained in contact with the templet surface as the tool **12** and tracer are moved from right to left across the templet reproducing the pattern of the templet on a smaller scale on the wheel **65** being dressed. Inasmuch as the templet moves with the slide **52** from left to right as the dressing tool **12** and follower **13** are moved from right to left, this differential is taken into consideration in determining the ratio of reduction so that if a 10 to 1 ratio is desired, the tool will move one unit to the left as the piston **48** is moved 9 units to the right, producing a differential of 10 to 1. Likewise the tool is mounted in such position that the arc through which it travels with respect to the arc through which the follower travels also has a ratio of 1 to 10 so that longitudinal and transverse movement of the tool with respect to the templet has a ratio of 1 to 10.

Both tool and follower are mounted for simultaneous rotation so that the point of the dressing tool with respect to the work being dressed and the point of the follower with respect to the templet are always in corresponding positions. This prevents the diamond from being torn from its fastening and also permits the surface being dressed to be contacted at the most desirable angle.

To provide for a fine adjustment of the tool toward and away from the surface being dressed, I provide sub-base **60** having a slide guide **61** on which the base **10** slides. Adjustment of base **10** on sub-base **60** is accomplished by means of the micrometer screw **62**. Thus adjustment of the tool through all angles and for all longitudinal and transverse movements can be controlled within extremely fine lengths. Thus it is easily possible to reproduce contours to .0002 of an inch or less.

As pointed out above, one of the great difficulties with tools of the kind under consideration is the replacing of the dressing tool **12**, such that the diamond point is accurately centralized. The greatest difficulty with this adjustment is that great skill is required to centralize the diamond when placed in the tool holder. An interchange of the diamond consumes a great deal of time. To save time, in the past the same diamond is used on the rough wheels as well as on the finishing wheels, which method is not the most efficient method of operation. It is desirable to change the diamond rapidly in a few seconds. It is also necessary to utilize different follower fingers with different diamonds, but both should be rapidly interchangeable. No problem is involved in changing the follower.

According to my invention, and as best shown in Figures 1, 3 and 4, the diamond **12'** on the tool holder is mounted in a block **70** secured to the support **71** on the top of the bracket **14** by means of cap screws **72**. The block can thus be replaced in exactly the same position. To insure that the diamond point is properly centered and centralized, I provide the block with three sets of set screws **73**, **74** and **75** by which adjustment of the diamond point can be made while the block is positioned in an optical comparator device, where the dressing tool can be fixed and accurately adjusted in the block to within very fine limits from a chart on the comparator screen. Once this has been done it is only necessary to replace the block on the support and the tool will be automatically centralized, thus eliminating the need for experienced help.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is:

1. A wheel forming device including a slide, fluid pressure operated means connected to said slide for moving said slide linearly, an arm pivoted at one end to said slide, a tool holder pivotally mounted on said arm adjacent its pivoted end, a tool supported on said tool holder, a templet, a follower mounted on said arm at a point removed from its pivoted end and contacting and movable along the surface of said templet to control transverse movement of said tool, movable means controlling said fluid pressure operated means, said last means supporting said templet, said templet and said follower having movement in opposite directions, the ratio of transverse movement of said tool holder with respect to the transverse movement of said follower, the ratio of the longitudinal movement of said tool holder with respect to the longitudinal movement of said movable controlling means being the same.

2. A wheel dressing apparatus including a slide, a hollow cylinder attached to said slide, a slide guide supporting said slide and a stationary piston received within said cylinder, a lever pivoted at one end to said slide, a dressing tool pivoted to said arm adjacent the pivoted end of said lever, a fixed cylinder, a movable piston received therein and conduit means connected between said cylinders for transferring fluid under pressure from said fixed cylinder to said movable cylinder to move said slide, means connected to said movable piston for moving said movable piston, a templet carried by said last means, a templet follower mounted on the lever at a point remote from its pivoted end and contacting said templet to determine the path followed by said dressing tool upon movement of said slide.

3. Apparatus for forming a contour on a grinding wheel including a slide, an arm pivoted at one end to said slide, a tool mounted on said arm, a tracer mounted on said arm, a movable cylinder connected to said slide, a fixed piston within said movable cylinder a base for supporting said slide, a cylinder fixed to said base and having a piston movable therein, and conduit means connecting said cylinders to permit fluid transfer therebetween, an elongated slide guide extending from said base and provided with a rack, a slide connected to said movable piston and supporting a rotatable pinion, and means connected to said pinion for rotating said pinion for causing movement of said last slide along said slide guide, and

a templet mounted on said last slide and having a contour to be reproduced on said grinding wheel, said tracer being in contact with the surface of said templet to determine the transverse movement of said tool during longitudinal movement of the slide supporting said tool for reproducing the templet contour on a reduced scale on said grinding wheel.

4. Apparatus for forming the contour of a grinding wheel including a slide movable along a longitudinal path, a dressing tool mounted on said slide and movable transversely of said longitudinal path, means including a movable cylinder connected to said slide and a stationary piston within said cylinder for moving said slide, and means including a fixed cylinder and a movable piston mounted within said fixed cylinder and having a volumetric displacement per linear unit of travel less than said movable cylinder per linear unit of travel, conduit means connecting said cylinders for transferring fluid between said cylinders, whereby a reduction of movement of said movable cylinder with respect to said movable piston results, a templet connected to and movable with said movable piston, a follower connected with said dressing tool for determining the transverse movement of said dressing tool and contacting said templet, said dressing tool reproducing the contour of said templet on a reduced scale when said movable piston is operated to cause movement of the movable cylinder and said slide, and a sub-base on which all of the above-named elements are mounted for movement transversely of said longitudinal path, and means connected to said slide for finely adjusting the transverse position of the elements mounted on said sub-base.

5. Apparatus for forming the contour of a grinding wheel including a slide movable along a longitudinal path, a dressing tool mounted on said slide and movable transversely of said longitudinal path, means including a movable cylinder connected to said slide and a stationary piston within said cylinder for moving said slide, and means including a fixed cylinder and a movable piston mounted on within said fixed cylinder and having a volumetric displacement per linear unit of travel less than said movable cylinder per linear unit of travel, conduit means connecting said cylinders for transferring fluid between said cylinders, whereby a reduction of movement of said movable cylinder with respect to said movable piston results, a templet connected to and movable with said movable piston, a follower connected with said dressing tool for determining the transverse movement of said dressing tool and contacting said templet, said dressing tool reproducing the contour of said templet on a reduced scale when said movable piston is operated to cause movement of the movable cylinder and said slide.

6. Apparatus for forming the contour of a grinding wheel including a slide movable along a longitudinal path, a dressing tool mounted on said slide and movable transversely of said longitudinal path, means including a movable cylinder connected to said slide and a stationary piston within said cylinder for moving said slide, and means including a fixed cylinder and a movable piston mounted within said fixed cylinder and having a volumetric displacement per linear unit of travel less than said movable cylinder per linear unit of travel, conduit means connecting said cylinders for transferring fluid between said cylinders, whereby a reduction of movement of said movable cylinder with respect to said movable piston results, a templet connected to and movable with said movable piston, a follower connected with said dressing tool for determining the transverse movement of said dressing tool and contacting said templet, said dressing tool reproducing the contour of said templet on a reduced scale when said movable piston is operated to cause movement of the movable cylinder and said slide.

7. Apparatus for forming the contour of a grinding wheel including a slide movable along a longitudinal path, a dressing tool mounted on said slide and movable transversely of said longitudinal path, means including a movable cylinder connected to said slide and a stationary piston within said cylinder for moving said slide, and means including a fixed cylinder and a movable piston mounted within said fixed cylinder and having a volumetric displacement per linear unit of travel less than said movable cylinder per linear unit of travel, conduit means connecting said cylinders for transferring fluid between said cylinders, whereby a reduction of movement of said movable cylinder with respect to said movable piston results, a templet connected to and movable with said movable piston and a follower connected with said dressing tool and contacting said templet.

8. Apparatus for forming the contour of a grinding wheel including a slide movable along a longitudinal path, a dressing tool mounted on said slide and movable transversely of said longitudinal path, means including a movable cylinder connected to said slide and a stationary piston within said slide for moving said slide, and means including a fixed cylinder and a movable piston mounted within said fixed cylinder and having a volumetric displacement per linear unit of travel less than said movable cylinder per linear unit of travel, conduit means connecting said cylinders for transferring fluid between said cylinders, whereby a reduction of movement of said movable cylinder with respect to said movable piston results, a templet connected to and movable with said movable piston, a follower connected with said dressing tool for determining the transverse movement of said dressing tool and contacting said templet, said dressing tool reproducing the contour of said templet on a reduced scale when said movable piston is operated to cause movement of the movable cylinder and said slide, and means including a slide sub-base and a slide guide upon which said apparatus is mounted for moving all of the above apparatus as a whole transversely of said longitudinal path.

9. Apparatus for forming a contour on a grinding wheel and including a slide, pivoted means mounted at one end on said slide, a dressing tool mounted on said pivoted means adjacent one end thereof, a templet follower mounted on said pivoted means, means connected to said slide including fluid pressure responsive means for moving said slide longitudinally, means including a piston operated device connected to said fluid pressure responsive means for forcing fluid into said fluid pressure responsive means for moving said slide, a templet carried by said last means, said follower and said templet being in engagement during operation of said device to determine movement of said tool transversely of said longitudinal path, said tool and said follower being mounted for rotation on parallel axes and link mechanism for causing simultaneous rotation of said follower and said tool, said fluid re-

sponsive means and said piston displacing different volumes per linear unit of travel whereby a reduction of movement of said tool with respect to said piston results, said tool being mounted more closely adjacent the pivoted end of said lever than said follower whereby the arc through which said tool and said follower move are comparable to the differences of linear motion of said tool and said piston.

10. A wheel dressing apparatus, including a slide, a hollow cylinder attached to said slide, a slide guide supporting said slide, a stationary piston received within said cylinder, a dressing tool mounted on said slide, a fixed cylinder, a movable piston received therein and conduit means connecting said cylinders for transferring fluid under pressure from said fixed cylinder to said movable cylinder to move said slide, and means connected to said fixed cylinder for moving said movable piston, said movable piston being hollow and provided with a screw plug at one end thereof for permitting bleeding of air from said pistons and said conduit when fluid is injected into said pistons and said conduit.

11. Apparatus for forming a contour on a grinding wheel and including a first slide, a dressing tool and a follower mounted on said first slide, means secured to said first slide for moving said slide linearly and axially of the grinding wheel being dressed, said tool and said follower being mounted for rotation on parallel axes on said first slide, a second slide movable parallel to the movement of said first slide, a templet mounted on said second slide, said follower and said templet being in engagement during operation of said apparatus to determine movement of said tool transversely of the path of linear movement of said slides, a link mechanism connecting said tool and follower for causing simultaneous rotation of said follower and said tool about said parallel axes, means connected to said second slide and movable therewith, operating connections connecting the means secured to said first slide and the means connected to said second slide for causing movement of said slides in opposite directions, said operating connections including means for moving said first slide a lesser distance than the distance through which said second slide moves when said apparatus is operated to move said second slide.

12. Apparatus for forming a contour on a grinding wheel including a slide movable axially of said grinding wheel, an arm pivoted at one end to said slide, a tool pivoted to said arm adjacent the pivoted end of said arm, a templet mounted on said apparatus and movable parallel to said slide, a follower contacting said templet and pivotedly mounted at the free end of said arm and connected by a link to said tool, a movable cylinder fixed to said slide, a piston within said cylinder, a base supporting said slide, said piston being fixed to said base, a cylinder fixed to said base and having a piston movable therein, conduit means connecting said cylinders, an elongated slide guide extending from said base and provided with a rack, a slide mounted on said slide guide and connected to said movable piston, a rotatable pinion supported on said last slide and contacting said rack and means connected to said pinion for rotating said pinion for causing movement of said last slide along said slide guide.

13. Apparatus for forming a contour on a grinding wheel and including a slide movable axially of said grinding wheel, pivoted means pivotedly mounted on one end of said slide, a dressing tool mounted on said pivoted means adjacent the pivoted end thereof, a follower mounted on said pivoted means and spaced from said tool, means including fluid pressure responsive means connected to said slide for moving said slide linearly along the axis of the grinding wheel, means connected to said fluid pressure responsive means for forcing fluid into said fluid pressure responsive means for moving said slide and including a movable support, a templet supported on said movable support and adjacent said follower and movable parallel to said slide, said follower and said templet being in engagement during operation of said apparatus to determine movement of said dressing tool transversely of the path of linear movement, said templet and said follower moving in opposite directions during operation of said apparatus.

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