July 8, 1952 E. C. OLIVER 2,602,438

WHEEL CONTOURING DEVICE

Filed Sept. 21, 1946 3 Sheets-Sheet 1

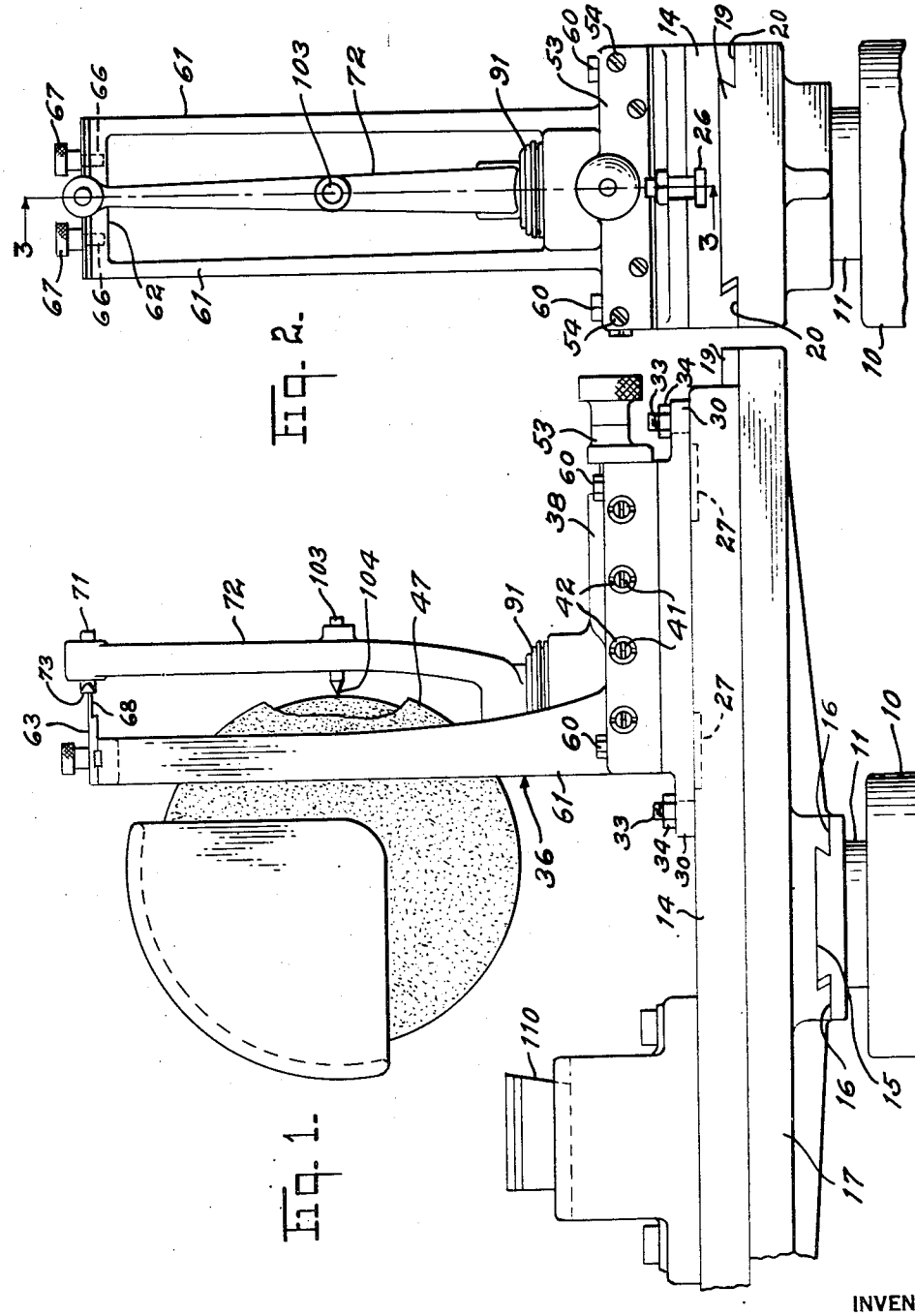

Fig. 2.

Fig. 1.

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Filed Sept. 21, 1946 3 Sheets-Sheet 2

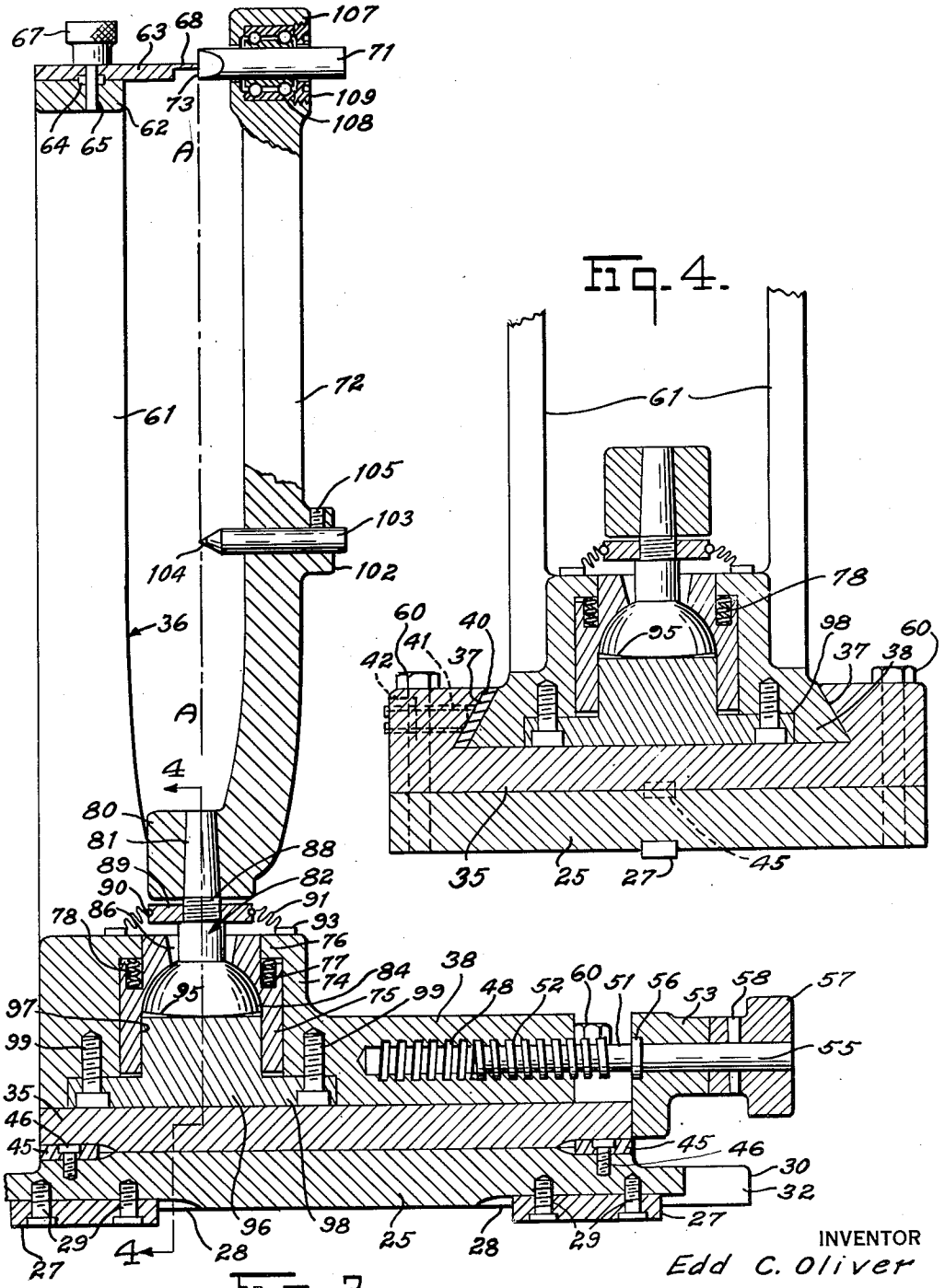

Fig. 3.

Fig. 4.

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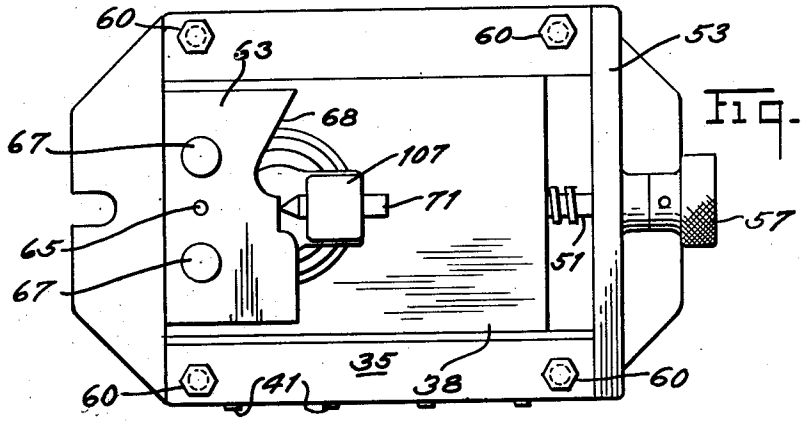

Fig. 5.

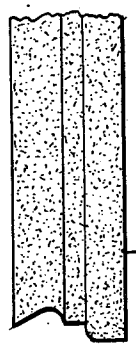

Fig. 6.

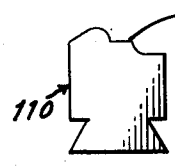

Fig. 7.

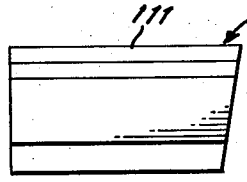

Fig. 8.

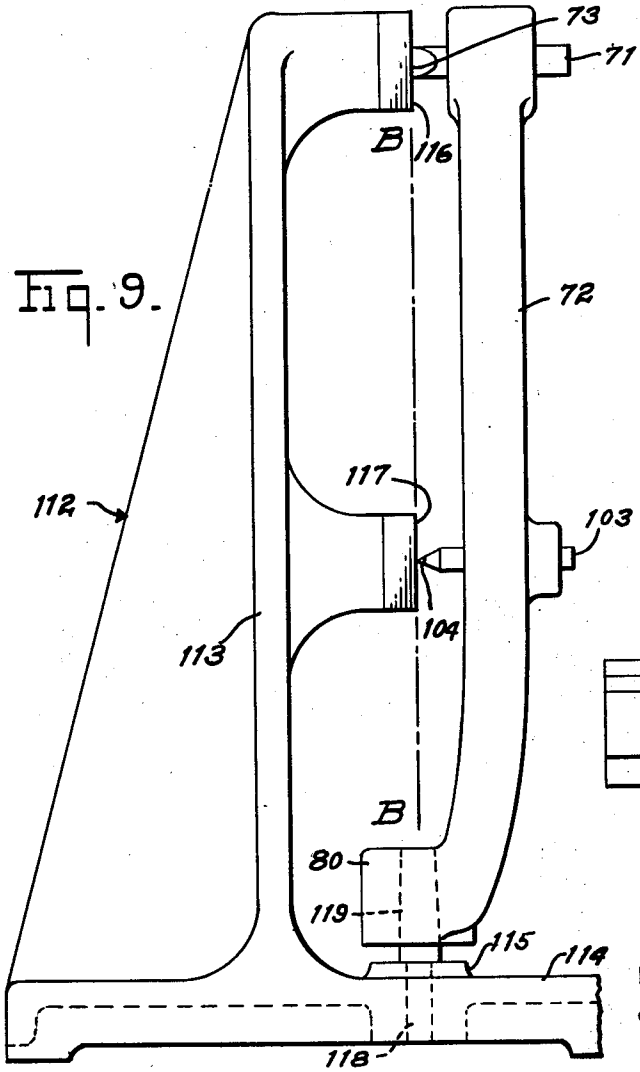

Fig. 9.

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Patented July 8, 1952 2,602,438

UNITED STATES PATENT OFFICE

2,602,438

WHEEL CONTOURING DEVICE

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Application September 21, 1946, Serial No. 698,453

8 Claims. (Cl. 125—11)

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This invention relates to apparatus for contouring or configurating form wheels and more especially to means for configurating an abrasive wheel especially usable for imparting a predetermined formation to objects.

The invention has for an object the provision of means adapted for engagement with a rotating wheel for impressing or imparting a predetermined form to the wheel whereby the latter may be utilized to impart a reciprocal configuration thereof into an article or object.

The invention embraces a means for contouring an area of a wheel from a pattern or template formed with the predetermined configuration whereby the shape of the template is reproduced in the wheel by a cutting instrumentality.

Another object of the invention is the provision of a fixture applicable to a grinding machine for cutting or impressing a predetermined shape in an abrasive wheel, said fixture being adaptable for dressing the formed wheel to re-establish the form initially imparted to the wheel.

Another object of the invention resides in the provision of a fixture for contouring abrasive wheels and embodies a template having the formation desired to be cut or impressed into the wheel, the fixture incorporating a means of adjustment whereby the same may be moved toward the wheel to compensate for wear thereof.

Another object resides in the provision of a fixture equipped with a cutting instrumentality for engagement with a wheel to be formed, the fixture embodying template means of the shape to be impressed in the wheel, the template being of a larger size than the form to be impressed whereby a high degree of accuracy may be obtained for the formation in the wheel.

Still another object is the provision of a fixture for cutting form configurations into an abrasive wheel, the fixture being arranged to be readily removable from a table or support and which may be quickly and easily replaced in wheel dressing position without readjustment of the fixture.

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

Figure 1 is a side elevation view of a portion

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of a grinding machine illustrating the apparatus of my invention associated therewith;

Figure 2 is an end elevational view of the fixture and grinding machine table shown in Figure 1;

Figure 3 is a vertical sectional view taken substantially on the line 3—3 of Figure 2;

Figure 4 is a detail sectional view taken substantially on the line 4—4 of Figure 3;

Figure 5 is a top plan view of the arrangement shown in Figure 3;

Figure 6 is a fragmentary view illustrating a typical formation impressed on the periphery of a grinding wheel;

Figure 7 is an end view showing a form of skiving tool which may be formed by engagement with the wheel;

Figure 8 is a side view of the skiving tool shown in Figure 7; and

Figure 9 is an elevational view illustrating a gage usable with an element of the apparatus of my invention for accurately positioning the wheel cutting instrumentality.

While I have illustrated a form of my invention as utilized for contouring or configurating an operative portion of a grinding or abrasive wheel, it is to be understood that I contemplate the employment of my invention for contouring operations wherever the same may be found to have utility.

Referring to the drawings in detail, there is illustrated in Figures 1 and 2 a portion of a grinding machine showing the fixture of my invention associated therewith. The grinding machine is provided with a supporting frame or pedestal 10 within which is formed a cylinder (not shown), the latter slidably accommodating a vertically adjustable post or ram 11 for elevating the grinding machine table or platen 14. The upper portion of the post 11 is provided with a tang 15 forming ways 16 slidably supporting an intermediate member or cross head 17. The cross head 17 is provided with a tang 19 and ways 20 extending longitudinally of the member 17 and at right angles to the direction of ways 16. The table 14 is mounted directly upon the ways 20 for slidable movement lengthwise of the cross head 17 while the latter may be moved crosswise in the direction of ways 16 to attain transverse adjustment of the table. The adjustment of the cross head 17 upon the post 11 and longitudinal movement of table 14, with respect to the cross head 17 are obtained by conventional hand wheel and lead screw means (not shown).

The arrangement of my invention for contour-

ing or forming an area of an abrasive or grinding wheel is preferably adapted to be supported on the grinding machine table 14 but it is to be understood that the arrangement of my invention may be mounted in other ways or upon other means without departing from the spirit of the invention.

As particularly illustrated in Figures 3 and 4, a base plate or standard 25 of the fixture is adapted to rest upon the upper surface of the table 14. The table 14 is formed with a longitudinally extending T-shaped recess or slot 26 adapted to accommodate lugs or keys 27 which are mounted in suitable recesses 28 formed in the standard or base 25, the lugs being secured to the standard by means of screws 29.

The standard 25 is formed at its ends with projecting flanges 30 provided with slots 32 adapted to receive bolts 33 for securing the standard 25 upon the table. The head portions of bolts 33 are carried in the T-shaped recess or slot 26, the bolts adapted to receive securing nuts 34.

Mounted upon the standard 25 is a base member or plate 35 which forms a mounting to support the upwardly extending frame structure 36 of the fixture. The member 35 is formed with angularly disposed surfaces 37 forming ways to accommodate a lower portion 38 of the frame 36. Disposed between one of the angular surfaces 37 and the tang portion 38 of frame 36 is a gib 40. Mounted in threaded openings in member 35 is a plurality of adjusting screws 41 having their forward extremities engaging gib 40. By manipulating the screws 41 the position of the gib 40 may be adjusted to provide for a smoothly operating slidable fit between tang 38 and member 35. Lock nuts 42 are provided to retain screws 41 in adjusted position. The adjacent surfaces of members 25 and 35 are formed with registering recesses adapted to receive and accommodate keys or blocks 45 for properly aligning frame 36 with the standard 25, the keys or blocks 45 being secured to member 25 by means of screws 46.

Means are provided for adjusting or moving the frame 36 with respect to the supporting frame member 35 for the purposes of moving a cutting instrumentality toward the rotatable grinding or abrasive wheel 47. To this end the portion 38 of frame 36 is bored and provided with threads 48, preferably of the so-called "square" type, as shown in Figure 3. Extending into the threaded bore is a shaft 51 provided with a threaded portion 52 cooperating with the threads 48 in the member 38. Mounted upon one end of member 35 is a transversely extending bar 53 which is held in place by means of screws 54. The bar 53 is provided with an opening through which extends a cylindrical portion 55 of member or shaft 51, the shaft being provided with an integral flange or collar 56 which is received into a circular recess formed in the bar 53. Mounted upon the portion 55 is a knurled manipulating knob 57 secured to the portion 55 by means of a dowel 58. By rotating the knob 57, the frame 36 may be moved or adjusted longitudinally of the supporting plate 35.

The frame 36 is formed with a pair of upwardly extending strut-like portions 61 preferably integrally joined at their upper extremities by means of a connecting portion or ledge 62. The portion 62 functions as a platform or mounting for a template 63. Different forms of template 63 may be employed as patterns for imparting various

forms or configurations to the grinding or abrasive wheel 47. Means are provided for accurately regulating or positioning a template plate upon the platform 62 which is inclusive of a transversely extending key 64 adapted to be received into registering recesses or slots formed in both the template 63 and the support 62. This means provides against movement of the template in one direction. A dowel pin 65 is pressed into an opening formed in the platform 62 and template 63 is formed with a circular opening to receive the portion of the dowel 65 projecting above the platform 62. This arrangement provides against movement of the template longitudinally of the key 64. The platform 62 is also formed with spaced threaded openings to receive threaded tenon portions 66 of knurled template securing screws 67. When it is desired to change templates it is only necessary to remove the finger screws 67, affix a different template on the platform 62 and replace the screws 67. The operative or working portion of the template in which is fashioned the pattern or configuration desired to be imparted in the wheel 47 is indicated at 68. It is to be noted that the pattern portion 68 of the template is made relatively thin so as to provide, as nearly as possible, a line contact with a template follower or stylus 71. Figure 5 illustrates a typical pattern fashioned on a template 63, although it is to be understood that any configuration may be formed upon the template.

The arrangement of my invention is inclusive of an element or tool holder mounted upon the frame in such a manner as to be movable to bring the cutting instrumentality or tool into engagement with the grinding wheel to be configurated in accordance with the pattern formed on the template 63. To obtain an accurate reproduction of the template formation in the grinding wheel the movement of the tool carrying element should take place about a relatively fixed axis. In the embodiment disclosed, the cutting tool supporting element 72 is mounted for relatively slight movement during wheel contouring operations along the axis A—A indicated in Figure 3, but the axial movement of element 72 is very slight for most contouring operations so that the oscillation of the holder virtually takes place about a point.

It is to be understood that substantially accurate reproduction of the template may be formed in a wheel without permitting axial movement to the tool carrying element but I have found that by providing for axial movement of said element or holder, faithful reproductions of the template pattern may be formed in the wheel. In my preferred embodiment, the frame 36 is formed with a boss portion 74 provided with a cylindrical bore in which is snugly, yet slidably disposed a bushing-like member 75. The upper portion of the boss 74 is formed with an inwardly extending flange 76 arranged to fit in an annular recess formed in the upper portion of the member 75. The member 75 is provided with a plurality of spaced sockets or wells 77 within which are disposed a plurality of expansive coil springs 78 and which abut the flange 76 and serve to resiliently urge the member 75 downwardly.

The holder 72 is formed at its lower portion with a boss 80 which is provided with a tapered opening adapted to receive a tapered tenon 81 of a member 82. The angle of taper of portion 81 and the walls of the tapered opening are such that the friction between the surfaces retains the member 82 in the boss 80. Member 82 is

formed at its lower end with a semi-spherically shaped formation 84 which is adapted to engage in a semi-spherically shaped socket or recess formed in the member 75. A frusto-conical opening or chamber 86 communicates with the semi-spherical recess in member 75, the chamber 86 being of a dimension to accommodate oscillatory movement of the holder 72.

The member 82 is provided with a threaded portion 88 adapted to receive a disc 89 as shown in Figures 3 and 4. The disc 89 is formed with a peripheral channel or groove adapted to accommodate a resilient or elastic band 90 to which is connected an accordion type dust seal 91 formed of several convolutions of flexible air impervious material. The flexible material 91 is secured to an annulus or ring 93, the latter resting upon the upper surface of the boss 74. The resiliency in the flexible material 91 is adequate to maintain contact of the annulus 93 with the boss 74 during relative movement of the holder 72 in order to maintain an effective seal between the annulus 93 and the boss 74.

The lower surface of the enlarged portion 84 of member 82 is of an arcuate or convex formation 95, the curvature thereof being generated about a point located on the line A—A at the axis of the cutting instrumentality 104. The portion 84 is held in the socket formed in member 75 by means of a member 96 which extends within the cylindrical interior wall 97 of member 75. Member 96 is formed with a peripheral flange 98 which extends into an annular recess formed in member 38, member 96 being secured to member 38 by means of screws 99. In this manner the center of the semi-spherically shaped portion 84 of member 82 will always be directed or guided in movement along the axis A—A. Movement of the holder may take place in an upward direction as the coil springs 78 may be compressed to permit member 75 to move upwardly. This vertical movement of portion 84 and member 75 will occur during oscillatory movements of member 72 whenever the follower 71 moves out of the axis A—A during contouring operations.

The holder 72 is provided intermediate its ends with a boss 102 which is bored to accommodate a cutting diamond supporting rod 103 which is provided at a tapered end with a cutting diamond 104 or similar cutting instrumentality. The rod 103 is maintained in adjusted position in the holder 72 by means of a set screw 105. The cutting diamond 104 is adapted for engagement with the grinding wheel 47 for impressing or cutting a contour or pattern of template 63 in the peripheral area of the grinding wheel 47.

In the preferred embodiment of my invention the template follower 71 is movably mounted so as to permit the straight edge 73 to maintain proper engagement of the follower 71 with the template 63. The follower 71 may however be fixedly secured in the holder 72 to secure satisfactory operation under most normal conditions. In order however to secure extremely accurate reproduction of the template plate in the periphery of a grinding wheel, especially when impressing a pattern or contour in a wheel where the holder 72 moves through a substantial angle with respect to the vertical axis A—A, it is desirable to provide a relatively movable follower 71. To this end, the holder 72 is formed at its upper end with a boss portion 107 within which is journaled an anti-friction bearing 108 preferably of the ball type as shown in Figure 3, which is held in place in holder 72 by means of a threaded retaining disc 109. By this arrangement of supporting the follower 71 so as to be relatively movable with respect to the holder 72, the straight edge 73 of the follower is permitted to remain in a substantially vertical position in engagement with the template 68 even though the holder 72 may be disposed at an angle with respect to the axis A—A.

Figure 6 illustrates, in plan view, a fragmentary portion of the abrasive or grinding wheel 47 showing a pattern formed in the periphery of the wheel. This pattern is also shown in plan view in Figure 5 as embodied in the template 68. It should be noted that the template pattern is double the size of the corresponding shape impressed in the wheel 47, as the ratio from the point of engagement of surface 95 with member 96 to the cutting diamond 104 is one half of the distance from the surface 95 to the point of engagement of the template 68 with the follower 71. While I have illustrated the arrangement wherein the template size is twice the size of the configuration in the wheel, it is to be understood that the pattern may be of a different size depending upon the proportionate distances of the cutting diamond 104 and the template 68 from the surface 95.

Figures 7 and 8 illustrate a form of skiving tool 110 which is adapted to have its upper face or surface 111 formed with the shape of the grinding wheel through engagement of the skiving tool 110 with the wheel 47.

Figure 9 illustrates a form of gage for predetermining the proper position of the diamond cutting tool 104 with respect to the straight edge 73 of the follower 71. The gage 112 comprises a triangular base 114 formed with an integral upright standard 113 equipped with pad portions 116 and 117, the forward surfaces of which are aligned or lie in a plane passing through the axis B—B. The pads 116 and 117 are adapted to be engaged respectively by the straight edge 73 of template follower 71 and the diamond cutting point or tool 104. The base portion 114 is formed with a boss 115 drilled to accommodate a tenon 118 of a member 119, the latter being tapered to fit the tapered opening in the holder 72 normally accommodating member 81. When it is desired to set the diamond 104 in proper position, the holder 72 is removed from the tapered member 81 and the holder placed over the tapered member 119 mounted upon the base 114. The straight edge 73 is then brought into engagement with the surface of pad 116 after which the rod 103 carrying the diamond cutting point 104 is moved until the point engages the surface of pad 117. After this operation the set screw 105 is securely drawn up to retain the rod 103 in its adjusted position. The holder 72 is then withdrawn from engagement with the member 119 and redisposed over the tapered member 81. Contouring operations may be resumed, the operator oscillating or moving the holder 72 so as to bring the diamond 104 into engagement with the area of the abrasive or grinding wheel 47 to be shaped or formed. The operator continuously oscillates the holder to various positions wearing away the wheel 47 under the cutting influence of the diamond 104, this action continuing until every portion of the pattern formed on template 63 is engaged by the straight edge 73 of follower 71. When every portion of the template may be engaged by the straight edge 73 without further cutting action of

the diamond **104** on the wheel **47**, the contour or configuration to be cut or formed in the wheel has been completed.

The arrangement of my invention provides for a high degree of accuracy of reproduction of a template pattern on the abrasive or grinding wheel face as any angular movement or position of holder **72** during the contouring operations does not affect the accuracy of the reproduction in the grinding wheel as the straight edge **73** may remain in a vertical position and in proper engagement with the template **68** and the member **84** will move upwardly to compensate for angular positions of the holder **72**.

Upon the completion of a contouring operation the table or platen **14** may be moved longitudinally in a right-hand direction as viewed in Figure 1, moving the contouring mechanism away from the abrasive wheel **47**, at the same time bringing the skiving tool **110** to be shaped by wheel **47** into engagement with the latter. In certain grinding operations it may be desirable to remove the contouring fixture and this may be accomplished by removing the bolts **60** which secure the portion **35** to the plate **25** and permits quick removal of the standard or frame **36**. When contouring operations are to be resumed on the wheel **47**, the frame **36** may be replaced upon the plate **25** and the bolts **60** reinserted. The keys **45** cooperating with recesses formed in member **35** serve to accurately reposition the frame with respect to the plate **25**.

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

I claim:

1. An abrasive wheel contouring device including in combination, a frame; a holder mounted upon said frame for oscillatory movement with respect thereto; a cutting implement mounted upon the holder; a template carried by the frame; a template follower supported by the holder; said follower cooperating with the template for directing the movement of the cutting implement in accordance with the configuration of the template; a member carried by said holder having a convex surface generated as a portion of a sphere whose center lies on the axis of the operative portion of the cutting implement; an abutment on said frame adapted to be engaged by the convex surface on said member, and means carried by the frame for retaining said convex surface in engagement with the abutment on said frame.

2. An abrasive wheel contouring device including in combination, a frame; a holder mounted upon said frame for oscillatory movement with respect thereto; a cutting implement mounted upon the holder; a template carried by the frame; a template follower supported by the holder; said follower cooperating with the template for directing the movement of the cutting implement in accordance with the configuration of the template; a member associated with said holder having a convex surface generated as a portion of a sphere whose center lies on the axis of the operative portion of the cutting implement; said member having a semi-spherically shaped portion; a bushing element slidably arranged on said frame and surrounding said member; said bushing having an interior spherically-shaped recess adapted to accommodate the spherically-shaped portion of said member; and resilient means disposed between and engaging the frame and the bushing for urging the latter into engagement with the semi-spherically shaped portion of said member.

3. An abrasive wheel contouring device including in combination, a frame; a holder mounted upon said frame for oscillatory movement with respect thereto; a cutting implement mounted upon the holder; said cutting implement having an operative point for engagement with a wheel to be contoured; a template carried by said frame; a follower for said template including a member journaled for relative rotatable movement upon said holder; a member secured to said holder and having a semi-spherically shaped portion; said semi-spherically shaped portion being formed with a convex surface, the curvature of said convex surface being a portion of a sphere generated about the operative point of said cutting implement as a center; a bushing embracing the semi-spherically shaped portion of said member and slidably mounted in said frame; an abutment formed on said frame and having a uniplanar surface arranged to be engaged by the convex surface on said member; resilient means engaging the frame and the bushing for urging said member in a direction to engage said convex surface with the surface of said abutment, and a flexible sealing means arranged between and engaging said member and said frame.

4. An abrasive wheel contouring device including in combination, a frame; a holder mounted upon said frame for oscillatory movement with respect thereto; a cutting implement mounted upon the holder; a template carried by the frame; a template follower supported by the holder and arranged for relative rotary movement with respect thereto; said follower cooperating with the template for directing the movement of the cutting implement in accordance with the configuration of the template; a member associated with said holder having a convex surface generated as a portion of a sphere whose center lies on the axis of the operative portion of the cutting implement; a uniplanar surface on said frame engageable with the convex surface; said member having a semi-spherically shaped surface; a bushing element slidably supported upon said frame and in engagement with said member; and resilient means engaging the frame and the bushing for urging the latter in a direction to maintain the convex surface in engagement with the uniplanar surface on said frame.

5. An abrasive wheel contouring device including in combination, a frame formed with a pair of spaced upright portions adapted to straddle an abrasive wheel; an implement holder; said holder being mounted on said frame for relative universal movement with respect thereto; a wheel cutting implement carried by the holder; a templet carried by the frame follower means carried by the holder and cooperating with the template for guiding the cutting implement into engagement with an abrasive wheel whereby the templet shape may be reproduced in the abrasive wheel; an abutment member carried by the frame; a second member connected with the holder; one of said members being formed with a partial spherically-shaped surface, the other of said members being formed with a uniplanar surface engageable with the spherically-shaped surface of said other member, a bushing sur-

rounding the member connected with the holder, and resilient means engaging the frame and bushing for maintaining said spherically-shaped and uniplanar surfaces in engaging relationship.

6. An abrasive wheel contouring device including in combination, a support; a frame element; means including a rotatable member connecting the support and frame element for adjusting the frame element with respect to the support; a holder element mounted upon said frame for oscillatory movement with respect thereto; a cutting implement mounted upon the holder; a template carried by one of said elements; follower means carried by the other of said elements cooperating with the template for directing the movement of the cutting implement in accordance with the pattern of said template; a member formed with a semi-spherically shaped portion terminating in a convex surface; said frame having an abutment arranged to be engaged by the convex surface; means including a bushing on said frame element adapted to engage said semi-spherically shaped portion; said bushing being arranged for movement relative to said frame element to accommodate relative angular movement of the holder element, and spring means engaging the bushing and frame element for normally urging the convex surface of said member in engagement with the abutment.

7. An abrasive wheel contouring device including in combination, a base member; a frame element mounted upon the base member and relatively movable with respect thereto; means including a rotatable member connecting said base member and frame element for adjusting the position of the frame element with respect to the base member; a holder element mounted upon said frame element for oscillatory movement with respect thereto; a cutting implement mounted upon the holder; a template carried by one of said elements; follower means carried by the other of said elements cooperating with the template for directing the movement of the cutting implement in accordance with the pattern of said template; a semi-spherically shaped member connected with said holder; means including a sleeve carried by said frame adapted to engage said semi-spherically shaped portion; said sleeve being arranged for slidable movement relative to said frame element to accommodate relative angular movement of the holder element, and spring means engaging the sleeve for normally urging the holder element toward its central position with respect to the frame element.

8. A fixture for contouring the peripheral area of an abrasive wheel including a support; a frame mounted upon said support; means including a rotatable member connecting the frame and support for adjusting the relative position of the frame with respect to the support; a template mounted upon the frame; an implement holder; said holder being mounted on said frame for limited universal movement with respect thereto; a stylus supported upon the holder and arranged for cooperation with the template; an abrasive wheel cutting implement carried by the holder; an abutment member carried by the frame; a second member secured to the holder; one of said members being formed with a partial spherically-shaped surface, the other of said members being formed with a uniplanar surface engageable with the spherically-shaped surface of said other member; a bushing surrounding the member secured to the holder; resilient means engaging the frame and bushing for maintaining said spherically-shaped and uniplanar surfaces in engaging relationship; said template and stylus cooperating whereby the cutting implement may be caused to reproduce the pattern of the template in an abrasive wheel.

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