Jan. 16, 1940. D. W. MARTIN 2,187,690

FORM TRUING

Filed Sept. 29, 1938 3 Sheets-Sheet 1

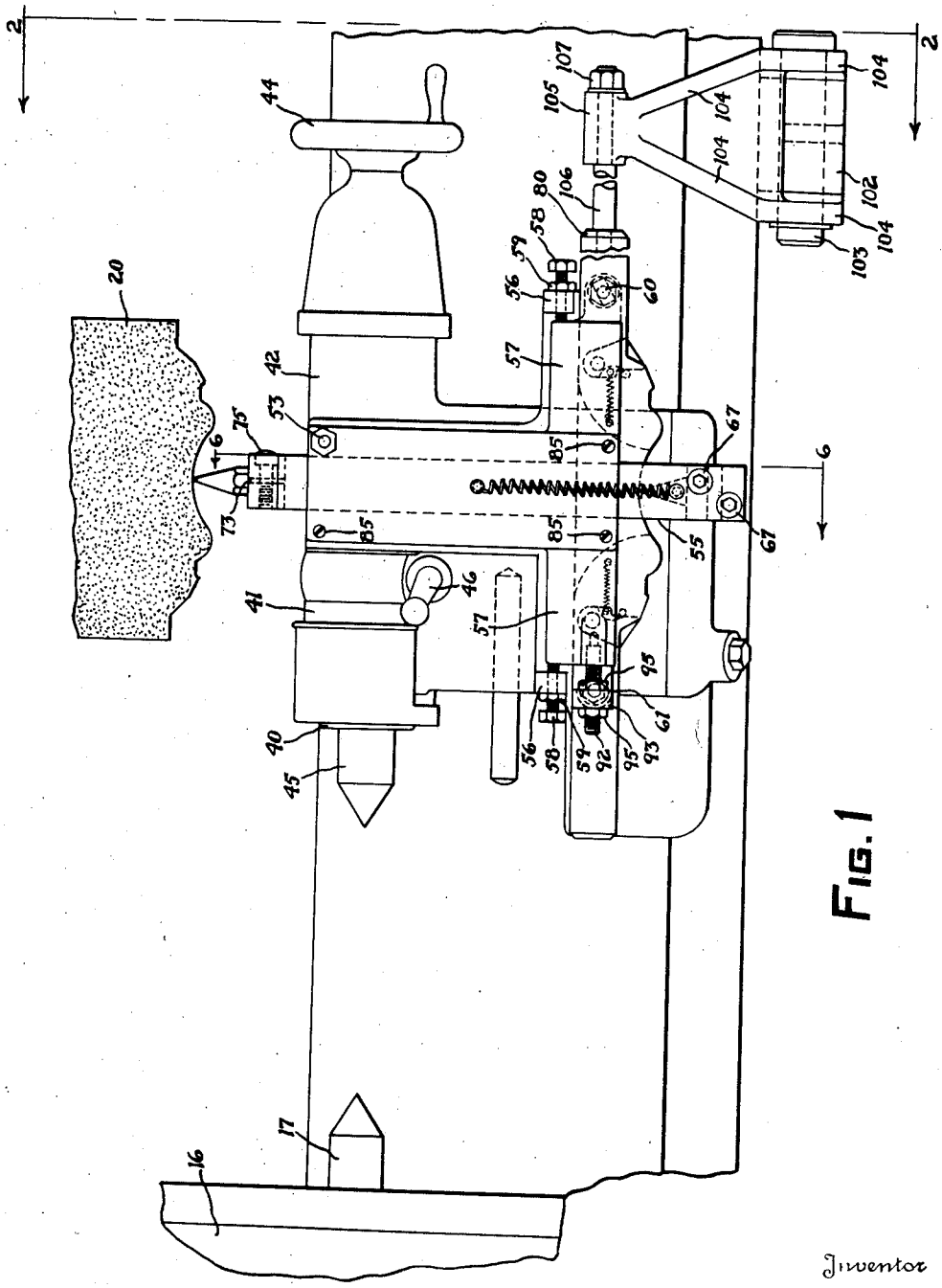



FIG. 1

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FORM TRUING

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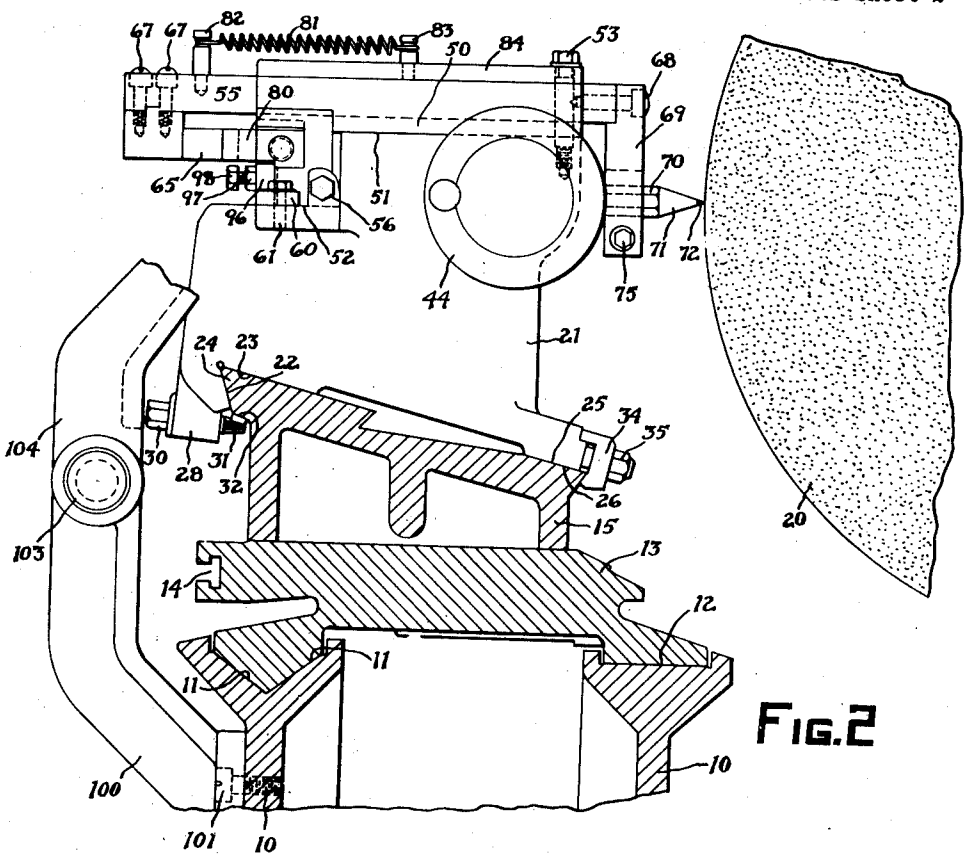



FIG. 2

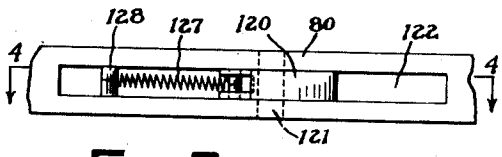



FIG. 3

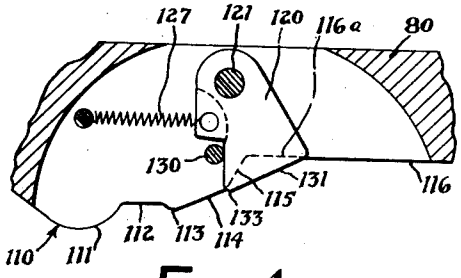



FIG. 4

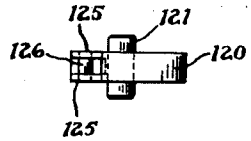



FIG. 5

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FORM TRUING

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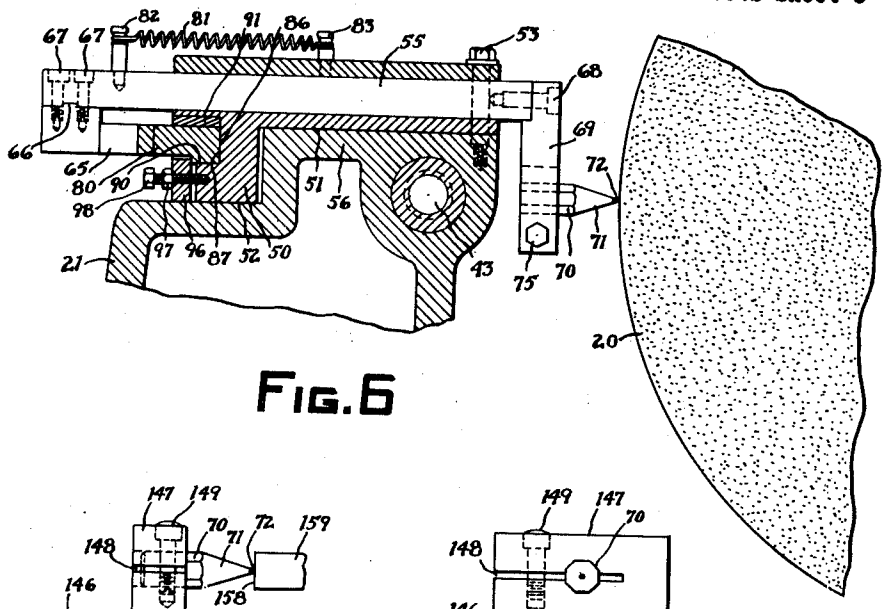



FIG. 6

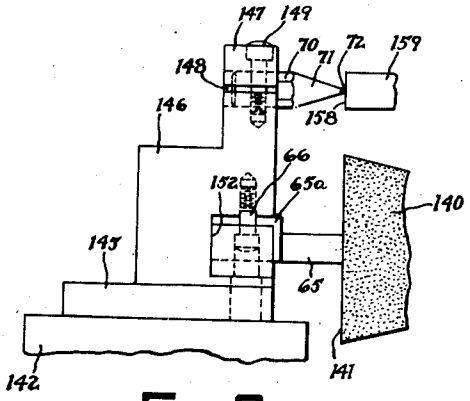



FIG. 9

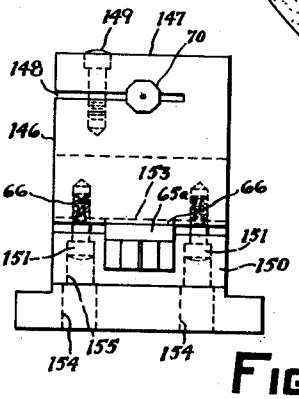



FIG. 8

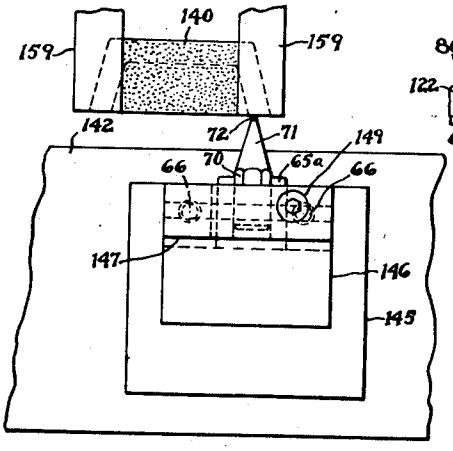



FIG. 10

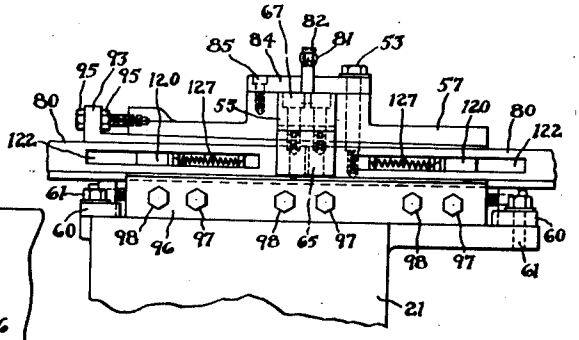



FIG. 7

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# UNITED STATES PATENT OFFICE

2,187,690

## FORM TRUING

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Application September 29, 1938, Serial No. 232,275

2 Claims. (Cl. 125—11)

The invention relates to the form truing of grinding wheels.

One object of the invention is to provide a form truing apparatus for the truing in a single operation of a wheel to a shape including steep surfaces. Another object of the invention is to provide a form truing apparatus incorporated in the tailstock which will quickly true a grinding wheel to a desired shape. Another object of the invention is to provide a method of truing a grinding wheel whereby complicatetd contours may be generated on the wheel. Another object of the invention is to provide a form truing device allowing a follower to move through one path in a given direction and in a different path in the reverse direction. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts, and in the several steps and relation and order of each of said steps to one or more of the others thereof, all as will be illustratively described herein and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings illustrating one of many possible embodiments of the mechanical features of this invention,

Figure 1 is a plan view of a portion of a grinding machine showing a form truing apparatus constructed in accordance with the invention.

Figure 2 is a sectional view through the base, carriage and table of the grinding machine showing the tailstock and form truing apparatus in elevation, the section being taken on the line 2—2 of Figure 1.

Figure 3 is a fragmentary front elevation on an enlarged scale of a portion of the form bar illustrating a latch provided in accordance with the invention.

Figure 4 is a sectional view taken along the line 4—4 of Figure 3.

Figure 5 is a front elevation of the latch of Figures 3 and 4 detached from the machine.

Figure 6 is a vertical sectional view taken on the line 6—6 of Figure 1.

Figure 7 is a fragmentary front elevation of the form truing apparatus.

Figure 8 is a front elevation of apparatus for shaping the forming follower.

Figure 9 is a side elevation of the apparatus of Figure 8.

Figure 10 is a plan view of the apparatus of Figures 8 and 9.

The apparatus of the invention may be applied to a cylindrical grinding machine of any desired type. As illustrated particularly in Figure 2, such a machine comprises a base 10 having V-ways 11 and a flat way 12 for the support of a carriage 13. Any suitable apparatus, not shown, may be provided to traverse the carriage 13 along the ways 11 and 12. Manually operated as well as power mechanical apparatus and hydraulic mechanisms are now well known for this purpose and on the front of the carriage 13 is a T-slot 14 for the adjustable positioning of table dogs automatically to reverse the direction of traversing of the carriage 13.

Mounted upon the carriage 13 and fastened to it in any suitable manner is a table 15. Referring to Figure 1, fastened to the table 15 near one end thereof is a headstock including a rotatable face plate 16 and a head center 17. A grinding wheel 20 which is to be form trued is mounted on a spindle, not shown, journalled in a cross slide mounted for movement in a direction transverse to the axis of the head center 17. The foregoing constitutes a conventional grinder to which the apparatus of the invention may be applied.

Considering now the apparatus which is more particularly the subject of the present invention, I provide a tailstock base 21 which is also the base and support for the form truing mechanism. This base 21 has a pair of surfaces 22 and 23 forming an interior dihedral angle and constituting ways which fit corresponding surfaces on a portion 24 of the table 15 forming an exterior dihedral angle of the same included angle. At the rear of the table 15 is a plane surface 25 forming a flat way for the support of a flat way surface formed on the under side of the base 21. I provide a depending lug 28 integral with the base 21 and below the surface 23 through which extends a bolt headed stud 30 the rear end of which is formed into a pinion gear 31 which meshes with a rack 32 fastened to the under side of the portion 24 of the table 15. By applying a wrench to the bolt headed stud 30 the entire base 21 may be moved along the table 15 for adjustment purposes. When the base 21 is adjusted to the desired position it is preferably locked there, as by means of one or more gibs 34 extending below the way surface 26 of the table 15 and capable of being tightened against the table 15 by means of bolts 35. Thus the base 21 for the tailstock and form truing apparatus may readily be adjusted along the table 15 and when brought to the desired position may be securely locked to the table 15 which in turn is rigidly attached to the carriage 13 which is

mounted for movement only in a straight line along the ways 11 and 12.

The tailstock itself may be of any desired or preferred type and as shown comprises a movable tailstock socket member 40 mounted for movement axially in extended bearings 41 and 42 formed integrally with the base 21, the socket member 40 being keyed to prevent rotation thereof and being moved axially by means of a screw 43 (Figure 6) fastened to a hand wheel 44. Into the socket member 40 is driven a tail center 45. A tail center locking device 46 is preferably also provided.

Refering now to Figures 1, 2 and 6 I provide a slideway member 50 which has a pair of flat surfaces 51 and 52 fitting flat plane horizontal surfaces formed on the footstock base member 21.

The slideway member 50 is pivotally mounted on the base member 21 by means of a pivot bolt 53 (Figure 1). This slideway member 50 supports a diamond holding slide 55 which fits in a groove in the slideway member 50. The reason for pivotally mounting the slideway member 50 on to the footstock base 21 is to enable the operator to adjust the mechanism so that the diamond slide 55 will move exactly perpendicularly to the direction of movement of the table 15 and carriage 13. For the purpose of accurately adjusting and locking in position the slideway member 50 I provide upwardly extending lugs 56, one on either side of lateral extensions 57 of the diamond slide 55, and adjusting bolts 58 extend through these lugs 56 and may be used accurately to position the slideway member 50 and to hold it rigidly. When the desired adjustment has been made, nuts 59 hold the bolts from moving. In order to hold the slideway member 50 from vertical movement I further provide ears 60 extending laterally from the slideway member 50 and having slots receiving bolts 61 which extend into the base 21.

The slide 55 has detachably connected to it on the front end thereof a follower member 65. As shown in Figure 6 this follower member 65 depends from the slide 55 and has a tongue portion 66 fitting in a groove in the slide 55 and is rigidly locked to the slide 55 by means of screws 67. At the other end there is attached to the slide 55 by means of screws 68 a truing bracket 69 having a hexagonal opening below the level of the slide 55 receiving a hexagonal diamond holder 70 having a conical end 71 with a diamond 72 set therein. The lower end of the bracket 69 is split as shown at 73 in Figure 1 and a clamping screw 75 rigidly locks the diamond holding member 71 in position or permits it to be removed and reinserted in a new angular position.

The follower 65 is maintained against a form bar 80 by means of a spring 81 extending between a pin 82 extending upwardly from the slide 55 and a pin 83 extending upwardly from a cover plate 84 which is attached to the slideway member 50 as by screws 85. The form bar 80 has a vertical plane back surface 86 which rests against a vertical plane 87 formed on the slideway member 50. One important reason for the adjustments provided for the slideway member 50 is to permit this surface 87 to be oriented exactly parallel to the apex of the dihedral angle of the ways 11. In other words, the support for the form bar should be exactly parallel to the direction of movement of the table or carriage of the grinding machine in order that the contour on the grinding wheel shall exactly correspond to the contour of the form bar 80. The form bar 80 also rests against a horizontal surface 90 provided on the slideway member 50 and is pressed into engagement with it by means of a tapered gib 91 which can be moved horizontally by means of a screw 92 passing through a lug 93 extending upwardly from the gib 91, the screw 92 passing into a tapped hole in the slideway member 50 and being locked in position by a pair of nuts 95. Thus the form bar is received in the slideway member 50 and lost motion in a vertical direction is effectively eliminated. For holding the form bar 80 in contact with the surface 87 I provide a slideway member 96 which may be drawn horizontally toward the slideway member 50 by means of bolts 97 and may be locked in position by stand-off screws 98.

The foregoing constitutes means for mounting the form bar in back of the follower member 65 and holding it against surfaces formed in the slideway member 50 but the form bar is stationary i. e., it is tied to the base 10 of the machine, while the rest of the apparatus described above the carriage 13 is movable since the carriage 13 is traversed along the slideways 11 and 12. Referring now to Figures 1 and 2, I provide a bracket 100 bolted by means of bolts 101 to the base 10 of the machine and this bracket has a journal boss 102 at the top thereof receiving a pin 103 which extends through a forked arm 104 and thus pivotally mounts the arm 104 to the bracket 100. Extending through a boss 105 constituting the outer end of the arm 104 is a shaft 106 which is threaded at both ends, one end being screwed into the form bar 80 and the other end receiving a nut 107 for locking it to the boss 105, there being a shoulder on the shaft 106 resting against the end of the boss 105. This holds the form bar stationary with respect to the base 10 so that as the carriage 13 traverses the follower 65 will ride over the form bar and this action in turn will cause the diamond slide 55 to move forward and back following the contour of the form bar, the spring 81 maintaining the follower 65 in contact with the form bar.

I provide apparatus which according to the illustrative embodiment of the present invention is incorporated in the form bar and permits the diamond to move to generate a surface on the grinding wheel having an angle steeper than forty-five degrees to the axis of the wheel. Difficulty has heretofore been experienecd in moving a diamond at such an angle by means of a form bar or any similar camming device. According to the preferred embodiment of the present invention I permit the diamond to move toward the grinding wheel under spring pressure to generate the desired contour but when the diamond is moved in the reverse direction and is to be moved outwardly I cause the follower to by-pass the steep portion of the form bar.

Referring now to Figure 4, I have shown a form bar which has a front forming surface 110 including a portion with a fixed radius 111, a straight portion at a slight incline 112, a small bump 113, a portion with a steeper incline 114 and a very steep portion 115 merging into a perfectly straight portion 116. The follower member 65 will ride over all of the portions excepting portion 115 with no difficulty because they are none of them inclined at more than forty-five degrees to the line of movement of the carriage 13. When it comes to the portion 115 the follower member 65 will readily move over it to the right, but since the portion 115 makes an angle with the straight portion 116 of more than forty-five degrees, the follower member 65 will not ride

by this surface 115 to the left without deforming the parts or possibly breaking one or more of them. I provide a latch to by-pass the follower 65 away from this surface 115 and a short portion 116a of the surface 116.

Referring now to Figures 3, 4, and 5, the latch 120 is pivotally mounted on a pin 121 and is located in a cutout 122 having horizontal upper and lower walls formed in the form bar 80. In the latch 120 is a cutout forming a pair of ears 125 between which extends a pin 126 to which is attached a spring 127 anchored to a stationary pin 128 thus urging the latch 120 in a clockwise direction. Normally the latch is held in the position shown in Figure 4 against a stop pin 130. With the latch in this position the follower 65 can move from the right to the left and will engage and pass along a front surface 131 of the latch 120 which is inclined to the surface 116 by an acute angle less than forty-five degrees or by an obtuse angle inclined more than one hundred and thirty-five degrees. However when the follower 65 is moving outwardly on the form bar 80 it contacts a corner 133 of the latch 120 and since the latch is only loosely held by the spring 127 it is swung around the pivot 121 thus allowing the point of the follower 65 to ride along the steep surface 115 on to the straight surface 116a.

Thus using the apparatus of my invention it is possible to form grinding wheels to shapes which hitherto could not be generated by form truing since as the diamond moves toward the axis of the wheel it follows the form bar to generate the desired shape, although when moving outwardly from the wheel the diamond follows a course which jumps the steep indentations formed in the wheel. It is sufficient, however, for shaping a grinding wheel to move the diamond in one direction relatively to it and therefore I can generate the desired shape in a grinding wheel by the mechanism herein described.

For the correct generation of a shape on the grinding wheel the same as the shape of the form bar 80 in silhouette, it is desirable that the point of the follower be the same shape as the hexagonal diamond holder 70 and its conical end 71 and the diamond 72. I provide a device to shape the follower the same as these parts in plan view silhouette. Every time the diamond holder is turned to a different position in the truing bracket 69 this silhouette changes somewhat because the diamond 72 is not ordinarily a body of simple geometrical shape. The diamond 72 is usually an irregular diamond fragment and what silhouette it has in plan view depends upon its orientation in the diamond holder 69. Accordingly I provide apparatus which may be used not only to form originally the shape of the follower but also which may be used to reform it from time to time.

Referring now to Figures 8, 9 and 10, I provide a grinding wheel 140 mounted and rotated by any suitable mechanism and which has a flat or plane grinding face 141. This grinding wheel 140 is adjacent to a table 142 with a plane horizontal upper surface. I provide a rectangular parallelopipedal base 145 integrally formed with an upstanding block 146 which includes an upward extension 147. In the upward extension 147 is a hexagonal hole of a size to receive the diamond holder 70. One side of the extension 147 is slotted at 148 so that the diamond holder 70 may be securely clamped in the extension 147. A screw 149 effects the clamping.

The follower member 65 includes a follower block 65a which fits in a cut out formed in a clamping block 150 which may be securely fastened to the block 146 by means of screws 151. The clamping block 150 and the follower block 65a fit in a cut out 152 formed in the block 146. The tongue 66 fits in a groove 153 formed in the block 146 and the follower block 65a and the clamping block 150 may be slid laterally into position prior to inserting the screws 151 which are inserted through holes 154 in the base 145 and concentric holes 155 in the block 146. The parts associate so as to locate the follower block 65a with its center exactly below the axis of the diamond holder 70.

When the parts are set up as described the operative portion of the follower 65 may be shaped by simply moving the base 145 over the table 142 with the diamond 72 or the conical surface 71 in contact with the plane front surface 158 of a block 159 supported in any suitable manner above the grinding wheel 140 with the surface 158 in the same geometrical plane as the front face 141 of the grinding wheel 140. Thus the follower 65 may be shaped or reshaped, it preferably being made of cast iron or other metal. For every reshaping thereof the diamond holder 70 can be moved slightly more into the extension 147 to provide some material to be ground off the follower 65.

In operating the machine, after locating the base 21 and adjusting the slideway member 50 and shaping the follower 65 as just described, the operator transfers the follower 65 to the diamond holding slide 55 and fastens it in position. Then either manually or by power he traverses the grinding carriage 13, moving the cross feed of the grinding machine until the grinding wheel 20 contacts the diamond 72. It should be understood that normally the grinding wheel 20 will have been preshaped to approximately the desired shape by some rougher means of truing or by molding the grinding wheel 20 into approximately that shape. The apparatus of the present invention is designed to give great accuracy to the shape of a grinding wheel, as desired, for the purpose of grinding any article that has to be shaped to a peculiar contour within close limits. For example, dies for the drawing of metal to make moldings or other articles should be carefully formed and the apparatus of the present invention can be used to form a grinding wheel so that by a plunge cut grinding operation such dies can be readily shaped. By repeated reciprocations of the carriage an ordinary cylindrical grinding wheel can be shaped into a special shape with the apparatus of the present invention but quicker results can be achieved using some approximate method for preliminarily shaping the grinding wheel.

Whatever the case may be, the operator form trues the grinding wheel by slow reciprocation of the carriage 13 while gradually feeding the grinding wheel toward the truing device. The form bar 80 moves the slide 55 to shape the wheel exactly, and for steep portions such as the portion 115 of the form bar and the corresponding portion on the grinding wheel the diamond moves into contact with the wheel and generates the correct shape thereon once for each complete reciprocation. In the reverse direction the latch 120 causes the form bar to move gradually away from the grinding wheel as already described.

It will thus be seen that there has been provided by this invention an apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In form truing apparatus a form bar, a slide, a follower carried by the slide, resilient means causing the follower to engage the form bar, and a latch to lift the follower away from the form bar in one relative direction of traverse while allowing the follower to contact the form bar in the reverse direction of traverse.

2. In form truing apparatus a combination with a slide, a follower attached to the slide, a truing device also attached to the slide, a form bar in position to contact the follower, and means to traverse the slide relative to the form bar in a direction substantially perpendicular to the direction of movement of the slide, of additional means to cause the follower to follow the form bar in one relative direction of traverse and to ride away from the form bar in the opposite direction of traverse.

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