Dec. 27, 1949 E. F. WHITE 2,492,722

APPARATUS FOR DRESSING GRINDING WHEELS

Filed May 2, 1946 3 Sheets-Sheet 1

Fig. 1.

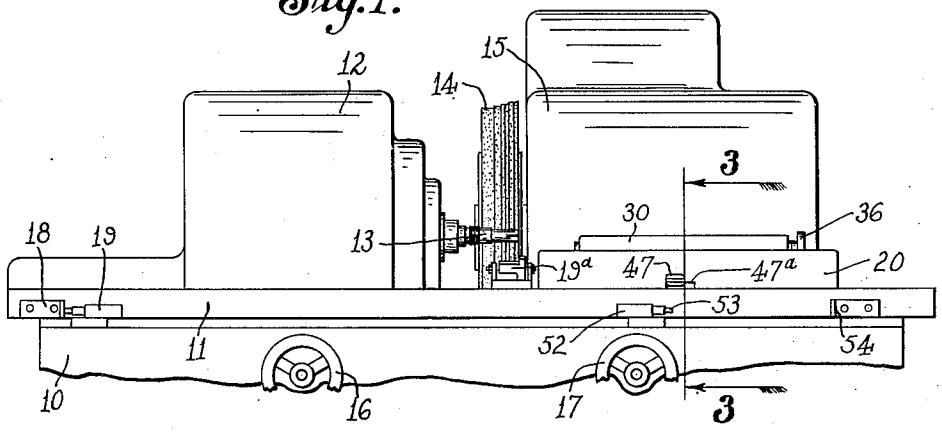


Fig. 2.

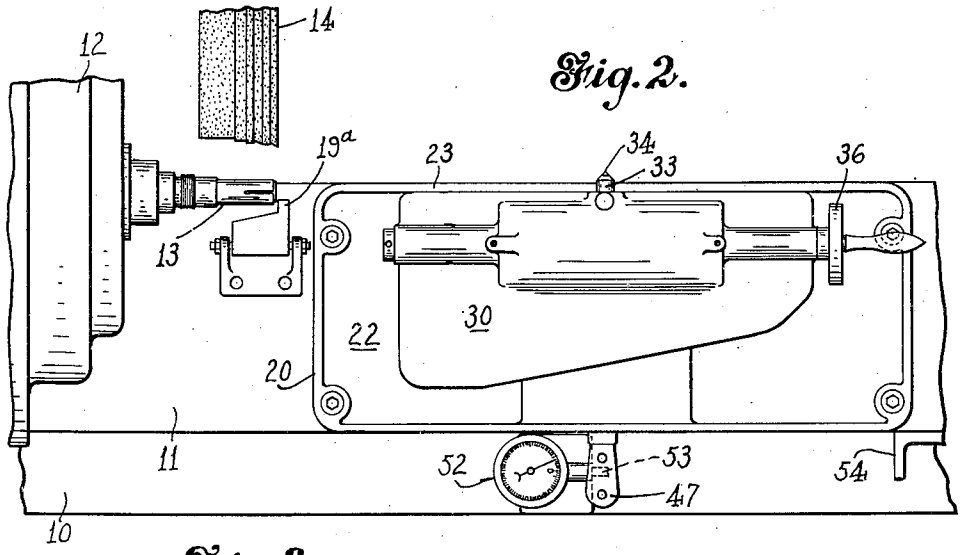
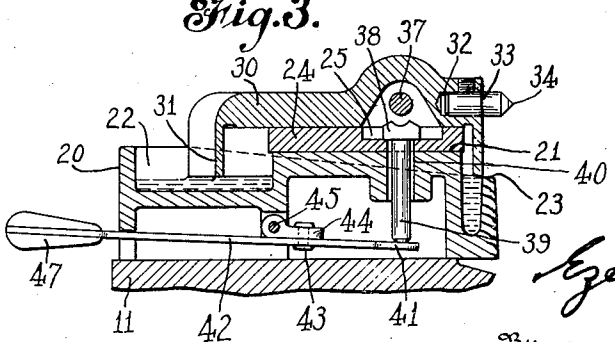


Fig. 3.



Inventor

Ezekiel Field White

By Rockwell & Barcholow

Attorneys

Dec. 27, 1949 E. F. WHITE 2,492,722

APPARATUS FOR DRESSING GRINDING WHEELS

Filed May 2, 1946 3 Sheets-Sheet 2

Fig. 4.

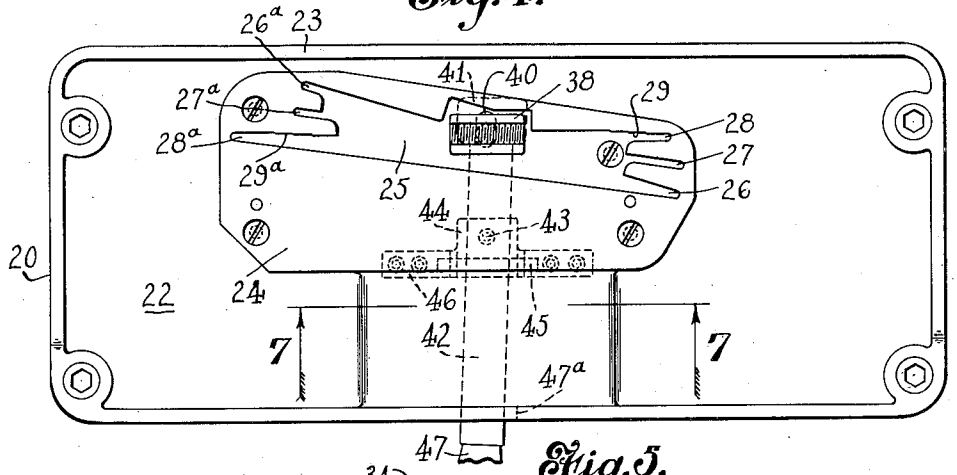


Fig. 5.

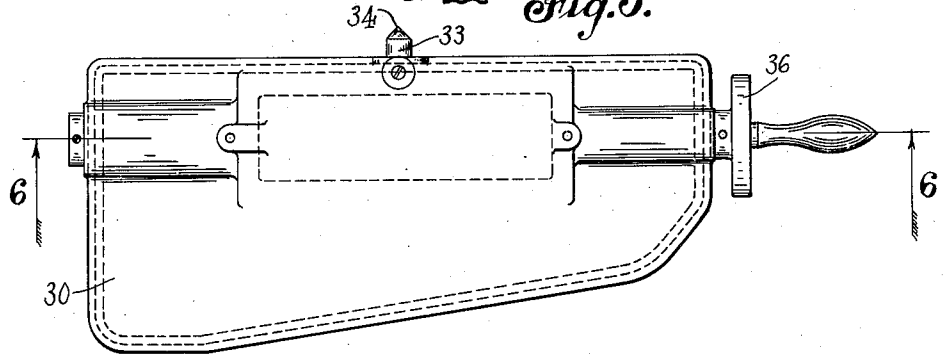


Fig. 6.

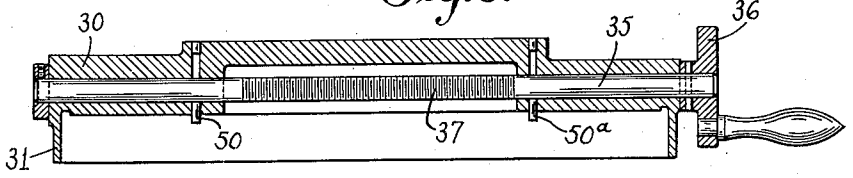
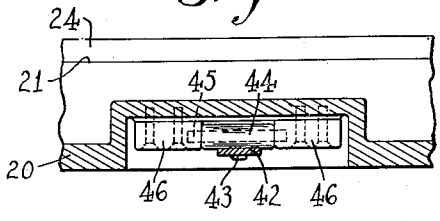


Fig. 7.



Inventor

Ezekiel Field White

By Pickwell & Anderson

Attorneys

Dec. 27, 1949 E. F. WHITE 2,492,722

APPARATUS FOR DRESSING GRINDING WHEELS

Filed May 2, 1946 3 Sheets-Sheet 3

Fig. 8.

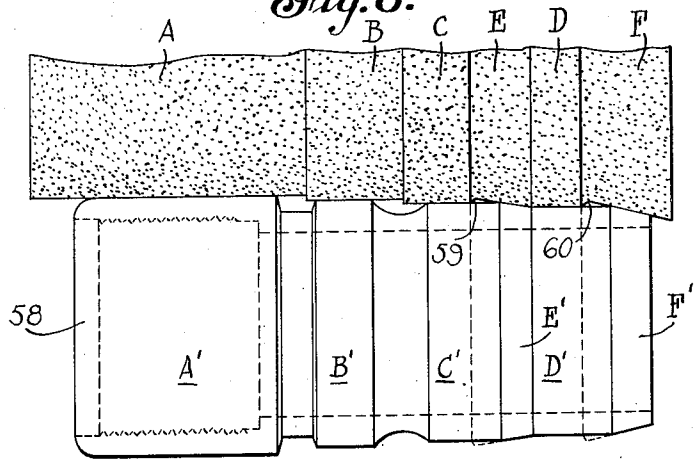


Fig. 9.

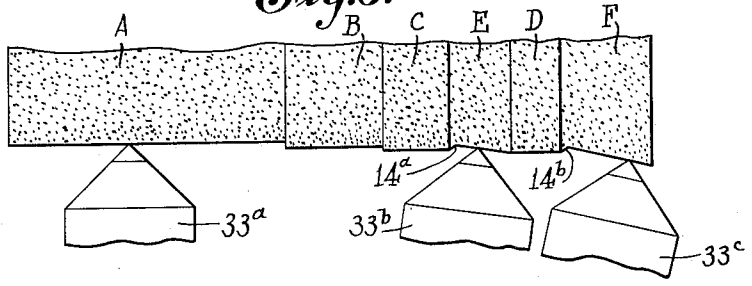


Fig. 11.

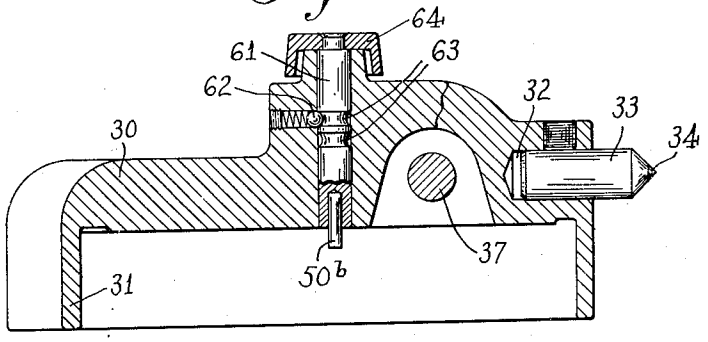
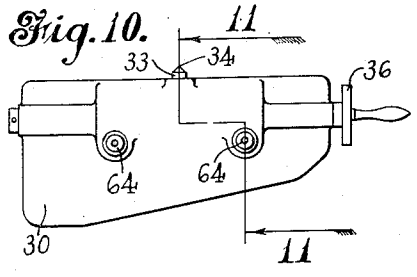


Fig. 10.



Inventor

Ezekiel Field White

By Rockwell & Beckstrom

Attorneys

Patented Dec. 27, 1949 2,492,722

UNITED STATES PATENT OFFICE

2,492,722

APPARATUS FOR DRESSING GRINDING WHEELS

Ezekiel Field White, West Hartford, Conn.

Application May 2, 1946, Serial No. 666,713

16 Claims. (Cl. 125—11)

1

This invention relates to an apparatus for dressing grinding wheels, and more particularly to the dressing of a grinding wheel, the surfaces of which are not all parallel to each other, so that certain areas or zones upon the wheel stand at an angle to other or others of the areas or zones upon the wheel.

In grinding operations, it has been the custom, particularly in grinding small work, to advance the work against a rotating grinding wheel, the surface of which is complemental to that desired upon the finished workpiece. Thus, if the surface of the work is irregular in shape, the surface of the grinding wheel has also been irregular in shape so that all of the areas on the workpiece would be properly ground by the wheel in one operation.

It has been necessary to keep the surface of the grinding wheel truly and accurately dressed in order to perform accurate grinding upon the work, and it has usually been necessary to redress the wheel after a certain number of operations owing to the wear upon its surface. This dressing operation has usually been performed by traversing a cutting tool, such as a diamond, over the surface of the wheel and controlling the tool so that it will generally follow the outline of the surface desired upon the wheel. This method has the disadvantage, however, that, while it may produce fairly accurate results when the diamond cutter is sharp, it will not produce such results when the latter is dull, and this is particularly true when the work, and, therefore, the wheel, is provided with cylindrical and frusto-conical portions or areas, the conical portions lying at an angle to the cylindrical portions.

The reason for this will be apparent, for, when the diamond is dull and the cutter is traversed over the surface of the wheel, the blunt point of the diamond will, when it approaches the edge of one of the surfaces, cut into the adjacent edge of the adjacent surface so that it will not effect a sharp line of demarcation between the cylindrical and conical surfaces, and the wheel will not have the proper profile to accurately shape the work.

The present invention is designed to prevent this inaccuracy due to the point of the cutter becoming dull, and it is contemplated that with the employment of the apparatus shown a grinding wheel may be properly and accurately dressed by a cutter, regardless of how dull the point may have become, so along as it will cut the wheel. More specifically, this result is effected by maintaining the axis of the cutter at substantially right angles to the surface of the wheel upon

2

which it is operating at all times during the cutting operation. In other words, when the cutter is operating on a portion of the surface of the grinding wheel which is parallel to the axis of the wheel, the cutter will stand at right angles to the wheel axis, but when the cutter operates upon a portion of the surface of the wheel which is at an oblique angle to the wheel axis, the cutter will be swung pivotally through the proper angle which will position it at right angles to the surface which is to be dressed.

The surface of the grinding wheel will thus be properly dressed, and in order to accomplish this a certain amount of undercutting is required where a cylindrical portion of the wheel joins a frusto-conical portion. Therefore, the wheel is not dressed to the exact form of the finished work owing to the necessity for this undercutting due to the angular relation of the diamond to the axis of the wheel. As will be hereinafter explained, this undercut, which is produced on one area of the wheel while the cutter is operating on an adjacent area, will not affect the final shape of the finished work, and this undercut will be produced whether the cutter has a sharp or blunt point.

In performing grinding operations with a wheel dressed according to the present invention, and particularly when the work is composed of cylindrical and frusto-conical portions, the work is advanced against the rotating grinding wheel until the desired dimensions have been secured, except at portions opposite the undercut zones upon the wheel at which a certain amount of surplus material will remain. The work is then moved laterally with relation to the wheel to remove this surplus stock occurring at the junction of the cylindrical and conical portions of the work, and thus the junction between two such portions is sharp and formed to perfect dimensions.

One object of the invention is to provide a new and improved apparatus for dressing grinding wheels.

A further object of the invention is to provide an apparatus for dressing grinding wheels having surfaces making various angles with the axis of the wheel, whereby the cutting or dressing tool will be so controlled as to cut a true and accurate surface on the wheel regardless of whether the cutting tool may be sharp or dull.

Still another object of the invention is to provide an improved apparatus for dressing grinding wheels having a cutter mounted upon a carrier, and provision for traversing the cutter

along the surface of the wheel as well as for permitting the carrier to swing angularly in order to maintain the axis of the cutter at right angles to the surface of the wheel engaged by it even though certain of the surfaces upon the wheel may stand at an angle to other surfaces thereof.

To these and other ends, the invention consists in the novel features and combination of parts to be hereinafter described and claimed herein.

In the accompanying drawings:

Fig. 1 is a front elevational view of a portion of a grinder to which my invention is applied;

Fig. 2 is a partial top plan view of the same, showing the wheel dressing device;

Fig. 3 is a sectional view on line 3—3 of Fig. 1;

Fig. 4 is a top plan view of the dressing device with the movable carrier removed to show the master plate;

Fig. 5 is a top plan view of the tool carrier;

Fig. 6 is a sectional view taken on line 6—6 of Fig. 5;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 4;

Fig. 8 is an enlarged view showing the action of a grinding wheel upon a piece of work;

Fig. 9 is an enlarged fragmentary view, showing the action of the cutter when the wheel is being dressed;

Fig. 10 is a view similar to Fig. 5, showing a slightly modified form of cutter carrier; and

Fig. 11 is a sectional view taken on line 11—11 of Fig. 10.

To illustrate a preferred embodiment of my invention, I have shown in Figs. 1 and 2 of the drawings a grinding machine comprising a base or bed 10 upon which is slidably mounted a work slide 11 having thereon work-rotating mechanism 12 for rotating the work spindle 13 to rotate the work in contact with the surface of a grinding wheel 14, the wheel being rotated by suitable mechanism 15. As will be understood by those skilled in the art, the foregoing elements may be of the usual form, and controls 16 and 17 are provided to move the grinding wheel up to the work and for moving the slide 11 along the bed.

A stop 18 on the carriage slide cooperates with a gauge 19 on the bed to set the carriage at the proper position for grinding the work, while a work stop or gauge 19a on the carriage determines the precise positioning of the work with respect to the grinding wheel 14 in order that the work will be given the proper shape or profile. The structure so far described may be that of the conventional grinding machine and illustrates the type of device to which my novel structure may be applied as will now be described.

Secured to the carriage slide 11 is a base member 20 provided with an upwardly facing table 21 surrounded by a well 22 for a sealing fluid, this well being bounded at the front of the table by a lip 23. Rigidly mounted upon the table 21 is a master plate or matrix 24, this plate being of the form shown in Fig. 4. As illustrated, it is provided with a recess or opening 25 at its upper surface, this recess being provided at each end with fingers or slots designated by the numerals 26, 27, 28, 26a, 27a, and 28a. It may also be noted that the inner (upper as shown in Fig. 4) edges of the slots 28 and 28a are provided with stepped portions 29 and 29a, the purpose of which will be described hereinafter.

Mounted upon the master plate 24 is a tool carrier or cutter carrier 30, this carrier having a peripheral depending flange 31 adapted to make sealing contact with the liquid in the well 22. The tool or cutter carrier 30 is freely mounted upon the plate 24 so that it may move slidably longitudinally thereof and also be moved freely transversely of the plate and also be swung rotatably to a limited extent thereon. The cutter carrier is provided with a socket 32 in which the tool 33 may be secured, this tool carrying the cutter point 34 which may be the usual diamond cutter.

As illustrated, the well 22 extends entirely around the carrier 30, as also does the lip 31. Thus the interior of the tool-carrying mechanism is sealed against the entrance of extraneous material, particularly grit, and thus undue wear on the parts, and particularly the master plate 24, is prevented. It will be understood that the level of the water or liquid within the well 22 will be maintained at a definite height, and, as shown, the master plate is mounted above this level, but the downwardly projecting lip or skirt 31 will contact the liquid level and form a seal against the entrance of extraneous matter to the surface of the plate.

Rotatably mounted in the cutter carrier 30, as shown more especially in Figs. 5 and 6, is a shaft 35 suitably restrained against longitudinal movement, this shaft carrying a hand wheel 36 by which it may be rotated and being provided adjacent its central portion with threads 37.

Cooperating with the threads 37 of the shaft 35 is a nut 38 carried upon a pin 39 passing loosely downwardly through elongated openings 40 in the master plate and the table 21. The lower end of this pin rests upon the forward end 41 of a lever 42 pivoted at 43 to a shoe 44 rockably mounted upon a pin 45, which pin has its ends rockably mounted in brackets 46 (Fig. 7) secured to the lower side of the base member 20. The lever 42 extends outwardly through a stepped opening 47a in the base member, and is provided with a handle 47 by which the outer end of the lever may be depressed, thus raising the inner end and carrying the nut 38 into operative engagement with the screw threads 37 of the shaft 35. The lever may then be moved laterally about its pivot 43 to engage in the shallower portion of the opening 47a and thus hold the nut 38 in raised position so that rotation of the shaft 35 will feed the cutter carrier and cutter across the surface of the grinding wheel 14.

It has already been stated that the tool carrier 30 is capable of universal movement upon the master plate 24, and it is for this reason that the opening 40, through which passes the pin 39, is elongated transversely of the master plate 24 so as to permit the cutter carriage 30 to move transversely to the axis of the shaft 35 and still retain feeding relation between this shaft and the nut 38.

To guide the cutter carrier 30 in its movements the latter is provided with downwardly projecting pins 50 (Fig. 6) on its under surface, which pins are adapted to be guided within the recesses 26, 27, 28, 26a, 27a, and 28a at the ends of the opening or recess 25. It will, of course, be understood that the shape and disposition of these guide slots in the master plate to control the movement of the cutter carrier or tool carrier will depend upon the profile of the surface of the grinding wheel, and as will be hereinafter explained the particular master plate shown is so constructed as to properly guide the cutting tool in dressing a grinding wheel of the form shown in Figs. 8 and 9.

The bed 10 of the machine may be provided

with a micrometer gauge 52 having a plunger 53 designed to be contacted by a stop 54 attached to the carriage slide 11 to determine accurately the position of the tool 33 with respect to the grinding wheel 14 so that, when it is desired to dress the wheel, the slide 11 may be moved to the left, as shown in Fig. 1, until the member 53 is contacted by the stop 54 and the reading of the gauge shows that the cutting tool has been brought to the proper position relatively to the grinding wheel.

As shown in Figs. 8 and 9, the grinding wheel is provided with a plurality of cylindrical zones or areas A, B, C and D, the surfaces of which are parallel to the axis of the wheel and also with frusto-conical areas E and F, the surfaces of which are inclined to the axis of the wheel and, of course, also inclined to the surfaces of the cylindrical zones. A workpiece 58 is shown in Fig. 8, the workpiece in this instance being a choke member or sleeve to be applied to a gun barrel, and it will be noted that this member is provided with cylindrical zones A', B', C' and D' and the frusto-conical or tapered zones E' and F' which are complemental to the surface of the grinding wheel.

As heretofore stated, if the grinding wheel 14 were dressed by the ordinary method when the cutter became dull, it would not dress the surface accurately adjacent the junction between the surfaces E and F and the adjacent surfaces or zones C and D. By the present invention accurate dressing of the wheel is obtained by maintaining the axis of the cutting point at right angles to the surface of the wheel being dressed at all times as shown diagrammatically at 33^a, 33^b, and 33^c in Fig. 9.

When the operator of a grinding machine desires to redress the grinding wheel, the slide 11 is moved to the left so as to carry the work 13 away from the wheel and bring the cutting tool 33 to the proper position relatively to the wheel 14. This position is determined by the reading of the gauge 52. The operator then moves the cutter carrier 30 to the left until the pin 50^a seats against the end of the slot 26 in the master plate 24. He then swings the carrier 30 until the pin 50 engages the upper edge of the slot 26^a and with his hand maintains forward pressure upon the carrier 30 so that the pins 50 and 50^a will follow the upper edges of the slots 26 and 26^a when the carrier is moved transversely of the grinding wheel. The operator then raises the nut 38 by pressing downwardly on the handle 47 of the lever 42 and moves this handle laterally in the stepped opening 47^a, so that the nut will be maintained in engagement with the threads 37 of shaft 35. By means of the hand wheel 36, the carrier 30 is then fed toward the left, as shown in the drawings, until the pin 50 has reached the end of the slot 26^a. The surface F of the grinding wheel has been dressed by this operation, the tool being held at the angle shown in Fig. 9 at 33^c. When the pin 50 has reached the end of the slot 26^a the nut 38 is dropped and the carrier 30 moved again to the left to permit the pin 50 to drop into the slot 27^a and the pin 50^a is then moved forwardly and positioned in the slot 27. The cutter is again fed across the work by rotation of the hand wheel 36, the cutter at this time being mounted at the angle shown at 33^b in Fig. 9 and dressing the inclined surface E upon the wheel.

In the same manner, the pins 50 and 50^a are then positioned in the slots 28 and 28^a and the

tool again fed across the work. The stepped upper edges 29 and 29^a of these slots cause the tool to dress the areas D, C, B and A which are of unequal radii. During this movement the tool is maintained at a position at right angles to the axis of the work as shown at 33^a in Fig. 9.

It will be apparent that at the ends of the movements of the tool over the surfaces F and E, small undercut corners 14^a and 14^b may be left adjacent the zones D and C in order to prevent the tool cutting over into these zones, and when the workpiece 58 is ground on the wheel small projections 59 and 60 may be left thereon. These may readily be removed, however by moving the workpiece 58 to the left while in contact with the wheel after the completion of the rest of the grinding operation. This movement to the left, as will be seen, will remove the surplus material at 59 and 60 and leave the workpiece with the smooth cylindrical surfaces C' and D' shown in Fig. 8.

By dressing the grinding wheel in the manner described above accurate results are always obtained and are not dependent upon the sharpness of the diamond point employed. Thus a point may be used as long as it is sharp enough to cut, and the shape and dimensions of the work produced will be the same with the last use of the point as with the first regardless of the wear to which it may have been subjected.

In Figs. 10 and 11 of the drawings I have shown a slightly modified form of my invention, particularly with respect to the pins 50 and 50^a. In the form of my invention previously described these pins are fixed with respect to the cutter 30. It may be, however, that in some kinds of work the master plate will be of complex form, and it will be difficult, when the pins are fixed, to cause these pins to enter the various guiding surfaces of the plate. As shown in Fig. 11, for example, the pins 50^b are set in the lower ends of plungers 61, these plungers being slidably mounted in the upper portion of the tool carrier 30 and being releasably held in upper or lower positions by spring-pressed balls 62 engaging in upper and lower annular recesses 63 in the plungers 61. Each of the plungers 61 may be provided with a cap 64 by which they may be raised or depressed when desired.

Thus when it is desired to move the pins from one slot to another of the master plate the plunger 61 may be raised to raise the pins 50^b out of engagement with the master plate, and the cutter carrier may then be moved to the proper position after which the pins will be lowered to a position to engage the plate. Otherwise, the modification shown in Figs. 10 and 11 does not differ from that shown in the remaining figures of the drawings.

While I have shown and described some preferred embodiments of my invention, it will be understood that it is not to be limited to all of the details shown, but is capable of modification and variation within the spirit of the invention and within the scope of the claims.

What I claim is:

1. An apparatus for dressing grinding wheels comprising a cutting tool, a carrier therefor, means mounting said carrier for substantially rectilinear movement to cause the tool to traverse the surface of the wheel, means for varying the angle of the path of such movement with respect to the wheel axis, said means comprising a plate having an elongated opening therein, a plurality of guide slots communicating with said opening

at each end thereof, and said carrier being provided with elements received in said slots.

2. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base, cooperating means on said plate and carrier to guide the latter through movements in substantially rectilinear paths at different angles with respect to the axis of the wheel being dressed, said cooperating means including a plurality of elements projecting from the carrier, said plate being provided with an elongated opening therein, a plurality of guide slots communicating with said opening at each end thereof, said elements being received in said slots, and means for securing a cutting tool to the carrier.

3. An apparatus for dressing rotatably mounted grinding wheels, comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having a plurality of guide means to guide said carrier in substantially rectilinear paths across portions of the surface of the wheel and at different angles with respect to the axis of the wheel, said guide means including a plurality of slots formed in said plates certain of which extend at oblique angles to the axis of the wheel, and an opening in said plate with which the inner ends of said slots communicate.

4. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having means for holding the carrier at various angular positions with respect to the plate, said last-named means including an elongated opening in the plate and a plurality of guide slots communicating with said opening at each end thereof, means for moving said carrier across the surface of the wheel in substantially rectilinear paths when so held, and a cutting tool secured to the carrier.

5. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having a plurality of rectilinear guide slots arranged at different angular positions thereon, said plate having an elongated opening with which the inner ends of said slots communicate, cooperating means on the carrier to engage said guide means and restrain the movements of the carrier in paths determined by said guide means, means to move said carrier across the surface of the wheel, and a cutting tool secured to the carrier.

6. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having an elongated opening therein and a plurality of guide slots communicating with said opening at each end thereof, some of which are arranged at oblique angles to others thereof, a cutting tool secured to the carrier, pins on the carrier adapted to be received in said slots, and means for traversing the carrier along the plate whereby the movement of the carrier is guided by engagements of the pins in the slots.

7. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having an elongated opening therein and a plurality of guide slots communicating with each opening at each end thereof, some of which are arranged at oblique angles to others thereof, a cutting tool secured to the carrier, pins on the carrier adapted to be received in said slots, and means to effect movement of the carrier with respect to the plate to cause the cutter to traverse the grinding wheel.

8. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having an elongated opening therein, a plurality of guide slots communicating at their inner ends with said opening at each end thereof, some of which are arranged at oblique angles to others thereof, a cutting tool secured to the carrier, pins on the carrier adapted to be received in said slots, means to effect movement of the carrier with respect to the plate to cause the cutter to traverse the grinding wheel, and the outer ends of said slots being closed to limit the traverse movement of the carrier.

9. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having a plurality of elongated slots therein, some of which are arranged at oblique angles to others thereof, a cutting tool secured to the carrier, pins on the carrier adapted to be received in said slots, means to effect movement of the carrier with respect to the plate to cause the cutter to traverse the grinding wheel, said last-named means comprising a threaded shaft rotatably carried by one of said parts, and a cooperating nut associated with the other part.

10. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having a plurality of elongated slots therein, some of which are arranged at oblique angles to others thereof, a cutting tool secured to the carrier, pins on the carrier adapted to be received in said slots, means to effect movement of the carrier with respect to the plate to cause the cutter to traverse the grinding wheel, said last-named means comprising a threaded shaft rotatably carried by one of said parts, a cooperating nut associated with the other part, and said nut being shiftable into and out of engagement with the shaft.

11. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base having a plurality of elongated slots therein, some of which are arranged at oblique angles to others thereof, a cutting tool secured to the carrier, pins on the carrier adapted to be received in said slots, means to effect movement of the carrier with respect to the plate to cause the cutter to traverse the grinding wheel, said last-named means comprising a

threaded shaft mounted on the carrier, a nut movably associated with the plate, and means for moving said nut into and out of engagement with the shaft.

12. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base, a guide plate carried by the base upon which the tool carrier is slidably supported, means for sealing the space between the carrier and base to prevent extraneous material reaching the plate, said means comprising a liquid well provided upon the base, and a downwardly projecting flange on said carrier adapted to engage the liquid in said well.

13. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base, cooperating means on said plate and carrier to guide the latter through movements in substantially rectilinear paths at different angles with respect to the axis of the wheel being dressed, said last-named means comprising a plurality of slots in said plate some of which that are arranged at oblique angles to others thereof, and an opening in said plate with which said slots communicate, means for securing a cutting tool to the carrier, and means for sealing the space between the base and carrier to prevent extraneous material entering therebetween.

14. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base, cooperating means on said plate and carrier to guide the latter through movements in substantially rectilinear paths at different angles with respect to the axis of the

wheel being dressed, means for securing a cutting tool to the carrier, means providing a well on said base adapted to contain a liquid, and a downwardly depending flange on the carrier adapted to project into said liquid.

15. An apparatus for dressing rotatably mounted grinding wheels comprising a tool carrier, a base upon which said carrier is mounted, means for maintaining the carrier on the base for sliding and swinging movement thereon, a guide plate on said base, cooperating means on said plate and carrier to guide the latter through movements in substantially rectilinear paths at different angles with respect to the axis of the wheel being dressed, means for securing a cutting tool to the carrier, means providing a well on said base adapted to contain a liquid, and a downwardly depending flange on the carrier adapted to project into said liquid, said well and flange surrounding the carrier.

16. An apparatus for dressing rotatably mounted grinding wheels, comprising a tool carrier, a guide plate upon which said carrier is slidably mounted, means providing a well for a sealing liquid surrounding said plate, and a flange upon said carrier projecting into said liquid to prevent the entrance of extraneous matter between the carrier and plate.

EZEKIEL FIELD WHITE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,056,149	Griffing	Sept. 29, 1936
2,294,494	Wilson	Sept. 1, 1942
2,304,970	Turner	Dec. 15, 1942
2,313,055	De Vlieg	Mar. 9, 1943
2,391,122	Bunker et al.	Dec. 18, 1945