Feb. 1, 1944. D. F. PRICE ET AL 2,340,683

GRINDING WHEEL DRESSER

Filed June 6, 1940 3 Sheets-Sheet 1

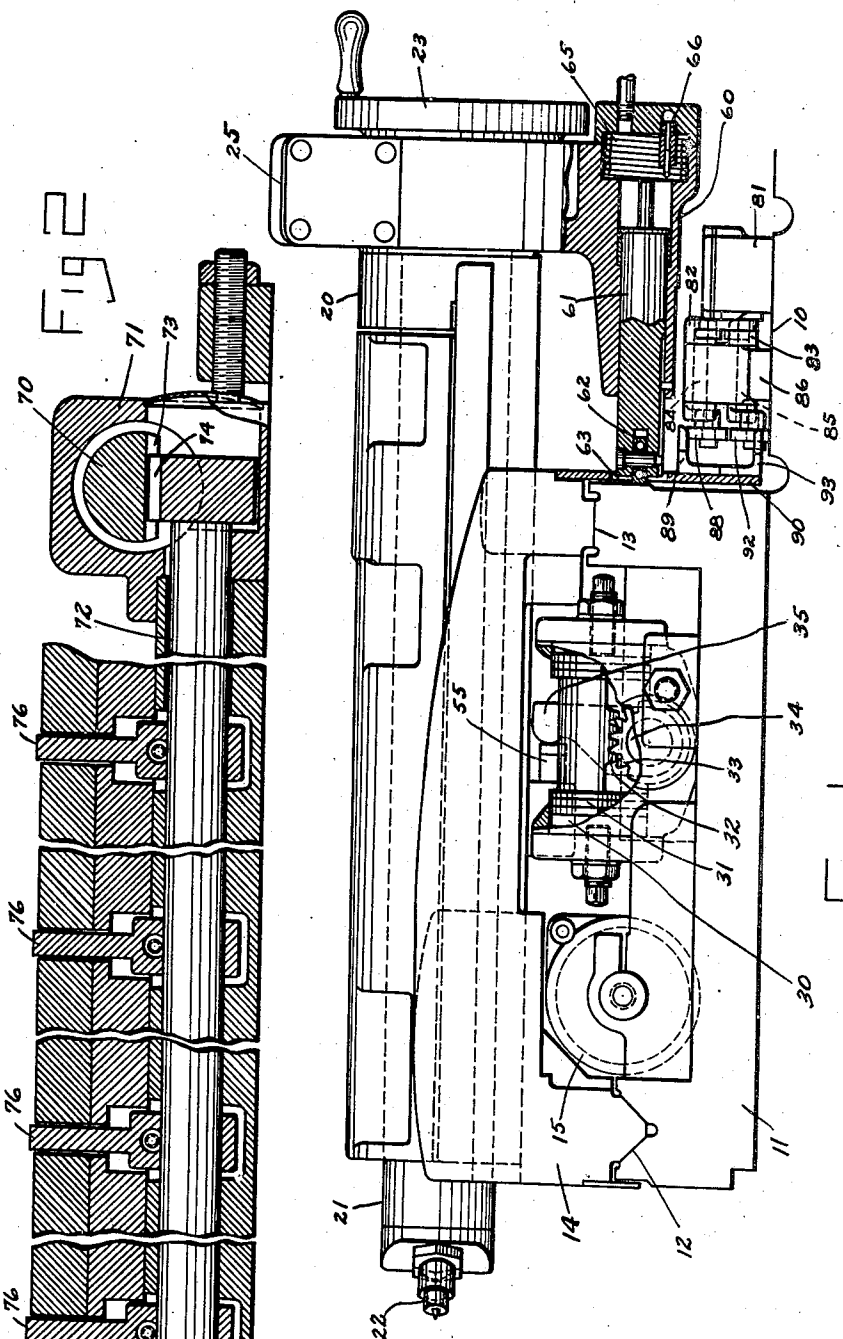


Fig 2

Fig 1

Inventors

DONALD F. PRICE

HAROLD E. BA'SIGER

MILBURN A. HOLLENGREEN

By Hugh M Rocks

Attorney

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Filed June 6, 1940 3 Sheets-Sheet 2

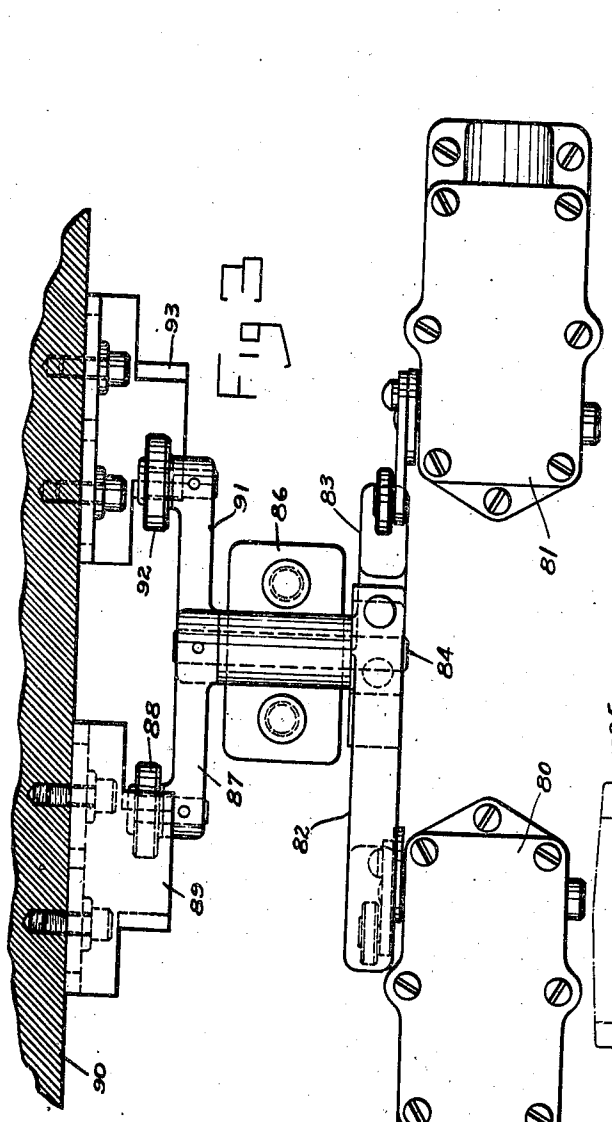


Fig. 3

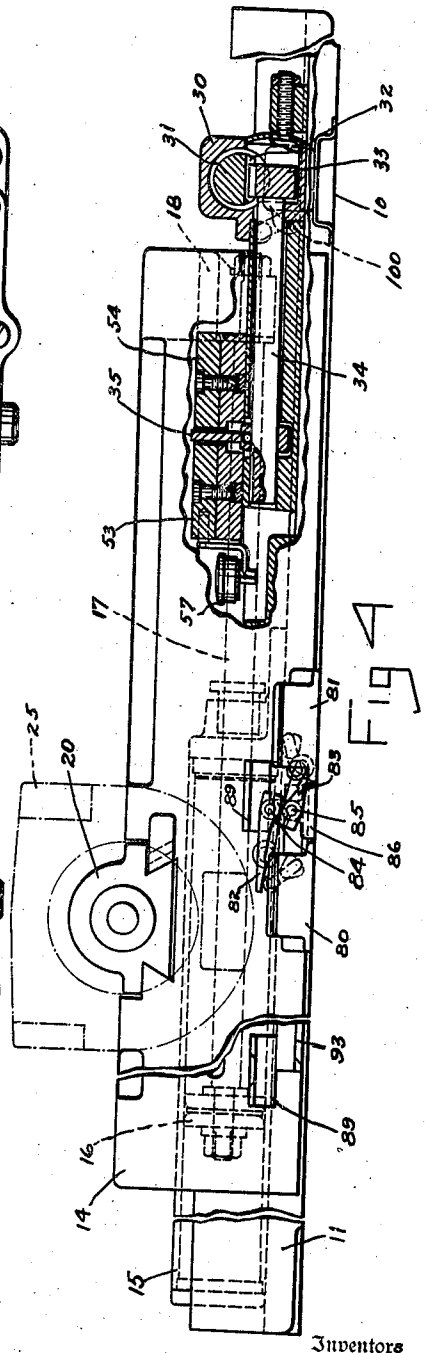


Fig. 4

Inventors
DONALD F. PRICE
HAROLD E. BALSIGER
MILBURN A. HOLLENGREEN

By Hughes & Rockey

Attorney

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Filed June 6, 1940 3 Sheets-Sheet 3

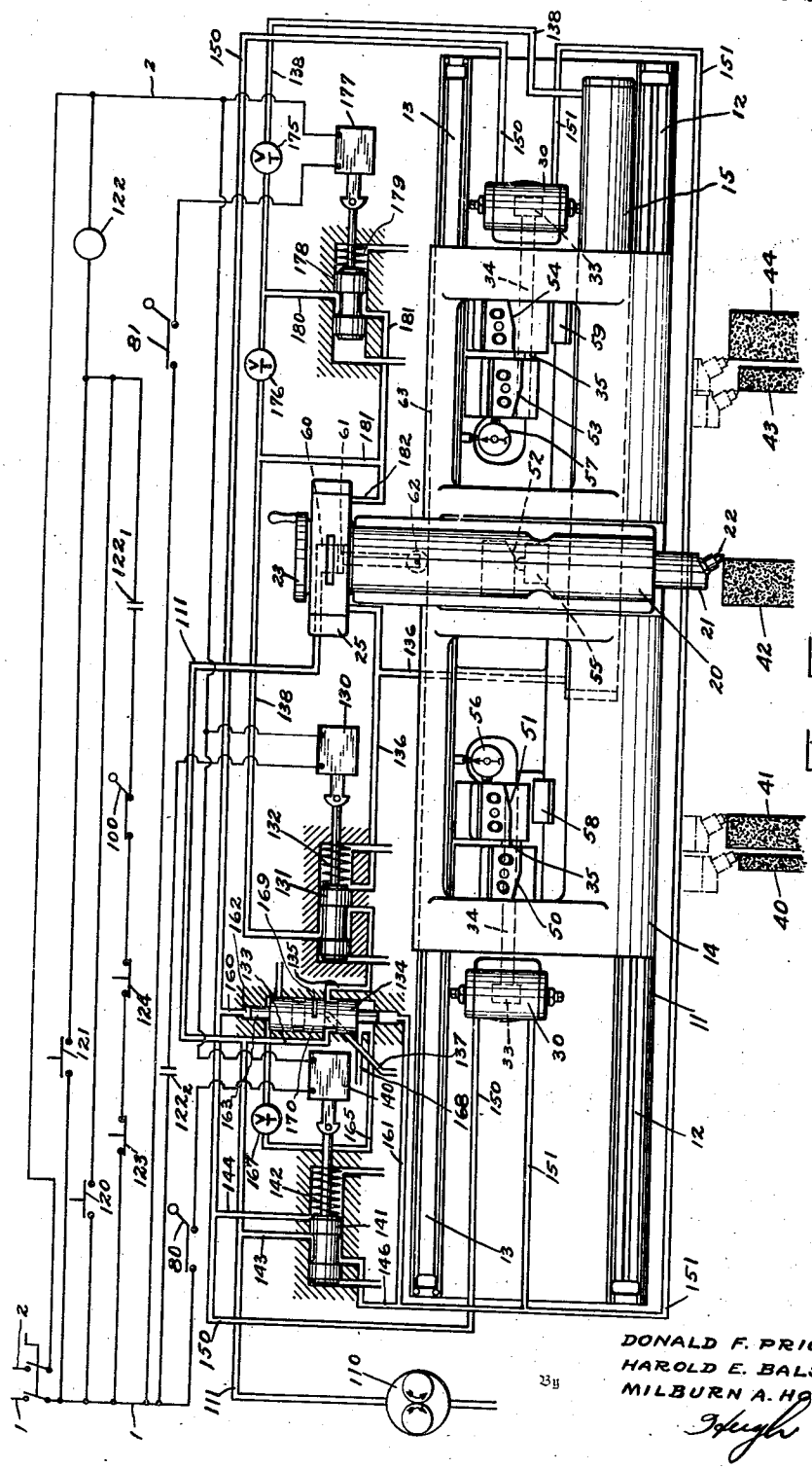


Fig 5

Inventors
DONALD F. PRICE
HAROLD E. BALSIGER
MILBURN A. HOLLENGREEN

By Hughes & Rockwell
Attorney

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UNITED STATES PATENT OFFICE

2,340,683

GRINDING WHEEL DRESSER

Donald F. Price, Harold E. Balsiger, and Milburn A. Hollengreen, Waynesboro, Pa., assignors to Landis Tool Company, Waynesboro, Pa.

Application June 6, 1940, Serial No. 339,174

13 Claims. (Cl. 125—11)

Our invention relates to wheel dressing mechanisms for grinding machines, particularly for that type of machine having a plurality of irregularly spaced grinding wheels mounted on a spindle between the bearings thereof.

An object of our invention is to provide means for shifting a dressing device toward or away from the grinding wheels under conditions where a cam or contour bar will not function satisfactorily, viz., where two wheels of different diameters are spaced apart a distance less than the difference in radius between the wheels.

A further object is to provide means for shifting said dressing device toward and from the wheels only when said device has been positioned relative to the proper wheel.

A further object is to provide a dresser movable transversely in either direction during traverse in one direction.

In supporting work for a grinding operation on a machine of the type referred to herein, steady rests on the center bearings were thought sufficient to prevent distortion. However, it has been determined that the rests on the two center bearings tend to distort work in opposition to the distortion caused by the feed of the grinding wheel on the work pieces. If ground with straight faced wheels while so distorted the finished work piece will consist of tapered portions instead of straight portions.

A further object therefore is to dress each of a plurality of grinding wheels with a predetermined taper to compensate for distortion in the work during grinding.

Our mechanism for dressing closely spaced grinding wheels of different diameters consists of a mechanism or mechanisms mounted on the wheel support and movable therewith. Said mechanism consists of a hydraulically oscillated finger which projects into operative relation with the dresser as the dresser carriage passes across the position where said mechanism is located. Where more than one set of closely spaced wheels is used on a machine, a mechanism of this type can be located in position relative to each set of wheels; or a plurality of fingers may be positioned, one to each set of wheels, with a single actuating means for all of them. Available dressers for closely spaced wheels have the longitudinal and transverse movements of the tool rigidly interlocked. One of the features of our invention is that the tool may be shifted transversely in either direction while the carriage moves continuously in one direction.

Figure 1 is an end elevation of our device partly in section.

Figure 2 is a partial sectional elevation showing an optional form of our invention.

Figure 3 is a plan view showing the relative positions of a pair of control switches and the means for actuating same.

Figure 4 is a rear elevation partly in section.

Figure 5 is a plan view in conjunction with a piping and wiring diagram.

In the drawings, numeral 10 indicates a portion of a wheel support or base, on which are mounted a plurality of grinding wheels 40 to 44 inclusive, 11 a slide base secured to said wheel support and having ways 12 and 13 running transversely of the direction of movement of said support. A carriage 14 is slidably mounted on said slide base and may be reciprocated thereon by means of a motor consisting of a cylinder 15 attached to said slide base and having a piston 16 slidably mounted therein; a piston rod 17 on said piston extends thru one end of said cylinder and is attached to carriage 14 by means of bracket 18.

A tool slide 20, similar to that disclosed in Ott et al. application, Serial No. 220,776, filed July 22, 1938, which became Patent No. 2,248,463, July 8, 1941, is slidably mounted on said carriage for movement transversely thereof. A tool holder 21 having a diamond tool 22 inserted therein is supported in said tool slide, and may be adjusted manually toward and from a grinding wheel along with said tool slide by means of a hand wheel 23 as shown in said above mentioned application. Said hand wheel may be actuated automatically at the reversal of movement of carriage 14 by means of a piston actuated pawl (not shown) in cylinder 25.

Mechanism for shifting said slide rapidly from a position for dressing a wheel of one diameter to position for dressing a wheel of a smaller diameter, consists of a cylinder 30 mounted on slide base 11 between the ways 12 and 13. Piston 31, reciprocably mounted in said cylinder, has a toothed portion 32 intermediate the ends thereof which engages the teeth of a pinion 33. Said pinion is secured to a shaft 34. On another portion of said shaft is fixed a finger 35. Where a plurality of irregularly spaced wheels on a single spindle must be dressed, a duplicate of the above described structure may be used in each case where closely spaced wheels differing considerably in diameter are used.

The means for guiding the diamond tool 22 as it passes across the several grinding wheels consists of a series of cams 50 to 54 inclusive, ad-

justably mounted on slide base 11. Said cams may be adjusted to guide the dressing tools to form straight or tapered surfaces on the wheels. Said cams may be adjusted also to change the size of any or all of the surfaces being ground by determining the amount to be removed from each wheel. Indicators 56 and 57 show the amount of taper on cams 51 and 53. Stops 58 and 59 are located in the path of a follower 55 on the underside of tool slide 20. Said stops prevent accidental jumping of the diamond tool toward the grinding wheel. Said follower 55 is held in engagement with said cams by a back lash mechanism consisting of cylinder 60 formed in the lower portion of a housing which includes the cylinder 25. A piston 61 in cylinder 60 extends beyond the end of said cylinder and has a ball bearing roller 62 mounted in the outer end thereof. Said roller engages a guide surface 63 on the side of slide base 11. This allows carriage 14 to follow ways 12 uninfluenced by back lash pressure. Fluid under pressure is directed into said cylinder direct from the source of supply. The end of cylinder 60 is enlarged to receive a coil of tubing 65, one end of which is open to said cylinder, the other end being connected to a check valve 66 thru which fluid under low pressure passes thru additional tubing (not shown) to the various guide surfaces to provide a supply of lubricant therefor.

In Figure 2 is shown an optional method for actuating a series of tool slide positioning fingers. Instead of having a separate piston and cylinder for each finger, a single motor consisting of a piston 70 in cylinder 71 rotates shaft 72 by means of rack teeth 73 on said piston engaging pinion 74 on said shaft. A series of fingers 76 suitably spaced are secured to said shaft and rotate therewith.

It will be noted that the finger 35 or any other finger is located between the cams which guide the dresser across the closely spaced wheels of different diameters. The function of the finger is to lift the follower from one cam to the other, and in so doing said finger moves to a position flush with the cam to which the follower is moving so that said follower may move smoothly off of the finger and on to the cam.

Means for controlling the rapid transverse movement of the dresser and the rapid and slow traverse movements consists of a pair of switches 80 and 81 mounted on the wheel support adjacent slide base 11. Said switches are actuated by arms 82 and 83 respectively. Arm 82 is secured to one end of a shaft 84 and arm 83 is secured to one end of a shaft 85. Said shafts are rotatably mounted in a support bracket 86. At the opposite end of shaft 84 is secured an arm 87 having a roller 88 for successively engaging a series of cams 89. Said cams are attached to carriage 14 by means of a plate 90 suspended therefrom. An arm 91 is secured to shaft 85 on the end thereof opposite from arm 83, and a roller 92 on said arm successively engages a series of cams 93. Said cams also are mounted on plate 90.

Switch 80 is a normally open switch and it serves to control the transverse movement of the diamond tool. Switch 81 is also normally open and functions when closed to effect a slow down of the movement of carriage 14 as the diamond tool 22 is passing across a grinding wheel.

A third switch 100 may be mounted in any suitable position to engage carriage 14 or some member movable therewith when said carriage reaches the end of its movement in one direction.

Operation

Fluid under pressure for operating our device is supplied by a pump 110 thru a line 111. From said line it is directed thru branch lines to each of the several mechanisms. To initiate operation of our device, the operator presses either of the start switches 120 or 121, one of which may be located at the front of the machine and the other at the rear. The circuit thus closed energizes relay 122 closing the normally open contacts 122_1 and 122_2. Contact 122_1 completes a holding circuit which includes a normally closed limit switch 100 and a pair of stop switches 123 and 124 in series. Said stop switches may be located at widely spaced positions on the machine; for example, one at the front and one at the rear. Closing contact 122_2 completes a circuit to energize a solenoid 130 which then shifts a valve 131 against the action of a spring 132. Fluid under pressure is directed to said valve from line 111 thru branch line 133, valve 134 and line 135. Solenoid 130 being energized, valve 131 is in the extreme right hand position. Fluid under pressure in line 135 is therefore directed thru line 136 to the left end of a traverse cylinder 15 shifting piston 16 therein to the right and with it the carriage 14. Fluid from line 136 is also directed to cylinder 25 to rotate hand wheel 23 and feed diamond tool 22 as described in the above mentioned application. Fluid under constant pressure from line 111 is also directed into cylinder 60 where by urging the roller 62 constant pressure from line 111 is also directed erted against the tool slide 20 to withdraw same and thereby hold follower 55 firmly in contact with any of the cams 50 to 54 inclusive, and to shift the diamond tool 22 from forward position to rearward position when necessary.

The dressing traverse starts from the left hand position. Follower 55 is in contact with the inclined portion of cam 50 and diamond tool 22 is therefore out of line with wheel 40. Switch 80 is held in closed position at this time by one of the cams 93. Switch 80 completes a circuit to energize solenoid 140. When so energized said solenoid holds a valve 141 in the right hand position against spring 142. Fluid from pressure line 111 is directed to said valve thru a line 143. When said valve is in the right hand position fluid is directed thru a line 144 to a line 150 which in turn carries said fluid to one or more cylinders 30. Piston 31 in said cylinder acting thru the mechanism described above, moves finger 35 to a position where the face thereof is flush with the face of cam 50. As the diamond tool 22 passes across wheel 40, follower 55 moves onto finger 35. At the same time, the cam 93 releases switch 80 and solenoid 140 is deenergized. Valve 141 is shifted by spring 142 to the left hand position and fluid from line 143 is directed thru line 146 to line 151 which carries said fluid to the opposite end of said one or more cylinders 30. Piston 31 in said cylinder moves to shift finger 35 from a position flush with cam 50 to a position flush with cam 51. Fluid under pressure in cylinder 60 is thus permitted to shift tool slide 20 rearwardly until follower 55 is in position to engage cam 51. When fluid under pressure is directed to one side or the other of cylinder 30, it is also directed thru lines 160 or 161 to one end or the other of the pressure actuated valve 134. Said valve is similar in most respects to that shown in

copending application Serial No. 138,245, filed April 21, 1937. The fluid for shifting said valve is directed against a portion of small cross section 162. The rate of movement of said valve is controlled by the action of an intermediate surface 163 on said valve. When fluid under pressure is directed against the small portion at one end of the valve, the intermediate surface at the other end thereof acts on a body of fluid expelling it first thru a free line 168, and then thru a passage 165 having a throttle valve 167 therein, to the intermediate surface at the opposite end of said valve. Throttle valve 167 determines the rate of movement of valve 134. Said valve moves rapidly until the free exhaust line 168 is closed thereby. At the same time another portion of said valve breaks the connection between lines 133 and 135. A slot 169 thru the center land 170 connects line 135 with an exhaust line 137 so that both ends of cylinder 15 are open to exhaust pressure. The movement of valve 134 is timed to prevent traverse movement while diamond 22 is moving in or out. At the same time that the valve covers exhaust line 168, slot 169 passes across the end of line 135 connecting said line with exhaust passage 137. Thereafter, valve 134 moves rapidly on until lines 133 and 135 are again connected and the dressing traverse is resumed. Carriage 14 and diamond tool 22 move at a speed suitable for dressing as said tool engages wheel 41. Exhaust fluid from the right hand end of cylinder 15 passes thru line 138, throttle valves 175 and 176 to traverse reversing valve 131 from which it is exhausted. Valve 175 is set for the rapid movement of the dresser between wheels. Valve 176 is set for the slow traverse of the dresser across a wheel. The traverse speed is selected by one of a series of cams 89 actuating a limit switch 81. These cams are so positioned that they actuate switch 81 during the passage of the diamond tool 22 across the face of a grinding wheel. When switch 81 is closed, solenoid 77 shifts bypass valve 178 to the right against a spring 179. Normally, said valve connects passages 180 and 181 to bypass slow speed valve 176. When shifted by said solenoid the passage of fluid thru said valve is stopped and it passes instead thru said slow speed valve 176 thus limiting the supply of fluid under pressure to an amount sufficient only for a slow traverse. As soon as the diamond passes off the face of the wheel, switch 81 is released, solenoid 177 deenergized, and valve 178 shifted by spring 179 to the position shown in Figure 5. In this position of the valve, fluid under pressure is again bypassed around valve 176 and the traverse speed increased in proportion to the flow for which valve 175 is adjusted to more rapidly bring the dressing tool to the next wheel.

When carriage 14 reaches the end of its movement toward the right it engages a limit switch 100. Said switch is normally closed and therefore the circuit therethru is broken upon engagement of said carriage therewith. Breaking said circuit deenergizes relay 122 and thru contact 122_2 deenergizes solenoid 130. Spring 132 shifts valve 131 to the left to direct fluid under pressure from line 135 thru line 138 to the right hand end of cylinder 15 to move carriage 14 to the left. The speed control for the dressing traverse and the traverse between wheels is the same as described above except that the fluid is moving thru line 138 in the opposite direction.

As carriage 14 begins to move to the left, fluid from line 181 passes thru line 182 to cylinder 25 for resetting the feed pawl piston therein. After the diamond tool 22 moves across the wheel 44 on the return stroke, one of the cams 93 actuates switch 80. Solenoid 140 is energized and shifts valve 141 to the right to direct fluid under pressure from line 143 thru lines 144 and 150 to cylinder 30. Finger 35 between cams 53 and 54 is in contact with follower 55 and shifts same from the face of cam 54 to that of cam 53. As described above, the traverse movement is stopped during the shifting of said finger. Diamond tool 22 is thus moved transversely into contact with grinding wheel 43. Then the traverse movement is resumed. After the diamond tool has made the return pass over wheel 40 it is moved a short distance farther during which follower 55 follows the inclined portion of cam 50 and said diamond tool is withdrawn a short distance in a transverse direction. Said diamond tool remains in this position until the initiation of another dressing operation. The diamond tool may be returned to starting position at any time before the carriage 14 reaches the end of its stroke from left to right. This may be accomplished by pressing either of the stop switches 123 or 124. Pushing either of these switches has the same effect as the operation of switch 100 by carriage 14 described above.

As the diamond moves from one wheel to another, switch 80 is depressed and released alternately by the cams 93, and thus said diamond may be shifted transversely either toward or away from the grinding wheels as it traverses them in one direction.

It has been found that during grinding a plurality of surfaces on a work piece simultaneously, the work piece becomes distorted and even though the wheel faces are straight the resulting work has tapered surfaces at some or all of the portions ground. In order to correct this condition, separate adjustable cams 50 to 54 inclusive are used to guide the dressing tool 22 across each wheel. Each of these cams may be adjusted to cause the tool 22 to dress a tapered surface on each wheel, the degree of taper corresponding to the amount of distortion occurring at each surface. Adjustment of said cams may be utilized to maintain a fixed relation between the surfaces of the various wheels. If a particular wheel is grinding under or over size, the corresponding cam may be adjusted to guide the tool 22 so as to take a light or heavy cut. Likewise, if it is desired to make a change in size of a certain portion, the change may be effected by adjusting the corresponding cam as described above.

What is claimed is:

1. A mechanism for dressing a plurality of spaced wheels comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, a mechanism mounted independently of said dressing tool and operable for effecting said transverse movement of said tool, and means for initiating operation of said mechanism only when said tool has been moved longitudinally into operative relation therewith.

2. A mechanism for dressing a plurality of spaced wheels comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, a mechanism mounted independently of said dressing tool for effecting said transverse movement of said tool, and means operable automatically for actuating said mechanism in response to the longitudinal movement of said dresser into operative relation with said mechanism.

3. A mechanism for dressing a plurality of spaced wheels comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, a mechanism mounted in fixed relation to said wheels for effecting said transverse movement of said tool including a dresser shifting finger and a motor for actuating same, and automatic means for actuating said mechanism in response to the longitudinal movement of said dresser into operative relation with said mechanism.

4. A mechanism for dressing a plurality of spaced wheels comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, a mechanism mounted in fixed relation to said wheels for effecting said transverse movement of said tool including a dresser shifting finger and a motor for actuating same, and a mechanism operable in response to longitudinal movement of said dresser into a predetermined position for initiating operation of said motor.

5. A mechanism for dressing a plurality of spaced wheels comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted on said base for movement longitudinally and transversely of said wheels, a mechanism mounted in fixed relation to said wheels for effecting said transverse movement of said tool, automatic means including a control device for actuating said mechanism in response to the longitudinal movement of said dresser into operative relation with said mechanism, and for resetting said mechanism and said dresser in response to longitudinal movement away from said operative relation in either direction.

6. A mechanism for dressing a plurality of spaced wheels, comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, mechanisms mounted in fixed relation to said wheels for effecting said transverse movement of said tool at predetermined points in said longitudinal movement, including a plurality of dresser shifting fingers, and a motor for actuating each of said fingers, and means operable automatically in response to said longitudinal movement for actuating said mechanisms.

7. A mechanism for dressing a plurality of spaced wheels, comprising a base for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, mechanisms mounted in fixed relation to said wheels for effecting said transverse movement of said tool at predetermined points in said longitudinal movement, including a plurality of dresser shifting fingers, and a motor operable automatically in response to said longitudinal movement for actuating said mechanisms.

8. A mechanism for dressing a plurality of grinding wheels comprising a base member for rotatably supporting said wheels, a dressing tool slidably mounted for movement longitudinally and transversely of said base, means for guiding said tool and for compensating for distortion of the work during grinding including a series of adjustable cams corresponding to the wheels to be dresssed, one or more of said cams being adjusted so as to cause a tapered surface to be dressed on the corresponding wheel, the degree of taper corresponding to the amount of deformation in that portion of the work during the grinding operation.

9. A device for dressing a plurality of grinding wheels including a base, a dressing tool slidably mounted for movement longitudinally and transversely of said base, a series of cam surfaces for guiding said dressing tool across the face of each of said wheels, a follower on said dressing tool, means for urging said follower against said cams, means for lifting said follower and said dresser transversely from one cam to another, and means including a control device for initiating actuation of said lifting means automatically in either direction during said longitudinal movement in one direction.

10. A device for dressing a plurality of grinding wheels some of which are closely spaced and others of which are widely spaced, including a base, a dressing tool slidably mounted for movement longitudinally and transversely of said base, a series of cams for guiding said dressing tool across the face of each of said wheels, a follower on said dressing tool, means for urging said follower against said cams, means for shifting said follower and said dresser transversely from one cam to another including a rotatable shaft, means on said shaft for engaging said follower, and automatic means for rotating said shaft in either direction during said longitudinal movement in one direction.

11. A device for dressing a plurality of grinding wheels including a base, a dressing tool slidably mounted for movement longitudinally and transversely of said base, a series of cam surfaces for guiding said dressing tool across the face of each of said wheels, a follower on said dressing tool, means for urging said follower against said cams, means for lifting said follower and said dresser transversely from one cam to another, a control member operable in response to said longitudinal movement for initiating said transverse movement in one direction and operable upon further longitudinal movement in the same direction for initiating said transverse movement in the opposite direction.

12. A mechanism for dressing a plurality of grinding wheels comprising a base member for rotatably supporting said wheels, a dressing tool slidably mounted for movement on said base, mechanisms for effecting relative longitudinal and transverse movement of said tool and a control device actuated by the means for causing said transverse movement for preventing said longitudinal movement.

13. A mechanism for dressing a plurality of spaced grinding wheels comprising a dressing tool slidably mounted for movement longitudinally and transversely of said wheels, a series of spaced cam surfaces for guiding said dressing tool across the face of each of said wheels, a follower on said dressing tool, means for urging said follower against said cams, and power means operable automatically in response to said longitudinal movement for lifting said follower and said dresser transversely from one cam surface to another.

DONALD F. PRICE.
HAROLD E. BALSIGER.
MILBURN A. HOLLENGREEN.