Sept. 1, 1942. J. C. WILSON 2,294,493

APPARATUS FOR WHEEL DRESSING

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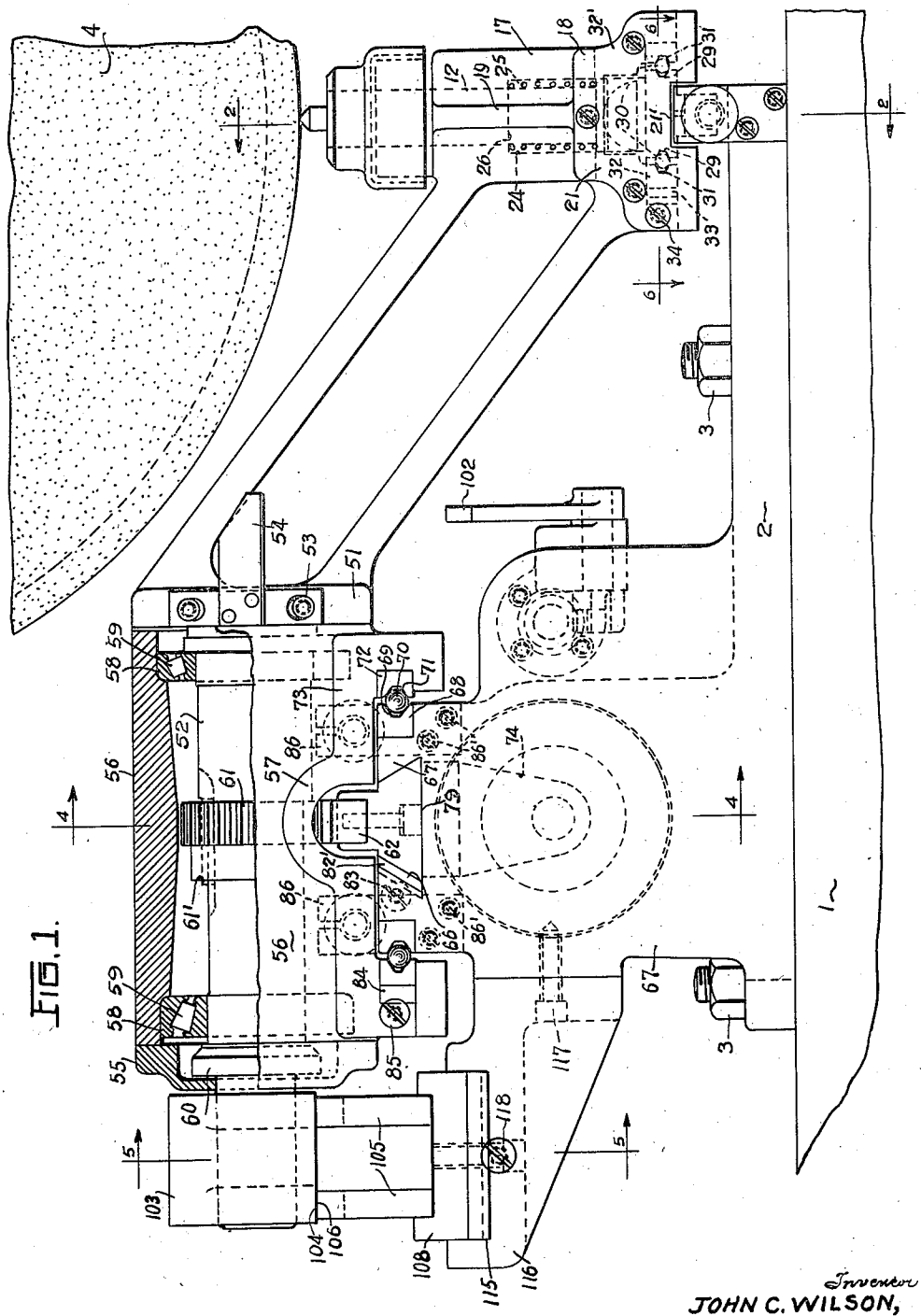


FIG. 1.

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FIG. 2.

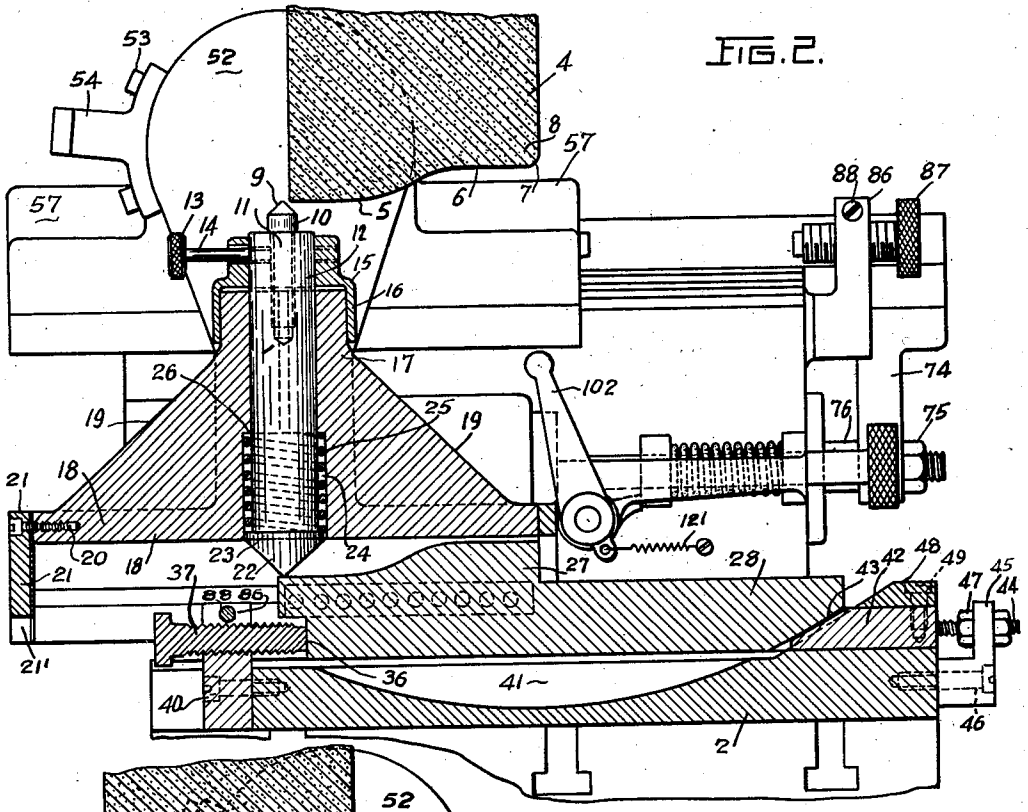
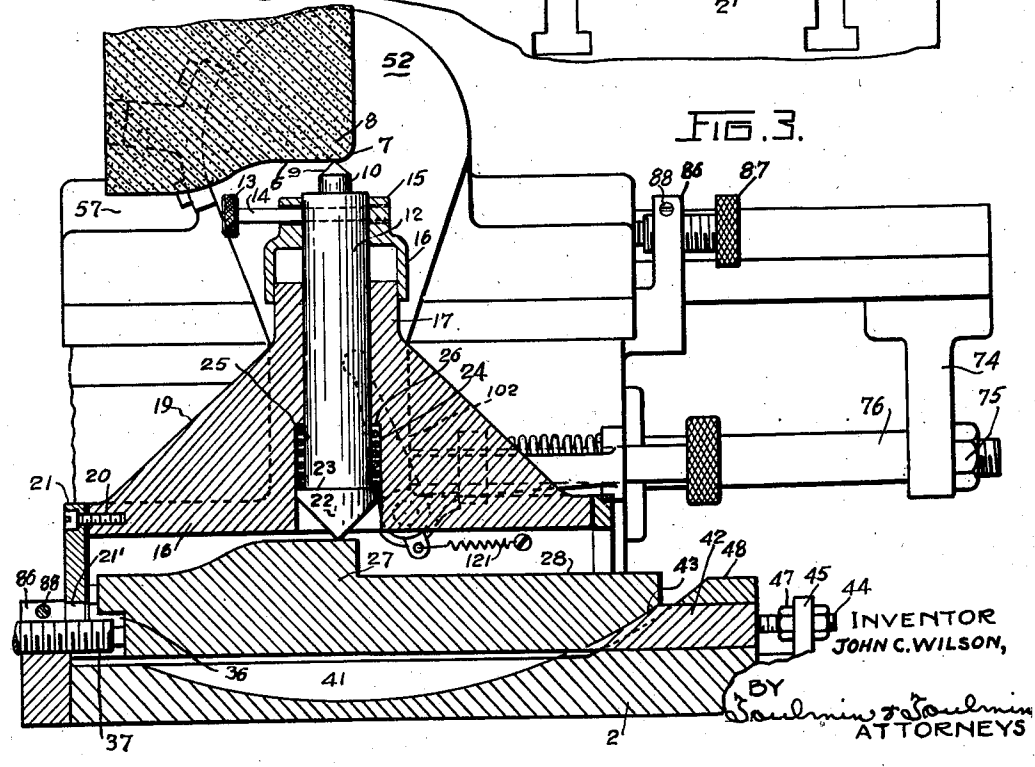


FIG. 3.



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FIG. 4.

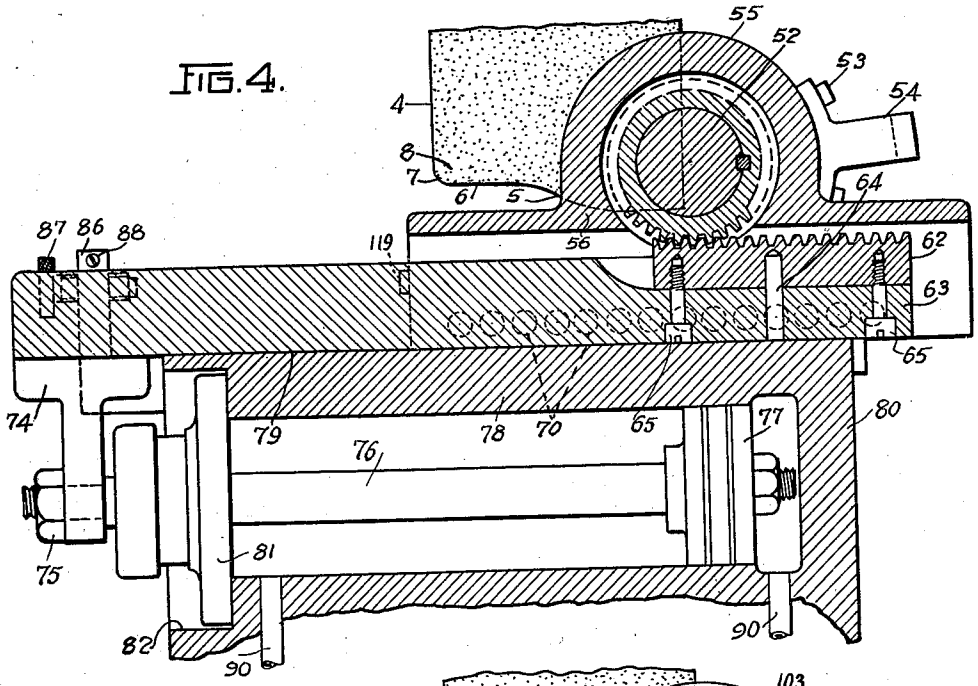
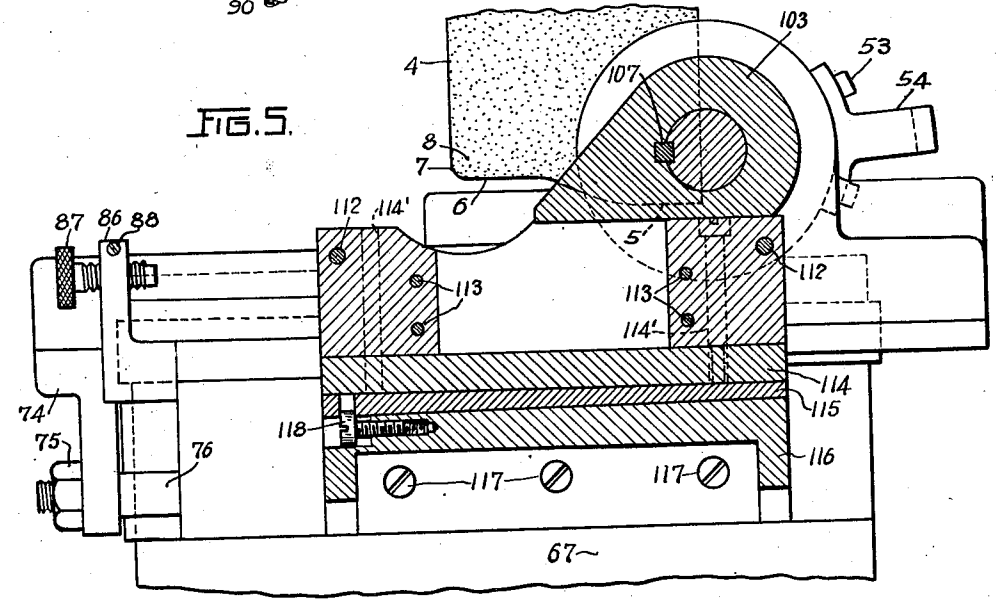


FIG. 5.



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FIG. 6.

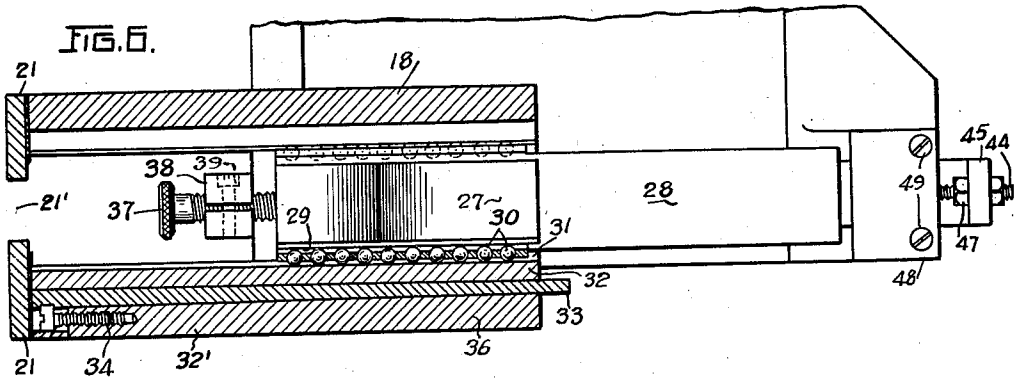
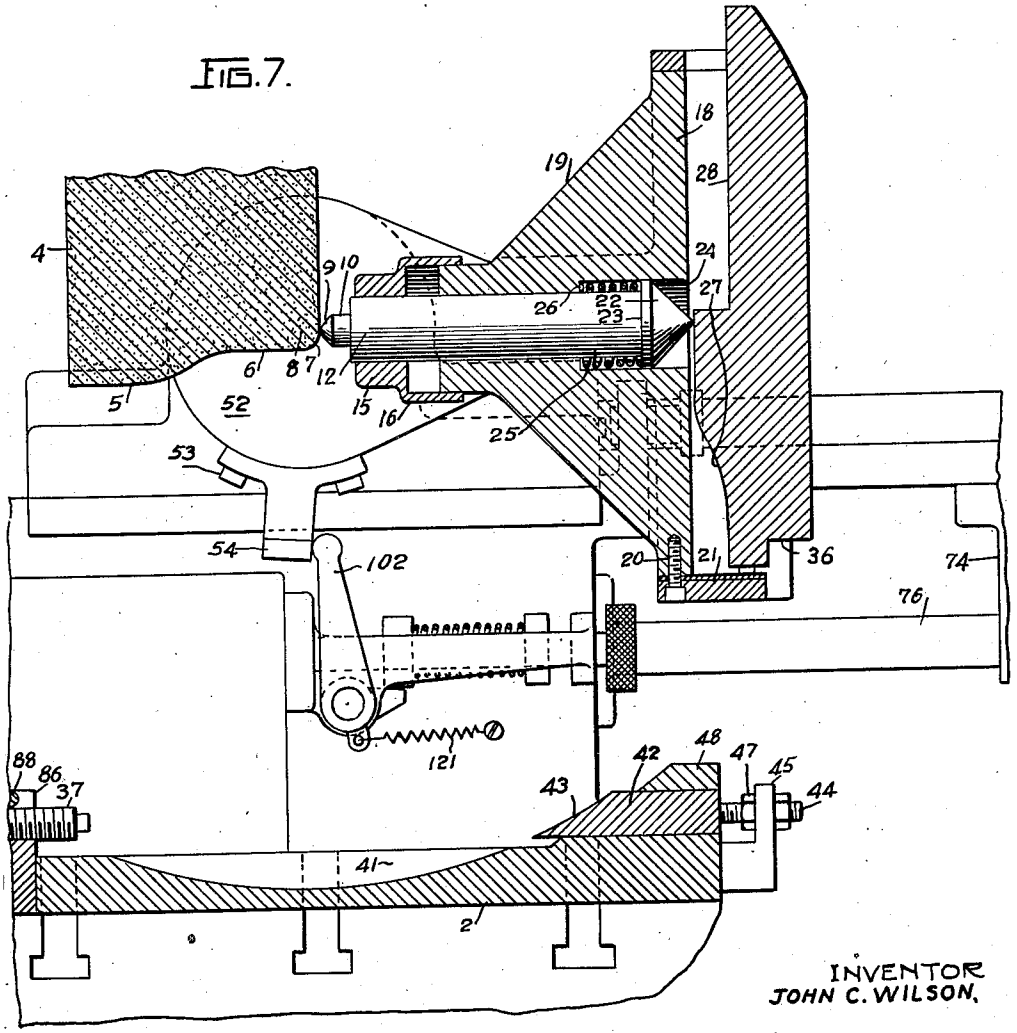


FIG. 7.



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APPARATUS FOR WHEEL DRESSING

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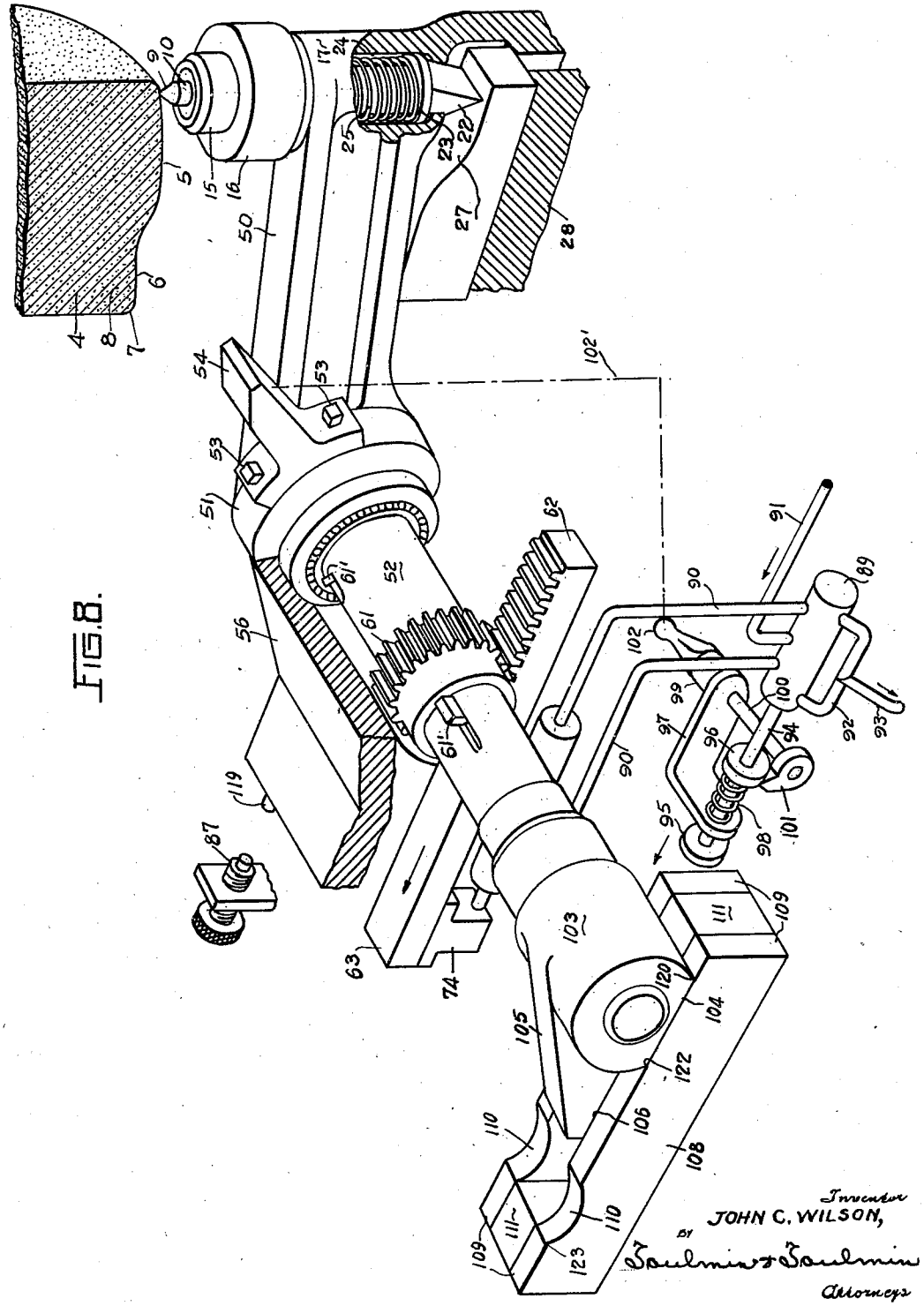


FIG. 8.

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UNITED STATES PATENT OFFICE

2,294,493

APPARATUS FOR WHEEL DRESSING

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Application August 28, 1940, Serial No. 354,556

17 Claims. (Cl. 125—11)

The present invention relates to grinding machines, and more particularly to a dresser attachment for the machine.

In the fabrication of machine tools and machine elements, particularly for aircraft engine and similar production, it is often necessary to provide a grinding wheel which has an abrading surface of irregular configuration. For example, this surface may be formed by a wheel having a portion of its thickness of one diameter and another portion of another diameter, the periphery being terminated at the edge of the wheel in a rounded surface. This shape is set forth merely by way of example since there is a multitudinous number of grinding wheels having different shapes employed in this highly specialized art.

In order to assure extreme accuracy of the grinding operation in quantity production, it is necessary that the grinding wheel be dressed from time to time, and that the dressing operation be performed in such a manner that the wheel will have the same peripheral shape after being dressed that it had before the dressing operation. Heretofore, wheels were usually dressed by hand tool provided with a diamond nib, particularly those wheels of complicated shape, so that the accuracy with which the dressing operation was performed would vary since it depended solely on the experience and skill of the dressing operator.

The primary object of the present invention is to provide a dresser tool attachment for a grinding wheel in which the tool accurately follows the initial shape of the grinding wheel periphery, regardless of the number or character of the irregularities of that shape, so that the dressed wheel has exactly the same configuration after the dressing operation as it had before.

Another object is to provide an attachment, as explained above, in which the tool not only follows all of the irregularities of the external periphery of the wheel surface but also follows a rounded edge provided on the wheel.

Another object is to provide a dresser tool mechanism in which the path over which the dresser tool is moved can be readily changed to accommodate any change in the configuration of the wheel surface.

Still another object is to provide a dresser tool mechanism which may be attached to any standard form of grinding machine, and in which the movements of the tool can be constrained to a predetermined path corresponding to the desired shape of the grinding wheel.

A more general object is to provide an inexpensive dresser tool mechanism in which the tool is caused to pass and accurately follow the entire grinding periphery of the wheel, first in one direction and then in the opposite direction, regardless of the intricacy of shape of the wheel.

The above objects are attained, in brief, by securing the dresser tool to a follower which is caused to pass over a cam having a shape which corresponds accurately with the shape of the grinding wheel, and in order to cause the tool to dress the rounded terminating edge or edges of the wheel the dresser tool, follower and cam are rotated as a unit in a circle, the center of which corresponds with the center of the round peripheral portion of the wheel. All of the various movements of the dresser tool, follower and cam are made frictionless by the use of ball bearings, and ample adjustment through wedge-shaped gibs is provided in order to take up the wear.

The invention will be better understood when the specification is perused in connection with the accompanying drawings.

In the drawings:

Figure 1 is an elevational assembly view looking toward the side of the grinding wheel, and showing the improved dresser attachment which forms the subject of this invention.

Figure 2 is a sectional view taken along the line 2—2 in Figure 1, but showing the dresser tool in elevation. In this figure the diamond nib is just starting to dress the nearer edge of the grinding wheel.

Figure 3 is a view similar to Figure 2, but showing the nib at a position on the wheel just before it proceeds around the rounded edge of the wheel.

Figure 4 is a section taken at line 4—4 in Figure 1, illustrating the internal construction of the hydraulic motor and the manner of connecting the motor to the rack for actuating the main shaft of the attachment.

Figure 5 is a sectional view taken along the line 5—5 in Figure 1, looking in the direction of the arrows. This figure shows details of the shoe on the shaft and the template over which the shoe moves.

Figure 6 is a view partly in section and looking along the line 6—6 in Figure 1.

Figure 7 is somewhat similar to Figure 3, but shows the cam and follower in a position removed ninety degrees after the diamond nib has been caused to follow the rounded edge of the grinding wheel.

Figure 8 is a perspective diagrammatic view

of the essential elements of the improved dresser attachment, including the hydraulic motor and its pilot valve for actuating and controlling respectively the excursion of the dresser tool over the grinding wheel periphery.

In general the attachment is of a character that it may be bolted in place to the reciprocating work table of a grinding machine, and so positioned that at any desired time the table may be moved with respect to the grinding wheel and the attachment operated to cause the diamond nib to dress the periphery of the wheel. The work table of the grinding machine is illustrated in Figure 1 by the reference character 1. The apparatus to be described, with the exception of the source of pressure fluid, is carried on a base 2 bolted as at 3 to the table 1. The grinding wheel is illustrated at 4, and has as a typical shape a large diameter portion 5 which merges over curved sections into a smaller diameter portion 6 (Figure 8), and is terminated at the left-hand edge by a rounded portion 7, the radius center being indicated at 8.

The dressing tool 9 may comprise the usual form of diamond nib secured in any suitable manner to a round shoulder portion 10, which is provided with a shaft 11. The latter is slidably supported in the end of a follower rod 12, and is secured at any desired position with respect to the rod by means of a thumb screw 13 (Figure 2). The shank 14 of the thumb screw passes through an opening in a cap 15 which is secured to the follower 12, this cap having a downwardly extending sleeve portion 16 of somewhat larger diameter. This sleeve-like portion slidably fits over an upwardly extending hub member 17, which is provided at the bottom with an outwardly extending flange member 18 and ribbed at each side as indicated at 19. To the left-hand end of the flange member 18, as seen in Figure 2, there is screwed, as indicated at 20, a downwardly extending cover plate 21 provided with a slot 21', the purpose of which will be explained hereinafter.

The lower end of the follower 12 terminates in a portion 22 having straight tapered sides, preferably giving a line effect (instead of a point) at its lowermost edge. The tapered portion carries a shoulder 23 which fits snugly but slidably within a bore 24 formed in the hub member 17. There is a compression spring 25 contained within the annular space between the bore 24 and the follower 12, this spring bearing at one end against a counterbore surface 26 and the shoulder 23. The purpose of this spring is to urge the follower 12 downwardly against a cam surface indicated at 27, which has a configuration exactly the same as that of the portions 5 and 6 (Figure 8) of the grinding wheel. The cam 27 has a length approximately the same as the thickness of the grinding wheel, measured from the center 8 (Figure 8) to the right-hand edge of the wheel.

The cam 27 is carried on a relatively long base member 28, which is provided at each side with longitudinally extending V-shaped grooves 29 (Figure 1). These grooves carry ball bearings 30, preferably held in place by a retaining plate (not shown) and which are adapted to roll in an adjacent groove 31 formed in a rail 32. The rails 32 are secured in any suitable manner within the lower end of the hub member 17, which is provided with a flared end portion 32' (Figure 1) having a rectangular cross section in order to receive these rails. The pressure exerted on the ball bearings 30 by the respective rails 32 may be controlled by means of a wedge-shaped gib 33, which forces the left-hand rail (Figure 1) against its set of ball bearings as a screw 34 is turned (see also Figure 6).

The left-hand end of the base member 28, as seen in Figure 2, is provided with a cut-back shouldered portion 36 against which the stop screw 37 abuts. The latter is threaded through a split collar 38 (Figure 6), the tightness of which can be adjusted by a screw 39. This collar is screwed as indicated at 40 (Figure 2), or secured in any suitable manner to the base 2. The latter is provided with a hollowed-out portion 41, of dish-like configuration, the radius of which coincides with the center 8 of the rounded edge of the grinding wheel. The purpose of this hollowed-out portion will be explained hereinafter.

Resting on the base 2 at the end opposite the cam 27, there is a plate 42 having an inner tapered surface 43, this plate being slidably adjustable with respect to the base 2 by means of a screw 44 which is carried by a bracket 45. The latter preferably is secured to the base 2 by means of screws 46. The screw 44 is preferably provided with any suitable form of locknut mechanism indicated at 47. There is a tapered surface or edge provided at the right-hand end of the base member 28, as seen in Figure 2, which corresponds with the taper 43 of the plate 42. A flat bar 48 with an inner tapered edge backed away from the edge 43 may be screwed, as indicated at 49, to the plate 42. The taper 43 of the plate 42 and the corresponding taper of the base member 28 preferably form a continuation (with slight modification) of the curvature of the hollowed-out portion 41. It is apparent that the purpose of the screws 37 and 44 is to adjust the longitudinal position of the cam 27 (Figure 2) in order to accurately align the cam surface with the corresponding surface of the grinding wheel 4. The screw 44, in addition, adjusts the base member 28 which carries the cam in the vertical plane.

In accordance with the present invention the lowermost point or edge of the follower 12 is caused to ride up on the cam surface 27 when it is desired to dress the wheel, and the attachment which has previously been bolted to the grinding machine table, has been brought into dressing position. The mechanism for performing this function has been shown in simplified form in Figure 8. The hub member 17 is provided with a webbed crank 50, this crank terminating in an enlarged portion 51 of a shaft 52. There is bolted, as indicated at 53, to this enlarged portion an outwardly extending dog member 54. There is a hollow shroud member 55 spaced from the enlarged portion 51 (Figure 1) of the shaft by a barrel casting 56, which has an arch configuration and terminates on each side in an outwardly extending hollow circular portion 57. The shroud member 55 is preferably secured to the barrel casting 56 in any suitable manner. At each end of the barrel casting 56 there is provided a roller race 58 (Figure 1), the rollers of which are indicated at 59. The inner portion of each race is secured to the main shaft 52 of the attachment and serves rotatably to support the latter.

The shaft 52 is provided with a shoulder 60 which is contained within a chamber formed in the shroud member 55 and bears against the inner surface of the member in order to prevent any undue longitudinal movement of the shaft. At approximately the midpoint of the barrel

casting 56 the shaft 52 is provided with a pinion 61, keyed to the shaft, as indicated at 61', this pinion being adapted to mesh with a toothed rack indicated at 62. As seen in Figure 4, the toothed portion of the rack may constitute a block which is carried on a support member 63, to which it is secured preferably by means of one or more dowels 64 and screws 65. The support member 63 is provided at its opposite sides with wedge-shaped surfaces, indicated at 66 (Figure 1), to form a dove-tail slide member. This member is adapted to slide within a wedge-shaped groove formed in an upstanding frame member 67, which constitutes an integral portion of the base 2. The frame member 67 is provided at each side at the top with a notched-out portion which receives a rail 68. Each rail is provided with a V-shaped groove 69, which receives ball bearings 70. These bearings are held in place and adapted to rotate along a V-shaped groove 71 formed in a rail 72, which is provided with an extension 73 on each side of the arch portion 57 of the barrel casting 56.

The left-hand end of the dove-tail slide member 63 (Figure 4) is provided with a downwardly extending projection 74 which is secured, as by a nut 75, to a shaft 76 on which is mounted a piston 77. The latter is adapted to reciprocate within a cylinder 78, which is secured in any suitable manner to the frame member 67 and is provided at the top with a flat surface 79 on which the dove-tail slide member 63 is adapted to slide. The right-hand end of the cylinder 78 (Figure 4) is closed by an integral portion 80, the left-hand end being closed by a closure member 81 secured in any suitable manner to the cylinder walls within a countersunk opening 82. The shaft 76 is adapted to slide through the closure member 81. The latter contains any suitable form of packing gland to prevent the escape of fluid from the interior of the cylinder. It is evident that as the piston 77 moves to the left (Figure 4) the slide member 63 is also caused to move to the left, carrying with it the rack 62 and causing the shaft 52 to be rotated clockwise, as seen in Figure 4.

In order to take up the wear at the tapered surfaces 66 there may be provided a tapered gib 82' (Figure 1), the position of which may be adjusted by a screw 83, as is well known in the art. There is a similar tapered gib 84 provided at the back of one of the rails 72, and adjusted in position by the screw 85 to eliminate the effect of wear at the ball bearings 70. There is a pair of upstanding projections or brackets 86 secured to the left-hand end of the cylinder 78, or any other portion of the main frame, by screws 86', these brackets being positioned on opposite sides of the dove-tail slide 63 (Figure 1). Each bracket is split at the top adjustably to receive a knurl headed screw 87, which is held fixedly in place by a tightening screw 88. The purpose of the screws 87 will be explained presently.

For controlling the movement of the piston 77 within the cylinder 78, there is provided a pilot valve 89 of any suitable and well known type, having a pair of alternately operative outlet pipes 90 and a common inlet pressure pipe 91. From the extreme ends of the pilot valve there is taken a pair of exhaust pipes 92, leading to a common exhaust 93. The pipe 91 is connected to a source of pressure fluid, preferably oil. The double-acting piston within the valve carries a reciprocating shaft 94 on which is fixedly mounted a pair of collars 95, 96. The shaft or rod 94 is supported at the end opposite the cylinder on a bracket 97, which is illustrated in Figure 8 as being L-shaped and which may be secured to any stationary part of the frame. A compression spring 98 is positioned between one leg of the bracket 97 and the inside surface of the collar 96. The other leg of the bracket 97 is provided with a boss 99 which serves as a bearing for a shaft 100, which is provided at one end with a rotary latch member 101 and at the other end with an upstanding trip lever 102.

The arrangement is such that when the collar 95 is pulled to the left (Figure 8) the collar 96 loads the spring 98, permitting the right-hand side of the collar 96 to strike the left-hand side of the latch 101 and forcing the latch to rotate in the clockwise direction, carrying with it the trip lever 102. The movement of the collar 95 also moves the shaft 94 to the left together with the piston within the valve 89, and permitting pressure fluid from the pipe 91 to enter the cylinder and to pass upwardly through the pipe 90. The pressure fluid flows through the pipe 90 and does work within the cylinder 78, as will be explained more in detail hereinafter, and afterwards is exhausted back through the pipe 90, and through the valve 89 to the pipe 92 when the shaft 94 is moved inwardly toward the valve 89. This inward movement of the shaft is caused by tripping of the lever 102, as will be explained hereinafter, which causes the latch 101 to release itself from the collar 96 and permitting the latter to be moved to the right, due to the urge of the spring 98. Under these circumstances pressure fluid will pass through the pipe 91, through the left-hand outlet pipe 90 (Figure 8) and to the opposite end of the cylinder 78 to perform work therein. On exhaust the fluid returns by the left-hand pipe 90, through the valve 89 and the left-hand pipe 92 to the exhaust 93. Thus pressure fluid is caused to flow through the right-hand pipe 90 by pulling the collar 95 to the left, and is caused to flow through the left-hand pipe 90 when the trip lever 102 is moved to the right.

The shaft 52 is provided at its nearer end, as seen in Figure 8, with a shoe 103 which has a general circular shape but is provided with a flattened surface 104 at its bottom side. There is an outwardly extending web 105 secured to the shoe, which has a bottom surface 106 in line with the flattened surface 104. As will be seen in Figure 5, the shoe 103 is keyed to the shaft as indicated at 107. The flattened surfaces 104, 106 rest on the top surface of a built-up template, generally designated 108. This template is formed of two side members 109 having a rectangular configuration, and each provided with a circular notch 110. The side plates 108 are separated from one another by intervening blocks 111 at each end of the template, these blocks being secured to the side plates preferably by dowel pins 112 and screws 113 (Figure 5). The entire assembly 108 rests on and is secured to a plate 114 by screws 114'. This plate, in turn, is supported on a tapered gib 115 which separates the plate 114 from an L-shaped bracket member 116. The latter may be secured to the frame member 67 by means of screws 117. The position of the gib 115 may be adjusted with respect to the plate 114 and the L-shaped member 116 by means of a screw 118, as is well known in the art. The purpose of the gib 115 is to adjust the position of the upper surface of the template 108.

Complete description of the operation

Assume that it is desired to dress the surfaces 5, 6, also the rounded end portion 7 of the grinding wheel 4; assume further that the diamond nib 9 is in the approximate position shown in Figure 8. The collar 95 is pulled to the left, as explained hereinbefore, causing pressure fluid to pass through the right-hand pipe 90 and to enter the cylinder 78 to the right of the piston 77 (Figure 4). The latter is then caused to move to the left, carrying with it the shaft 76, which as explained hereinbefore, is connected with the left-hand end of the dove-tail slide 63. The teeth of the rack 62 are thus caused to move to the left (Figures 4 and 8), which would normally cause the shaft 52 to rotate in the clockwise direction.

The shoe portion 103 of the shaft 52 has a flattened surface at the bottom which bears against the flat surface of the template 108, and precludes any rotation of the shaft 52. Thus the only movement which the rack 62 can communicate to the shaft 52 through the gear 61 is a longitudinal movement parallel to the upper surface of the template 108. It is apparent that the shaft 52 carries with it not only the barrel casting 56, since there is no relative motion at the roller bearings 59, but also the crank 50 which supports the diamond nib 9 through the hub 17.

It has been explained that the cam 27 has the same configuration at the top surface as the shape of the grinding wheel periphery. Consequently, as the hub 17 is caused to move to the left the tapered end portion 22 of the follower 12 rides over the cam surface so that there is a movement upward of the follower to correspond with the cam contour and against the compressing action of the spring 24. Thus the diamond nib 9 is caused to dress the periphery of the grinding wheel 4 to a shape determined by the shape of the cam 27. This operation continues as long as the shaft 52 is caused to move longitudinally over the template 108, assuming that pressure fluid is being continually admitted through the pipe 91, the right-hand pipe 90 and to the right of the piston 77 (Figure 4).

It has been pointed out that the dovetail slide 63 is mounted on ball bearings 70 so that little or no friction is encountered, except for the rotative urge exercised by the rack on the pinion and which is forestalled by the flat surfaces 104 and 106 formed on the shoe. This action continues until the end of the barrel casting 56 nearer the screw 87 actually contacts the screw. For contact purposes there may be provided a pair of buttons 119 opposite the screws or adjustable stops 87. Consequently, as the barrel casting continues to move to the left the contact members 119 will strike the stops 87, which prevents further longitudinal movement of the casting 56 and the contained shaft 52. The stop 87 is adjusted at such a point that when contact is made with the member 119 the diamond nib 9 will be directly under the center point 8 of the grinding wheel, as shown in Figure 3. The shaft 52 is so arranged that its axis at this moment exactly coincides with the center point 8, and this feature has also been shown in Figure 3. The slot 21' is sufficiently large to permit the head of the screw 37 to pass through the same in order that the hub member 17 and its contained follower can move to the right all of the way, as explained above and as shown in Figure 3.

It now becomes necessary to move the nib 9 around the rounded edge 7 of the wheel. This operation is accomplished by means of the circular notch 110 in the template 108. In sliding over the upper surface of the template the lower right-hand corner of the shoe 103, as indicated at 120 (Figure 8), will have reached the right-hand edge of the notch 110. Consequently, assuming that the rack 62 continues to move to the left, the circular portion of the shoe 103 will now be in such a position with respect to the notch 110 that the pinion 61 is permitted to rotate clockwise at least through a predetermined arc, depending on the peripheral length of the notch 110. It was pointed out that the barrel casting 56 has been brought to a stop by the screw 87 so that the only movement which the shaft 52 can have is one of rotation, this rotary effort being effected at the roller bearings 59. This rotational movement of the shaft carries with it the crank 50, also the hub 17, the flange member 18 and the cam 27. The cam 27 and the base member 28 are effectively held to the flange member 18 during this upward rotation of these elements by means of the ball bearings 30 which ride in the rails 32, secured respectively to each of these elements. It has been pointed out that the base 2 is hollowed-out at 41 so as to provide clearance for the lower left-hand end of the base member 28 on which the cam 27 is supported.

The elements which move as a result of the rotation of the shaft 52 are shown in their upwardly extended positions in Figure 7. It will be noted that these elements have moved through approximately 90 degrees, carrying with them the diamond nib 9 which is caused to dress the rounded surface 7 of the grinding wheel. In order to insure accuracy in the size of the radius of this rounded surface not only must the axis of the shaft 52 exactly coincide with the center point 8 when the shaft will have reached the position at which the barrel casting 56 abuts the adjustable stop 87, but also the curvature of the circular notch 110 must have a center which also coincides with the center point 8. As the shaft 52 rotates clockwise (Figure 8) in order that the diamond nib 9 will generate an arc corresponding to the curved surface 7, the dog 54, which is secured to the enlarged portion 51 of the shaft, is caused to move downwardly and to strike the trip lever 102. The fact that the dog moves in such a path is indicated in Figure 8 by the dot-dash line 102'.

It has been explained that as the lever 102 is moved upwardly (Figure 8) the latch 101 releases the collar 96, thus unloading the spring 98 and causing the shaft or rod 94 to move to the right. This movement changes the position of the piston in the pilot valve 89 in such a way that pressure fluid from the pipe 91 is now admitted to the left-hand outgoing pipe 90 (Figure 8), causing the piston 77 in the main cylinder to move to the right (Figure 4). Pressure fluid to the right of the piston 77 now finds ready access to the exhaust through the right-hand pipe 90, the valve 89 and the right-hand pipe 92 to the exhaust pipe 93. Thus the rack 62 is caused to move to the right and the shaft 52 is rotated counter-clockwise. The dog 9 is caused to move away from the trip lever 102, but the latter is biased by a spring 121 (Figure 2) which holds it in the

forward position until the collar 95 is again moved to the left, as explained hereinbefore.

The shaft 52 is therefore caused to rotate counter-clockwise through a 90-degree angle while the circular portion of the shoe 103 is contained within the circular notch 110. When the nib has reached the point directly below the center point 8 (Figures 3 and 8), further movement to the right of the rack 62 will cause the shaft 52 to move only in the longitudinal direction, due to the fact that the edge 122 of the shoe will have reached the edge 123 of the circular notch, thus preventing any further rotation. The shaft, together with the crank 50 and the hub 17, will thereupon be given a longitudinal movement, and the diamond nib will describe a vertical movement corresponding to the shape of the cam 27. When the nib has reached the nearer edge of the grinding wheel 4, as seen in Figure 8, the right-hand end of the shaft 76 will have contacted the wall 80 of the cylinder 78, and sufficient back pressure will be built up to the left of the piston as might cause a relief valve (not shown) to operate and to prevent further pressure fluid from being delivered to the pipe 91.

From the foregoing it is evident that I have disclosed a dressing tool attachment in which the diamond nib 9 is caused to move over the irregular surface of a grinding wheel, and then to follow that surface over a rounded edge, finally causing the nib to retrace its movement over the same path. Thus the wheel is dressed twice, the diamond nib moving in two directions and automatically coming to a stop when the nib has reached one end of its travel in order to reverse its path of movement, and coming to a permanent stop on conclusion of the complete dressing excursion. It is apparent that the cam 27 may be provided with any shape or contour to accommodate the most intricate configuration that the periphery of the wheel may take, and that the dressing tool will faithfully follow the path determined by the cam. Inasmuch as the rack 62 is given a constant velocity of movement in the longitudinal direction, the diamond nib is caused to dress the wheel at a constant speed regardless of the intricacies of the irregularity of shape which tend to give to the dressed surface its optimum grinding quality as determined by the dressing speed.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims.

Having thus fully described by invention, what I claim as new and desire to secure by Letters Patent, is:

1. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel which has an irregular periphery terminating in a rounded edge, said attachment comprising a cam and a follower to which the dressing tool is attached, said cam having a configuration which corresponds to that of the wheel periphery, means for drawing said follower across the cam in order to cause the dressing tool to dress the periphery of the wheel, and means for moving said cam and follower over a path corresponding to the rounded edge of the wheel to continue the dressing function of said tool.

2. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel which has an irregular periphery terminating in a rounded edge, said attachment comprising a cam and a follower to which the dressing tool is attached, said cam having a configuration which corresponds to that of the wheel periphery, means for maintaining the cam stationary and for moving the follower across the cam in order to cause the dressing tool to dress the periphery of the wheel, and means for moving both the cam and the tool through a circular path in order to cause the tool to pass over the rounded edge of the wheel to continue its dressing function.

3. A dressing attachment for a grinding wheel which has a rounded edge, said attachment comprising a dressing tool secured to a rod slidably carried on a base including a cam means for moving said rod with respect to said base to cause the tool to dress the periphery of the wheel, and means for moving the rod, base and cam as a unit to cause the tool to dress the rounded edge of the wheel.

4. A dressing attachment for a grinding wheel which has a rounded edge, said attachment comprising a dressing tool secured to a slidable member mounted on a base, means for moving the slidable member and base as a unit from one edge of the wheel toward the rounded edge and simultaneously moving the slidable member with respect to the base to accommodate irregularities in the periphery of the wheel surface, means for terminating the further movement of the slidable member and base in a direction along the periphery of the wheel, and means for moving the slidable member and base as a unit about the rounded edge of the wheel, said dressing tool being in contact with the wheel during all of the movements of the slidable member whereby the periphery of the wheel including the rounded edge is dressed.

5. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface terminating in a rounded edge, said attachment comprising a cam and follower to which the dressing tool is secured, said follower being secured to a crank terminating in a shaft, a pinion on said shaft meshing with a rack, means for moving the rack and pinion as a unit in the direction of the length of the rack to cause the dressing tool to be moved over the periphery of the grinding wheel, and means for moving the pinion with respect to the rack to rotate said shaft whereby the dressing tool is moved over the rounded edge of the grinding wheel.

6. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface terminating in a rounded edge, said attachment comprising a cam and follower to which the dressing tool is secured, said follower being secured to a crank terminating in a shaft, a pinion on said shaft meshing with a rack, means including a hydraulic cylinder for moving the rack and pinion as a unit in the direction of the length of the rack to cause the dressing tool to be moved over the periphery of the grinding wheel, and means for moving the pinion with respect to the rack to rotate said shaft whereby the dressing tool is moved over the rounded edge of the grinding wheel.

7. A grinding machine attachment for causing a dressing tool to be moved over an irregular grinding wheel surface terminating in a rounded edge, said attachment comprising a cam and follower to which the dressing tool is secured, said follower being secured to a crank terminating in a shaft, a pinion on said shaft meshing with a rack, means for moving the rack and pinion as a unit in the direction of the length

of the rack to cause the dressing tool to be moved over the periphery of the grinding wheel, means for moving the pinion with respect to the rack to rotate said shaft whereby the dressing tool is moved over the rounded edge of the grinding wheel, and means for returning the dressing tool over the rounded edge and then over the irregular surface of the grinding wheel.

8. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means comprising a shaft, a crank mounted thereon and carrying the dressing tool, said shaft and crank being adapted to move as a unit in a direction across the wheel periphery to cause said tool to dress the outer portion of the wheel periphery, means for restraining the shaft and crank from rotation during the period of time that the tool is moving across the outer portion of said periphery, said shaft and crank being then adapted to rotate through an angle determined by the length of arc of the rounded edge of the wheel.

9. A dressing attachment for a grinding wheel which has a rounded edge, said attachment comprising a dressing tool secured to a rod slidably carried on a sleeve through which the rod extends to rest on a cam, means for moving the sleeve in a direction along the length of the cam whereby the rod is caused to trace the shape of the cam in terms of a corresponding movement of the dressing tool along the periphery of the wheel, and means for moving the sleeve and contained rod, also the cam around an arc corresponding to the curvature of the dressing tool around the rounded edge of the wheel, whereby the outer periphery of the wheel is dressed in accordance with the configuration of the cam surface and the rounded edge of the wheel is dressed to a shape determined by the curved path through which the dressing tool is moved.

10. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft and a crank mounted thereon carrying the dressing tool, a pinion secured to said shaft and adapted to be actuated by a rack, means for moving the rack while preventing rotation of the shaft whereby the shaft, crank and dressing tool are moved as a unit in a horizontal direction across the periphery of the wheel, said rotation-preventing means being rendered inoperative at the termination of said horizontal movement, whereby the shaft and crank are permitted to rotate as the rack is actuated further and the dressing tool is carried around the rounded edge of the wheel.

11. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft and a crank mounted thereon carrying the dressing tool, a pinion secured to said shaft and adapted to be actuated by a rack, means for moving the rack while preventing rotation of the shaft whereby the shaft, crank and dressing tool are moved as a unit in a horizontal direction across the periphery of the wheel, said rotation-preventing means being rendered inoperative at the termination of said horizontal movement, whereby the shaft and crank are permitted to rotate as the rack is actuated further and the dressing tool is carried around the rounded edge of the wheel, said rotation-preventing means comprising a shoe secured to said shaft and having round and flat surfaces, the flat surface of said shoe being adapted to slide over the flat surface of a template, and the round surface of said shoe being adapted to rotate in a circular notch in said template at the termination of the movement over the flat surface of the template.

12. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft carrying a crank at one end and a shoe at the other end, said dressing tool being mounted on said crank, said shoe having a cylindrical portion provided with a flat surface and resting on a template having a flat horizontal surface terminating in a circular notch, means for moving the shoe along the flat surface of the template in order to cause the shoe, shaft, crank and dressing tool to move in a horizontal plane until the shoe reaches said notch, and means for rotating the shaft, crank and dressing tool when the cylindrical portion of the shoe fits itself within the circular notch of the template whereby the dressing tool is moved first in a horizontal direction and then in a circular path to dress the outer periphery of the grinding wheel and its rounded edge.

13. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft carrying a crank at one end and a shoe at the other end, said dressing tool being mounted on said crank, a pinion secured to the shaft intermediate the crank and shoe, a rack for actuating the pinion, said shoe having a cylindrical portion provided with a flat surface and resting on a template having a flat horizontal surface which terminates in a circular notch, means for moving said rack in a horizontal direction in order to move the shoe along the flat surface of the template thus causing the shoe, shaft, crank and dressing tool to move in a horizontal plane until the shoe reaches said notch, said rack being adapted to be moved further in order to cause the shaft, crank and dressing tool to be rotated when the cylindrical portion of the shoe fits itself within the circular notch of the template, and means for reversing the direction of travel of the rack in order to cause the shaft, crank and dressing tool to rotate in the opposite direction and later to cause the shaft, crank and dressing tool to move in the horizontal plane in the opposite direction, whereby the dressing tool is moved first in the horizontal direction and then in a circular path to dress the outer periphery of the grinding wheel and its rounded edge and later the dressing tool is caused to retrace these two paths but in the opposite direction.

14. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft carrying a

crank at one end and a shoe at the other end, said dressing tool being mounted on said crank, a pinion secured to the shaft intermediate the crank and the shoe, a rack for actuating said pinion, and means including a template on which the shoe rests for preventing rotation of the shaft as the rack is moved whereby the movement of the rack is translated to the shaft as the planar movement normal to the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel.

15. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft carrying a crank at one end and a shoe at the other end, said dressing tool being mounted on said crank, a pinion secured to the shaft intermediate the crank and the shoe, a rack for actuating said pinion, and means including a template on which the shoe rests for preventing rotation of the shaft as the rack is moved whereby the movement of the rack is translated to the shaft as the planar movement normal to the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said template having a shape such that at the termination of the planar movement the shoe is permitted to rotate in response to further movement of the rack in order to cause the dressing tool to move over the rounded edge of the wheel.

16. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft carrying a crank at one end and a shoe at the other end, said dressing tool being mounted on said crank, a pinion secured to the shaft intermediate the crank and the shoe, a rack for actuating said pinion, means including a template on which the shoe rests for preventing rotation of the shaft as the rack is moved whereby the movement of the rack is translated to the shaft as the planar movement normal to the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said template having a shape such that at the termination of the planar movement the shoe is permitted to rotate in response to further movement of the rack in order to cause the dressing tool to move over the rounded edge of the wheel, and means for reversing the movement of the rack when the dressing tool has reached the end of the rounded edge of the wheel whereby the dressing tool is caused to retrace its path over the rounded edge of the wheel and then over the outside periphery of the wheel in order to dress the wheel twice.

17. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge, means for moving said tool over the periphery of the wheel and then over the rounded edge of the wheel, said means including a shaft carrying a crank at one end and a shoe at the other end, said dressing tool being mounted on said crank, a pinion secured to the shaft intermediate the crank and the shoe, a rack for actuating said pinion, means including a template on which the shoe rests for preventing rotation of the shaft as the rack is moved whereby the movement of the rack is translated to the shaft as the planar movement normal to the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said template having a shape such that at the termination of the planar movement the shoe is permitted to rotate in response to further movement of the rack in order to cause the dressing tool to move over the rounded edge of the wheel, means for reversing the movement of the rack when the dressing tool has reached the end of the rounded edge of the wheel whereby the dressing tool is caused to retrace its path over the rounded edge of the wheel and then over the outside periphery of the wheel in order to dress the wheel twice, and a double-acting fluid cylinder for actuating the rack first in one direction and then in the other direction, the direction of the pressure fluid admitted to said cylinder being controlled by a pilot valve which in turn is controlled by a dog secured to the shaft and operating in response to a predetermined rotation of the shaft to reverse the operation of said pilot valve.

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