

Sept. 1, 1942.

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2,294,492

DRESSER ATTACHMENT FOR GRINDING MACHINES

Filed Aug. 28, 1940

4 Sheets-Sheet 1

FIG. 1

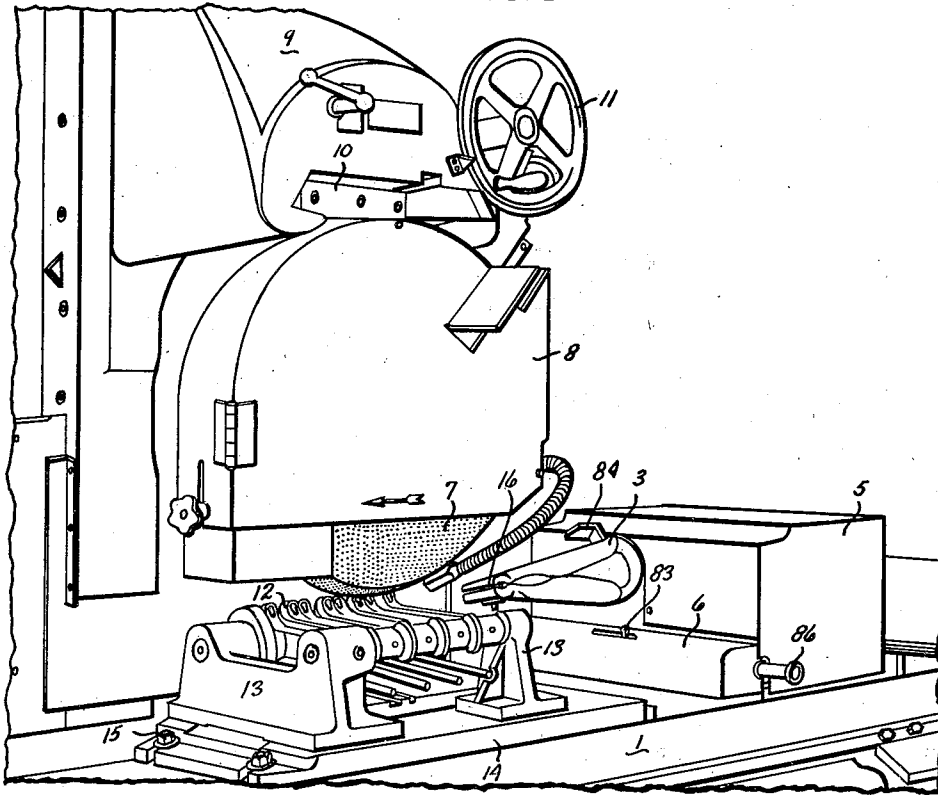
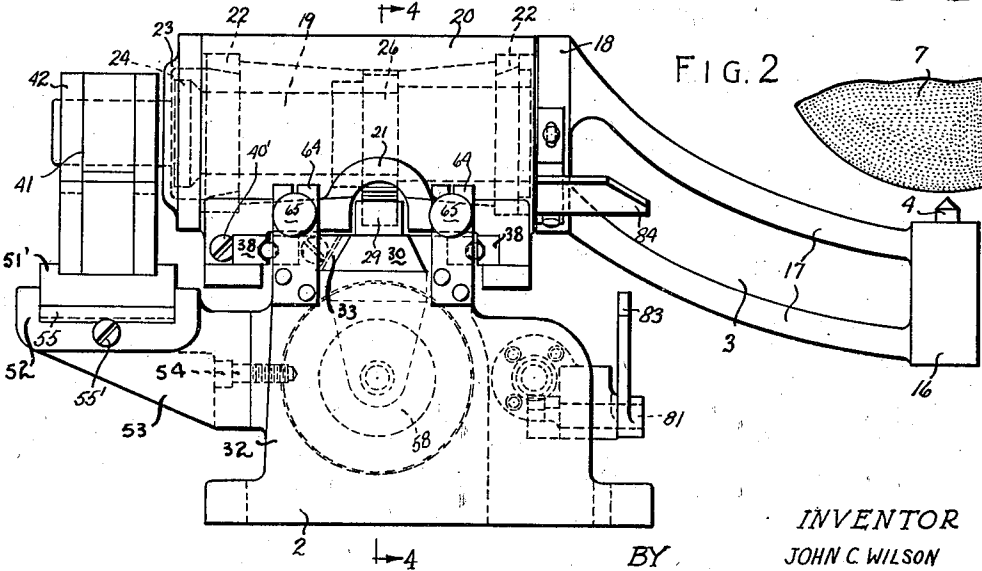


FIG. 2



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4 Sheets-Sheet 2

FIG 3

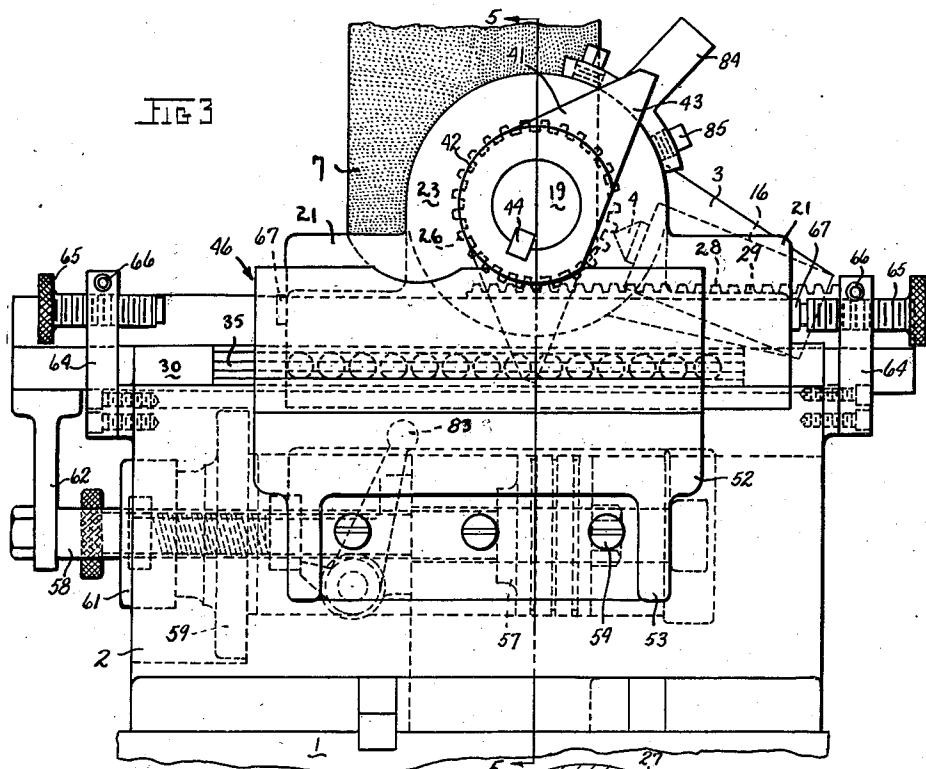
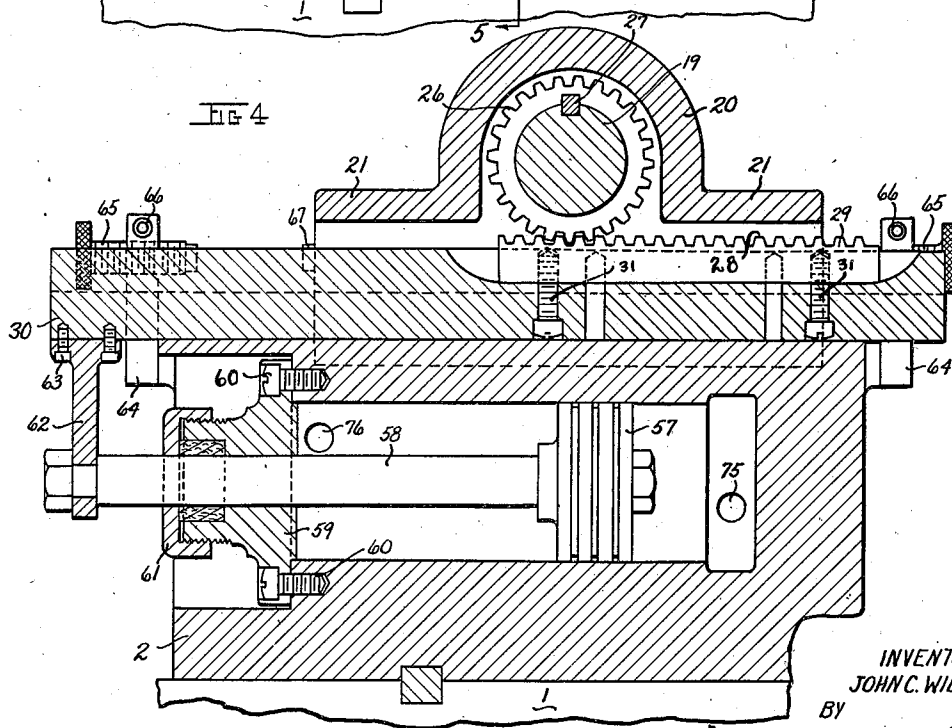


FIG 4



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4 Sheets-Sheet 3

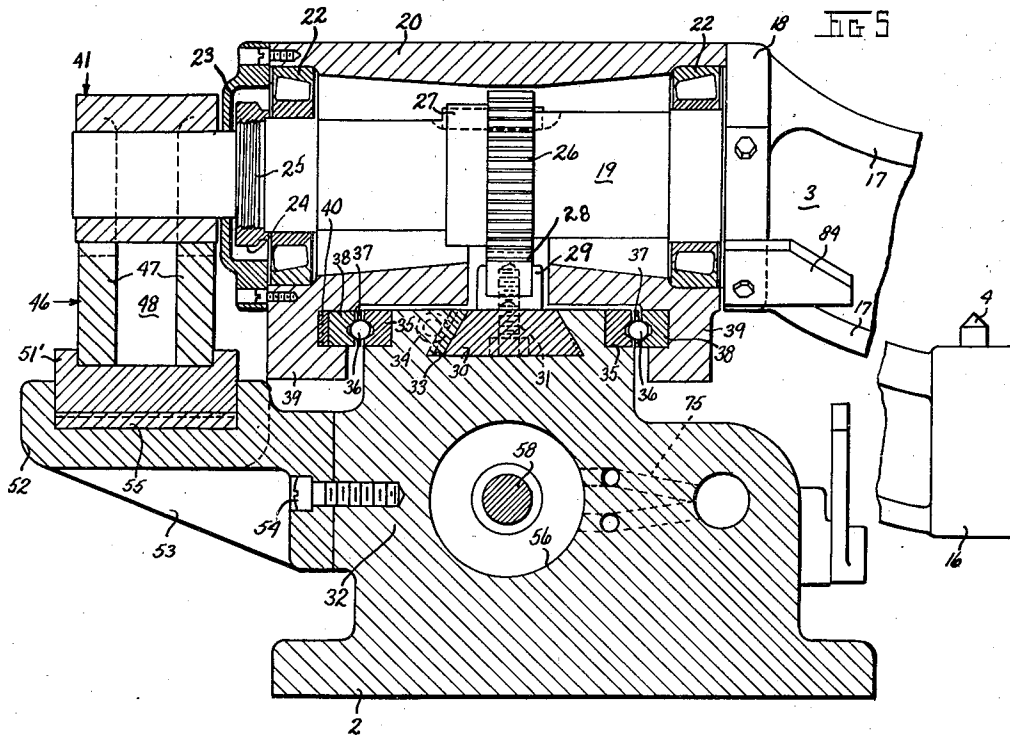
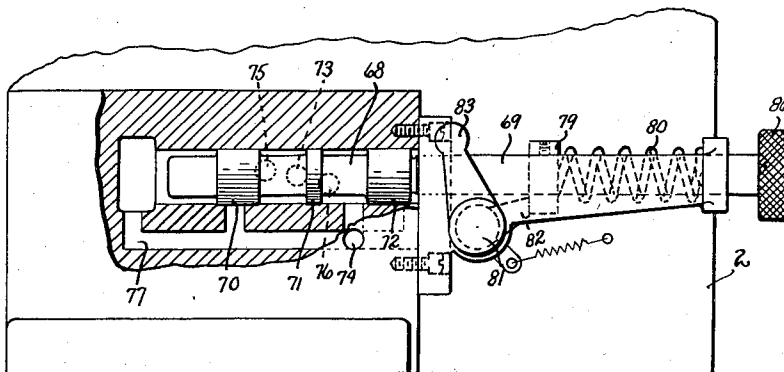


FIG 6



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4 Sheets-Sheet 4

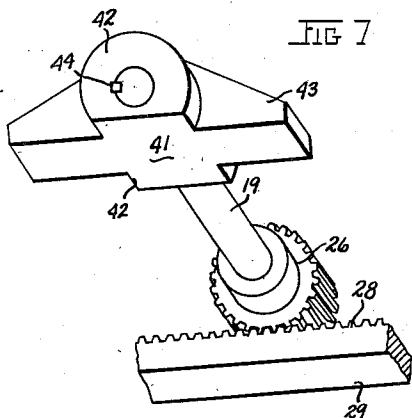


FIG 7

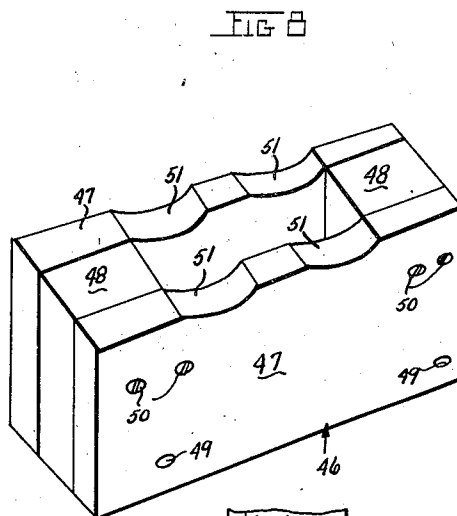


FIG 8

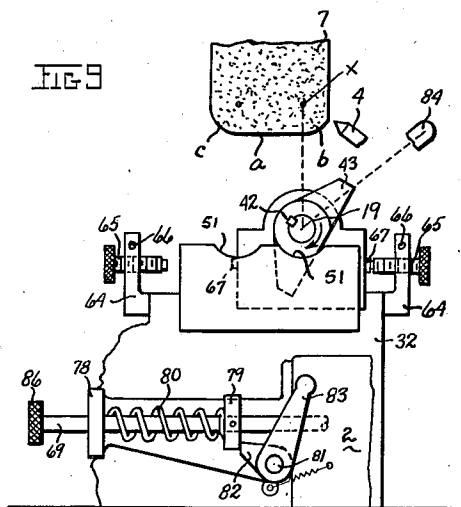


FIG 9

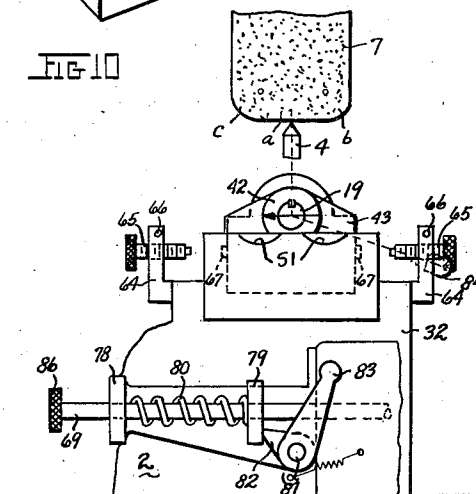


FIG 10

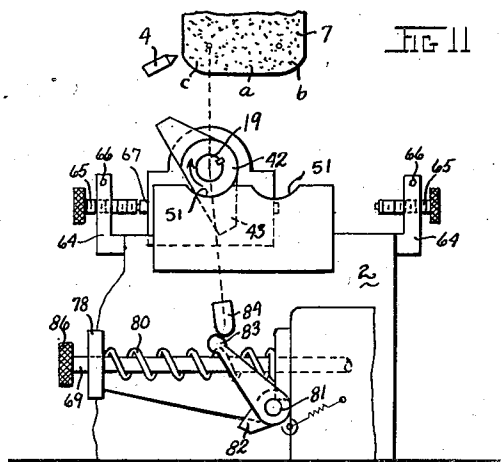


FIG 11

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UNITED STATES PATENT OFFICE

2,294,492

DRESSER ATTACHMENT FOR GRINDING MACHINES

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Application August 28, 1940, Serial No. 354,555

21 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. The arrangement is such that the grinding wheel leaves the impression of its irregular surface on the tools or elements being ground. This impression may be obtained from a wheel having an outer periphery of uniform diameter and terminating at each edge of the wheel in a rounded surface. The radii of these rounded surfaces, as well as the uniformity of the straight peripheral portion, must be accurately determined and maintained during the grinding operation.

In the case of quantity production, for example when simultaneously grinding a group of aircraft engine rods by passing the wheel first in one direction and then in the opposite direction over the rods, and then grinding a successive group of rods in the same manner, it becomes necessary to always maintain the grinding wheel in a dressed condition. The dressing operation must be such that the wheel will have the same peripheral shape, after being dressed, that it had before the dressing operation if the successive groups of engine rods are to conform strictly to the predetermined dimensions and shape. Heretofore wheels were usually dressed by a hand tool provided with a diamond nib, particularly those wheels of complicated shape as when the edges were rounded-over so that the accuracy with which the dressing operation was performed would depend solely on the experience and skill of the dressing operator.

The primary object of the present invention is to provide an improved wheel dressing attachment for a grinding machine, and in which the dressing tool is caused faithfully to follow not only the irregularities of the wheel periphery but also the rounded edges at each side of the wheel.

Another object is to provide an attachment, as explained above, in which the dressing tool is caused to move over the periphery of the wheel in a predetermined path, including a circular path at each edge of the wheel.

The final object is to provide a 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, then in

the opposite direction and over the rounded surfaces formed at each edge of the wheel.

The above objects are attained, in brief, by securing the dresser tool to a crank which is attached to a shaft, the latter being caused to rotate through a given arc by which the tool is drawn over one of the rounded surfaces, then the shaft is moved in a plane parallel to the main periphery of the grinding wheel during which time the tool is moved over such periphery. The shaft is then rotated in a direction opposite its original rotation to cause the tool to describe an arc corresponding to the rounded edge at the opposite side of the wheel, and on conclusion of the entire movement the tool is caused to retrace its path so that the grinding wheel is dressed twice and over its entire cutting surface, including both rounded edges.

All of the various movements of the dresser tool are made frictionless by the use of ball bearings, and ample adjustment is provided through wedge-shaped gibs in order to take up the wear.

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

In the drawings:

Figure 1 is a side elevational view of the upper portion of a typical form of grinding machine which is provided with the improved dresser attachment. Certain machine elements, such as aircraft engine rods, which lend themselves to quantity production and fabrication, are shown in position ready to be ground by a wheel that has previously been dressed by the improved attachment.

Figure 2 is a side elevational view of the improved dresser attachment.

Figure 3 is also an elevational view looking toward the left-hand end of the structure shown in Figure 2.

Figure 4 is a cross sectional view taken along the line 4—4 in Figure 2.

Figure 5 is a sectional view taken along line 5—5 in Figure 3 through the length of the attachment, down the middle, but showing certain parts, including the shaft and crank, in elevation.

Figure 6 is a fragmentary elevational view looking at the lower right-hand end of the structure shown in Figure 5, but with the pilot valve broken away in section to show its internal construction.

Figure 7 is a fragmentary perspective view showing the structural relationship between the rack, pinion, crank shaft and shoe by which the crank which carries the diamond nib is caused

to describe a path corresponding to the periphery of the grinding wheel.

Figure 8 is a perspective view of a template which cooperates with the shoe shown in Figure 7 in order to obtain the predetermined movement of the crank and its shaft.

Figure 9 is a diagrammatic view showing the dresser tool at the beginning of its dressing operation, and also depicting the relative positions of the control mechanism by which the tool is caused to move over the periphery of the grinding wheel. In this view (as well as in Figures 10 and 11) the grinding wheel has been shown above its true position for the sake of clarity, and dotted lines have been used to indicate the true relationship.

Figure 10 shows apparatus similar to that in Figure 9 except that the dresser tool has now reached the straight peripheral portion of the grinding wheel and the positional relationship of the control mechanism has been changed accordingly.

Figure 11 is still another diagram, but showing the dresser tool at the end of its movement in one direction after having described a rounded path corresponding to the rounded edge opposite the edge adjacent the dresser tool in Figure 9.

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 designated 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 (Figure 5) which may be bolted to the table 1.

As shown in Figure 1, the attachment comprises a crank generally designated 3 and carrying a diamond nib 4, the crank being connected to a mechanism contained within a box 5 which gives the crank three types of motion, a rotating motion around one edge of the grinding wheel, a lateral motion over the straight periphery of the grinding wheel, and finally a rotary motion over the rounded edge at the other side of the grinding wheel periphery. These movements of the crank and its mechanism are caused by a hydraulic cylinder, also contained within the box 5, the piston within the cylinder being controlled by a pilot valve contained within the box 6. The grinding wheel is indicated in Figure 1 by the reference numeral 7, and there is the usual steel guard 8 inclosing practically all of the wheel except the lower abrading surface. The guard is secured to the frame 9 of the machine. The hand wheel 11 controls the lateral movement of the grinding wheel on its dovetail slide 10 as is well known in the art.

The work being ground has been typically illustrated by a group of aircraft engine rods 12 which are clamped in position between two up-standing work holders 13, supported on a base 14 which is bolted as at 15 to the table of the machine. These engine rods have a configuration that requires rounded surfaces at each end, separated by a flat surface. The distance between these rounded surfaces or fillets might be the same as the thickness of the grinding wheel 7 or may be greater than this thickness so that in order to grind both of the rounded surfaces it is necessary automatically to move the table 1

in a transverse direction, as is well known in the art. It is apparent that under these conditions the rounded edges of the wheel must conform strictly to a predetermined radius, and this dimension must be rigidly maintained during the successive grinding of each group of the engine rods in order that the latter might have strictly the same finished dimensions. When the grinding wheel requires dressing it is desirable that the dressing tool be brought under the wheel in such a position that the diamond nib 4 is caused to dress the periphery of the wheel including the rounded edges, and this dressing operation must be accurately performed from time to time depending on the dressing requirements. The structural details of the improved dressing attachment are illustrated for the most part in Figures 2, 3, 4 and 5.

The diamond nib 4 is secured in any suitable manner to a hub 16 which is carried on the end of the crank 3, the latter being typified as a flat member provided with reinforcing webs 17 (Figure 5). The left-hand end of the crank 3 (Figure 5) terminates in a round shoulder member 18 which is carried on a crank shaft 19. The latter is contained within a barrel casting 20, which has a general circular configuration as indicated in Figure 4, and is provided at each side with an arch-shaped wing 21. The purpose for this wing-shaped extension will be explained hereinafter. The barrel casting 20 is provided at each end with a roller bearing 22 which serves as a rotatable support for the shaft 19. To the end of the barrel casting 20 opposite the shoulder member 18 there is secured a cap 23, hollowed out to receive a nut 24 which engages threads 25 cut on the shaft. The purpose of this nut is simply to maintain the axial position of the shaft.

Intermediate the ends of the shaft and also contained within the barrel casting 20 there is a hubbed pinion 26, keyed to the shaft as indicated at 27, this pinion being adapted to mesh with the teeth 28 of a rack 29 (Figure 7). The rack 29 is supported on and secured to a dovetail slide 30 by means of screws 31, this slide being adapted to move in a corresponding groove formed at the upper surface of a solid block of metal 32 which forms an integral part of the base 2 (Figure 5). In order to take up wear between the dovetail slide member 30 and the sides of the groove there may be provided a tapered gib 33 longitudinally adjustable by a screw 34, as is well known in the art. The adjustment should be such as freely to permit relative longitudinal movement between the slide 30 and the block 32 under conditions which will be explained hereinafter.

The block 32 is provided at each side of its upper surface with a cutaway portion to receive a rail 35. Each rail is provided with a V-shaped groove at its outer surface, these grooves being adapted to receive ball bearings 36 spaced apart by means of a retaining plate 37. The ball bearings are adapted to roll in V-shaped grooves formed in the opposite rails 38 which are held in position by the flange member portions 39 provided at each end of the barrel casting 20 (Figure 5). The tightness of the balls within their respective grooves may be adjusted by means of a tapered gib 40 and an adjusting screw 40' (Figure 2). It is apparent that the presence of the ball bearings 36 permits a lateral movement between the barrel casting 20 and the metal

block 32, carrying with it the shaft 19, the pinion 26, rack 29 and the dove-tail slide 30.

The shaft 19 carries at its end beyond the cap 23 a shoe, generally designated 41, and having a cylindrical portion 42 positioned on opposite sides of a triangular portion 43. The shoe is keyed to the shaft, as indicated at 44. The flat portion of the shoe 41 rests on a template 46 (Figure 5), the details of which are shown in Figure 8. The template is constituted of two flat plates 47 spaced from one another by a pair of flat intermediate blocks 48, and all doweled together as indicated at 49, and screwed as indicated at 50. The plates 47 are provided at their upper edges with a pair of spaced circular notches 51, the notch of one plate being in line with the corresponding notch of the other plate to form the general arrangement shown in Figure 8. The centers of curvature of these notches lie in the horizontal plane containing the center line of the crankshaft 19. The spacing of the notches is determined by the width of the straight portion of the grinding wheel periphery, as will be explained hereinafter. The template 46 is held in place by a grooved block 51' which rests in a groove on a bracket 52 having supporting ribs 53. The bracket has an L-shaped form and is screwed to the block 32 as indicated at 54.

In order to regulate the vertical position of the shoe 41, thus preventing strain on the shaft 19, there may be provided a tapered gib 55 positioned between the lower surface of the block 51' and the horizontal surface of the groove in the member 52. The position of the tapered gib 55 may be adjusted by a screw 55' (Figure 2). The block 32 is hollowed out to form a cylinder 56. Within this cylinder there is a hydraulic piston 57 secured to a shaft 58 which extends through a combined packing box and retaining plate 59 of any suitable construction, the latter being secured to the cylinder by means of screws 60 (Figure 4). A cap 61 may be screwed over the combined packing and retaining element 59. The left-hand end of the shaft (Figure 4) is secured to a downwardly extending lug or bracket 62 which is screwed as indicated at 63 to the dove-tail slide 30. The arrangement is such that as the piston 57 is caused to reciprocate within the cylinder 56, under conditions which will be explained presently, the dove-tail slide 30 is given a similar motion with respect to the block 32, causing the rack 29 to communicate its longitudinal movement to the pinion 26. During one portion of the operation the pinion is permitted to rotate, thus rotating the shaft 19, but during another portion of the operation the pinion is not permitted to rotate so that the effect of the rack is to cause the barrel casting 20, and all of the contained elements, to be moved transversely of the block 32. It is apparent that the arch-shaped wings 21 of the barrel casting have an interior dimension of arch sufficient to clear the rack 29.

Secured to the opposite end faces of the block 32, as seen in Figure 4, there is a pair of up-standing bifurcated brackets 64 at each end, each of these brackets carrying an adjustable stop screw 65 which may be tightly secured in any desired position by means of a clamping screw 66 which spans the bifurcated portion of the bracket. Contact elements 67 are provided on the opposite end surfaces of the wing portions 21 of the barrel casting in line with the stop screws 65. The purpose of these screws and the

cooperating contact elements will be pointed out hereinafter.

For controlling the piston 57 in the hydraulic cylinder there is provided a two-way pilot valve, generally designated 68 and illustrated in Figure 6. This valve may be formed of a cylinder contained within the block 32, and has a cooperating valve rod 69. This rod is provided with three enlarged portions 70, 71 and 72, so spaced with respect to the pressure fluid inlet and outlet conduits as to control pressure fluid which is admitted to the opposite sides of the piston 57 in succession. Conduits are taken from a source of pressure fluid, which may be an oil pump (not shown), these conduits entering the pilot valve as indicated by the dotted circle 73 which represents the inlet, and the circle 74 which represents the outlet from the valve. A conduit 75 is taken from the pilot valve to the right-hand side of the piston 57 (Figure 4), and a conduit 76 connects the left-hand side of the piston to the valve. A common exhaust passageway 77 is taken from three positions along the cylinder of the valve, this passageway communicating with the outlet conduit 74 (Figure 6).

The arrangement is such, and assuming that the valve shaft has the same position as shown in Figure 6, that pressure fluid from the pump is admitted to the valve at the conduit 73 and passes through the compartment formed by the enlarged portions 70, 71, into the conduit 75, and is admitted to the right of the piston 57 (Figure 4). However, as the rod 69 is moved to the left (Figure 6), the enlarged portion 71 is now positioned between the conduit inlets 75, 73, preventing pressure fluid from flowing into the conduit 75 but opening this conduit to the exhaust passageway 77 since the portion 70 has now uncovered that passageway. Under these conditions the pressure fluid inlet 73 is now in communication with the conduit 76, and the exhaust passageway to this conduit is closed by the portion 72 so that pressure fluid is now admitted to the left-hand side of the piston 57 (Figure 4); and the right-hand side of the piston is now open to exhaust. Consequently, by moving the valve rod 69 either to the left or right pressure fluid is caused to enter either one side or the other side of the piston 57.

In order to control the position of the rod 69 there is provided the following mechanism: Projecting outwardly from the side of the block 32 there is a bracket 78 having an opening which receives the rod 69. A collar 79 is pinned to the shaft, and between the collar and the bracket 78 there is a compression spring 80. A pin 81 extends outwardly from the block 32, this pin serving as a pivot for a latch 82, to which is rigidly secured a trip lever 83. Directly in line with the trip lever there is a dog 84, bolted as indicated at 85 to the shoulder member 18 of the shaft 19, the arrangement being such that as the shaft is rotated the dog will be caused to strike the lever 83.

Complete operation

Assume that it is desired to dress the straight periphery *a* (Figure 9) of the wheel, also the right-hand rounded edge *b* and the left-hand rounded edge *c*; assume further that the diamond nib 4 is in a position to contact the right-hand side of the wheel at the points where the curved surface starts to form. This is conveniently designated position No. 1 (not shown on the drawings). It will be noted that the axis of the

shaft 19 coincides (as indicated by the dotted line) with the center point x of the rounded edge b , and furthermore that the axis of the shaft coincides with the center of curvature of the right-hand pair of notches 51 in the template 46. The winged shoe member 41 will take at this moment an upward diagonal position with the left-hand triangular portion 43 positioned downwardly within the space in the template formed between the blocks 48. The position of the shaft 19 will be such, under these conditions, that the dog 84 carried by the shoulder member 18 will also extend upwardly and outwardly as indicated in Figure 9. In order to cause the diamond nib 4 to move downwardly around the curved edge and to the left, the knurled knob 86 is pulled to the left, causing the collar 79 to place the spring 80 under compression so that when the knob is released the collar 79 will contact the left-hand end of the latch 82, causing the trip lever 83 to be moved to the right. This is the position indicated in Figure 9.

A similar position has also been illustrated in Figure 6 except that this view has been taken from the opposite side of the pilot valve of Figure 9, so that the knob 86 in Figure 6 would actually be moved to the right. It will be noted that the inlet conduit 73 of the pressure fluid line is in communication with the conduit 75, by which fluid is admitted to the right-hand side of the piston 57 in the main cylinder (Figure 4). The piston will then move to the left, carrying with it the rack 29.

A left-hand movement of the rack, as seen in Figure 7, will cause a clockwise rotation of the pinion 26, causing the circular hubs 42 of the shoe 41 to be rotated within the right-hand pair of circular notches 51 of the template 46. During this time the rotation of the shaft causes the shoulder member 18 to rotate, carrying with it the crank 3, also the diamond nib which is secured to the hub portion 16 of the crank. Since the center point x (Figure 9) of the curve b , the axis of the shaft 19 and the center of curvature of the notch 51 lie on a common axis, the diamond nib 4 will be caused to trace a path of the desired predetermined radius, therefore dressing the curved surface b of the wheel. When the shaft 19 has been rotated in this manner through the necessary angle, the flat surface of the right-hand wing 43 (Figure 7) of the shoe 41 will strike the upper surface of the right-hand intermediate block 48 (Figure 8) of the template, and further rotation of the shaft 19 is precluded.

As the rack 29 continues to move to the left, due to the continued admission of pressure fluid to the right of the piston 57, the movement of the rack can be communicated to the pinion 26 only as a transverse movement of the pinion, its shaft 19 and the shoe 41. These three elements are therefore moved bodily to the left, carrying with them the barrel casting 20 which is adapted to slide with respect to the main block 32 at the dove-tail slide 30. The positional relationship between the essential elements of the mechanism during the transverse movement of the shaft 19 is shown in Figure 10. It will be noted that during this movement no change is made in the position of the knurled knob 86 and hence the trip lever 83 remains in the position in which it was initially set when the operation first started. The transverse movement of the barrel casting 20 causes a similar movement of the shoulder member 18 to which the crank 3, the hub portion 16 and the diamond nib 4 are

attached. Consequently, this movement of the barrel casting causes the diamond nib to move in a path parallel to the table of the grinding machine and therefore to dress a straight surface which is normal to the sides of the grinding wheel.

As the diamond nib 4 proceeds along the outer periphery of the grinding wheel it will come to a point directly below the center of the left-hand curve c of the wheel. At this instant the left-hand contact members 67 (Figures 4 and 11) are caused to contact the right-hand ends of the screws 65, the latter being adjusted to provide a contact at this particular point. Under these conditions further movement to the left of the barrel casting 20 is precluded, so that the only movement possible for the pinion to make at this time in response to further movement to the left of the rack 29 is that of rotation. At the moment contact is established between the member 67 and the screws 65, the center line of the shaft 19 will coincide with the center of the curve c and will also be in line with the center point of the left-hand curved notches 51. Consequently, the hub portions 42 of the shoe 41 will be in a position to rotate within the left-hand circular notches 51, and the right-hand wing portion 43 of the shoe will be received by the deep slot formed between the intermediate blocks 48 of the template. The shaft 19 will be caused to rotate in a clockwise direction, carrying with it the shoulder member 18, the crank 3, the hub 16 and the diamond nib 4.

Since the center point of the left-hand circular notches corresponds in position to the center point of the rounded edge c of the grinding wheel, the diamond nib will be caused to describe a circular path of any radius determined by the length of the crank. As the rack continues to move to the left the diamond nib will finally reach a point on the surface c of the grinding wheel at which the curved portion merges with the left-hand side of the wheel. In case the pitch radius of the pinion 26 is equal to the radius of the curves b , c of the wheel, the diamond nib will move at a constant linear speed over the entire periphery of the wheel including the curved surfaces.

It will be noted from a comparison of Figures 9, 10 and 11, that the dog 84 has been swinging through an arc while the nib was tracing the curvature a and then is moved in a horizontal path while the surface a of the grinding wheel was being dressed, the dog finally moving inwardly and upwardly during movement of the diamond nib 4 over the surface c of the grinding wheel, so that when the surface has been completely dressed the dog 84 is caused to contact the trip lever 83. This movement of the trip lever releases the latch 82 from the inside surface of the collar 79, permitting the spring 80 to push the collar to the right and giving the rod 69 a similar movement.

Referring now to Figure 6, an inward movement of the rod 69 to the left causes the enlarged portion 71 to be interposed between the conduit openings 73, 75, thus cutting off pressure fluid from the conduit 75. As the enlarged portion 70 is moved to the left the conduit 75 is placed in communication with the exhaust passageway 77 to permit pressure fluid at the right of the main piston 57 to be exhausted back to the pump. It will be noted that the inlet conduit 73 is now in communication with the conduit 76, permitting pressure fluid to be admitted to the

left-hand side of the main piston 57. The large portion 72 has in the meantime sealed the chamber to the left of the main piston from the exhaust passageway. The piston 57 is therefore now caused to move to the right, producing first a counter-clockwise rotation of the shaft 19 since the hub members 42 of the shoe 41 are seated within the left-hand circular notches 51 of the template, and this proceeds until the lower flat surface of the left-hand wing portion 43 of the shoe contacts the upper surface of the left-hand block 48 of the template, at which time the shaft 19 is prevented from further rotational movement.

It will be noted that during this rotational movement of the shaft 19 the dog 84 will have broken contact with the trip lever 83 so that in order to maintain the lever in this reverse position, preventing any movement at this time of the valve rod 69, a tension spring 87 (Figure 11) may be provided. The movement of the shaft 19 and the corresponding movement of the diamond nib 4 is exactly the reverse of that described in connection with the forward movement, so that the shoe 41 is now caused to move in a horizontal plane along the top surface of the template 46 until the hub portions 42 reach the right-hand pair of circular notches 51. At this time the diamond nib is directly below the center point of the curved edge b of the grinding wheel. The right-hand pair of stop screws 65 is so adjusted that at this moment the contact members 67 at the right side of the barrel casting 20 are caused to abut the adjustable stops. Inasmuch as the longitudinal movement of the barrel casting and its contained shaft is prevented by the adjustable stop screws 65, further movement to the right of the rack 29 will cause the pinion 26 to be rotated in counter-clockwise direction, causing the diamond nib 4 to describe a circular path around the curved surface b of the grinding wheel. When the pinion 26 has rotated through a ninety-degree angle so that the diamond nib has reached approximately a horizontal position at a point where the curved surface b merges with the right-hand side of the grinding wheel, further movement of the piston 57 is automatically precluded. This automatic stopping function may be obtained in any suitable and well known manner, for example by means of excessive back pressure built up between the left-hand side of the piston and the adjacent cylinder end by which pressure fluid is by-passed through a relief valve (not shown) and thus prevented from entering either the pilot valve or the hydraulic cylinder.

From the foregoing it is evident that I have disclosed an improved dresser attachment for a grinding wheel, in which the dresser tool is caused automatically to move from one side of the wheel around a curved surface of predetermined radius, then along a straight surface and finally around another curved surface to the other side of the wheel, after which the dresser tool is caused to reverse its movement defining exactly the same path as it had during its forward motion. The wheel is therefore dressed twice, after which further movement of the diamond nib is automatically stopped in any suitable manner. It will be understood that if desired any number of excursions may be provided for the diamond nib by simply pulling the knob 86 to the left to reset the trip lever 83 after the diamond nib has terminated its single excursion. It is further apparent that all of the relative movements, both rotary

and slidable, are substantially frictionless in that the roller bearings 22 permit the shaft 19 to rotate relative to the barrel casting 20, and the ball bearings 36 permit the barrel casting 20 and the shaft 19 to move as a unit with respect to the metal block 32.

In order to prevent grinding dust from entering any of these bearings it may be desirable to provide the sheet metal box 5 over the main part of the attachment, and a smaller box 6 over that part of the attachment which contains the pilot valve, permitting only the crank 3, the trip lever 83 and the starting knob 86 to be exposed. The attachment is preferably secured rigidly to the table 1 of the grinding machine, but may be normally positioned out of the way of the articles being momentarily ground so that when it becomes necessary to dress the wheel the table may be run a sufficient distance toward the grinding wheel to permit the diamond nib 4 accurately to dress the entire cutting periphery of the wheel.

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

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

1. A grinding machine attachment for dressing a grinding wheel having a straight peripheral portion and two rounded edge portions, means for moving a dressing tool from one side of the wheel over one of the rounded edges, then along the straight portion, then around the other rounded edge, said means including a cylindrical member which carries the dressing tool, means for sequentially rotating said member and for moving the member in a translatable direction parallel to the axis of the cylinder to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface, said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and translatable movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges and means for reversing the movement of the tool to cause the latter to retrace its path back to its initial position whereby the entire abrading surface of the wheel is dressed twice.

2. A grinding machine attachment for dressing a grinding wheel having a straight peripheral portion and two rounded edge portions, means for moving a dressing tool from one side of the wheel over one of the rounded edges, then along the straight portion, then around the other rounded edge, said means comprising a crank to which the dressing tool is secured and a crank shaft, said crank shaft being adapted to rotate when one of the rounded edge portions is being dressed, then being adapted to be moved in a direction parallel to the straight peripheral portion of the wheel in order to cause said portion to be dressed by the dressing tool, said shaft being then adapted to be again rotated in order to cause the dressing tool to move around the remaining edge portion, said crank shaft being carried on a cylindrical member, means for sequentially rotating said member and for moving the member in a translatable direction parallel to the axis of the cylinder to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface,

said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and translatory movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges and means for reversing the movement of the tool to cause the latter to retrace its path back to its initial position whereby the entire abrading surface of the wheel is dressed twice.

3. A grinding machine attachment for dressing a grinding wheel having a straight peripheral portion and two rounded edge portions, means for moving a dressing tool from one side of the wheel over one of the rounded edges, then along the straight portion, then around the other rounded edge, said means comprising a crank to which the dressing tool is secured, a crank shaft and a motor for operating said shaft, said crank shaft being carried on a cylindrical member, means for sequentially rotating said member and for moving the member in a translatory direction parallel to the axis of the cylinder to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface, said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and translatory movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges and means for reversing the movement of said tool to cause the latter to retrace its path back to its initial position whereby the entire abrading surface of the wheel is dressed twice, said last-mentioned means comprising a device for reversing the direction of rotation of said motor.

4. A grinding machine attachment for dressing a grinding wheel having a straight peripheral portion and two rounded edge portions, means for moving a dressing tool from one side of the wheel over one of the rounded edges, then along the straight portion, then around the other rounded edge, said means comprising a crank to which the dressing tool is attached and a crank shaft, a pressure fluid motor for actuating said shaft, said motor being adapted through suitable mechanism to rotate the shaft at the time one of the rounded edges of the grinding wheel is being dressed, then to move the shaft in a direction parallel to the straight peripheral portion of the wheel during the time that the last-mentioned portion is being dressed, and then to rotate the shaft in the same direction as before in order to cause the dressing tool to dress the other rounded edge of the grinding wheel, said crankshaft being carried on a cylindrical member, means for sequentially rotating said member and for moving the member in a translatory direction parallel to the axis of the cylinder to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface, said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and translatory movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges.

5. A grinding machine attachment for dressing a grinding wheel having a straight peripheral portion and two rounded edge portions, means for moving a dressing tool from one side of the wheel over one of the rounded edges, then along

the straight portion, then around the other rounded edge, said means comprising a crank to which the dressing tool is attached and a crank shaft, a pressure fluid motor for actuating said shaft, said motor being adapted through suitable mechanism to rotate the shaft at the time one of the rounded edges of the grinding wheel is being dressed, then to move the shaft in a direction parallel to the straight peripheral portion of the wheel during the time that the last-mentioned portion is being dressed, and then to rotate the shaft in the same direction as before in order to cause the dressing tool to dress the other rounded edge of the grinding wheel, said pressure fluid motor comprising a hydraulic cylinder with a double-acting piston, and means including a pilot valve for controlling the admission of pressure fluid alternately to the opposite sides of said piston whereby the motor moves the shaft in a direction such as to cause the dressing tool to dress the entire periphery of the grinding wheel including both rounded edge portions, and then the shaft is moved in the opposite direction to cause the dressing tool to retrace its movement over the grinding wheel, said crankshaft being carried on a cylindrical member, means for sequentially rotating said member and for moving the member in a translatory direction parallel to the axis of the cylinder to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface, said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and translatory movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges.

6. A dressing attachment for a grinding wheel which has rounded edges separated by a straight portion, said attachment comprising a dressing tool secured to the end of a crank, said crank being carried on a shaft, means for rotating the shaft to cause the tool to dress one of the rounded edges of the wheel, means for moving the shaft, crank and dressing tool within a plane which passes through the axis of the shaft and parallel to the straight portion of the grinding wheel whereby the dressing tool is caused to move over the straight portion of the wheel periphery, and means for rotating the shaft upon conclusion of the planar movement of the shaft whereby the dressing tool is caused to move over the other rounded edge of the wheel, said means for moving the shaft, crank and dressing tool comprising a cylindrical member, means for sequentially rotating said member and for moving the member in a translatory direction parallel to the axis of the shaft to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface, said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and translatory movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges.

7. A dressing attachment for a grinding wheel which has rounded edges separated by a straight portion, said attachment comprising a dressing tool secured to the end of a crank, said crank being carried on a shaft, means for rotating the shaft to cause the tool to dress one of the rounded edges of the wheel, means for moving the shaft, crank and dressing tool within a plane which passes through the axis of the shaft and parallel

to the straight portion of the grinding wheel whereby the dressing tool is caused to move over the straight portion of the wheel periphery, means for rotating the shaft upon conclusion of the planar movement of the shaft whereby the dressing tool is caused to move over the other rounded edge of the wheel, said means for moving the shaft, crank and dressing tool comprising a cylindrical member, means for sequentially rotating said member and for moving the member in a transitory direction parallel to the axis of the shaft to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface, said last-mentioned means including a shoe secured to said member and a template over which the shoe rides to control the rotational and transitory movements of said member whereby the dressing tool is caused to dress the entire cutting surface of the wheel including the rounded edges and means for causing the tool to retrace its path over one rounded edge, then over the straight peripheral portion, and finally over the other rounded edge to its initial position.

8. A grinding machine attachment for dressing a grinding wheel having a straight peripheral portion and two rounded end portions, a dressing tool carried by a crank, a crank shaft having a pinion, means for rotating said pinion in one direction to cause said tool to dress one of the rounded end portions of the wheel, and means for causing the pinion to move in a plane which passes through the shaft whereby the dressing tool dresses the straight peripheral portion of the wheel, said pinion-rotating means being thereupon again effective to cause said tool to dress the other rounded end portion, the pitch diameter of said pinion being substantially equal to the radius of the two rounded end wheel portions whereby said dressing tool has the same linear speed throughout its entire dressing operation.

9. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface having an outer peripheral portion which terminates at each end in a rounded edge, said attachment comprising a dressing tool secured to a crank, a crank shaft, a pinion on said shaft meshing with a rack, means for moving the rack while permitting the shaft to rotate whereby said tool dresses one of the rounded edges of the wheel, means for restraining the shaft from rotation during further movement of the rack whereby the shaft, crank and dressing tool are moved in a direction parallel to the straight peripheral portion of the wheel in order to dress said portion, and means for thereafter permitting rotation of the shaft during still further movement of the rack whereby the other rounded edge of the wheel is dressed by said tool.

10. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface having an outer peripheral portion which terminates at each end in a rounded edge, said attachment comprising a dressing tool secured to a crank, a crank shaft, a pinion on said shaft meshing with a rack, means for moving the rack while permitting the shaft to rotate whereby said tool dresses one of the rounded edges of the wheel, means for restraining the shaft from rotation during further movement of the rack whereby the shaft, crank and dressing tool are moved in a direction parallel to the straight peripheral portion of the wheel in order to dress said portion, and means for thereafter

permitting rotation of the shaft during still further movement of the rack whereby the other rounded edge of the wheel is dressed by said tool, said rack-moving means comprising a hydraulic motor controlled by a pilot valve.

11. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface having an outer peripheral portion which terminates at each end in a rounded edge, said attachment comprising a dressing tool secured to a crank, a crank shaft, a pinion on said shaft meshing with a rack, means for moving the rack while permitting the shaft to rotate whereby said tool dresses one of the rounded edges of the wheel, means for restraining the shaft from rotation during further movement of the rack whereby the shaft, crank and dressing tool are moved in a direction parallel to the straight peripheral portion of the wheel in order to dress said portion, and means for thereafter permitting rotation of the shaft during still further movement of the rack whereby the other rounded edge of the wheel is dressed by said tool, said rack-moving means comprising a double-acting hydraulic cylinder to which pressure fluid is admitted alternately to opposite ends of the cylinder and controlled by a pilot valve, a dog projecting outwardly from said shaft and in line with a reversing lever on said pilot valve, said dog being so positioned that after the shaft has terminated its last rotational movement the dog will strike the reversing lever of the pilot valve to cause pressure fluid to be admitted to the opposite end of the hydraulic cylinder whereby the rack is caused to move in the opposite direction and the dressing tool is caused to retrace its path of movement to its initial position and the grinding wheel periphery is dressed twice.

12. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which terminates in rounded edges, said attachment comprising a dressing tool secured to a crank, a crank shaft therefor, a pinion on the shaft meshing with the rack, means for rotating the pinion with respect to the rack so as to cause the dressing tool to move over one of the rounded edges of the grinding wheel, 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 rotating the pinion with respect to the rack in order to cause the dressing tool to move over the other rounded edge of the grinding wheel.

13. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which terminates at each end in a rounded edge, means for moving said tool first over one of the rounded edges of the wheel, then over the peripheral portion of the wheel and finally over the other 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 permitting rotation of the shaft whereby the dressing tool is caused to dress one of the rounded edges of the wheel, and means for preventing further rotation of the shaft when the rack is actuated 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 other rounded edge of the wheel.

14. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which terminates at each end in a rounded edge, means for moving said tool first over one of the rounded edges of the wheel, then over the peripheral portion of the wheel and finally over the other 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 permitting rotation of the shaft whereby the dressing tool is caused to dress one of the rounded edges of the wheel, and means for preventing further rotation of the shaft when the rack is actuated 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 other rounded edge of the wheel, said rotation-preventing means comprising a shoe secured to said shaft and having flat and rounded surfaces, the flat surface of said shoe being adapted to slide over the flat surface of a template, the last-mentioned surface being provided with a pair of spaced circular notches having a circularity which corresponds to the round surface of said shoe, said round surface of the shoe being adapted to rotate in the first circular notch in the template during the first rotational effort of the shaft, after which the flat surface of the shoe slides over the flat surface of the template and then the round surface of the shoe rotates in the other circular notch of the template at the termination of the movement over the flat surface of the template in order to permit the shaft again to rotate and to cause the dressing tool to dress the remaining rounded edge 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 at each end, means for moving said tool first over one of the rounded edges, then over the outer periphery of the wheel and then over the other 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 secured to said crank, said shoe having a cylindrical hub portion which terminates on each side in a flat horizontal portion, a template for cooperating with said shoe, said template having a flat horizontal surface which terminates at each end in a circular notch, and means for causing the cylindrical portion of the shoe to fit itself within one of the circular notches whereby the shaft is adapted to rotate and the dressing tool is caused to move over one of the rounded edges of the wheel, said last-mentioned means serving to move the flat surface of the shoe along the flat surface of the template at the conclusion of the rotating movement to cause the shoe, shaft, crank and dressing tool to move in a horizontal plane until the shoe reaches the second circular notch, whereupon the cylindrical portion of the shoe is caused to rotate within said notch and the shaft, crank and dressing tool are rotated to cause the dressing tool to move over the other

rounded edge of the grinding wheel whereby the entire grinding surface of the wheel is dressed.

16. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a rounded edge at each end, means for moving said tool first over one of the rounded edges, then over the outer periphery of the wheel and then over the other 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 secured to said crank, a pinion secured to the shaft intermediate the crank and shoe, a rack for actuating said pinion, said shoe having a circular portion provided with a flat surface and resting on a template having a flat horizontal surface which terminates at each end in a circular notch, means for moving said rack in a horizontal direction while the cylindrical portion of the shoe is in one of the circular notches of the template whereby the shaft, crank and dressing tool are rotated and said tool is caused to dress one of the rounded edges of the wheel, the flat surface of said shoe being adapted to move along the flat surface of the template on further movement of said rack whereby the shoe, shaft, crank and dressing tool are caused to move in a horizontal plane in order to dress the outer peripheral portion of the wheel, said shoe continuing this planar movement until it reaches the second circular notch in the template whereby upon further movement of the rack the shaft, crank and dressing tool are caused to rotate in order to dress the other rounded edges of the wheel, 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 during the time that the cylindrical portion of said shoe is in the second circular notch of the template, further movement of said rack in the reverse direction causing the flat surface of the shoe to slide along the flat surface of the template whereby the shaft, crank and dressing tool are caused to move in a horizontal plane in the reverse direction and the dressing tool is caused to redress the outer peripheral portion of the wheel, further movement of the rack in the reverse direction moving the shoe to such a position that its cylindrical portion coincides with the other circular notch of the template whereby the shaft, crank and dressing tool are caused to rotate in the reverse direction and the dressing tool is returned to its initial position after having dressed both rounded edges and the intervening peripheral portion of the wheel twice.

17. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a pair of rounded edges, means for moving said tool over one of the rounded edges, then over the peripheral surface and then over the remaining rounded edge of the wheel, and means for reversing the movement of the tool so that the tool is caused again to dress both rounded edges of the wheel and the periphery of the wheel, said means including a cylindrical member which carries the dressing tool, means for sequentially rotating said member and for moving the member in a translatory direction parallel to the axis of the cylinder to correspond with the directions of the rounded edge and straight peripheral portions of the grinding wheel surface.

18. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a pair of rounded edges,

means for moving said tool over one of the rounded edges, then over the periphery of the wheel and finally over the other rounded edge, 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 said pinion, and means including a template on which the shoe rests for permitting rotation of the shaft as the rack is moved during the time that the dressing tool is being moved over one of the rounded edges, said means also serving to prevent rotation of the shaft as the rack is further moved whereby the movement of the rack is translated to the shaft as a movement in a plane which passes through the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said means serving finally to permit rotation of the shaft as the rack is further moved in order to cause the dressing tool to be moved over the other rounded edge of the wheel.

19. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a pair of rounded edges, means for moving said tool over one of the rounded edges, then over the periphery of the wheel and finally over the other rounded edge, 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 said pinion, and means for permitting rotation of the shaft as the rack is moved in order to carry the dressing tool around one of the rounded edges of the wheel, said means also serving to prevent rotation of the shaft as the rack is further moved whereby the further movement of the rack is translated to the shaft as a movement in a plane which passes through the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said means also serving to permit rotation of the shaft on further movement of the rack in order to carry the dressing tool over the other rounded edge of the wheel, said means including a template having a pair of spaced circular notches and an intervening flat surface, said shoe being adapted to rotate first in one notch in order to permit the shaft to rotate, then over the flat surface of the template to prevent rotation of the shaft, and finally to rotate in the second notch to permit the shaft to rotate and to carry the dressing tool through the corresponding movements in order to dress the entire periphery of the wheel including both rounded edges.

20. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a pair of rounded edges, means for moving said tool over one of the rounded edges, then over the periphery of the wheel and finally over the other rounded edge, 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 said pinion, means for permitting rotation of the shaft as the rack is moved in order to carry the dressing tool around one of the rounded edges of the wheel, said means also serving to prevent rotation of the shaft as the rack is further moved whereby the further movement

of the rack is translated to the shaft as a movement in a plane which passes through the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said means also serving to permit rotation of the shaft on further movement of the rack in order to carry the dressing tool over the other rounded edge of the wheel, said means including a template having a pair of spaced circular notches and an intervening flat surface, said shoe being adapted to rotate first in one notch in order to permit the shaft to rotate, then over the flat surface of the template to prevent rotation of the shaft, and finally to rotate in the second notch to permit the shaft to rotate and to carry the dressing tool through the corresponding movements in order to dress the entire periphery of the wheel including both rounded edges, and means for reversing the movement of the rack when the dressing tool has reached the end of the last rounded edge of the wheel whereby the shaft, crank and dressing tool are caused to retrace their paths including the path over the template and the dressing tool is moved first over one rounded edge of the wheel, then over the outside periphery of the wheel and finally over the other rounded edge of the wheel to its initial position.

21. A grinding machine attachment for causing a dressing tool to be moved over a grinding wheel surface which has a pair of rounded edges, means for moving said tool over one of the rounded edges, then over the periphery of the wheel and finally over the other rounded edge, 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 said pinion, and means for permitting rotation of the shaft as the rack is moved in order to carry the dressing tool around one of the rounded edges of the wheel, said means also serving to prevent rotation of the shaft as the rack is further moved whereby the further movement of the rack is translated to the shaft as a movement in a plane which passes through the axis of the shaft so as to carry the dressing tool over the outside periphery of the wheel, said means also serving to permit rotation of the shaft on further movement of the rack in order to carry the dressing tool over the other rounded edge of the wheel, said means including a template having a pair of spaced circular notches and an intervening flat surface, said shoe being adapted to rotate first in one notch in order to permit the shaft to rotate, then over the flat surface of the template to prevent rotation of the shaft, and finally to rotate in the second notch to permit the shaft to rotate and to carry the dressing tool through the corresponding movements in order to dress the entire periphery of the wheel including both rounded edges, said rack-actuating means comprising a double-acting fluid cylinder for moving the rack first in one direction and then in the other direction, the direction of 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 and thereby reverse the movement of the rack.

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