Dec. 4, 1956 C. H. JONES, JR 2,772,670

GRINDING WHEEL TRUING MECHANISM

Filed April 19, 1954 4 Sheets-Sheet 1

FIG. 1

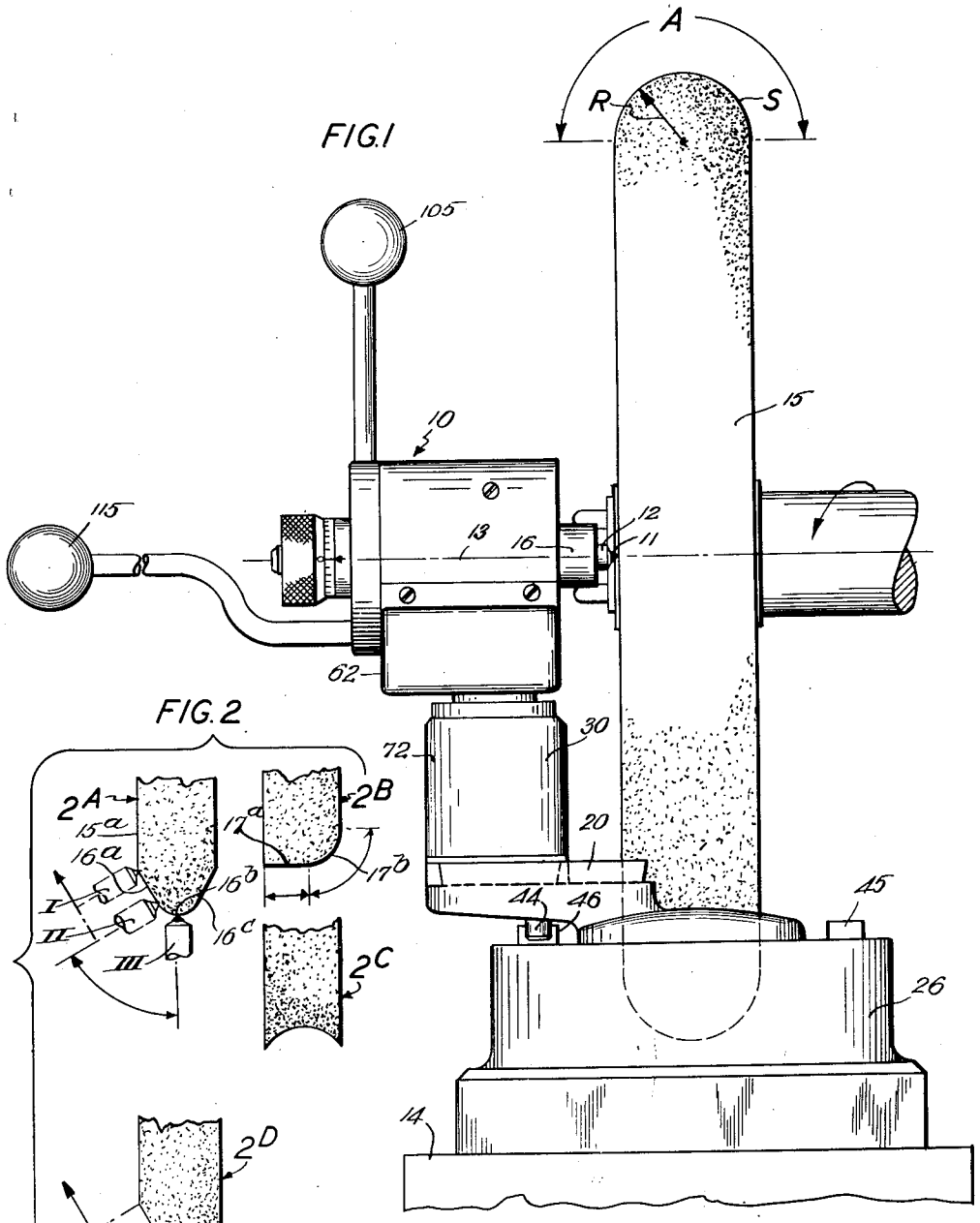


FIG. 2

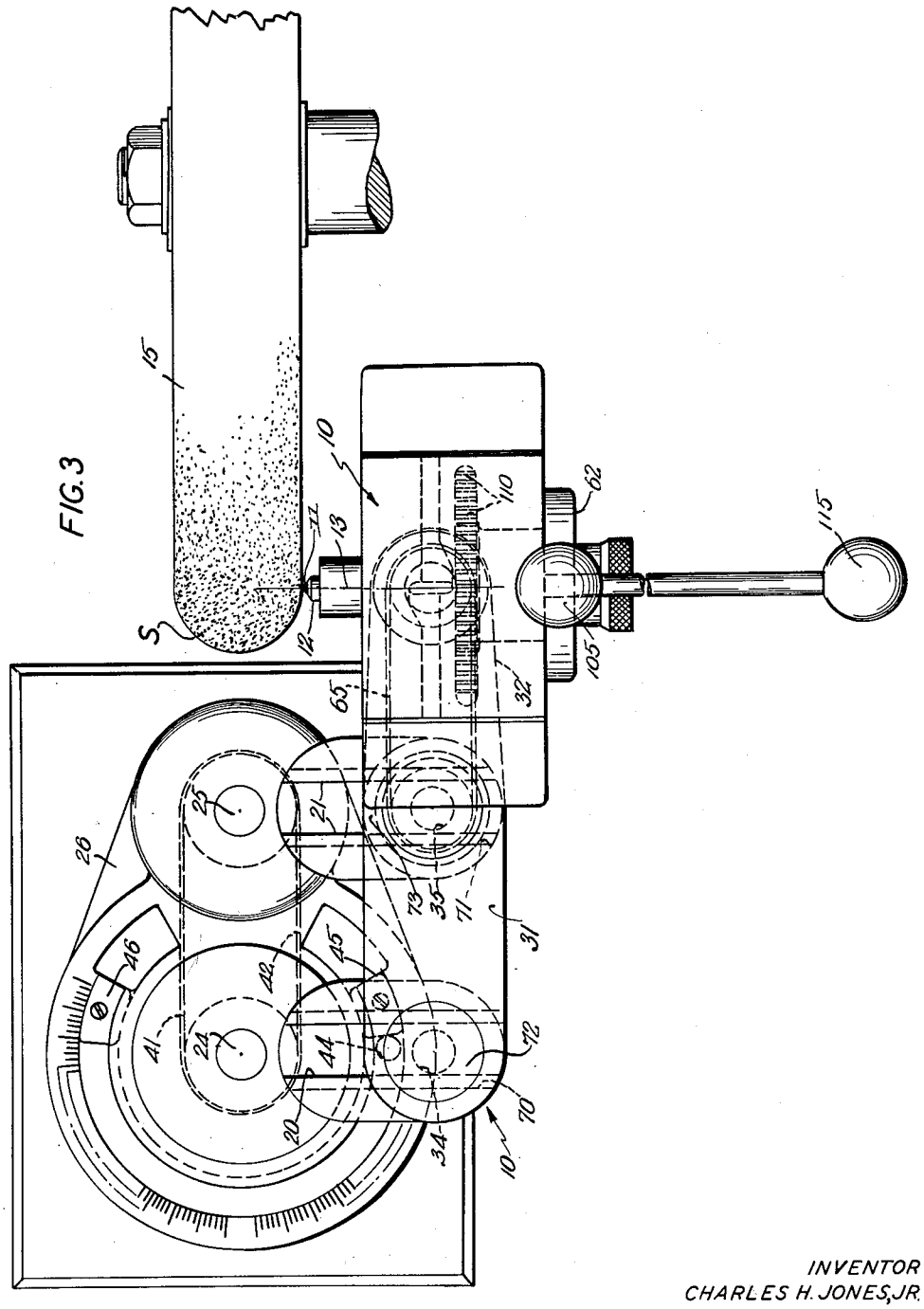
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GRINDING WHEEL TRUING MECHANISM

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FIG. 3



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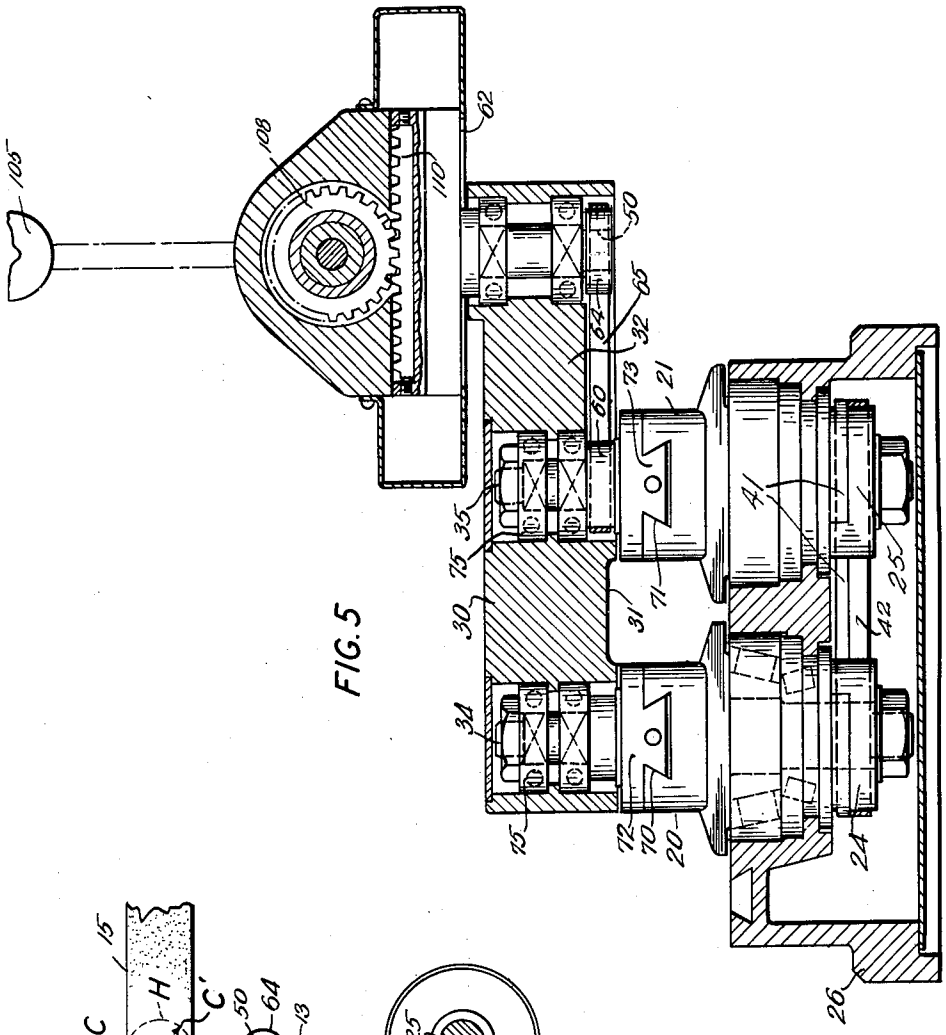


FIG. 5

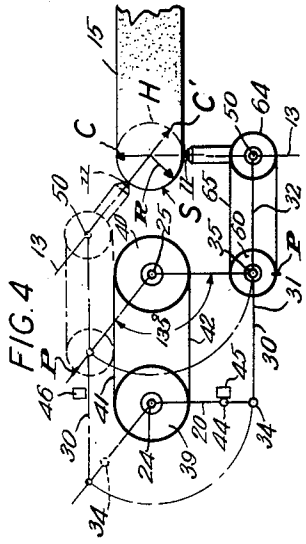


FIG. 4

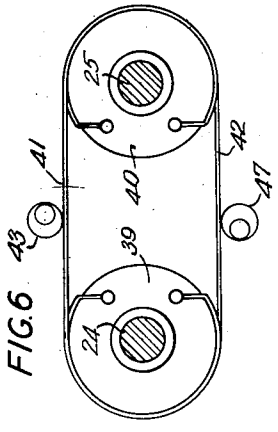


FIG. 6

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FIG.7

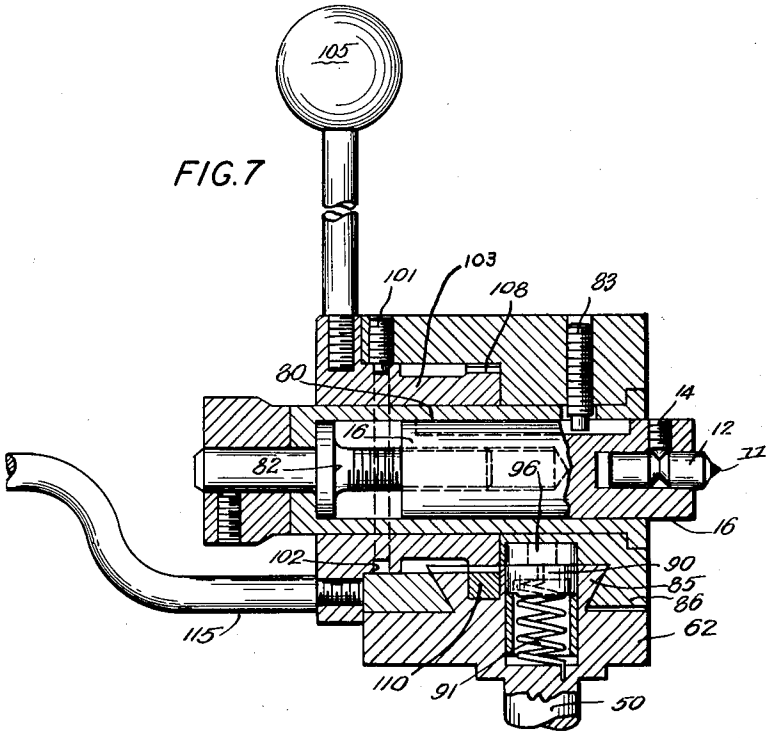


FIG.8

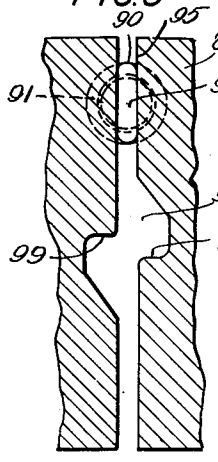


FIG.9

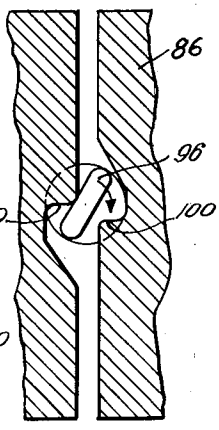


FIG.10

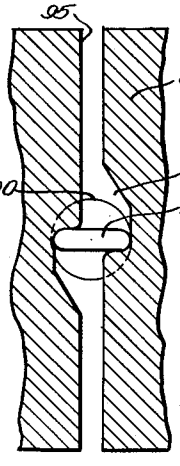
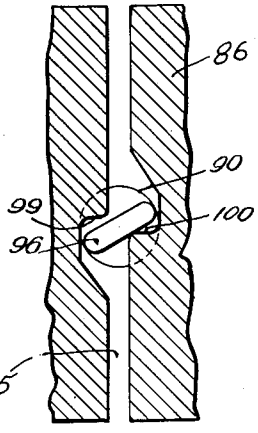


FIG.11



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United States Patent Office 2,772,670 Patented Dec. 4, 1956

2,772,670

GRINDING WHEEL TRUING MECHANISM

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Application April 19, 1954, Serial No. 423,984

10 Claims. (Cl. 125—11)

This invention relates to grinding wheel truing mechanism, more particularly to a device for truing a grinding wheel cutting surface which is complex in shape, that is, which has a normal section which may be concave, convex or a combination of one or more of these with one or more straight portions.

In the truing of the cutting surfaces of grinding wheels, particularly large wheels, it has been difficult to provide a pivot mechanism on which a truing tool may be swung on a radius to cut a convex shape because the pivotal axis passes through the wheel. Therefore, the pivotal mechanism has had to be located at a considerable distance from the truing tool above or below the wheel, thus making necessary a mechanism of great bulk and strength in order to provide a mounting which is sufficiently rigid to support the truing tool with accuracy as it moves around the radial periphery of the wheel face.

My invention provides a pivoting mechanism which is displaced from the actual pivotal axis around which the tool swings, so that it can be located directly adjacent the cutting face being trued, thereby making possible a much more compact mechanism, particularly since the distance between the pivot point of the truing mechanism and the tool is much decreased.

It is, of course, well known that in the motion of the truing tool along a cutting surface of arcuate section, the point of the tool must be maintained constantly normal to the surface, in other words radially with respect to the center of the arc through which the tool is moved. The mechanism of the invention accordingly also provides means by which the tool axis is maintained in such a constantly radial position as the tool is swung in an arc across the wheel face.

When the wheel cutting face includes a straight line section, the truing tool must also be moved along a straight line during a portion of its motion, as well as swung through an arc.

Accordingly, my invention also provides means to move the truing tool along a straight line, means to lock the pivotal movement at a desired point while the tool is being moved in the rectilinear portion of its movement, and means to maintain the tool in an indexed position with respect to its rectilinear movement while it is being moved pivotally.

These and other advantages are apparent in the following description of a preferred embodiment of my invention, together with the drawings in which:

Fig. 1 is a front view of the grinding wheel and the mechanism of the invention.

Fig. 2 (Figs. 2A–2D, inclusive) shows grinding wheel cutting surfaces of various shapes which may be trued by the mechanism of the invention.

Fig. 3 is a plan view of the grinding wheel and the device of the invention.

Fig. 4 is a schematic plan view of the mechanism of the invention associated with a grinding wheel.

Fig. 5 is a side view of the mechanism of the invention, partly in section.

Fig. 6 is a plan view of some of the details of the mechanism.

Fig. 7 is an elevation, partly in cross section, of part of the device of the invention including the truing tool.

Figs. 8, 9, 10 and 11 are top plan views of part of the indexing mechanism showing progressive relationship of the parts during operation.

Figures 1 and 3 show the truing mechanism of my invention, generally indicated at **10**, including the truing tool **11**, which may be the usual diamond mounted on a cylindrical base **12** held by a set screw **14** as seen in Fig. 7 in a cylindrical mount **16** and having a longitudinal axis indicated by the line **13**, which for convenience in description I call the truing tool axis. In these particular figures, the truing mechanism **10**, which has a base **26** shown adjustably positioned with respect to a grinding wheel **15** on a conventional magnetic chuck **14**, is arranged to true the cutting surface S of the grinding wheel **15**. The cutting surface S has a rounded or arcuate section having a radius R through an angle A, which in this case is 180° from one side to the other of the grinding wheel. The mechanism **10** is arranged to pass the point of the truing tool **11** in an arcuate path from one side face of the wheel **15** to the other on the radius R while maintaining the truing tool axis **13** in a constant radial position so that the tool point remains normal to the surface S during its motion, that is, with the axis **13** always passing through the center of the radius R, thereby to generate the surface S as the grinding wheel rotates relative to the truing tool **11**.

Figure 1 shows the truing tool **11** on the left-hand side of the wheel at the beginning of the truing operation and Fig. 3 shows the tool on the right-hand side of the wheel after it has passed through the angle A of 180°.

Figures 2A, 2B, 2C and 2D, inclusive, show various other shapes of grinding wheel cutting surfaces which may be generated by the same truing mechanism **10**, some of which may have sections including straight lines and others of which may include concave surfaces and which will be described in greater detail in connection with further description of the structure and operation of the mechanism.

In Fig. 3, it will be apparent that while the point of the truing tool **11** is passed during a truing cycle around a pivotal axis which passes through the center of the radius R, and therefore through the body of the grinding wheel **15**, the mechanism which supports the truing tool **11** is displaced from such a pivotal axis so that it may be located closely adjacent the line of contact between the truing tool **11** and the surface S with the resulting advantages of great strength and compactness.

The mechanism for moving the truing tool **11** in the above described arcuate path may perhaps best be understood by first referring to the simplified plan view schematic diagram thereof in Fig. 4. The mechanism **10** comprises in part what may be designated as a parallelogram motion, comprising a pair of arms **20** and **21**, see also Figs. 1, 3 and 5, of equal operating length and pivoted respectively at **24** and **25** on the base **26**, and a long arm **30** having portions **31** and **32** and which is pivotally attached to the outer ends of the arms **20** and **21** at **34** and **35**, respectively. The portion **31** of the arm **30** between the pivots **34** and **35** is equal in length to the distance between the pivots **24** and **25**. Thus the arm **30** may be moved bodily through an arc, the radius of which is equal to the length of the arms **20** and **21** between pivots, and at the same time the arm **30** remains parallel to a line through the fixed pivots **24** and **25**. The arms **20** and **21** have belt drums **39** and **40** fixed concentrically with their pivots and connected by belts **41**, **42**, preferably steel and arranged as seen in detail in Figs. 5 and 6. These belts serve to keep the arms **20**

and 21 synchronized and parallel in all rotative positions, particularly at dead center position when the arms are in line with the fixed pivots 24 and 25.

A stop pin 44, also seen in Figs. 1 and 3, is provided conveniently on the arm 20 to cooperate with adjustably positioned stops 45 and 46 on the base 26 to limit the rotative movement of the arms 20, 21 and 30 within 180° from one side of the grinding wheel 15 to the other. Thus the mechanism may be adjusted so that a pivot 50 on the end of the arm portion 32 may move in an arc through an angle of 180°, the center of which arc is located at the center of the radius R which is also the center of the arcuate cutting surface S to be generated and on a line through the pivots 24, 25. The position of the base may be adjusted by one's moving it on the chuck 14 to cause the pivots 24, 25 to line up with the center of the arc to be trued.

Mounted concentric to the pivot 35 and fast on the arm 21 is a belt drum 60, also seen in Fig. 5, and pivotally mounted at 50 on the arm 32 is a truing tool support head 62, also seen in Figs. 1, 3 and 5, having a fast thereto another belt drum 64, which rotates with the tool head 62. A belt 65, preferably steel, Fig. 5, connects the belt drums 60 and 64 so that they rotate synchronously in space.

In operation it will be seen that as the arms 20 and 21 are rotated around their respective pivots 24 and 25, for instance, through an angle of 135° to the dotted line position, as shown in Fig. 4, the point P on the belt drum 60, which is fixed to the arm 21, also rotates through an angle of 135° around the pivot 25, while the arm 30 remains, in its dotted line position, parallel to its original position, causing a relative rotation of 135° between the belt drum 60 and the arm extension 32. This relative rotation is transferred through the belt 65 to the belt drum 64 and hence to the truing tool 11 through its support head 62, which is integral with the belt drum 64, with the result that the truing tool axis 13 is also then swung through an angle of 135°, thus causing the truing tool axis 13 continuously to intersect the center of the radius R and to remain in a constantly radial aspect during its movement. Consequently, the point of the truing tool 11 moves in a circular arcuate path around the surface S having the radius R, the radius R being equivalent to the length of the arm 20 or 21 minus the distance from the point of the tool 11 to its pivot 50.

Thus far, for purposes of illustrating the principles of operation, the description has been liimted to the truing of a convex grinding wheel cutting surface S extending from one side face of the wheel to the other, but by various adjustments and the use of additional means the machine may be adapted to other shapes, including combinations of arcs and straight lines, Figs. 2A, 2B and 2D, and concave shapes, Fig. 2C.

As seen in Figs. 1, 3 and 5, the arms 20 and 21 have slideways 70 and 71 each containing an adjustably positioned slide 72, 73 forming supports for the pivots 34 and 35 and supporting the arm 30 conveniently by suitable bearings 75. Thus the radii of the arms 20 and 21 may be lengthened or shortened in setting up the mechanism for particular requirements.

In Fig. 7, it will be seen that the truing tool mount 16 may be adjustably positioned in the support head 62, in which it is slidably fitted in a sleeve 80, by means of an adjusting screw 82 and a set screw 83, thereby lengthening or shortening the distance between the point of the truing tool 11 and the axis of its pivot 50.

By reference again for simplicity to Fig. 4, it will be seen that when relative adjustments by the means just described may be made between the effective length of the arm 21 and the distance between the point of the truing tool 11 and its pivot 50 so that the truing tool point may be made to move along an arc H to generate a concave or hollow cutting surface on a grinding wheel of a type shown in Fig. 2C.

The desired effect is therefore produced by a combination of the pivoting truing tool support means 62, the support arm means 30 for moving the tool support pivot bodily through a predetermined circular arc, and the associated means, including the belt 65 and the belt drums 60 and 64, for turning the truing tool on its pivot in direct relation to its arcuate movement so as to maintain the truing tool axis 13 constantly in a radial position with respect to the center of the arc.

As previously stated, the mechanism may be adjusted to swing the point of the truing tool 11 through an arc of predetermined radius and having its center at any predetermined point.

The angularity of the arcuate shape of the cutting surface may be limited by adjustment of the stops 45 and 46, which act to limit the swinging of the arms 20 and 21 and hence the bodily arcuate movement of the truing tool 11, in cooperation with the stop 44 under the arm 20.

As has been previously mentioned, provision is also made by means about to be described for moving the truing tool rectilinearly and tangentially with respect to the arcuate cutting surface shape which may be generated in order to true a grinding wheel having a cutting surface of a complex shape, including a combination of arcuate and straight lined sections of the type illustrated in Figs. 2A, 2B and 2D.

Mounted on the truing tool pivoting head 62 and intermediate the truing tool and its pivot 50 is an indexing mechanism of the type described and claimed in copending application Serial No. 418,398. This comprises a slideway 85, Fig. 7, on the tool head 62 and a cooperating slide 86 thereon containing the sleeve 80, the tool mount 16 and the truing tool 11, whereby the tool 11 may be moved rectilinearly along its support head 62. Rotatively seated in the slideway 85 is a rotatable member in the form of a sleeve-shaped plug 90 adjacent the underside of the slide 86 and having a helical tortionally acting spring 91 urging the plug 90 in a clockwise direction, as viewed in Figs. 8–11. The slide 86 contains a track 95, in which rides a raised portion 96 of the plug 90, and a widened portion 98 including cooperating faces 99 and 100, angularly disposed to the track and preferably at right angles, and which are offset from each other by the width of the raised portion 96 of the plug 90, thereby allowing the rotatable member to turn under the urging of the spring 91 within limits when its raised portion 96 enters the widened track portion 98 during movement of the slide 86 along the slideway 85.

When the slide 86 is moved relative to the slideway and the rotatable member 90, the track 95 is engaged by the raised portion 96 of the plug 90, thus preventing the latter from turning. When the rotatable raised portion 96 reaches the widened portion 98, as seen in Fig. 11, it allows the rotatable raised portion 96 to turn in a counterclockwise direction as viewed, until the faces 99 and 100 of the widened track portion engage the rotatable raised portion 96, as seen in Fig. 10, against the force of the spring 91. At this stage the rotatable member 90 resists further movement of the slide 86 on the slideway 85, thus providing an indexed position of the turning tool 11 with respect to its rectilinear movement. When, however, an excess force is applied to move the slide 86 along the slideway 85 out of its indexed position, the face 100 of the widened track portion 98 forces the rotatable member 90 in a counterclockwise direction, as seen in Fig. 11, causing the raised portion 96 again to line up in the extension of the track 98 allowing the slide 86 to be moved further along the slideway 85, or alternatively in the reciprocal direction. In other words, the indexing mechanism has the same action when the slide is moved to and from the indexed position in either direction. The movement of the slide 86 relative to the center of the rotatable member 90 is exaggerated in Figs. 9 and 11 since such movement will be almost im-

perceptible during rotation of the rotatable member **90** shown in these three figures.

In Fig. 7 is seen a rotatable operating member **103** received and retained by a set screw **101** in the body of the slide **86**. It has conveniently an operating handle **105** for manual rotation and a gear **108** engaging a rack **110** fast in the slideway **85**, thus providing increased leverage and precision and ease of operation for movement of the slide along the slideway in either direction by rotation of the handle **105**.

The truing tool pivoting head **62** has a handle **115** for pivotal operation of the tool rotating mechanism **10** as a whole between predetermined limits established by adjustment of the stops **45** and **46**.

For truing a cutting surface of the type illustrated in Fig. 2A, the mechanism is adjusted by the parts above described so that the tool may be pivotally moved in an arc having a desired radius and angularity to coincide with the arcuate portion **16***b* of the cutting surface as shown, while the slide **86** is in the indexed position illustrated in Fig. 10. For this purpose the base **26** is positioned so that the pivots **24, 25** are in line with the center of the arc **16***b*. The mechanism is then pivotally swung over against the stop **46** by means of the handle **115** in a clockwise direction, from the position illustrated in Fig. 3. The slide **86** is then moved to the left by motion of the handle **105** to the left, as viewed in Fig. 3, to move the truing tool **11** far enough to the left so that it will intersect the left-hand side of the grinding wheel **15***a*, Fig. 2A, when the entire mechanism is swung over to the left-hand position, as the operator faces the machine, as shown in Fig. 1. With the mechanism held against the stop **46**, the operator then moves the handle **105** toward the front of the machine, thus bringing the truing tool rectilinearly along the straight portion **16***a* from the position marked I in Fig. 2A to the position marked II in Fig. 2A, at which point the slide **86** is now in the indexed position, illustrated in Fig. 10, locking it temporarily against further rectilinear movement. The mechanism is now pivotally swung by the handle **115** from the stop **46** to the stop **45**, as illustrated by the position marked III, during this movement to generate the arcuate portion **16***b* of the cutting surface in Fig. 2A. Thereafter, the handle **105** is moved out of the indexed position further to move the slide **86** in the same direction as previously to generate the straight portion **16***c* in Fig. 2A, after which the tool may be passed back over the surface in the reverse direction or else withdrawn in some other convenient manner, as by retraction of the adjusting screw **82**.

The truing of the cutting surface in Fig. 2B, comprising the straight portion **17***a* and the arcuate portion **17***b*, is done in essentially the same manner, with the exception that one of the rectilinear passes is omitted. Adjustments are made to locate the center of the arc **17***b* and to correspond with its radius and angularity, thus also establishing the angularity of the straight portion **17***a*. The truing pass can be done from either direction as preferred, the mechanism being held against the pre-adjusted stop **46** while the rectilinear surface **17***a* is being trued, and the slide **86** being in the indexed position of Fig. 10, while the arcuate portion **17***b* is being generated by pivotal movement of the mechanism between the stops **46** and **45**.

The cutting surface **18***a* and **18***b* of Fig. 2D is generated in the same manner as in the operation for Fig. 2B, except that the parts are adjusted for a smaller radius and greater angularity of the arcuate part of the surface **18***b*.

The genertion of the concave surface H, shown in Fig. 2C, has been described in connection with the description of Fig. 4 and it will be apparent that concave surfaces may be combined with surfaces having rectilinear sections in the same manner by adjustment of the parts.

Fig. 6 shows details of the manner of using a double steel belt **41—42** tensioned by eccentrically mounted idlers **43** and **47** for precisely synchronizing the rotation of the belt drums **39** and **40** more precisely to preserve the accuracy of operation of the pivoting mechanism **10**.

Other mechanical details, including the use of adequately accurate bearings and other structural parts, will be apparent from the drawings, the combination of essential means for performing the described functions of the mechanism, comprising the essence of my invention, which is therefore not intended to be limited to the particular details shown.

It will be apparent that the base **26** may be fixedly mounted and adjustments made to establish the relation of the pivots **24, 25** with the wheel by motion of the wheelhead by the conventional hand wheel or other means, or that the base **26** may be mounted on a table which may be moved to make these adjustments.

I claim.

1. Grinding wheel truing mechanism including a truing tool, indexing means for the tool comprising a first and a second element, said tool being supported in one of said elements, said elements being adjacent and relatively movable in a predetermined path, a rotatable member seated in said second element adjacent said first element, a spring urging said rotatable member to turn, a track in said first element corresponding to said path, said rotatable member having a raised portion slidably engaging said track, said track having a widened portion including cooperating faces angularly disposed to said track which are offset from each other thereby allowing said rotatable member to turn within limits when its said raised portion enters said widened track portion during relative movement of said elements, said angularly disposed faces engaging said raised portion against the force of said spring when the rotatable member is in said turned position thereby causing said rotatable member to resist further relative movement of said elements.

2. Grinding wheel truing mechanism to move the point of a truing tool along an arc across the face of a grinding wheel while the axis of the tool remains radial to the center of the arc, comprising in combination a truing tool, a pivot for the truing tool, a pair of crank arms each having an axis of rotation which is displaced from the central axis of the arc a support arm pivotally connected between the cranks equidistantly from their centers thereby providing a parallelogram mechanism said support arm having an extended portion which supports said pivot for moving the pivot bodily through the arc; and means connected between one of the crank arms and the pivot to rotate the tool in equal angular relation to the arcuate movement of the pivot.

3. In the combination as set forth in claim 2, means for adjusting the distance between the support arm and the centers of the crank arms.

4. In the combination as set forth in claim 2, means to adjust the distance between the tool point and the tool pivot.

5. In the combination as set forth in claim 2, means adjustably to limit the arcuate movement of the pivot to a predetermined angle.

6. In the combination as set forth in claim 2, slide means between said pivot and said tool arranged to provide rectilinear movement of said tool with relation to said pivot.

7. In the combination as set forth in claim 6, a rack on said slide means, a pinion engaged to said rack to operate said slide means, and means to rotate said pinion.

8. In the combination as set forth in claim 6, indexing means associated with said slide means for establishing a predetermined rectilinear relationship between said tool and said pivot.

9. Grinding wheel truing mechanism to move the point of a truing tool along an arc across the face of a grinding wheel while the axis of the tool remains radial to the

center of the arc, comprising in combination a truing tool, a pivot for the truing tool, a pair of crank arms each having an axis of rotation which is displaced from the central axis of the arc, a support arm pivotally connected between the crank arms equidistantly from their centers thereby providing a parallelogram mechanism, said support arm having an extended portion which supports said pivot for moving the pivot bodily through the arc, a belt drum fixed on one of the crank arms, a belt drum fixed to the pivot, and a belt connecting the belt drums to rotate the tool in equal angular relation to the arcuate movement of the pivot.

10. Grinding wheel truing mechanism to move the point of a truing tool along an arc across the face of a grinding wheel and along a straight line tangent to the arc comprising a truing tool, support means to move the truing tool through an arc while maintaining the tool in a position which is radial to the center of the arc, a first and a second element mounted on said support means, said tool being supported on one of said elements, said element being adjacent and relatively slidable in a straight line, a rotatable member seated in said second element adjacent said first element, a spring urging said rotatable member to turn, a track in said first element parallel to the direction of said slidable movement, said rotatable member having a raised portion slidably engaging said

track, said track having a widened portion including cooperating faces angularly disposed to said track which are offset from each other thereby allowing said rotatable member to turn within limits when its said raised portion enters said widened track portion during relative movement of said elements, said angularly disposed faces engaging said raised portion against the force of said spring when the rotatable member is in said turned position thereby causing said rotatable member to resist further relative movement of said elements.

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