March 7, 1961 N. HOGLUND 2,973,755

GRINDING WHEEL DRESSING APPARATUS

Filed Oct. 6, 1958 6 Sheets-Sheet 1

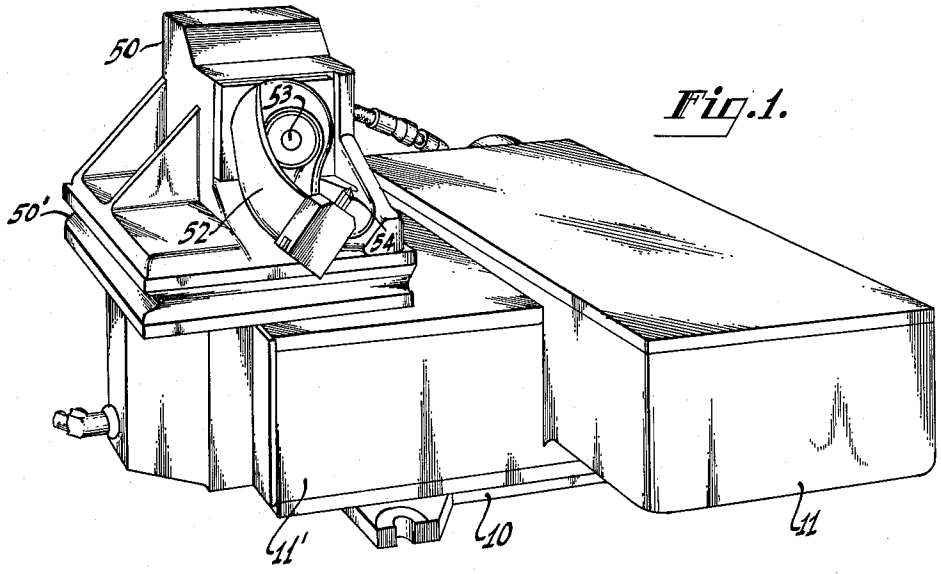


Fig. 1.

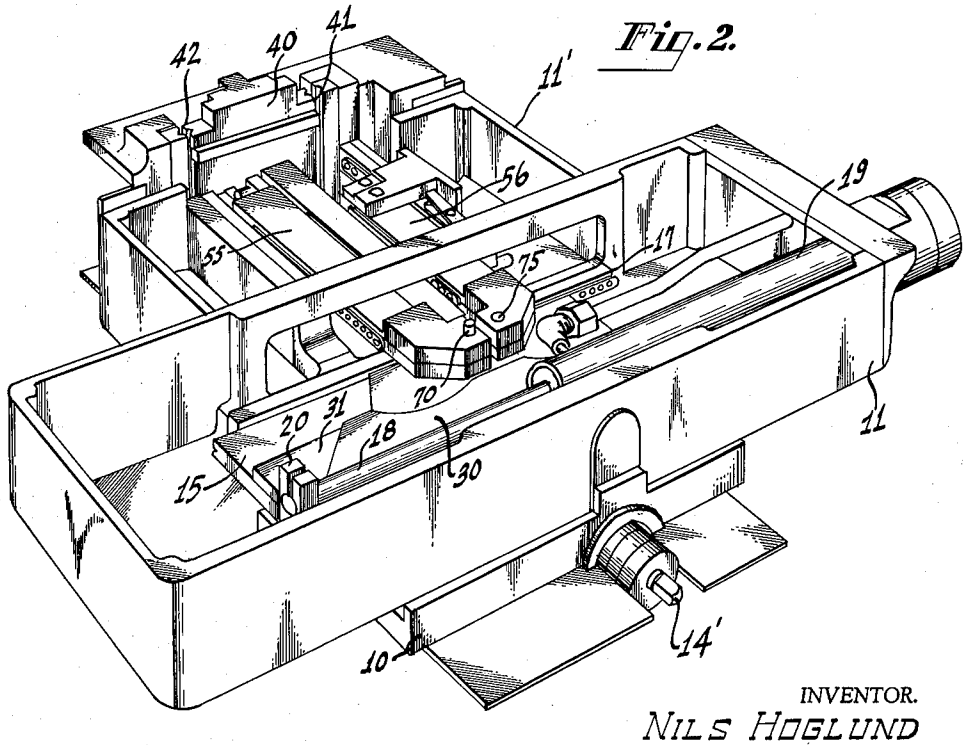


Fig. 2.

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GRINDING WHEEL DRESSING APPARATUS

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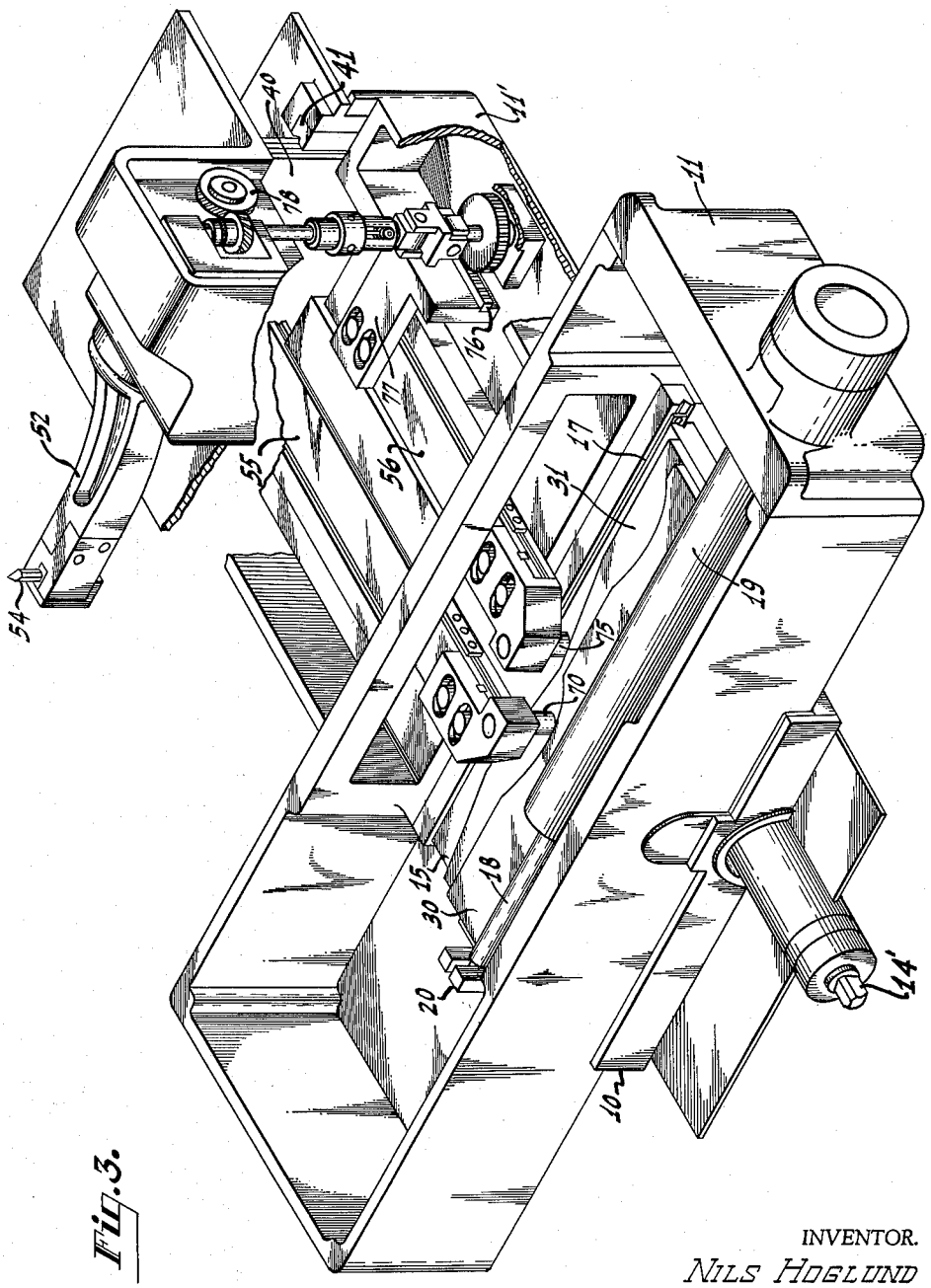


Fig. 3.

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GRINDING WHEEL DRESSING APPARATUS

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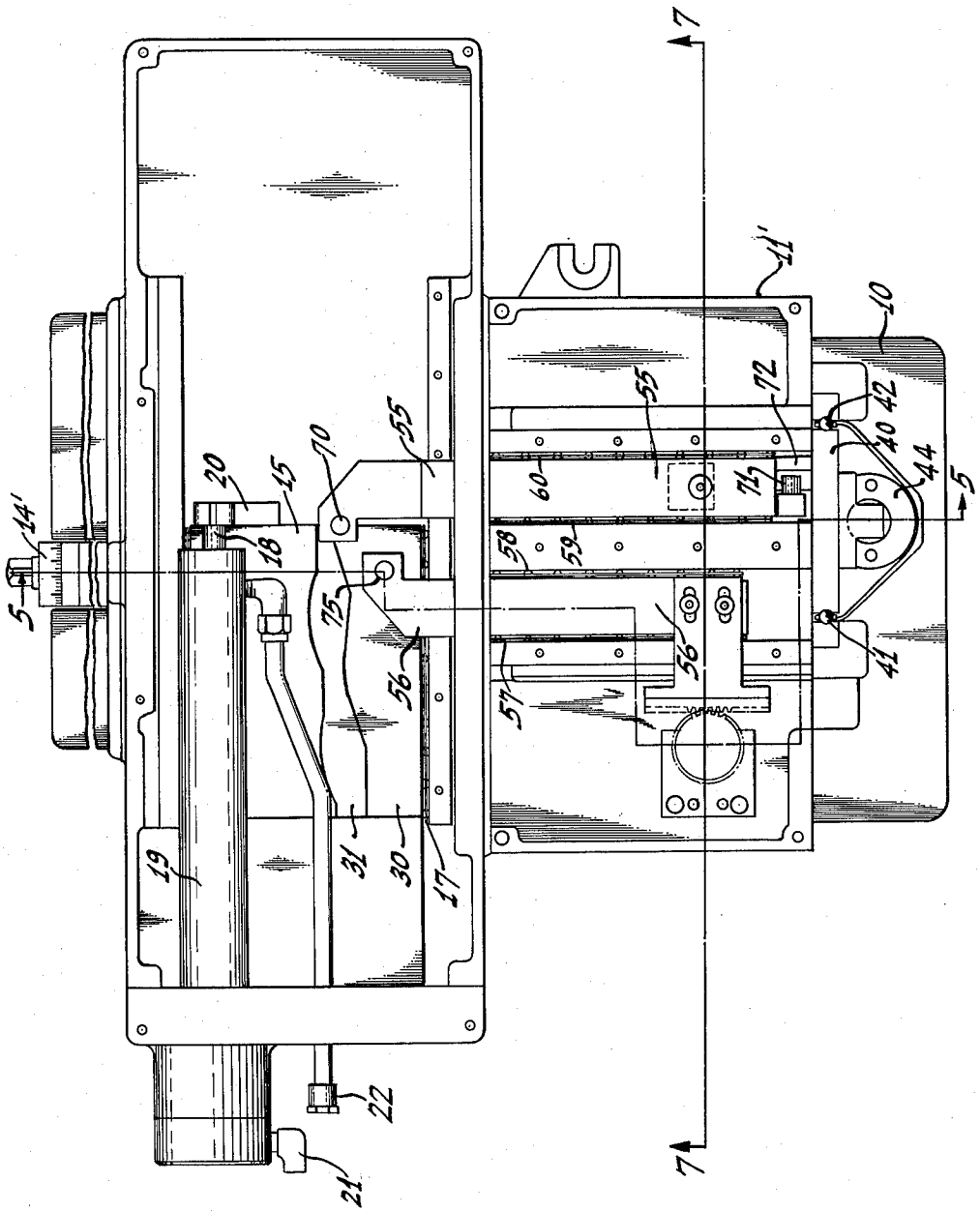


Fig. 4.

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GRINDING WHEEL DRESSING APPARATUS

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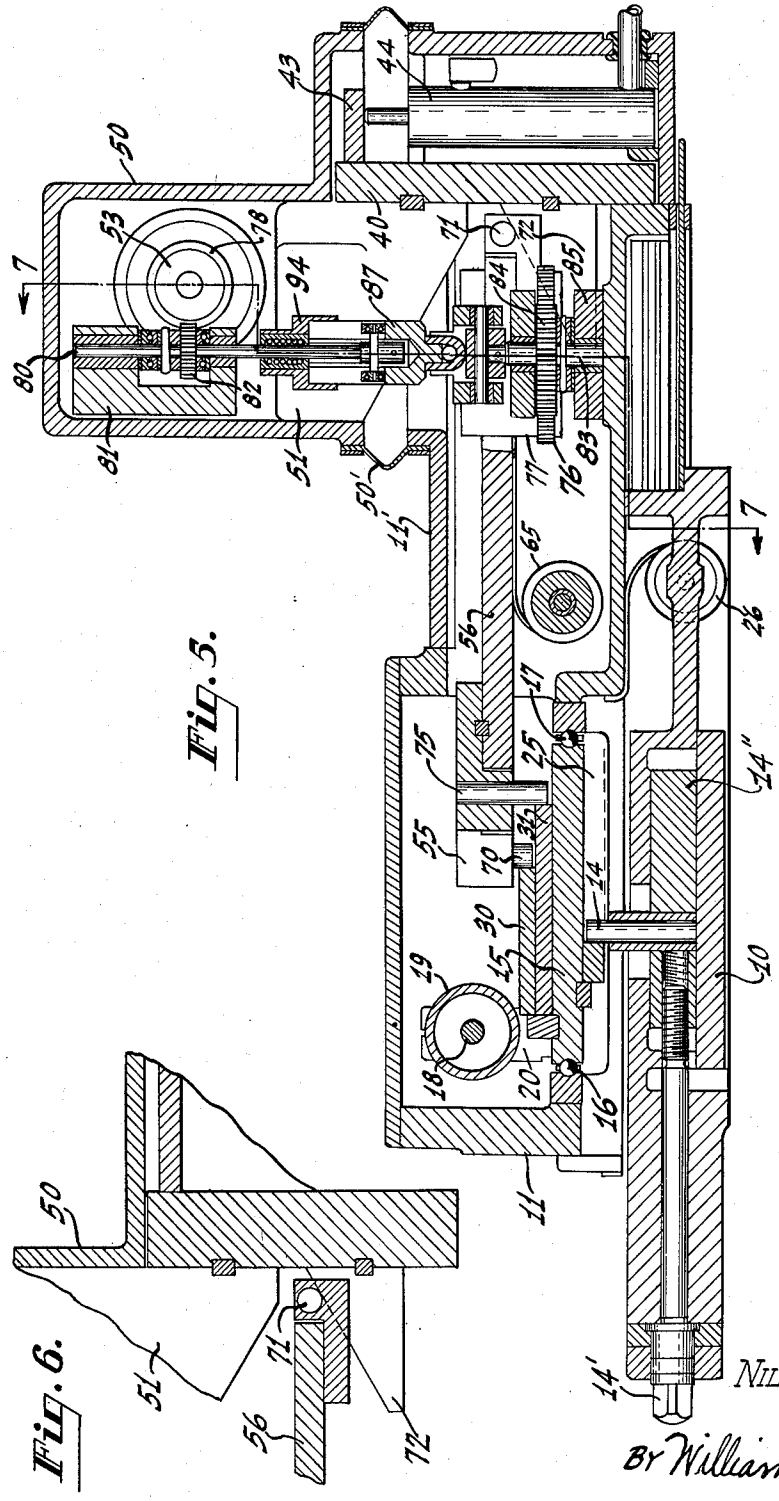


Fig. 5.

Fig. 6.

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GRINDING WHEEL DRESSING APPARATUS

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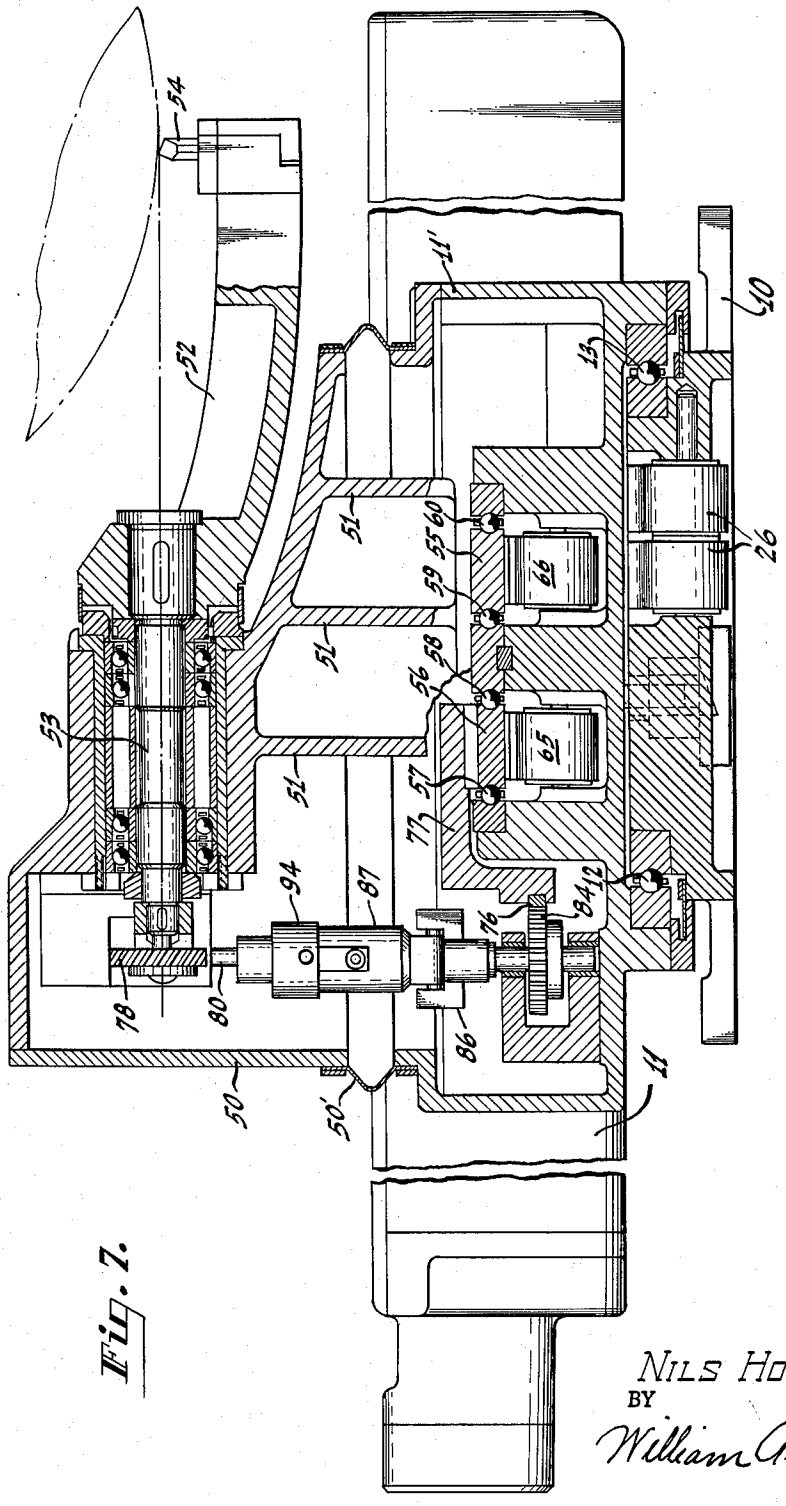


Fig. 7.

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GRINDING WHEEL DRESSING APPARATUS

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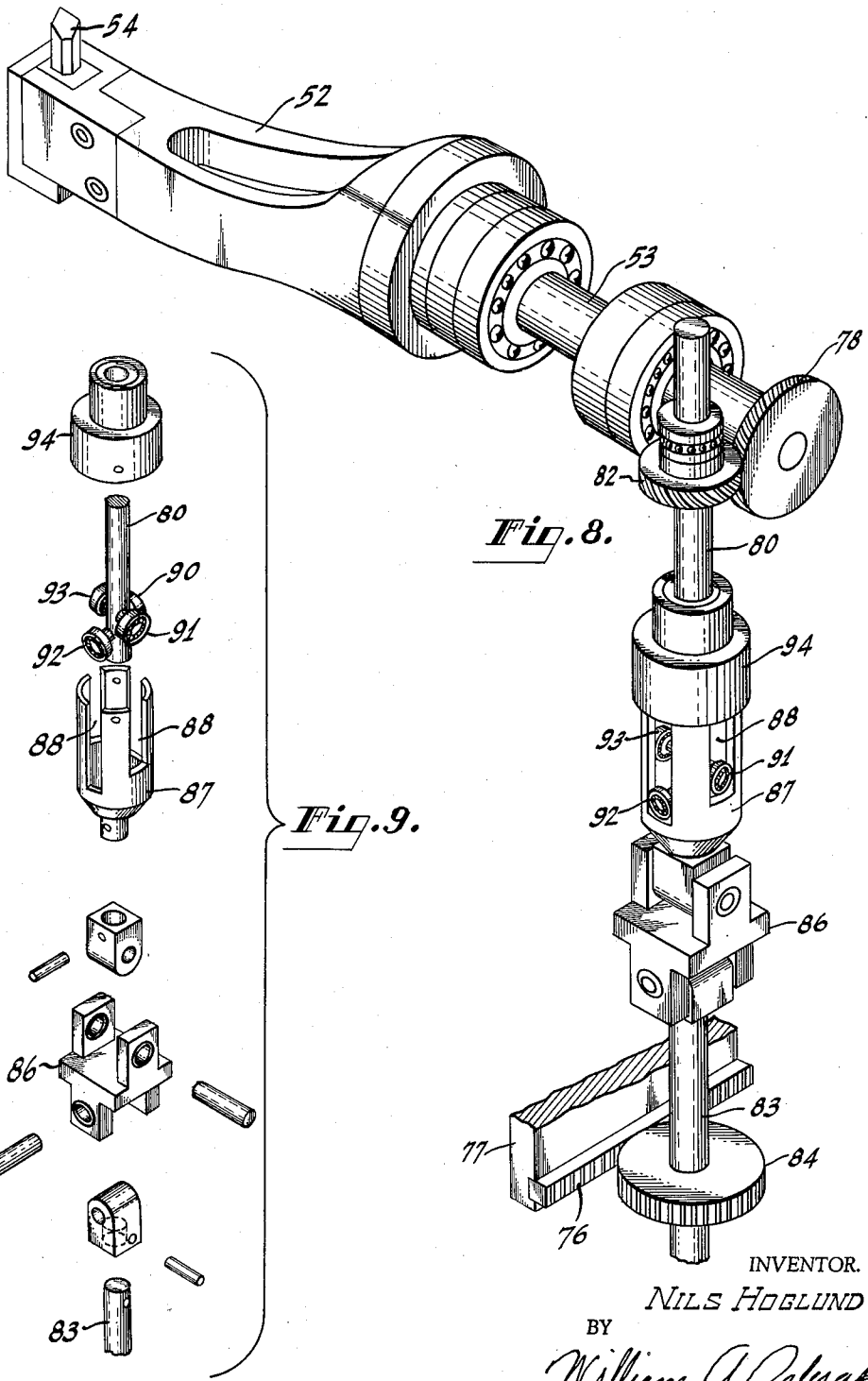


Fig. 8.

Fig. 9.

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United States Patent Office 2,973,755 Patented Mar. 7, 1961

2,973,755

GRINDING WHEEL DRESSING APPARATUS

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Filed Oct. 6, 1958, Ser. No. 765,490

11 Claims. (Cl. 125—11)

My invention relates to improved grinding wheel dressing apparatus.

In many types of dressing apparatus the cutting tool is held rigidly in one position relative to the contour being formed. This limits the complexity of the contours which can be dressed with a single cutting tool or diamond. In apparatus designed to dress complex contours, the apparatus employs two or more diamonds mounted in the same holder but positioned angularly with respect to each other so that clearance can be obtained in forming the complex contours. One cutting diamond will overlap when the other diamond leaves off on the contour being formed. No automatic power driven dressers are, so far as I am aware, capable of dressing complex contours with a single cutting diamond. Where manually operated apparatus is used, the operator must use his own judgment as to the proper position of the cutting tool to obtain the proper clearance and the most favorable relationship between the cutting diamond and the profile or contour being dressed on the grinding wheel.

It is therefore the principle object of my invention to provide an improved and automatic grinding wheel dressing apparatus which is capable of dressing complex contours with a single cutting tool or diamond.

In accordance with my invention, I slidably mount a housing on a base which provides movement of the housing parallel to the axis of the wheel being dressed. Within the housing is slidably mounted on ball bearing assemblies a main or cam slide assembly. This is automatically power driven by means of hydraulic mechanism.

On the underside of the slide is mounted a feed cam which determines the movement of the housing and mounted on the upper side of the slide are the contour and pivot cams which determine the path of movement of the tool across the grinding wheel being dressed.

Slidably supported on the housing for movement radially of the wheel being dressed is a tool slide. The tool slide rotatably supports a rotatable tool support. Slidably supported on the housing are a pair of slides which can be moved parallel to and independently of each other. Both slides have followers at one end thereof. One contacts the contour cam and the other contacts the pivot cam. On the other end of one of said pair of slides is a follower and on the other end of the other slide is a rack. The tool slide carries a feed cam in contact with the follower on one of said pair of slides for determining radial movement of the tool and there is connected between the rotatable tool support and rack a telescoping rotatable connection which determines the angular position of the rotatable tool support. Thus, as the housing moves parallel to the axis of the grinding wheel being dressed, the tool moves radially and angularly thereof to form the contour.

The detailed description of my invention follows, reference being had to the drawing, in which:

Fig. 1 is a perspective of a dressing wheel apparatus made according to my invention;

Fig. 2 is a perspective view with parts removed to show details of construction;

Fig. 3 is a perspective view with parts removed to show other details of construction;

Fig. 4 is a plan view with covers removed to show details of the main slide and the contour and rotating cams and associated slides;

Fig. 5 is a vertical section taken along the line 5—5 of Fig. 4;

Fig. 6 shows details of the cam and follower controlling the vertical movement of the tool slide;

Fig. 7 is a section taken along the lines 7—7 of Figs. 4 and 5;

Fig. 8 is a perspective showing the details of construction of the rotatable tool support connections to the slide for rotating the support; and

Fig. 9 is an exploded view of the telescoping connection used in Fig. 8.

In the drawings of Figs. 1, 4, 5 and 7, I provide a base **10** in which is slidably supported the housing **11**, by means of the ball bearing assemblies **12** and **13**. Mounted on the base **10** is an adjustable follower **14** which can be adjusted by means of the adjusting screw **14'** connected to the slide **14''** mounted on the base **10** and supporting follower **14**. This follower contacts a feed cam to determine movement of the housing **11** as will be described.

Main slide and cams

Within the housing **11** (Figs. 2, 3, 4 and 5) is the main cam slide **15** mounted in the ball bearing assemblies **16**, **17**. The slide is connected to and moved by the hydraulically operated piston **18** mounted in the cylinder **19** and connected to the slide **15** by bracket **20**. Fluid under pressure is fed to opposite sides of the piston to move it and the slide **15** back and forth through conduits **21**, **22**. This is the main driving mechanism for the apparatus and is automatically controlled by means not described.

Supported on the under side of the main cam slide **15** is the feed cam **25** of triangular shape in contact with the follower **14**. The biasing spring **26** connected between the base **10** and bottom of housing **11** urges the cam **25** against follower **14**. This determines the position of the housing.

Mounted on the main slide **15** in superimposed relationship are the contour cam **30** and the rotation cam **31**. As will be described below, these cams control the movement of the cutting diamond both vertically and the rotation thereof to form the complex contours having small and large diameters as the housing moves the tool across the surface of the wheel being dressed.

Tool slide and controls

Referring to Figs. 4, 5, 6 and 7, slidably mounted in the portion **11'** of the housing **11** is the tool slide **40** mounted in ball bearing assemblies **41**, **42**. The slide **40** is provided with a bracket **43** urged upwardly by the hydraulic piston and cylinder **44** which acts like a biasing spring. Mounted on the slide **40** is the housing **50**, mounted by means of the web elements **51**. A flexible cover **50'** connects the housing **11'** and the housing **50**. A rotatable tool support **52** is supported on the spindle **53**. The tool **54** is mounted at the end of the tool support **52**.

The connections between the main slide and the tool slide and rotatable support will now be described.

Slidably mounted within the housing portion **11'** and extending within the other portion of the housing **11** are a pair of slides **55** and **56** slidable parallel to and independently of each other and transversely of the movement of the main slide. These slides are mounted in ball bearing assemblies **57**, **58**, **59** and **60**. Biasing springs **65**, **66** bias the slides toward the main slide **15**. These springs are mounted in housing **11** and connected to slides **65** and **66**.

The slide **55** has mounted at one end the follower

70 which contacts the contour cam 30. At the other end of slide 55 is the follower 71 in contact with the cam 72 carried by the tool slide 40. The hydraulically operated cylinder and piston 44 continuously push the slide 40 and cam 72 against the follower 71 on slide 55. As the slide 55 is moved to the left in Fig. 5, the tool housing 50 is moved upwardly since the cam 72 is inclined to the left. Movement of slide 55 causes movement of slide 40 and tool 54 up and down or radially of the wheel being dressed.

Rotation of the tool support is controlled by slide 56 and its associated elements. A follower 75 is carried at one end of slide 56 and is in contact with rotation cam 31 being urged against the cam by biasing spring 65. At the other end of slide 56 is mounted a rack 76 by means of the bracket 77. The telescoping connecting mechanism for rotating the tool support 52 is connected between this rack 76 and the gear 78 fixed to shaft 53 upon which support 52 is fixed and supported (Figs. 7 and 8).

The telescoping connecting mechanism (Figs. 5, 8 and 9) has an upper shaft 80 mounted in the bracket 81 supported in the tool support housing 50. Fixed to the shaft 80 is the gear 82 in mesh with gear 78. The connecting mechanism has a lower shaft 83 having fixed thereto the gear 84 in mesh with rack 76. The shaft is rotatably mounted in bearing support 85.

Connected to the upper end of the lower shaft 83 is the universal coupling member 86, the details of which are shown in Fig. 9. The upper end of the universal joint 86 has fixed thereto the elongated cup-shaped member or spider 87 having the longitudinal slots 88 extending toward the free end thereof, one of said oppositely disposed pair of slots being longer than the other.

The upper shaft 80 has attached to its lower end ball bearing rollers 90, 91, 92 and 93 which are received within the slots and engage the walls of said slots. This provides a practically frictionless but tight telescoping connection between shafts 80 and 83 thus insuring extreme accuracy in turning of the tool support with substantially no backlash while the tool slide and housing are moved vertically. A cup-shaped retainer 94 fixed to shaft 80 fits over the end of the cup-shaped member 87 to maintain member 87 in alignment during operation.

In operation, as piston 18 is moved back and forth, it causes movement of the main slide 15 within the housing 11. Referring to Fig. 5, as slide 15 is moved toward the viewer and pin 14 is fixed to the base, the feed cam 25 will force the housing 11 toward the left against the action of the biasing spring assemblies 26.

The slides 55 and 56 with their followers 70 and 75 in contact with the contour cam 30 and pivot cam 31 are moved back and forth against the action of the biasing springs 65 and 66. As described above, by means of follower 71 and cam 72, the tool slide 40 with the housing 50 and tool support 52 are caused to move up and down, the hydraulically operated piston 44 pushing upwardly against bracket 43 to keep cam 72 and follower 71 in contact. As slide 56 moves back and forth, rack 76 causes rotation of gear 84 rotating the splined shaft assembly and gear 82 to cause oscillatory rotation of the rotatable tool holder 52 and pivoting of the diamond tool 54 about its own radius thus moving the diamond around a complex contour and still obtain the necessary clearance for the holder of the diamond to clear other parts of the profile.

What is claimed is:

1. Apparatus for moving a cutting tool across a workpiece including a slidable housing, a main slide on said housing movable in one direction, a pair of superimposed cams on said main slide, a tool slide on said housing movable transversely of said one direction, a rotatable tool support on said tool slide having an axis of rotation normal to the movement of said tool slide, connections between said tool slide and one of said cams for causing movement of said tool slide, connections between the other of said cams and said rotatable support and having telescoping sections for rotating said rotatable tool support when said main slide is moved, the connections between said tool slide and said one cam and between said rotatable support and said other cam including a pair of slides movable independently of and parallel to each other and transversely of said one direction, one of said pair of slides being connected between one of said cams and said tool slide and the other of said pair of slides being connected between the other of said cams and said telescoping sections.

2. Apparatus for moving a cutting tool across a workpiece including a housing, a main slide on said housing movable in one direction, a pair of superimposed cams on said slide, a tool slide on said housing movable transversely of said one direction, a rotatable tool support on said tool slide having an axis of rotation normal to the movement of said tool slide, connections between said tool slide and one of said cams for causing movement of said tool slide, and connections between the other of said cams and said rotatable support and having telescoping sections for rotating said rotatable tool support when said main slide is moved.

3. Apparatus for moving a cutting tool across a workpiece including a housing, a main slide on said housing movable in one direction, a pair of superimposed cams on said slide, a tool slide on said housing movable transversely of said one direction, a rotatable tool support on said tool slide having an axis of rotation normal to the movement of said tool slide, connections between said tool slide and one of said cams for causing movement of said tool slide upon movement of said main slide, and connections between the other of said cams and said rotatable support for rotating said rotatable tool support when said main slide is moved, the connections between said rotatable support and said other cam including a universal coupling member, an elongated cup-shaped member connected thereto and having longitudinal slots extending from the open end thereof, a rod member carrying a plurality of roller bearings slidable in said slots whereby relative longitudinal movement of said cup-shaped member and said rod can take place during movement of said tool slide.

4. A grinding wheel dressing apparatus including a housing, a main slide on said housing movable in one direction, a pair of superimposed cams on said main slide, a tool slide on said housing movable transversely of said one direction, a rotatable tool support on said tool slide having an axis of rotation normal to the movement of said tool slide, connections between said tool slide and one of said cams for causing movement of said tool slide, said connections including a slide having followers on each end one of which followers contacts said one cam, a cam on said tool slide, the other of said followers contacting said cam on said tool slide for causing movement thereof upon movement of said main slide, and connections between the other of said cams and said rotatable support for rotating said rotatable tool support when said main slide is moved, said last connections including a slide having a follower contacting the other of said cams and a rack on said last slide, a shaft having a pinion in contact with said rack, a universal coupling connected to said last shaft, an elongated cup-shaped member connected to said universal coupling and having longitudinal slots extending from the open end thereof, a rod member carrying a plurality of bearings slidable in said slots whereby relative longitudinal movement of said cup and said rod can take place during movement of said tool slide, and gear connections between said last rod member and said rotatable tool support.

5. A grinding wheel dressing apparatus including a base, a housing slidably mounted on said base for movement in one direction, a main slide on said housing movable in a direction transverse to said one direction, a

pair of superimposed cams on said main slide, a tool slide on said housing movable transversely of said one direction, a rotatable tool support on said tool slide having an axis of rotation normal to the movement of said tool slide, connections between said tool slide and one of said cams for causing movement of said tool slide, and connections between the other of said cams and said rotatable support and having telescoping sections for rotating said rotatable tool support when said main slide is moved.

6. Apparatus for moving a cutting tool across a workpiece including a base having a fixed follower thereon, a housing slidably mounted on said base, a main slide on said housing movable in one direction, a pair of superimposed cams on one side of said main slide, a feed cam on the other side of said main slide contacting said follower, a tool slide on said housing movable transversely of said one direction, a rotatable tool support on said tool slide having an axis of rotation normal to the movement of said tool slide, connections between said tool slide and one of said pair of cams for causing movement of said tool slide, and connections between the other of said pair of cams and said rotatable support and having telescoping sections for rotating said rotatable tool support when said main slide is moved.

7. A grinding wheel dressing apparatus including a base, a housing slidably mounted on said base for movement in one direction, a main slide within said housing movable transversely of said one direction and having a feed cam on one side and a pair of superimposed cams on the other side, a pair of slides mounted on said housing and having movement parallel to each other and to said one direction, each of said pair of slides having a follower engaging one of each of said superimposed cams, a tool slide on said housing and movable transversely of the movement of said pair of slides, rotatable tool supporting means on said tool slide for supporting a tool, and telescoped rotatable means connected between said rotatable tool supporting means and one of said pair of slides for rotating said rotatable supporting means upon movement of said one of said pair of slides, and other means connected between said other one of said pair of slides and said tool slide for causing movement of said tool slide upon movement of said other one of said pair of slides, and a fixed follower on said base contacting said feed cam for determining movement of said housing.

8. A grinding wheel dressing apparatus including a base, a housing slidably mounted on said base for movement in one direction, a main slide within said housing movable transversely of said one direction and having a feed cam on one side and a pair of superimposed cams on the other side, a pair of slides mounted on said housing and having independent movement parallel to each other and to said one direction, each of said pair of slides having a follower engaging one of each of said superimposed cams, a tool slide on said housing and movable transversely of the movement of said pair of slides, rotatable tool supporting means on said tool slide for supporting a tool, a rack on one of said pair of slides, and telescoped rotatable means connected between said rotatable supporting means and one of said pair of slides and carrying a pinion contacting said rack for rotating said rotatable tool supporting means upon movement of said one of said pair of slides, and other means connected between said other one of said pair of slides and said tool slide for causing movement of said tool slide upon movement of said other one of said pair of slides, and a fixed follower on said base contacting said feed cam for causing movement of said housing upon movement of said main slide.

9. A grinding wheel dressing apparatus including a base, a housing slidably mounted on said base for movement in one direction, a main slide in said housing having movement transversely to said one direction, and

power means connected to said main slide for moving said main slide, superimposed contour and rotation cams mounted on one side of said main slide, and a feed cam mounted on the other side of said main slide, a pair of slides mounted on said housing and having relative parallel movement with respect to each other and movement transversely of said main slide, a follower at the end of one of said pair of slides and a rack on the other, the other of said pair of slides having a follower at one end in contact with the contour cam and a second follower at the other end, a tool slide on said housing having movement transversely of the movement of said pair of slides, a rotatable support on said tool slide, a cam on said tool slide in contact with the second follower on said other of said pair of slides, a telescoping rotatable connection connected between said rotatable tool support and said rack including a gear on one end of said rotatable connection engaged with said rack, and gear means at the other end of said rotatable connection connected to said rotatable tool support, and a follower on said base in contact with said feed cam, movement of said main slide causing movement of said housing in said one direction and movement of said tool slide transversely thereto as well as rotation of said rotatable tool support.

10. A grinding wheel dressing apparatus including a base, a housing slidably mounted on said base for movement in one direction, a main slide in said housing having movement transversely to said one direction, superimposed contour and rotation cams mounted on one side of said main slide, and a feed cam mounted on the other side of said main slide, a slide mounted on said housing and having movement transversely of said main slide, a follower at the end of said last slide in contact with said rotation cam and a rack on the other end of said last slide, a tool slide in said housing having movement transversely of the movement of said last slide, a rotatable tool support on said tool slide, a telescoping rotatable connection connected between said rotatable tool support and said rack including a gear on one end of said rotatable connection engaged with said rack, and gear means at the other end of said rotatable connection connected to said rotatable tool support, means connected between said contour cam and said tool slide for causing movement of said tool slide upon movement of said main slide, and a follower on said base in contact with said feed cam, movement of said main slide causing movement of said housing in said one direction and movement of said tool slide transversely thereto as well as rotation of said rotatable tool support.

11. A grinding wheel dressing apparatus including a housing, a main slide in said housing having movement in one direction, superimposed contour and rotation cams mounted on one side of said main slide, a pair of slides mounted on said housing and having relative parallel movement with respect to each other and movement transversely of said main slide, a follower at the end of one of said pair of slides and a rack on the other, the other of said pair of slides having a follower at one end in contact with said contour cam and a second follower at the other end, a tool slide on said housing having movement transversely of the movement of said pair of slides, a rotatable tool support on said tool slide, a cam on said tool slide in contact with the second follower on said other of said pair of slides, a telescoping rotatable connection connected between said rotatable tool support and said rack including a gear on one end of said rotatable connection engaged with said rack, and gear means at the other end of said rotatable connection connected to said rotatable tool support, movement of said main slide causing movement of said tool slide as well as rotation of said rotatable tool support.

No references cited.