

- [54] **DRESSING APPARATUS WITH CUP SHAPED DRESSING WHEELS**
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- [22] Filed: **Sept. 29, 1970**
- [21] Appl. No.: **76,471**
- [30] **Foreign Application Priority Data**
Oct. 6, 1969 Japan 44/79801
- [52] U.S. Cl.....**125/11 CD**
- [51] Int. Cl.**B24b 53/14**
- [58] Field of Search.....51/128; 125/11 CD
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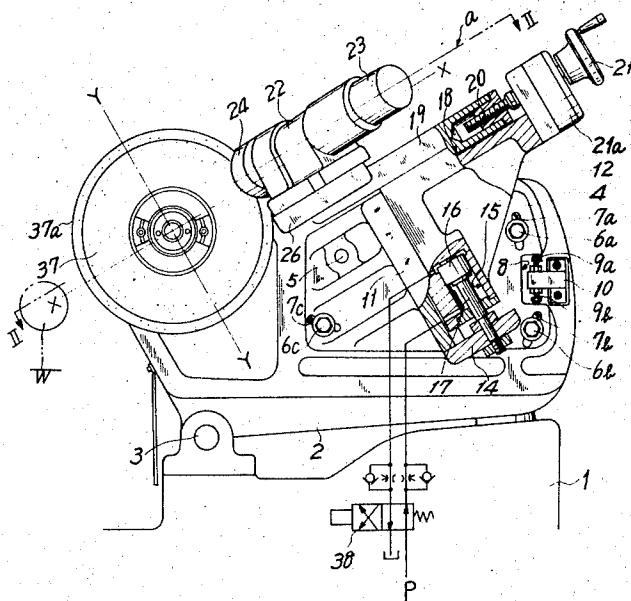
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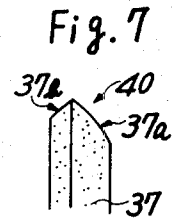
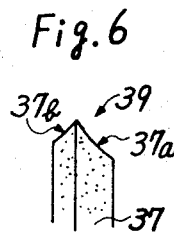
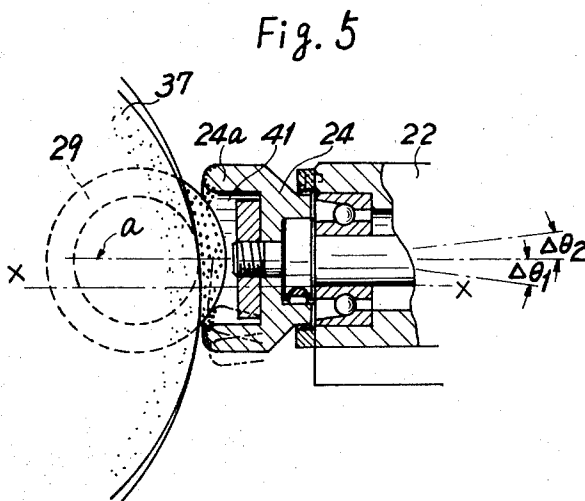
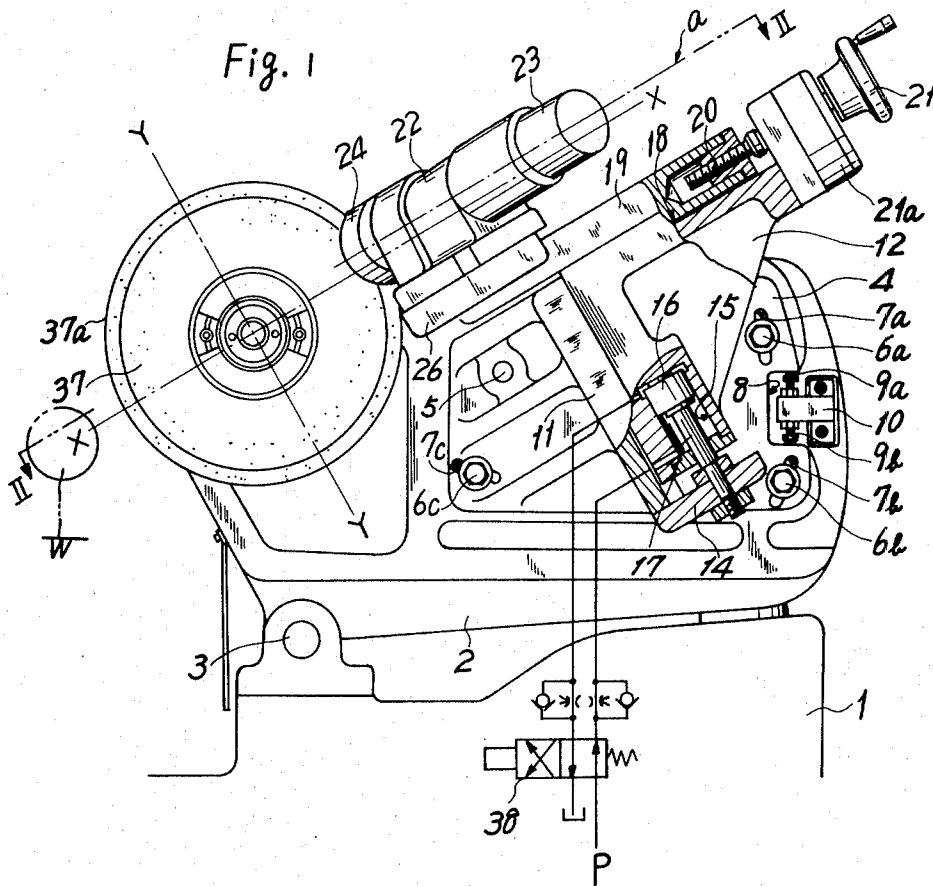
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[57] **ABSTRACT**

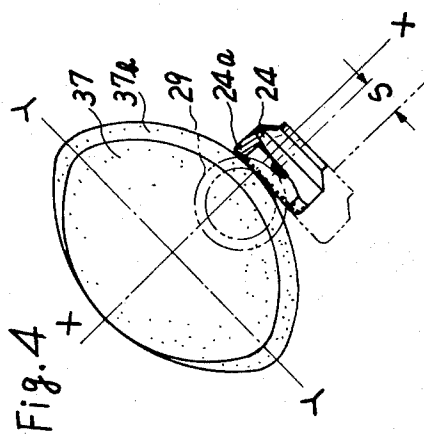
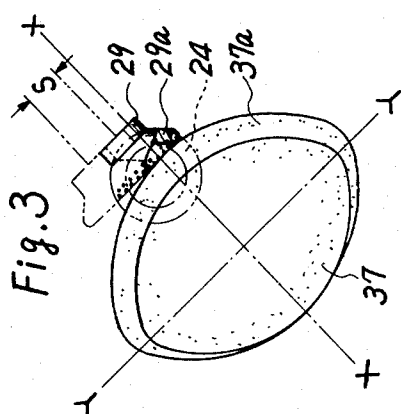
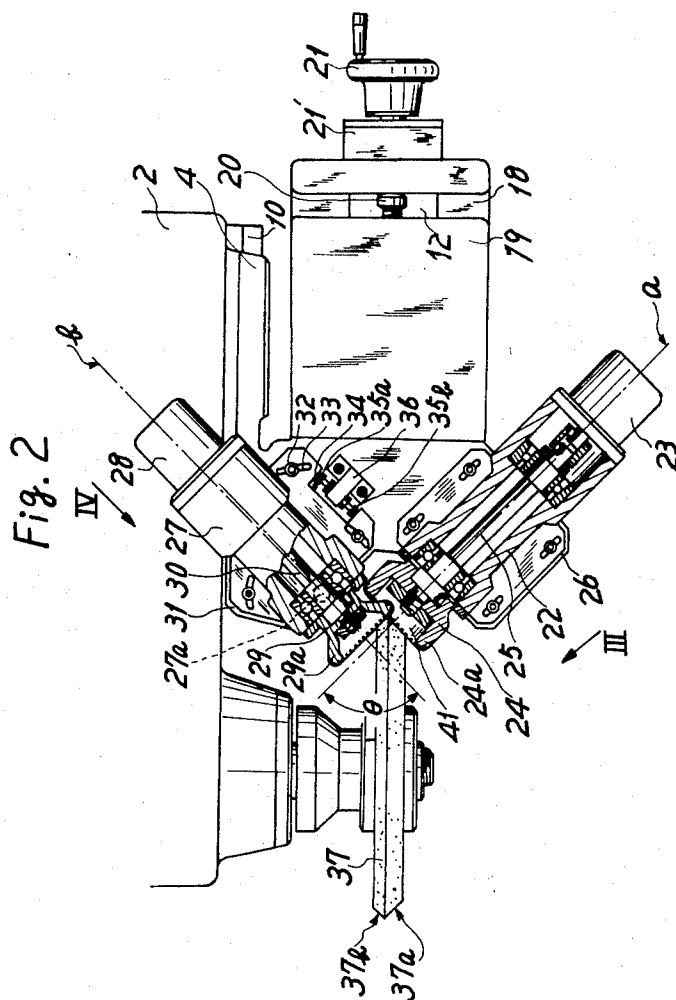
A dressing apparatus for simultaneously dressing two peripheral portions of a grinding wheel includes two cup shaped dressing wheels, each having the end face thereof embedded with diamond particles for respectively dressing each of the peripheral portions of the grinding wheel through movement in a direction parallel to a tangent of the grinding wheel. One end portion of one of the cup shaped dressing wheels is arranged to extend into the bore of the other cup shaped dressing wheel.

5 Claims, 7 Drawing Figures





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DRESSING APPARATUS WITH CUP SHAPED DRESSING WHEELS

BACKGROUND OF THE INVENTION

This invention relates to dressing apparatus for grinding wheels, and more particularly to a dressing apparatus having two cup shaped dressing wheels.

The periphery of some grinding wheels are so shaped as to include two angularly disposed peripheral portions. With such grinding wheels it has been necessary to dress the angularly related peripheral grinding surfaces in accordance with the workpiece to be ground. Moreover, in accordance with certain workpieces to be ground, it has been necessary to dress the angularly related peripheral grinding surfaces in concave or convex contours.

In the past, it has been known to employ a copying type dressing apparatus for angularly related grinding surfaces, wherein a single diamond dressing tool is moved in accordance with a template to copy the contour thereof. However, the coping type dressing device can only dress a grinding wheel in a shape dependent upon the template and thus, the template must be exchanged each time it is necessary to dress a grinding wheel in a different shape. Moreover, the copying type dressing apparatus takes a long time in the process of the dressing operation and thus reduces the efficiency of the grinding operation.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a dressing apparatus for dressing a grinding wheel having two angularly related peripheral portions without using a template.

Another object of the present invention is to provide a dressing apparatus capable of dressing a grinding wheel having two angularly related peripheral portions in concave or convex contours.

A further object of the present invention is to provide a dressing apparatus capable of dressing a grinding wheel having two angularly related peripheral portions in a minimum amount of time.

Briefly, in accordance with one embodiment of this invention, these and other objects are obtained by providing a dressing apparatus wherein two cup shaped dressing wheels are substantially simultaneously brought into engagement with two angularly related peripheral portions of a grinding wheel in a direction parallel to the tangent of the grinding wheel by a single fluid actuated means with one end portion of one of the cup shaped dressing wheels extended into the other cup shaped dressing wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects of the present invention will become fully apparent from the following description of a preferred embodiment of the present invention with reference to the accompanying drawings, in which:

FIG. 1 is a side view partly in section, showing a dressing apparatus in accordance with the present invention;

FIG. 2 is a view taken along the line II—II of FIG. 1;

FIG. 3 is a view taken in a direction indicated by the arrow III of FIG. 2;

FIG. 4 is a view taken in a direction indicated by the arrow IV of FIG. 2;

FIG. 5 is an enlarged sectional view showing the relationship between the cup shaped dressing wheel and the grinding wheel;

FIG. 6 illustrates a peripheral contour of a grinding wheel dressed in accordance with the present invention; and

FIG. 7 illustrates another peripheral contour of a grinding wheel dressed in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings and more particularly to FIGS. 1 and 2, there is provided a bed 1 on which a wheel base 2 is pivotally mounted by means of a pin 3. The wheel base 2 carries thereon a rotatable grinding wheel 37 having two outer peripheral portions 37a and 37b which intersect at a predetermined angle θ . The grinding wheel 37 is adapted to grind a workpiece W which is rotatably supported between the spindle head and the tail stock of the grinding machine through pivotal movement thereof about pin 3.

Received on the side wall of wheel base 2 is a mounting plate 4 secured thereon by bolts 6a, 6b and 6c which extend respectively through arcuated extending slots 7a, 7b and 7c in plate 4, to permit pivotal adjustment thereof about a pin 5. The rear portion of wheel base 2 has secured thereto a bracket 10 which has bolts 9a and 9b threadedly engaged therewith. The bolts 9a and 9b are capable of engagement within a recess 8 formed in the rear portion of the mounting plate 4 and are adjustable to selectively position the plate 4 about pin 5.

The side wall of mounting plate 4 has formed thereon an integral support 11 which includes a slide surface to be arranged in parallel relationship with a line Y—Y. The line Y—Y passes through the center of grinding wheel 37 and is at right angles with a line X—X defined by the center of wheel 37 and dressing points at which dressing tools, as described hereinafter, contact the grinding wheel 37.

On the slide surface of support 11 is slidably mounted a slide base 12 having a cylinder 15 formed therein. A piston 16 is slidably mounted within the cylinder 15 and has a piston rod 17 connected thereto. The piston rod 17 is connected to a bracket 14 secured to the support 11 such that the slide base 12 will be reciprocated along the slide surface of support 11 in a direction parallel to the line Y—Y by means of a change over valve 38 connected to the cylinder 15. The slide base 12 has thereon a slide surface 18 which extends transversely of the slide surface of support 11. On the slide surface 18 is slidably mounted a feed table 19, the rear end thereof being threadedly engaged with a screw 20 connected to an automatic feed means 21a. Numeral 21 indicates a manual hand wheel for manually moving the feed table 19.

The feed table 19 has an integral outwardly projecting plate 26 on which a dressing housing 22 is secured. Rotatably journaled in the housing 22 is a dressing spindle 25, the axis a thereof being at a predetermined fixed angle with respect to the axis of the grinding wheel 37. The dressing spindle 25 is connected at one end thereof to a drive motor 23 and carries at the other

end thereof a cup shaped dressing wheel 24. The end face 24a of the dressing wheel 24 is embedded with diamond particles.

Similarly, the feed table 19 has an integral outwardly projecting plate 31, the flat surface thereof being within the same plane containing the flat surface of projecting plate 26. Positioned on the plate 31 is a dressing housing 27 secured thereto by bolts 32 which extend through arcuately extending slots 33 provided on the dressing housing 27 so as to permit pivotal adjustment thereof about a pin 27a. A dressing spindle 30 is rotatably journaled in the housing 27. The feed table 19 has secured thereto a bracket 36 which has bolts 35a 35b threadably engaged therewith. The bolts 35a and 35b are engaged within a recess 34 formed on the dressing housing 27 and are adjustable to position the housing 27 in such a manner that the axis b of the dressing spindle 30 forms the angle θ with respect to the axis a of the dressing spindle 25. The dressing spindle 30 is connected at one end thereof to a drive motor 28 and carries at the other end thereof a cup shaped dressing wheel 29, the diameter thereof, in this embodiment, being equal to that of the dressing wheel 24. The end face 29a of the dressing wheel 29 is embedded with diamond particles. One portion of end face 29a is arranged to extend into the bore 41 of dressing wheel 24 such that the dressing wheel 29 does not interfere with the dressing wheel 24.

Since the height between the axis a of dressing wheel 24 and the flat surface of plate 26 is designed to be equal to that between the axis b of dressing wheel 29 and the flat surface of plate 31, the plane containing the axes a and b is in parallel relationship with the plane containing the line X—X and the axis of grinding wheel 37.

In operation, the dressing housing 27 is initially adjusted by bolts 35a and 35b in such a manner that the axis b of dressing spindle 30 is positioned at a predetermined angle θ with respect to the axis a of dressing spindle 25 which axis is stationary with respect to the axis of grinding wheel 37. The mounting plate 4 is then adjusted by bolts 9a and 9b so as to adjust the relative positions of the dressing wheels 24, 29 and the grinding wheel 37. Thereafter, the feed table 19 is advanced a required dressing amount toward the grinding wheel 37 by feed means 21a. Under these conditions, change over valve 38 is energized to permit fluid pressure to enter into the upper chamber of the cylinder 15 such that the slide base 12 is moved upwardly along the slide surface of support 11, which surface is in parallel relationship with the line Y—Y. Upon upward movement of slide base 12 through the distance S, which is slightly smaller than the stroke of cylinder 15, the end faces 24a and 29a are substantially simultaneously brought into contact with the peripheral portions 37a and 37b of grinding wheel 37 at the line X—X. Thereafter, the slide base 12 is moved upwardly by the completion of the stroke of cylinder 15 such that the grinding wheel is accurately dressed in a predetermined shape and size. The stroke of cylinder 15 may be shortened in order to decrease the dressing time. During the dressing operation the grinding wheel 37 is obviously being rotated as well as the dressing wheels 24 and 29.

When it is desired to dress the peripheral portions 37a and 37b of the grinding wheel in concave contours,

as shown in FIG. 6, bolts 6a 6b and 6c are loosened and the mounting plate 4 is rotated by adjusting bolts 9a and 9b about pin 5 in a clockwise direction to produce an angular displacement $\Delta\theta_1$, as viewed in FIG. 5. The mounting plate 4 is subsequently clamped to the wheel base 2 by bolts 6a, 6b and 6c. Thus, the axes a and b of dressing wheels 24 and 29 are inclined with respect to the line X—X by an angular displacement $\Delta\theta_1$, such that the end faces 24a and 29a of the dressing wheels 24 and 29 are positioned to slope upwardly in the direction of the grinding wheel 37. With the dressing wheels angularly positioned, the feed table 19 is moved toward the grinding wheel as required dressing amount by feed means 21 a and the slide base 12 is moved upwardly relative to support 11 by energization of the changeover valve 38. The outer peripheral portions of end faces 24a and 29a are substantially simultaneously brought into engagement with the peripheral portions 37a and 37b of the grinding wheel 37, such that the peripheral portions 37a and 37b are dressed in concave contours, as shown in FIG. 6.

When it is desired to dress the peripheral portions 37a and 37b of the grinding wheel 37 in convex contours, as shown in FIG. 7, the mounting plate 4 is adjusted about pin 5 by bolts 9a and 9b such that the axes a and b of the dressing wheels 24 and 29 are inclined with respect to the line X—X by an angular displacement $\Delta\theta_2$ (FIG. 5). Thus, the end faces 24a and 29a of the dressing wheels 24 and 29 are positioned to slope downwardly in the direction of grinding wheel 37. With the dressing wheels thus positioned, the feed table 19 is moved toward the grinding wheel a required dressing amount, and the slide base 12 is moved upwardly relative to support 11. Thus, the inner peripheral portions of end faces 24a and 29a are substantially simultaneously brought into engagement with the peripheral portions 37a and 37b of the grinding wheel 37, such that the peripheral portions 37a and 37b are dressed in convex contours, as shown in FIG. 7.

Since the axis a of the dressing wheel 24 is fixed with respect to the axis of the grinding wheel 37, the head stock (not shown) supporting the workpiece to be ground may be swung into position to grind the workpiece in a desired shape. However, the dressing housing 22 may be constructed to be adjustable in a similar manner to the dressing housing 27, instead of swinging the head stock into grinding position.

When using dressing wheels of different diameters, the distance between the axis of dressing wheel and the flat surface of the outwardly projecting plate must be changed in accordance with the difference in dressing wheel diameters so that both end portions of the dressing wheels may be substantially simultaneously brought into engagement with the peripheral portions of the grinding wheel to shorten the stroke of the cylinder.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that in the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by letters patent of the United States is:

1. A dressing apparatus for dressing a grinding wheel rotatably supported in a wheel base and having two peripheral portions, operative to grind a workpiece comprising:

- mounting means pivotally mounted on said wheel 5 base;
- means for adjusting the position of said mounting means relative to said wheel base;
- supporting means slidably mounted on said mounting means for movement in a direction parallel to a 10 tangent of said grinding wheel;
- means for moving said supporting means in said direction;
- table means slidably mounted on said supporting means for movement in a direction transverse to 15 said direction parallel to the tangent of said grinding wheel, said table means being disposed in opposite relation with the workpiece with said grinding wheel interposed therebetween;
- feed means for moving said table means in said transverse direction toward said grinding wheel; 20
- a first dressing housing mounted on said table means;
- a first cup shaped dressing wheel rotatably mounted in said first dressing housing for dressing one of said peripheral portions of said grinding wheel; 25
- drive means for rotating said first cup shaped dressing wheel;
- said first cup shaped dressing wheel having a bore formed therein;
- a second dressing housing mounted on said table 30 means;
- a second cup shaped dressing wheel rotatably mounted in said second dressing housing for dressing the other of said peripheral portions of said grinding wheel and including an end face; 35
- drive means for rotating said second cup shaped

dressing wheel; and

one portion of said end face of said second cup shaped dressing wheel being arranged to extend into said bore of said first cup shaped dressing wheel.

2. A dressing apparatus as set forth in claim 1, wherein:

said dressing apparatus further comprises means for pivotally supporting said first dressing housing on said table means; and

means for adjusting the position of said first dressing housing relative to said second dressing housing.

3. A dressing apparatus as set forth in claim 2, wherein:

said dressing apparatus further comprises means for pivotally supporting said second dressing housing on said table means; and

means for adjusting the position of said second dressing housing relative to said first dressing housing.

4. A dressing apparatus as set forth in claim 1, wherein:

said first and second housings are arranged in such a manner that said first and second cup shaped dressing wheels are substantially simultaneously brought into engagement with the peripheral portions of said grinding wheel during movement thereof in the direction parallel to the tangent of said grinding wheel.

5. A dressing apparatus as set forth in claim 1, wherein:

said means for moving said supporting means moves said first and second cup shaped dressing wheels over the dressing points where the dressing wheels contact with the grinding wheel.

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