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DIAMOND ROLLER DRESSER

Filed June 28, 1967

FIG.1
PRIOR ART

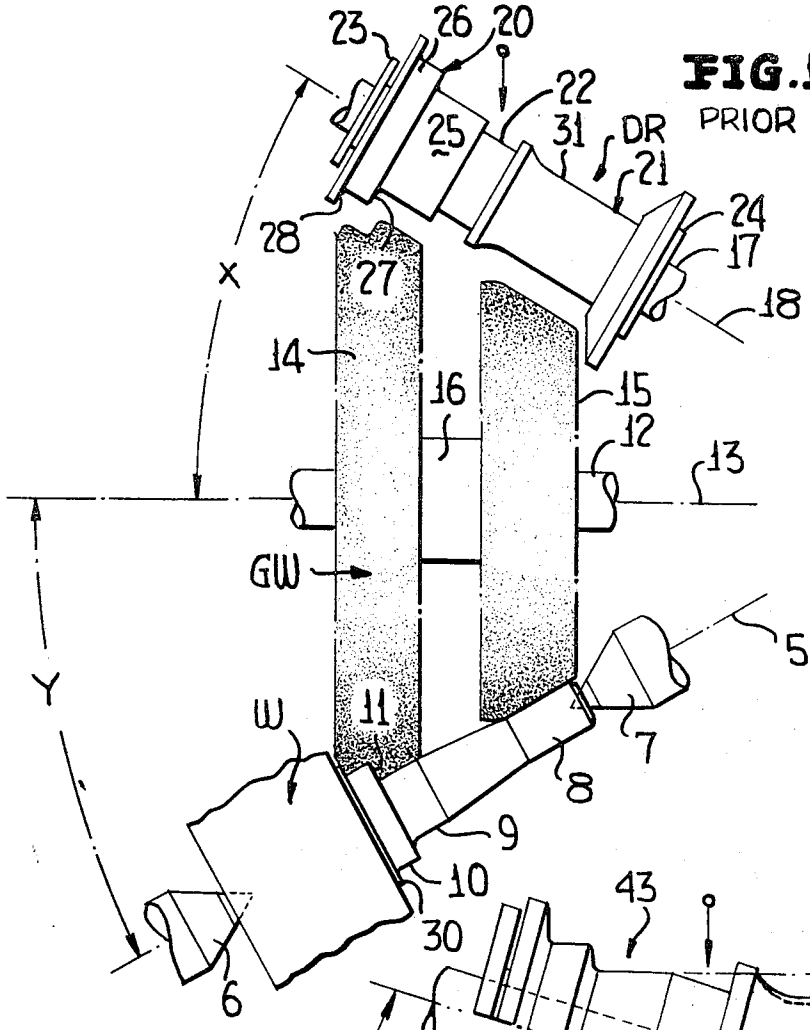
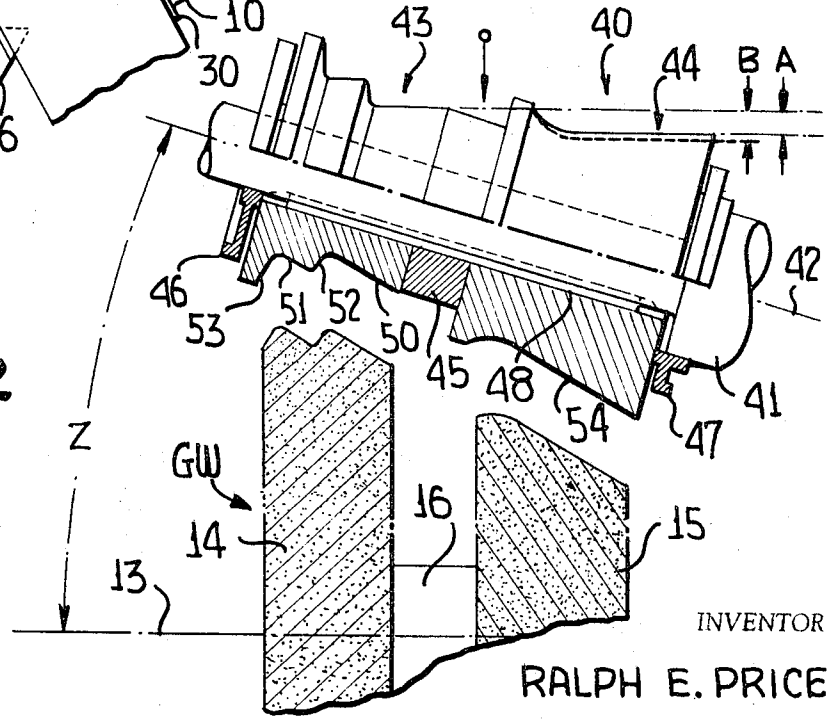


FIG.2



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DIAMOND ROLLER DRESSER

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ABSTRACT OF THE DISCLOSURE

This disclosure relates to a dressing roller for a grinding wheel which grinds adjacent cylindrical and annular surfaces of the workpiece. Portions of the dressing roller corresponding to the annular surface of the workpiece are frusto-conical rather than cylindrical and annular because an annular dressing surface does not perform a satisfactory dressing operation as does a conical surface. In order to dress a grinding wheel with such a dressing roller, the angle between the axis of the dressing roller and the axis of the grinding wheel must be different than the angle between the axis of the workpiece and the axis of the grinding wheel by an amount corresponding to the difference between the annular surface of the workpiece and the corresponding conical surface of the dressing roller. This disclosure particularly rleates to dressing rollers having diamond impregnated surfaces.

This invention relates in general to new and useful improvements in dressing rollers, and more particularly to diamond impregnated dressing rollers for dressing shaped grinding wheels used in the grinding of adjacent cylindrical and annular surfaces of a workpiece.

In the simultaneous grinding of adjacent cylindrical and annular surfaces of a workpiece, the grinding wheel is formed so that the annular surfaces of a workpiece are ground by a frusto-conical surface of the grinding wheel. In order to perform a grinding operation with wheels shaped in this manner, it is necessary for the axes of the grinding wheels and the workpiece to be at an angle, usually 30 degrees or 45 degrees.

Previous to this invention, the diamond impregnated dressing roller for dressing such grinding wheels had a contour substantially identical to that of the workpiece including the annular portions. The diameters of the various portions of the dressing rollers are usually larger than the corresponding diameters of the workpiece so that a maximum peripheral dressing surface is available. The practice is to make the smallest diameter not less than two inches. Such dressing rollers are supported for rotation about an axis also spaced 30 degrees or 45 degrees from the grinding wheel axis, the angle between the dressing roller axis and the grinding wheel axis corresponding to the angle between the grinding wheel axis and the workpiece axis.

When the angle between the dressing roller axis and the grinding wheel axis is the same as the angle between the workpiece axis and the grinding wheel axis, the annular portions of the dressing roller correspond to the annular portions of the workpiece. These annular portions of the dressing roller provide a finish on the corresponding portions of the grinding wheel which is inferior to the finish provided by the conical portions of the dressing roller. This is probably because the annular surface represents a relatively large dresser area in contact with the grinding wheel. A conical surface for the same purpose represents only a line contact with the grinding wheel.

The above undesired condition is solved in accordance with this invention by providing an angular relation between the dressing roller axis and the grinding wheel axis which is different from the angle between the workpiece axis and the grinding wheel axis, the angle between the dressing roller axis and the grinding wheel axis preferably being less. When the dressing roller is inclined in this manner, the previously annular portions thereof become conical portions so that all portions of the grinding wheel are dressed to the same quality finish.

In accordance with this invention, the dressing roller may also be formed of two axially spaced portions, one of which has provision for a slight axial adjustment relative to the other. This adjustment is provided by a spacer or a shim which may be ground to permit the desired adjustment.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawing:

In the drawing:

FIG. 1 is a schematic view showing the previously utilized relationship between the axes of a workpiece being ground, the grinding wheel, and the dressing roller for maintaining the shaped contour of the grinding wheel.

FIG. 2 is a fragmentary view on a large scale showing the grinding wheel and dressing roller of FIG. 1 with the relationship therebetween being modified in accordance with this invention and wherein the contour of the dressing roller has been changed.

Referring now to FIG. 1 in particular, it will be seen that there is illustrated a typical workpiece W which is mounted for rotation about a fixed axis **5** by means of a pair of aligned centers **6** and **7**. The illustrated workpiece is in the form of an automotive spindle although it may vary. It is to be noted that the workpiece W includes three cylindrical surfaces **8**, **9** and **10** with the cylindrical surfaces **9** and **10** being separated by an annular surface **11**.

The grinder also includes a grinding wheel GW which is preferably of a twopiece construction and is supported for rotation on a spindle **2** for rotation about a predetermined axis **13**. The grinding wheel GW preferably includes a grinding wheel member **14** and a grinding wheel member **15** separated by means of a suitable spacer **16**. It is to be noted that the grinding wheel members **14** and **15** have shaped contours in accordance with the portions of the workpiece W to be ground.

At this time it is pointed out that suitable means are provided for rotating both the workpiece W and the grinding wheel GW for rotation about their respective axes in a conventional manner. In addition, means are provided for supporting the centers **6** and **7** on the one hand and the spindle **12** on the other hand for relative movement so as to permit the grinding wheel GW to grind the workpiece W to the desired size as well as the desired configuration.

A dressing roller DR is provided for periodically dressing and maintaining the shape of the grinding wheel GW. The dressing roller DR is carried by a rotatable spindle or shaft **17** which, rotates about an axis **18**. The angle between the axis **18** of the spindle **17** and the axis **13** of the spindle **12**, which angle is referred to as angle X, in the past, has been equal to the angle Y between the axis **13** and the axis **5** about which the workpiece W rotates.

The dressing roller DR is formed of two elements **20** and **21** spaced apart by a spacer **22** generally in accordance with the spacing between the wheel elements **14** and **15** of the grinding wheel GW. The dressing roller portions **20**, **21** are retained in position on the spindle **17** by means of suitable retainers **23** and **24** carried by the spindle.

It is to be noted that the dressing roller DR has the same general contour as that of the workpiece W. The dressing roller portion **20** includes two cylindrical por-

tions 25 and 26, which correspond to the cylindrical surfaces 9 and 10 of the workpiece W, respectively. The dressing roller portion 20 also includes an annular surface 27, which corresponds to the annular shoulder 11 of the workpiece W. In addition, the dressing roller portion 20 includes an annular surface 28 which corresponds to a shoulder 30 on the workpiece W immediately adjacent the cylindrical surface 10. The dressing roller portion 21 also includes a cylindrical surface 31 which corresponds to the cylindrical surface 8.

At this time it is pointed out that the specific surfaces of the workpiece W and their corresponding surfaces on the dressing roller DR of themselves are not critical. The criticality resides in the fact that the workpiece W has cylindrical surfaces and adjacent annular surfaces which must be simultaneously ground. When the angular relationship between the axis of the spindle 12 and the axis of rotation of the workpiece W is the same as that between the axis of the spindle 17 and the axis of the spindle 12, it will be seen that the dressing roller will have like cylindrical and annular surfaces in order that the grinding wheel GW will have frusto-conical surfaces which engage the workpiece during the grinding operation. This, of course, is highly undesirable.

It will be noted that while the cylindrical surfaces 25, 26 and 31 of the dressing roller have line contact with the grinding wheel during the dressing thereof, as is the normally desired condition, the annular dressing surfaces 27 and 28 have face-to-face contact with the grinding wheel. As a result, the finish of the surfaces of the grinding wheel which are dressed by the dressing roller surfaces 27 and 28 is much inferior to the finish on those portions of the grinding wheel engaged by the cylindrical surfaces of the dressing roller.

After much study, it has been determined that the deficiencies of the previous grinding wheel and dressing roller relationship can be overcome by an unobvious, but simple, change in the dressing roller position. Referring now to FIG. 2 in particular, it will be seen that there is illustrated a dressing roller which is generally referred to by the numeral 40. The dressing roller 40, like the dressing roller DR, is carried by a spindle 41. The spindle 41 is suitably mounted for rotation about an axis 42 which, in its operative position, is disposed at an angle Z to the axis of rotation 13 of the grinding wheel GW. The dressing roller 40 is of a multiple component construction and includes portions 43 and 44 which are spaced along the spindle 41 with the spacing therebetween being controlled by a spacer 45. The components of the dressing roller 40 are retained on the spindle 41 by means of suitable retainers 46 and 47 and are keyed relative thereto for rotation therewith by means of a key 48.

It is to be noted that the dressing roller 40 has an effective contour which corresponds to the effective contour of both the dressing roller DR and the workpiece W. However, the dressing roller 40 has neither cylindrical nor annular dressing surfaces, all of the dressing surfaces of the dressing roller being frusto-conical. The dressing roller portion 43 has surfaces 50 and 51 which are disposed at a slight angle to the axis 42 and which correspond to the dressing surfaces 25 and 26 of the dressing roller DR. The dressing roller portion 43 also has surfaces 52 and 53 which are disposed at a relatively great angle to the axis 42 and which correspond to the annular dressing surfaces 27 and 28 of the dressing roller DR. Also, the dressing roller portion 44 has a dressing surface 54 which corresponds to the dressing surface 31 and which is also frusto-conical and extends at a slight angle to the axis 42.

At this time it is pointed out that generally speaking the angle Z should be approximately 15 degrees less than the angle Y. For example, a feasible relationship is to have the angle Y of a value of 30 degrees with the angle Z having a value of 15 degrees. It is to be noted that when the angle Y is approximately 30 degrees, although the

surfaces 9 and 10 of the workpiece are of different diameters, the corresponding surfaces of the grinding wheel GW which effect the grinding thereof, are substantially of the same diameter and therefore, wearing of the grinding wheel is substantially equalized. In a like manner, while the dressing surfaces of the dressing roller DR are of different diameters, because of the specific angle Z between the axes 13 and 42, the dressing surfaces of the dressing roller 40 more closely approach the same diameter. Therefore, the wearing of the dressing surfaces of the dressing roller 40 is more uniform than that of the dressing roller DR.

It is pointed out at this time that although the dressing roller 40 preferably has the dressing surfaces thereof impregnated with diamonds, the dressing roller 40 is subject to wear to the extent that one portion thereof, for example, the portion 44, may wear at a faster rate than the other portion, that is the portion 43. This results in a change in the diametrical relation between the surfaces 54. This wear is not permitted to continue to the point where one of the portions of the dressing roller loses contact with the grinding wheel. In order to maintain the proper relation between the two portions of the dressing roller, the spacer 45 may be shortened by grinding to permit a relative axial adjustment between the two portions 43 and 44. For example, the normal differential of the surfaces 50 and 54 is a dimension A, as is shown in FIG. 2. The change in relation between the surfaces 50 and 54 resulting from the greater rate of wear of the surface 54 results in this dimension increasing to a dimension B. By shortening the spacer 45 and permitting the portion 44 to move to the left, there is an effective outward shifting of that portion of the surface 54 which contacts the grinding wheel. As a result, the relation between the surfaces 50 and 54 returns to the original dimension A.

It will be readily apparent from the foregoing that a 0.001 inch reduction in the axial dimension of the spacer 45 will result in a corresponding axial movement of the portion 44 to the left and will cause an element of larger diameter of the portion 44 to move into the axial position previously occupied by an element of a smaller diameter with the new element being of the same diameter as the initial diameter of the worn element.

At this time it is also pointed out that the dressing roller 40 will be mounted on the spindle 41 having floating bearings and means for adjustment so that any overall axial change in position of the dressing roller required as a result of changing the width of the spacer 45 is taken care of automatically when reassembled.

At this time it is pointed out that the change in the position of the dressing roller 40, as compared to that of the dressing roller DR, in no way changes the contour of the grinding wheel GW nor the relationship thereof to the workpiece being ground. Therefore, it will be apparent that the grinder assembly generally shown in FIG. 1, but incorporating the dressing roller 40 disposed at the angle Z to the axis 13 of the grinding wheel, not only incorporates all of the beneficial effects of the assembly of FIG. 1, but also provides the additional advantageous relationship between the dressing roller and the grinding wheel discussed above.

In order to emphasize the improvement provided by changing the angle of the dressing roller axis, it should be pointed out that whereas, all dressing surfaces on the dressing roller of FIG. 1 are annular or cylindrical, the corresponding surfaces on the dressing roller in FIG. 2 are conical. This is the direct result of mounting the dressing roller at an angle less than the angle between the work and the grinding wheel.

Although only a preferred embodiment of the invention has been specifically illustrated and described herein, it is to be understood that minor variations may be made in the dressing roller construction and relationship thereof to the grinding wheel without departing from the spirit

and scope of the invention, as defined by the appended claims.

I claim:

1. In a grinding machine for grinding surfaces of a workpiece which include cylindrical and planar annular surfaces, mechanism including:

(a) workpiece support means for supporting a workpiece for rotation about a first axis,

(b) a grinding wheel having a contour arranged for simultaneously grinding cylindrical and planar annular surfaces on a workpiece carried by said workpiece support means,

(c) grinding wheel support means for supporting said grinding wheel for rotation about a second axis,

(d) a dressing roller for said grinding wheel, having a general contour corresponding to a contour intended to be ground on the workpiece, and

(e) dressing roller support means for supporting said dressing roller for rotation about a third axis in a position for engagement with said grinding wheel:

the improvement residing in said axes rotation being in angular relation to one another and the angle between said second and third axes being different from, the angle between said first and second axes with said dressing roller having a conical surface corresponding to each planar annular surface produced in the workpiece.

2. The mechanism of claim 1 wherein

(a) the angle between said second and third axes is less than the angle between said first and second axes.

3. The mechanism of claim 2 wherein

(a) the angular difference is on the order of 15°.

4. The mechanism of claim 1 wherein

(a) the angle between said first and second axes is on the order of 30°,

(b) and the angle between said second and third axes is on the order of 15°.

5. The mechanism of claim 1 wherein

(a) said grinding wheel has effective portions spaced axially of said second axis,

(b) said dressing roller has separate dressing portions spaced axially of said third axis,

(c) and said dressing roller has intermediate spacer means between separate dressing portions for correcting a change in the relation in said grinding wheel portions.

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