Dec. 9, 1969 H. R. DILKS 3,482,355

GRINDING WHEEL CONSTRUCTION

Filed Jan. 31, 1967 2 Sheets-Sheet 1

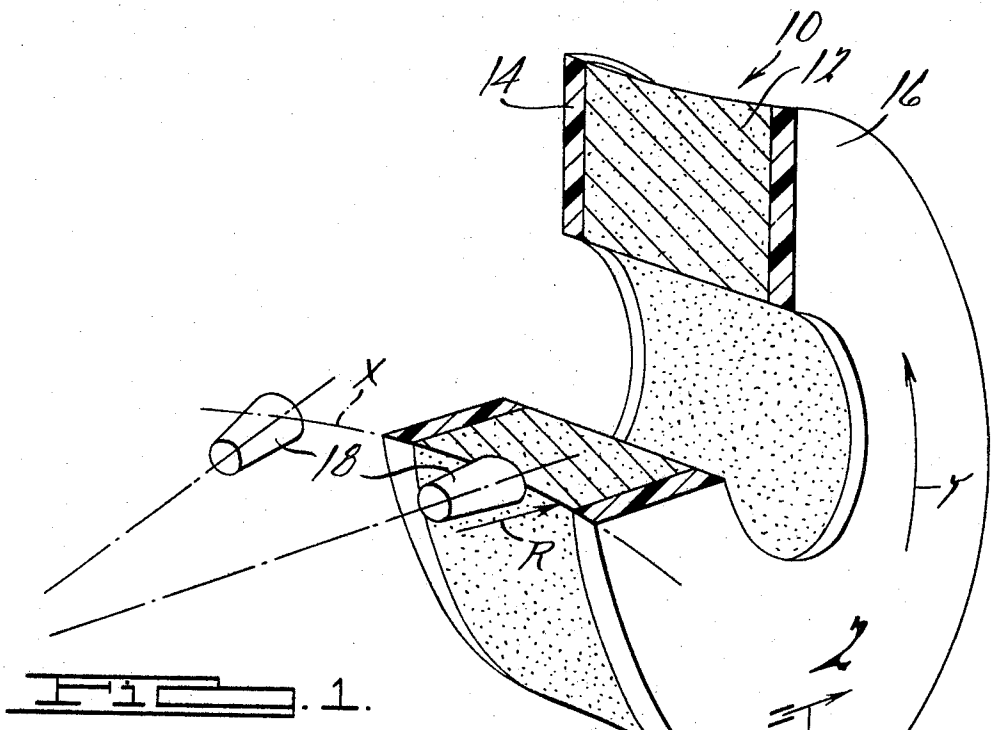

Fig. 1.

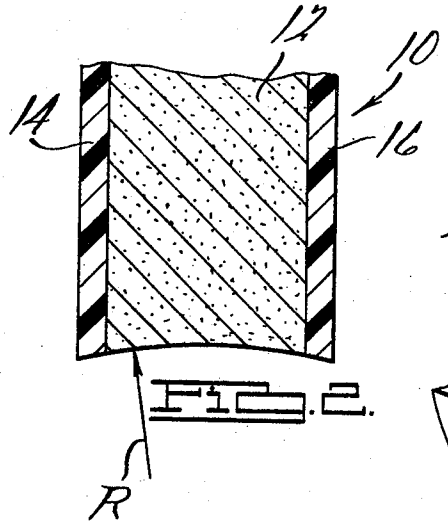

Fig. 2.

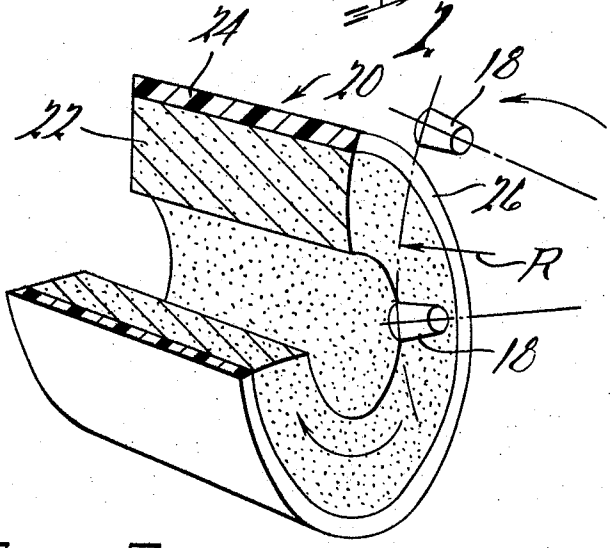

Fig. 3.

INVENTOR.
Harold R. Dilks
BY
Harness, Dickey & Pierce
ATTORNEYS

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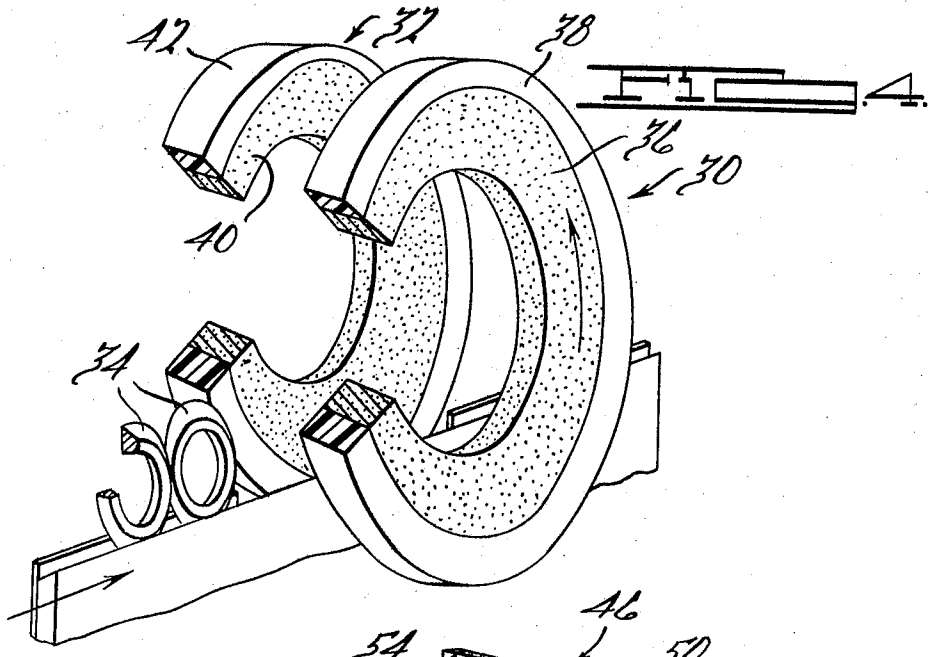

FIG. 4.

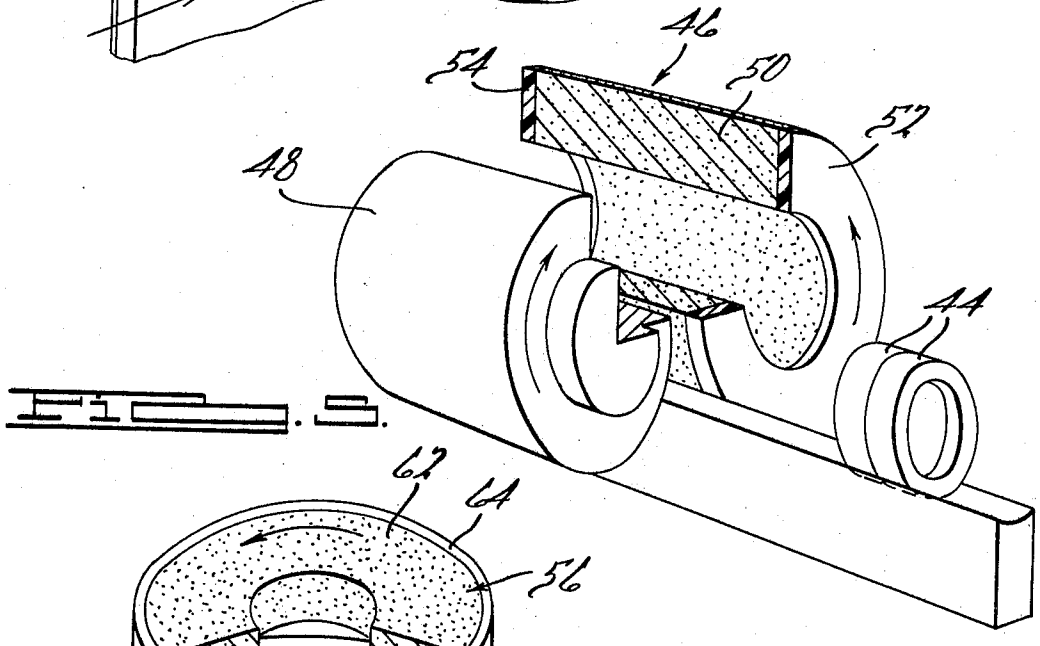

FIG. 5.

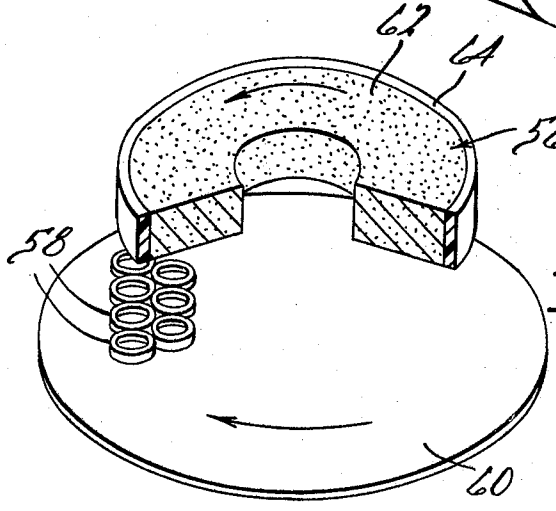

FIG. 6.

INVENTOR.
Harold R. Dilks
BY
Harness, Dickey & Pierce
ATTORNEYS

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GRINDING WHEEL CONSTRUCTION

Harold R. Dilks, Grosse Pointe, Mich., assignor to Federal-Mogul Corporation, Southfield, Mich., a corporation of Michigan

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U.S. Cl. 51—74 14 Claims

ABSTRACT OF THE DISCLOSURE

A grinding wheel having a laminated structure with the outer laminations located at the entrance and exit for workpieces to be ground and being of a nonabrasive material to guide the workpieces as they are moved into and out of engagement with the abrasive work surface of the wheel.

The present invention relates to grinding wheel structures and more particularly to a laminated grinding wheel structure utilizing nonabrasive guides at the entrance and exit of the work surface of the grinding wheel.

In grinding the spherical head on rollers for bearings, the work surface of the grinding wheel is contoured to have an arc generally equal to the radius of the portion of the sphere to be ground on the head of the rollers. It is conventional practice to provide entrance and exit guides which are made of metal. While the grinding wheel rotates, the metallic entrance and exit guides are fixed. During the grinding process, as the work surface of the grinding wheel wears away, the transition from the entrance and exit guides to the work surface becomes a step eventually resulting in poor grinding on the head of the roller. To avoid this, frequent adjustment of the entrance and exit guides is required. In the present invention the grinding wheel is formed of a laminated structure having nonabrasive entrance and exit guides which rotate with the wheel and which are made of material to have a wear rate which is approximately the same as the wear rate of the grinding wheel itself. With this construction the necessity for constant adjustment is obviated since the entrance and exit guides will generally continuously be provided with a contour blending smoothly with the contour of the grinding surface of the grinding wheel itself. In addition the present construction can provide better results even than the conventional grinding wheel with properly adjusted guides.

It is therefore a general object of the present invention to provide a novel grinding wheel construction.

It is another object of the present invention to provide a novel grinding wheel construction for grinding the spherical contour on the heads of rollers for bearings.

It is another object of the present invention to provide a novel grinding wheel structure having a laminated construction in which all segments of the lamination have approximately the same wear rate.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a generally pictorial view with some parts shown broken away of a grinding wheel embodying the features of the present invention for use in the formation of the spherical head on rollers for bearings;

FIGURE 2 is a radial sectional view of the grinding wheel of FIGURE 1 generally taken along the line 2—2;

FIGURE 3 is a generally pictorial view with some parts broken away of a different form of the grinding wheel for forming a spherical contour on the head of a roller for a bearing;

FIGURE 4 is a generally pictorial view with some parts broken away of another form of the invention depicting a double disc surface grinder;

FIGURE 5 is a generally pictorial view with some parts broken away of a centerless grinder; and

FIGURE 6 is a generally pictorial view with some parts broken away of a single disc surface grinder embodying features of the present invention.

Looking now to FIGURE 1, a grinding wheel assembly **10** is shown of a laminated construction having a center grinding wheel section **12** and entrance and exit sections **14** and **16**, respectively. The grinding wheel section **12** can be of a conventional grinding wheel construction and can be made of materials well known in the art. The entrance and exit sections **14** and **16** are formed of a nonabrasive material such as nylon, hard rubber or Teflon. The wear rate of the nonabrasive sections **14** and **16** is selected to be similar to the wear rate of the grinding wheel section **12**. The grinding wheel assembly **10** is utilized to grind a spherical contour on the head of rollers **18** for bearings. The rollers **18** are moved along an arcuate path, indicated by the arrow X, having a radius R at the head of the rollers **18** equal to the desired spherical radius to be formed (see FIGURE 2). At the same time the work engaging surface of the grinding wheel assembly **10** is dressed to the same radius R. The surfaces of the guide sections **14** and **16** are of a contour to blend smoothly with the grinding wheel section **12** and as shown in the drawing (FIGURES 1 and 2) have the same arcuate contour with the radius R; for smooth blending it is desired that the arcuate contour be substantially of radius R at least at the area adjacent the grinding wheel section **12**. The grinding wheel assembly **10** is rotated in the direction of the arrow Y. Thus, as the rollers **18** are moved along the arcuate path X, their end surfaces are moved into contact with the grinding wheel assembly **10**. Initially, the ends of the rollers **18** engage the entrance guide section **14**; the guide section **14**, which is rotating as a part of assembly **10**, properly aligns the rollers **18** prior to engagement of the rollers **18** with the grinding surface of the grinding wheel section **12**. The rollers **18** are moved across the grinding surface of the grinding wheel section **12** and as they are exited from the grinding wheel section **12** they engage the exit guide section **16**; the guide section **16**, which is rotating as a part of assembly **10**, maintains the rollers **18** in proper alignment until they have completely left the grinding surface of the grinding wheel section **12**.

It is important that the thickness of the entrance and exit sections **14** and **16** be sufficient relative to the size of the ends of the rollers **18** to be ground whereby the guiding functions can properly be effectuated. It can be appreciated that if the guide sections **14** and **16** were very thin relative to the size of the end surfaces of the rollers **18**, that the rollers **18** would not be properly guided on and off of the grinding surface of the grinding wheel section **10**.

The proper thickness of the guides **14** and **16** will vary with the size of the part being ground. A thickness equal to the diameter of the ends of the rollers to be ground would be adequate; the minimum thickness, however, can be readily determined by those skilled in the art. While the guide section **14** at the entrance performs a significant function, in practice most damage is done to roller members **18** at the exit and hence the exit guide section **16** performs the most critical function. Both guides **14** and **16**, however, cooperate together to form a total effect which is an improvement over conventional grinding apparatus.

It is preferred that the guide sections **14** and **16** be bonded or otherwise secured to the grinding wheel sec-

tion 12 to form a laminated structure with the grinding wheel section 12. However, it is possible that the sections 14 and 16 be clamped or in some other way secured thereto.

A different form of grinding wheel structure is shown in FIGURE 3 for grinding the spherical contour on the head of rollers 18; there the laminated wheel assembly 20 has a grinding wheel section 22 and a guide section 24. Rather than performing grinding on the circumferential surface, as with the wheel assembly 10 of FIGURES 1 and 2, grinding is performed on one of the end surfaces and hence the guide section 24 is located circumferentially about the grinding wheel section 22. Again, the guide section 24 is provided to be of a nonabrasive material having generally the same characteristics as the guide sections 14 and 16 in FIGURE 1. Note that the grinding surface of the wheel assembly 20 is contoured to provide for the formation of the spherical surface at the head of the rollers 18 as they are moved in the direction of the arc 26 having a radius R across the grinding surface of the grinding wheel assembly 20. The guide section 24 is contoured similarly to the grinding surface of wheel section 22 and provides a guiding function at the entrance as the rollers 18 are first brought into engagement with the grinding wheel section 22 and also at at the exit as they are moved out of engagement with the grinding wheel section 22.

FIGURE 4 shows a slightly different application of the present invention for use with a double disc surface grinder. A pair of grinding wheel assemblies 30 and 32 both are of a similar construction and have confronting surfaces which are spaced a selected distance to grind on workpieces 34 as they are moved therebetween. The grinding wheel 30 has a grinding wheel section 36 and a nonabrasive guide section 38 while the grinding wheel 32 has a grinding wheel section 40 and a nonabrasive guide section 42. The workpieces 34 have generally flat end surfaces which are connected by a tapered radially outer surface. In passing between the grinding wheels 30 and 32, the larger surface of the workpiece 34 will first engage the grinding wheel 32 before the smaller end surface will engage the grinding wheel 30. The thickness of the guide sections 38 and 42 are provided such that both surfaces of the workpieces 34 have been gripped and are between the grinding wheels 30 and 32 before the large end surface of a workpiece 34 engages the grinding section 40 of the grinding wheel 32. This assures that the workpieces 34 will be in proper alignment before any abrasive action takes place and prevents chattering of the workpieces 34 both as they enter and leave the grinding surface of the grand sections 36 and 40.

FIGURE 5 depicts a centerless grinder construction which includes a grinding wheel assembly 46 and a regulating wheel 48. The grinding wheel 46 and regulating wheel 48 are rotated about generally parallely extending axes. The grinding wheel 46 is formed of laminated construction having a center grinding wheel section 50 and guide sections 52 and 54. Again, the nonabrasive guide section 52 performs a guiding function for the workpieces 44 prior to their engagement of the grinding wheel section 50. The exit guide section 54 performs a more significant guide function for the workpieces 44 as they exit from the centerless grinder construction of FIGURE 5; thus guide section 54 is selected to be of proper thickness relative to the size of the workpieces 44 to provide proper guiding such that pieces 44 are guided and generally gripped by the exit guide section 54 as they leave the grinding wheel section 50.

FIGURE 6 shows a single disc surface grinder assembly in which a surface grinding wheel 56 is utilized to grind the end surfaces of a plurality of annular workpieces 58, which are located upon a support table 60. The support table 60 and the grinding wheel 56 are rotated generally about parallel eccentric axes. The grinding wheel 56 has a laminated structure having an inner grinding wheel section 62 and an outer guide section 64. The nonabrasive guide section 64 provides an important guide function as the workpieces 58 exit from underneath the grinding wheel 56 by minimizing the variations as the workpieces 58 are moved from a loaded to a no-load condition relative to the workpieces 58. Again, the thickness of the guide section 64 is selected relative to the size of the workpieces 58 such as to be able to properly provide the guiding function in the exiting of the workpieces 58.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. An apparatus for grinding workpieces including a grinding wheel construction having a grinding surface, means for rotating the grinding wheel, and means for moving the workpieces against and relative to the grinding surface along a path generally transverse to the direction of rotation, said grinding wheel construction comprising: a grinding wheel section formed of an abrasive material and having a grinding surface for grinding the workpieces, guide means formed of a generally nonabrasive material, means for securing said guide section means to said grinding wheel section for rotation therewith at the location of one of the entrance and exit for the workpieces along said path to said grinding surface, said guide section means having a workpiece engaging surface of a contour smoothly blending with the contour of said grinding surface and being of a pre-selected thickness to perform a guiding function for the workpieces in the transition between said guide section and said grinding section, said nonabrasive material of said guide section means having a wear rate generally similar to the wear rate of said abrasive material of said grinding wheel section whereby the smoothly blending contour between said grinding wheel and said guide section will be maintained as the material of both said grinding wheel section and said guide section are worn by use.

2. The grinding wheel construction of claim 1 on which said guide section means is located at the exit of said grinding surface.

3. The grinding wheel construction of claim 1 in which said guide section means is located at the entrance of said grinding surface.

4. The grinding wheel construction of claim 1 on which said guide section means is located at both the exit and entrance of said grinding surface.

5. The grinding wheel construction of claim 4 for grinding a spherical contour at one end of a part such as a roller for a bearing, said grinding surface and at least the portion of said workpiece engaging surface adjacent said grinding surface having a contour defined by an arc of a preselected radius.

6. The grinding wheel construction of claim 5 with said grinding surface and said workpiece engaging surface extending about the circumferential periphery of said wheel construction and about the axis of rotation of said wheel construction, said guide section means comprising a pair of guide sections located at axially opposite sides of said grinding wheel section and with said workpiece engaging surface being defined by workpiece engaging surface portions on each of said guide sections.

7. The grinding wheel construction of claim 5 with said grinding surface extending generally radially at one end of said grinding wheel construction and with said guide section means comprising a guide section located circumferentially about said grinding wheel section and having its workpiece engaging surface extending radially from said grinding surface.

8. The grinding wheel construction of claim 1 for grinding a spherical contour at one end of a part such as a roller for a bearing, said guide section means comprising

a guide section located at the axial side of said grinding wheel section at said exit, said grinding surface and said workpiece engaging surface extending about the circumferential periphery of said wheel construction and about the axis of rotation of said wheel construction.

9. The grinding wheel construction of claim **8** with said grinding surface and at least the portion of said guide section adjacent said exit of said grinding surface having a contour defined by an arc of a preselected radius.

10. The apparatus of claim **1** for grinding two end surfaces of a workpiece and comprising a second grinding wheel construction similar to the first said grinding wheel construction with both of said grinding surfaces extending radially and located in confrontation with each other for grinding the workpieces as they are passed in between, said guide section means including a guide section for each said grinding wheel construction extending about the radially outer periphery of said grinding wheel section.

11. The apparatus of claim **10** for use with workpieces having end surfaces axially offset and with said guide section having a pre-selected radial thickness for gripping the workpieces at both end surfaces prior to engagement with said grinding surfaces.

12. The apparatus of claim **1** with said grinding wheel construction being a part of a centerless grinder for grinding circular workpieces, said centerless grinder including a regulating wheel, said grinding surface and said workpiece engaging surface extending about the circumferential periphery of said wheel construction and about the axis of rotation of said wheel construction, said guide section means comprising a guide section located at the exit of said grinding wheel section.

13. The apparatus of claim **12** with said guide section means comprising a second guide section located at the entrance of said grinding wheel section.

14. The apparatus of claim **1** with said grinding wheel construction being a part of a surface grinder for grinding a flat surface on workpieces, said surface grinder including a support table for supporting the workpieces, said grinding surface extending radially from the axis of rotation of said wheel construction and said guide section means comprising a guide section extending circumferentially about the radially outer periphery of said grinding wheel section, said guide section having a radial thickness selected relative to the size of the workpieces to minimize variation in load to no-load conditions on the workpieces as they move out from between said wheel construction and said table.

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ROBERT C. RIORDON, Primary Examiner

D. G. KELLY, Assistant Examiner

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51—102, 116, 128, 208, 210