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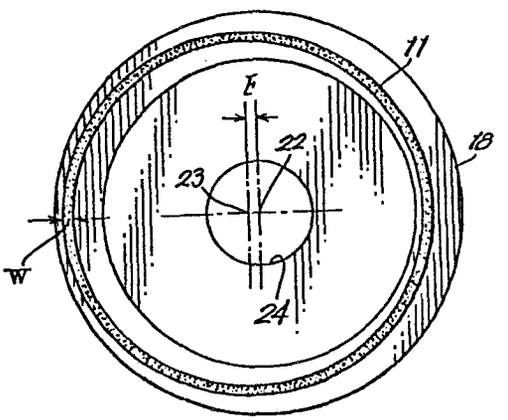
(54) Cup-type grinding wheel.

(57) A cup-type grinding wheel comprising an annular-shaped grinding body (11) eccentrically mounted on a wheel spindle stock (18) having a coaxis (23) with a non-eccentric rotary axis (22). In this way, only the grinding body (11) is eccentrically rotated to flatly grind the whole grinding surface without producing a projection (hitherto 20) at the central portion of a workpiece (12) to be ground.

FIG.2.



CUP-TYPE GRINDING WHEEL

The present invention relates to a cup-type grinding wheel which is used for surface grinding.

A surface grinding operation is known which is performed by passing workpieces 2, 2' to be ground under a rotating cup wheel 1 along an arcuate path as illustrated in Fig. 4. It is also known to effect another surface grinding operation as illustrated in Fig. 5, wherein the workpiece 2 to be ground is kept in one position and rotated about its own axis - as indicated by arrow 3. Although the first mentioned grinding operation is more frequently utilised, the latter operation is sometimes advantageous - depending upon the purpose of the working operation. In the operation as illustrated in Fig. 5 it is necessary to locate the axis of rotation 4 of the rotating of the workpiece 2 to be ground in the width W of an annular-shaped acting surface 5 of the wheel 1 as shown in Fig. 6. If the axis of rotation 4 is positioned out of the operating region of the annular wheel portion 5, as shown in Fig. 7, a central portion of the workpiece surface 2 to be ground is left unground corresponding to the inside of a circle 6 with a radius corresponding to a spacing R.

Even if the operational conditions illustrated in Fig. 6 are satisfied, there still remains a minute projection at the central portion of the workpiece surface 2. The height of the projection ranges from several microns to several tens of microns (μ) which is very disadvantageous when the grinding operation is required to produce flatness. However, even if the grinding wheel and its related machinery are carefully fixed and adjusted, the projection cannot be prevented from arising.

Generally, a grinding wheel tends to wear due to effect of the grinding operation and the whole acting surface of the wheel is not worn equally and it is the outer peripheral portion thereof which is worn to a greater extent. Because of the foregoing effect of wear, the acting surface assumes a conical shape (each wall portion slanting in section) as indicated by reference numeral 17 of Fig. 8.

Fig. 8 illustrates the relationship between a wheel and a workpiece to be ground, wherein a workpiece 12 to be ground, is placed on a rotary table 19 and an annular grinding body 11 is fixed to a wheel stock 18 (or wheel mounting plate or body) thus forming a cup-type wheel. Whilst being shown in a somewhat exaggerated manner, the lower, acting surface of the grinding body is worn so as to have a conical shape as denoted by reference numeral 17. Although the rotary axis 21 of the workpiece 12 to be ground passes through the central portion of an annular width W of the wheel, because of the effects of wear it assumes a relative positional relationship somewhat similar to that of Fig. 7 and as a result, a projection 20 is produced.

As will be described, it is possible to eliminate the aforementioned disadvantage of resultant projection by arranging the wheel so that it executes eccentric rotation. Whilst this arrangement is also proposed wherein a conventional grinding wheel is modified so that the mounting flange has an eccentric rotary axis and is connected to the grindstone or wheel. Accordingly, since both the flange and wheel are eccentrically displaced, an undesirable degree of unbalancing is produced - especially if such wheel should be rotated at a high speed which would subject both the wheel

and the machine to serious risk of damage. Thus, it is undesirable for this method of operation to be put into practice.

It is an object of the present invention to provide a cup-type grinding wheel, wherein the above-mentioned disadvantage inherent in the prior art operations is eliminated and wherein no such undesirable central projection is formed on the workpiece.

According to the present invention there is provided a cup-type grinding wheel comprising an annular grinding body (11) mounted to the peripheral portion of a wheel stock (18) in such a manner as to be eccentric with respect to the rotary axis (22) of the wheel.

Also according to the present invention there is provided a grinding machine including a cup-type grinding wheel as defined above, wherein said wheel is mounted to rotate about the axis of said wheel stock (18) and wherein mounting or support means for workpieces is located or locatable to rotate the workpieces about an axis which is cleared on opposite sides during the eccentric rotary action of the grinding body (11).

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a vertical sectional front view of a cup-type grinding wheel according to one embodiment of the present invention;

Fig. 2 is a plan view of the grinding wheel of Fig. 1;

Fig. 3 is a fragmentary elevational view of a part of the grinding wheel of Figs. 1 and 2 shown in an operational arrangement thereof;

Figs. 4 and 5 are schematic plan views illustrating two operating modes with different arrangements of the mounting relationship of a cup-type grinding wheel and a workpiece to be ground;

Figs. 6 and 7 are fragmentary schematic plan views illustrating the relationship between the wheel and workpiece in the operating mode illustrated in Fig. 5;

Fig. 8 is an elevational view showing the relationship between a wheel and a workpiece to be ground with the hitherto, undesired central projection on the workpiece being shown;

Fig. 9 is a surface roughness trace of the central portion of a workpiece ground by a conventional wheel; and

Fig. 10 is a surface roughness trace of a workpiece ground with a grinding wheel according to the present invention and in the requisite operational mode.

Referring to Figs. 1 and 2. A cup-type grinding wheel according to the present invention is illustrated in Figs. 1 and 2 and as will now be described.

In the drawings there is illustrated an abrasive annular-shaped grinding body 11 (220 mm outer diameter and 2 mm width including a 230 mesh diamond powder in its resin bond) having a centre 23 and which is eccentrically mounted on a wheel mounting plate, flange or stock 18.

The abrasive grinding body 11 contains abrasives such as diamond, CBN or the like abrasive material. The eccentricity E, i.e. the distance between centre 23 of annular body 11 and the centre and axis of rotation 22 of stock 18, is set to be larger than the width W of the annular portion of the grinding wheel measured in a radial direction. A centre hole 24 is provided in the stock 18 for mounting the wheel on a machine spindle (not shown).

Because of eccentricity of the grinding body 11, the grinding body 11 is caused to reciprocally grind between the left side 101 and the right side 101' of the rotary centre 21 of a workpiece 12 to be ground while travelling at a high speed in the circumferential direction as shown in Fig. 3. Accordingly, a projection, such as projection 20 shown in Fig. 8, is not produced.

Since the grinding body is displaced relatived to the axis of rotation of the stock 18 and mounting spindle, the rotary balance of the wheel is lost. However, balance of the wheel can be recovered by suitable means such as a balance weight. In the case where the wheel has a relatively small grinding width W with respect to the outer diameter, since the grinding body 11 is relatively light with respect to the weight of the wheel stock 18, no disadvantage should arise in performing a usual balancing operation as it is.

According to the present invention, the annular-shaped grinding body is eccentrically mounted on the wheel stock having a coaxis with the non-eccentric rotary axis. Accordingly, since only the grinding body is eccentrically rotated, unbalancing of rotation is extensively small when compared with the previously mentioned eccentric rotation of the whole wheel. Thus, balancing can be easily recovered by an adequate balancing operation.

When a conventional grinding wheel is used, the projection 20 is produced at the central portion of the grinding surface of the workpiece 12 as shown in Fig. 9. However, when the grinding wheel according to the present invention is used with an eccentricity of, for example, E = 2.5 mm, roughness of the surface becomes extremely good around the central area of the work, and no projection is produced at all - as represented in Fig. 10.

CLAIMS

1. A cup-type grinding wheel comprising an annular grinding body (11) mounted to the peripheral portion of a wheel stock (18) in such a manner as to be eccentric with respect to the rotary axis (22) of the wheel.

2. A cup-type grinding wheel as claimed in claim 1, wherein the grinding body (11) contains abrasives such as a diamond, CBN or the like hard abrasive material.

3. A cup-type grinding wheel as claimed in claim 1 or 2, in which the eccentricity (E) of the annular grinding body is larger than the width (W) of the annular portion 11 of the wheel.

4. A cup-type grinding wheel as claimed in any of claims 1 to 3, in which the wheel is counterbalanced to compensate for the unbalance effect of the eccentric disposition of the grinding body (11).

5. A grinding machine including a cup-type grinding wheel as claimed in any of claims 1 to 4, wherein said wheel is mounted to rotate about the axis of said wheel stock (18) and wherein mounting or support means for workpieces is located or locatable to rotate the workpieces about an axis which is cleared on opposite sides during the eccentric rotary action of the grinding body (11).

6. A cup grinding wheel comprising a cylindrical wheel stock (18) having mounting means for enabling the wheel stock (18) to be rotated about its central axis (22), and an annular grinding body (11) having an axis parallel to the central axis (22) of the wheel stock (18) and spaced therefrom to achieve eccentric mounting sufficient for the workpieces which are to be ground thereby.

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FIG. 1.

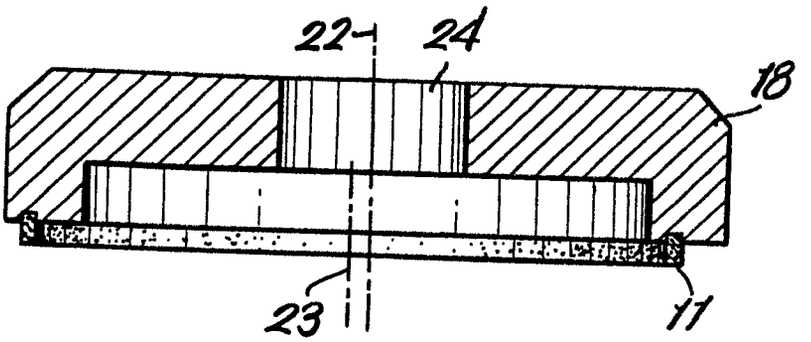


FIG. 2.

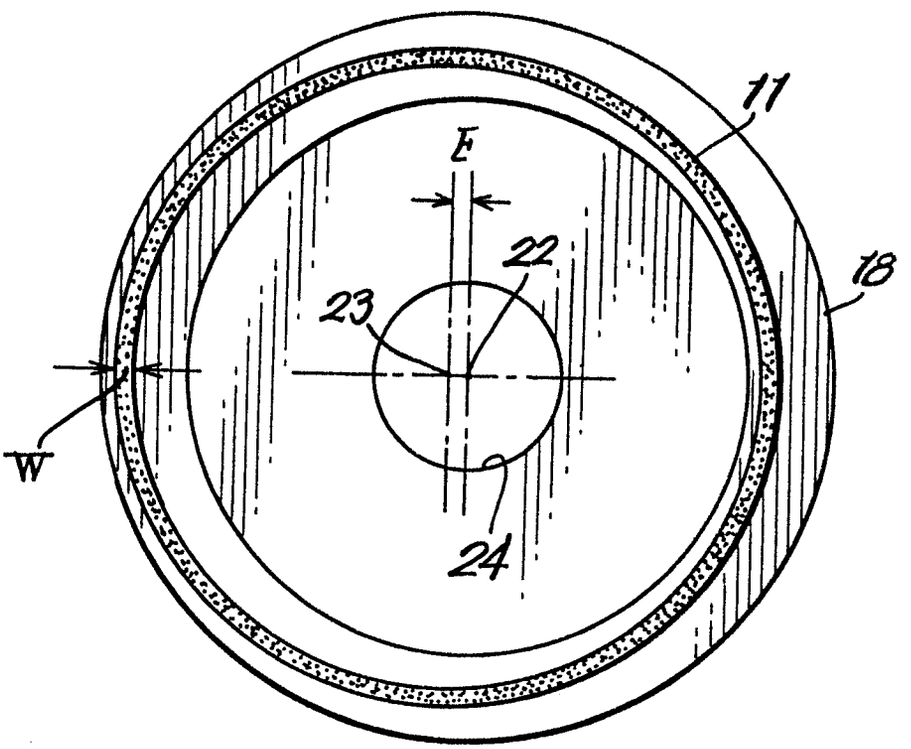


FIG. 3.

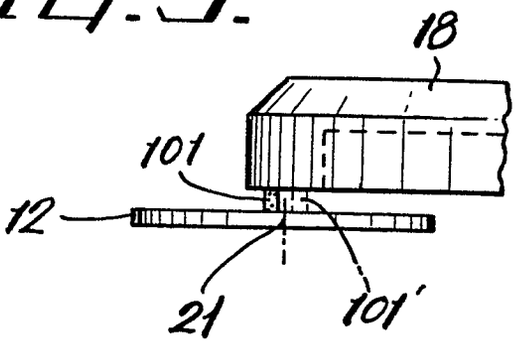


FIG. 4.

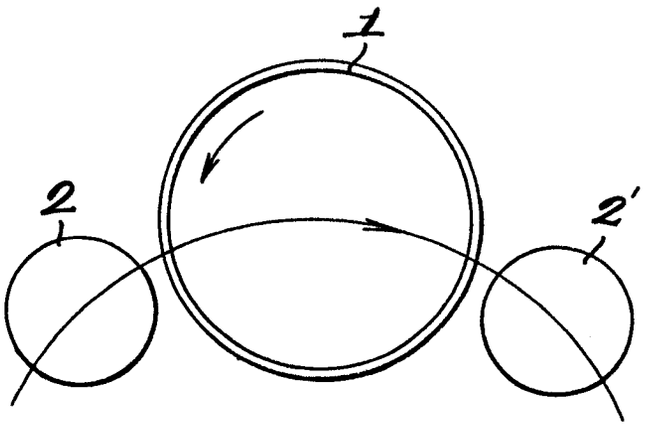


FIG. 5.

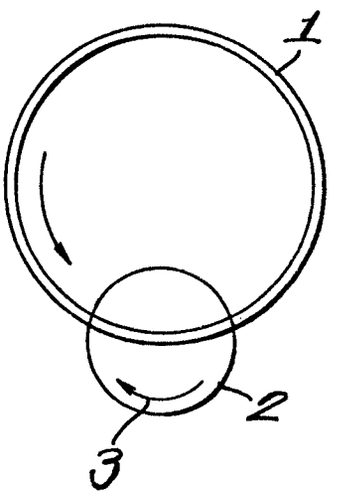


FIG. 6.

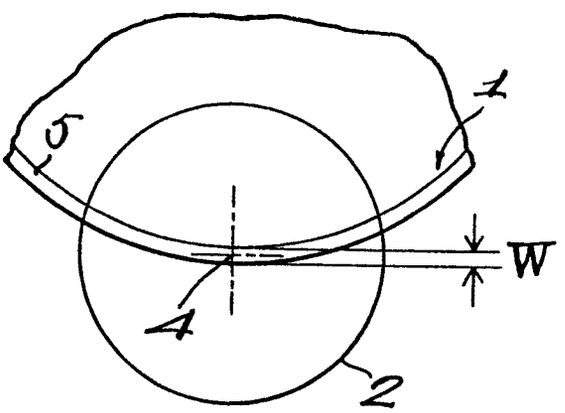


FIG. 7.

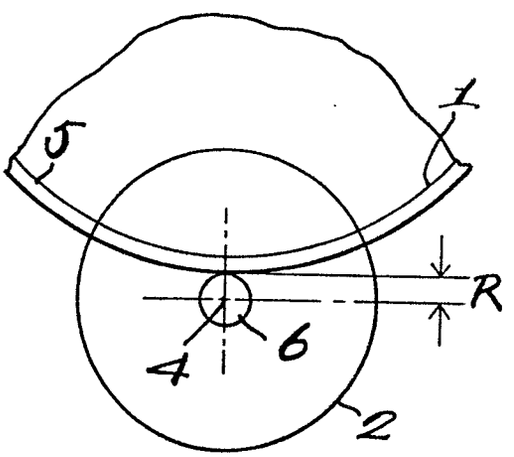


FIG. 8.

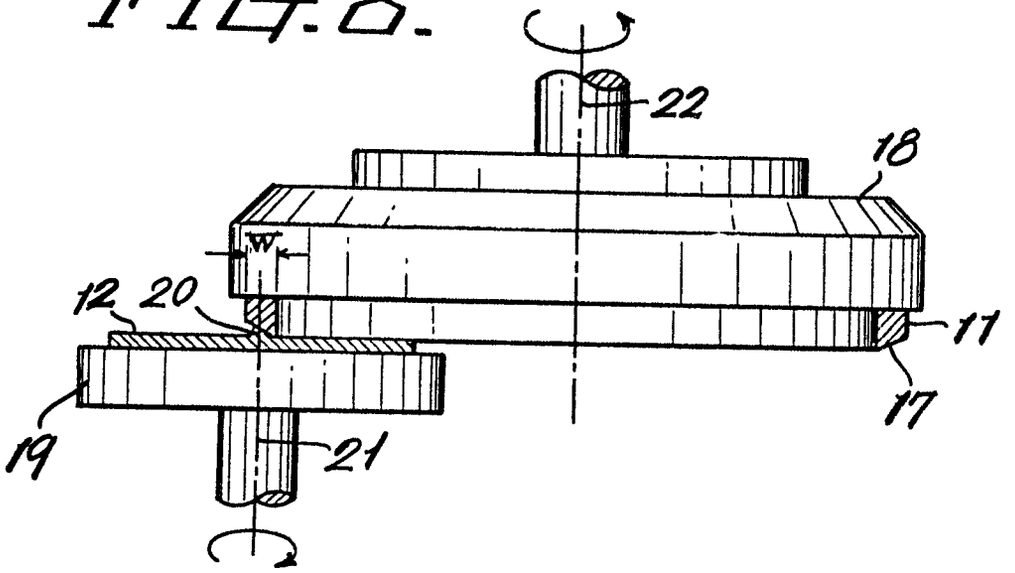
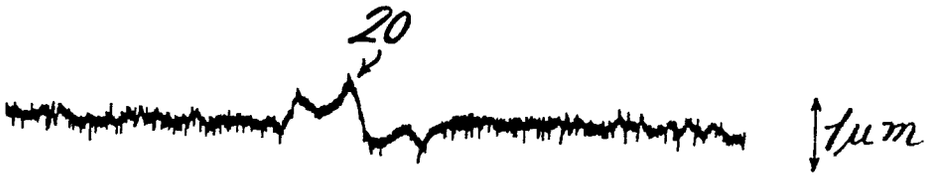


FIG. 9.



2.5mm

FIG. 10.

25mm