

[54] **FREE ABRASIVE MACHINE**
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 [22] Filed: **Mar. 5, 1971**
 [21] Appl. No.: **121,264**

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[52] U.S. Cl.51/209 DL, 51/131
 [51] Int. Cl.B24b 7/04
 [58] Field of Search.....51/129, 131, 109, 51/206.5, 209

[57] **ABSTRACT**

A free abrasive machine in which the rotary back up wheel has the gaps between adjacent sectors thereof which are nonlinear. The rings resting on the wheel have external teeth and a pinion gear on the axis of the wheel meshes with the teeth. A tooth type coupling between the back up wheel and the pinion gear selectively couples the pinion gear selectively couples the pinion gear to the wheel or releases it therefrom.

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5 Claims, 8 Drawing Figures

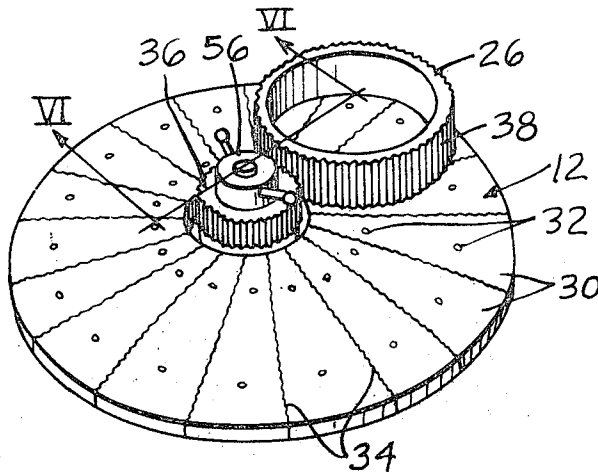


FIG-1

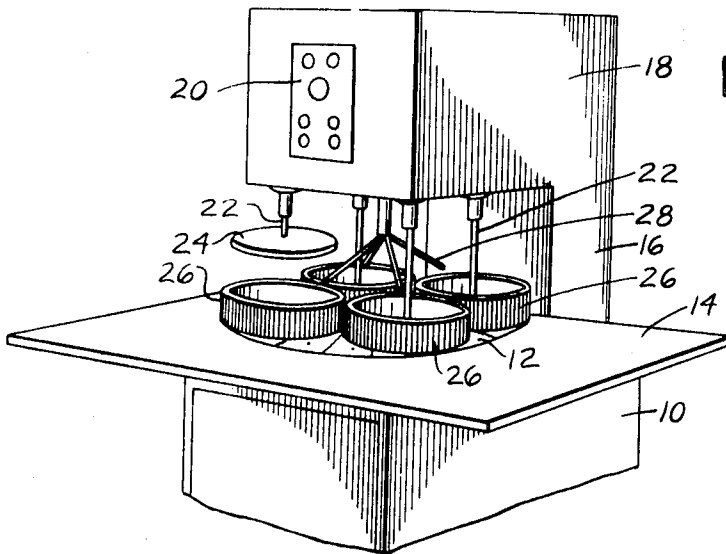


FIG-8

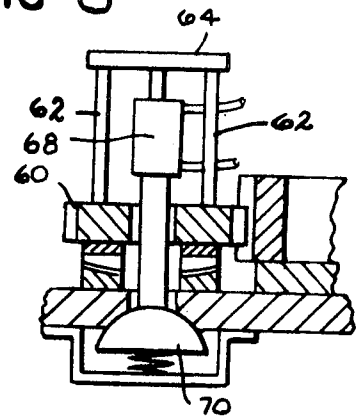


FIG-2

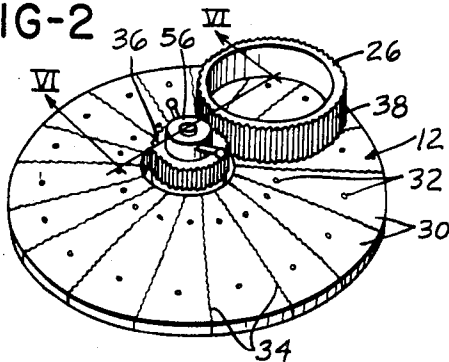


FIG-3

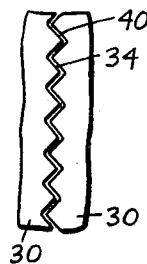


FIG-4

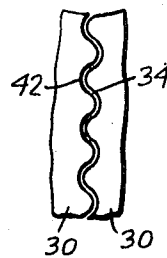


FIG-5

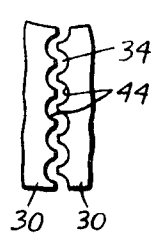


FIG-7

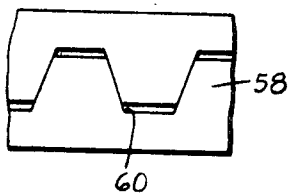
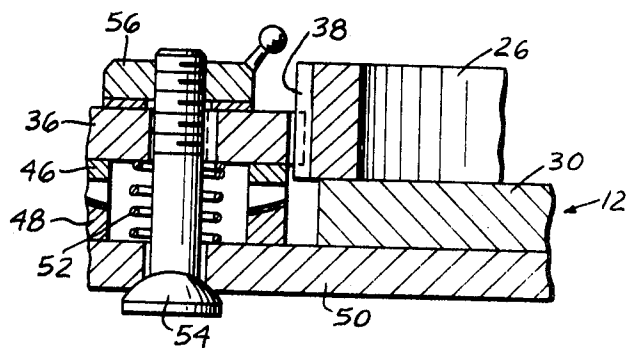


FIG-6



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FREE ABRASIVE MACHINE

The present invention relates to free abrasive machines and is particularly concerned with improvements in the back up wheel of such a machine and in the coupling of the central pinion gear on the wheel thereto.

Free abrasive machines are well known and comprise a hard alloy wheel disposed in a horizontal plane and rotatable on a vertical central axis. The wheel is formed of sectors with gaps between adjacent ones of the sectors and workpieces to be machined are placed on the wheel and may be pressed axially against the wheel and are driven from contact with the wheel while the wheel is driven in rotation and a slurry of abrasive material is flowed on the wheel.

Quite often, the workpieces to be machined in this manner are relatively small and they are held against rotating with the wheel by one or more retaining rings that rest on the wheel. The rings are held against bodily rotation with the wheel by pressure pads that enter the rings from the top and press the workpieces against the rotating back up wheel.

The retaining rings, while not rotating bodily with the wheel, will, nevertheless, rotate in the same direction as the wheel due to the greater frictional drag of the back up wheel on the rings toward the outside of the back up wheel.

The rotation of the rings on the back up wheel tends to wear the back up wheel to a configuration that is concave in the upward direction and, periodically, the direction of rotation of the rings is reversed and the back up wheel will then wear off more rapidly toward the outer periphery than toward the center, then will be restored to a flat condition and even so as to be convex upwardly.

The rotation of the rings in a direction opposite to the direction of rotation of the wheel is accomplished by a pinion gear carried by the wheel in the center thereof and meshing of external teeth on the rings. A coupling arrangement is provided for selectively coupling the pinion gear to the wheel for reverse rotation of the rings on the wheel and for releasing the pinion gear from the wheel for rotation of the rings on the wheel in the same direction as the wheel.

The back up wheel, as mentioned, is formed of a hard alloy material to reduce the wear rate thereof as much as possible and is formed in sectors which are spaced circumferentially to define gaps between the adjacent sectors for the drainage from the wheel of the slurry of abrasive material, and the swarf produced in grinding.

Heretofore, the gaps between adjacent sectors have been linear, extending radially of the wheel, and it has been the case that difficulty has been encountered in machining parts because they sometimes catch on the side edges of the sectors as the gaps pass therebeneath. Because workpieces are usually not flat when starting the free machining operation, considerable difficulty can be encountered because of the linear gaps between adjacent sectors of the wheel.

The present invention is concerned with improvements in the construction of the back up wheel which eliminates the problem referred to of workpieces catching on the edges of the gaps between the sectors of the back up wheel and is, furthermore, concerned

with an improvement in the coupling of the central pinion gear to the wheel so that the central pinion wheel is always exactly centered on the wheel when coupled thereto but is quite free to rotate relative to the wheel when uncoupled therefrom.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, the back up wheel of a free abrasive machine is formed of sectors which are circumferentially spaced so as to leave gaps therebetween while side edges of the sectors which face each other on opposite sides of the gaps are nonlinear, whereby the gaps formed thereby are nonlinear.

Preferably, each edge has some regular nonlinear configuration which can readily be machined thereon and the edge of the next adjacent sector which is opposite thereto is shaped in a substantially complementary manner so that the circumferential width of each gap is substantially the same from end to end thereof in the radial direction of the back up wheel.

The central pinion gear of the back up wheel is arranged to be coupled thereto by a toothed coupling having one element connected to the back up wheel and another element connected to the central pinion gear with the elements being respectively convex and concave toward each other so that when brought together the pinion gear will be accurately located on the wheel while, upon the coupling elements being released from each other, the pinion gear will be free to rotate relative to the gear.

The exact nature of the present invention and objectives and advantages thereof will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view showing a typical free abrasive machine adapted for practicing the present invention;

FIG. 2 is a perspective view showing the back up wheel of the machine and a retaining ring resting thereon;

FIGS. 3, 4 and 5 are fragmentary plan views drawn at enlarged scale and showing different manners in which the gap between adjacent sectors of the back up wheel can be formed;

FIG. 6 is a fragmentary view indicated by line VI—VI on FIG. 2 and showing the manner in which the central pinion gear is coupled to the back up wheel;

FIG. 7 is a fragmentary view showing the manner in which the teeth of the elements of the coupling between the pinion gear and the back up gear are formed.

FIG. 8 shows an arrangement for automatically shifting the central pinion gear between coupled and uncoupled position.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings somewhat more in detail, the free abrasive machine shown in FIG. 1 has a base portion 10 within which is mounted the motor which drives the rotary back up wheel 12 that is disposed in an aperture in a stationary work table 14. A column 16 extending upwardly from base 10 at the back of the machine carries a head 18 on which is mounted a control panel 20 and within which is mounted air pressure

cylinders for actuating rods 22 that carry pressure pads 24 on their lower ends.

Pressure pads 24 are adapted for entering the upper ends of retaining rings 26 resting on wheel 12 and within which rings workpieces to be abrasively machined are placed. Pads 24 prevent the rings from rotating bodily with the wheels but do not prevent the rings from rotating on their own axes.

A slurry of abrasive material is supplied to wheel 12, advantageously to the inside of rings 26 or the outside, depending on whether reversing gear 36 is free turning or engaged to drive, by the supply tubes 28 and runs off the wheel to a sump.

Turning now to FIG. 2, the back up wheel 12 is shown more in detail. The back up wheel consists of a plurality of sectors 30 secured to a suitable support as by screws 32 and circumferentially spaced so as to define gaps 34 therebetween extending substantially radially of the back up wheel. The sectors 30 terminate short of the center of the back up wheel and mounted on the axis of the back up wheel is a central pinion gear 36 meshing with the external teeth 38 formed on the rings 26.

The gaps 34, while extending in the radial direction of back up wheel 12, are, according to the present invention, nonlinear, as opposed to the straight linear gaps of back up wheels according to the prior art. The nonlinear gaps according to the present invention may be defined in a number of manners as shown in FIGS. 3 to 5.

In FIG. 3, the adjacent sectors shown have their facing side edges contoured in a zig zag manner as by a saw tooth configuration or in a series of Vee shapes 40 which nest with each other so that the resulting gap 34 is substantially the same dimension in the circumferential direction of the wheel from the radially inner end of the gap to the radially outer end thereof.

In FIG. 4, the sides of gap 34 are undulating as indicated at 42 with the undulations on the side of one sector nesting with the undulations of the next adjacent sector so that, as before, the gap 34 is substantially uniform in dimension in the circumferential direction.

In FIG. 5, each side edge of the sectors 30 is provided with substantially semicylindrical axial recesses 44 spaced in the radial direction of the respective sector and with the recesses of one sector being offset radially relative to the recesses of the next adjacent sector so that the circumferential dimension of the resulting gap 34 is substantially uniform from the radially inner end of the gap to the radially outer end of the gap thereof.

Other configurations for the side edges of the sectors will suggest themselves by means of which the gap can be maintained substantially uniform in circumferential dimension from end to end while preventing the presentation of long straight edges which might catch on workpieces and interfere with the machining operation.

In FIG. 6, the central pinion gear 36 will be seen to have secured to the bottom thereof, or formed integrally therewith, one element 46 of a toothed coupling, the other element 48 of which is secured to a member 50 forming the support for the sectors 30 of back up wheel 12.

A spring 52 acting between member 50 and pinion 36 normally holds the elements of the coupling disen-

gaged from each other while a screw 54 extending from member 50 through gear 36 carries a nut 56 that can be run down on the screw to move pinion gear 36 downwardly and bring the elements 46 and 48 into engagement.

FIG. 7 shows that the teeth 58 of each element taper inwardly in a direction away from the respective element and that the gaps 60 between the teeth are of such a size that the teeth of the other element will nest therein.

FIG. 6 will show that the teeth of the coupling elements are inclined in the radial direction so that the elements are respectively convex and concave toward the other thereof whereby when the coupling elements are coupled tightly together by running nut 56 down on screw 54, central pinion gear 36 will be accurately located on the back up wheel 12 and will rotate therewith.

The screw 54 preferably is somewhat free in member 50 and may extend through central pinion gear 36 with radial clearance so as not to interfere with the centering of the gear when the coupling elements are engaged or with the free rotation of the pinion gear when the coupling elements are disengaged.

The spring between the wheel and pinion gear can be eliminated by connecting the nut to the pinion gear in such a manner that the gear moves axially with the nut but is freely rotatable relative thereto. Further, power operating actuating means other than a screw and nut, such as elect, hydraulic or pneumatic motor, could be provided for moving the pinion gear axially on the back up wheel between coupling engaged and coupling disengaged positions.

It is also possible to drivingly uncouple the center pinion gear automatically as in response to a detection of change in level of the rotary table or from some other detected stimulus. This could be done, for example, by an arrangement such as that which is schematically illustrated in FIG. 8. In FIG. 8, the central gear 60 is connected by rods 62, with a cross head 64 to which is connected plunger 66 extending into fluid motor 68 mounted on the upper end of center post 70.

In this arrangement, when the fluid motor is energized in one direction the center pinion gear engages with the stationary element on the table and is, thus, held against rotation; whereas, when the fluid motor is energized in the other direction, the center gear can retract upwardly and disengage from the stationary coupling member and be free to rotate. As mentioned, this can be accomplished automatically, whereby the rotary table can be maintained within relatively close limits of flatness without attention on the part of the machine operator.

Modifications may be made within the purview of the appended claims.

What is claimed is:

1. In a free abrasive machine; a horizontal substantially planar back up wheel rotatable on a vertical axis and on which parts rest while being abraded, said wheel being formed of sectors arranged in closely spaced adjacent relation so as to have gaps therebetween and each extending substantially along a respective radius of the wheel, the edges of adjacent ones of said sectors which face each other comprising a plurality of nonlinear sections in end to end relation disposed partly on

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one side and partly on the other side of the respective radius of the wheel, said edges being spaced circumferentially from each other substantially a fixed distance throughout the radial extent of said sectors whereby the gap defined by each pair of said facing edges is nonlinear while being substantially uniform in circumferential dimension from end to end, each said gap being unobstructed to permit the drainage of abrasive slurry therealong.

2. A free abrasive machine according to claim 1 in which said edges are of zig zag form.

3. A free abrasive machine according to claim 1 in which said edges are in the form of a series of Vee

shapes with the Vees of one edge of each said pair of edges nesting with those of the other edge of the said pair.

4. A free abrasive machine according to claim 1 in which said edges are undulating.

5. A free abrasive machine according to claim 1 in which each said edge comprises a series of radially spaced substantially semicylindrical axial recesses with the recesses of each edge of said pair of edges offset radially of the sectors from the said recesses of the other edge of the said pair of edges.

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