Feb. 6, 1945. W. L. KEEFER 2,368,664

ABRADING APPARATUS

Original Filed June 21, 1941 3 Sheets-Sheet 1

Fig. 1.

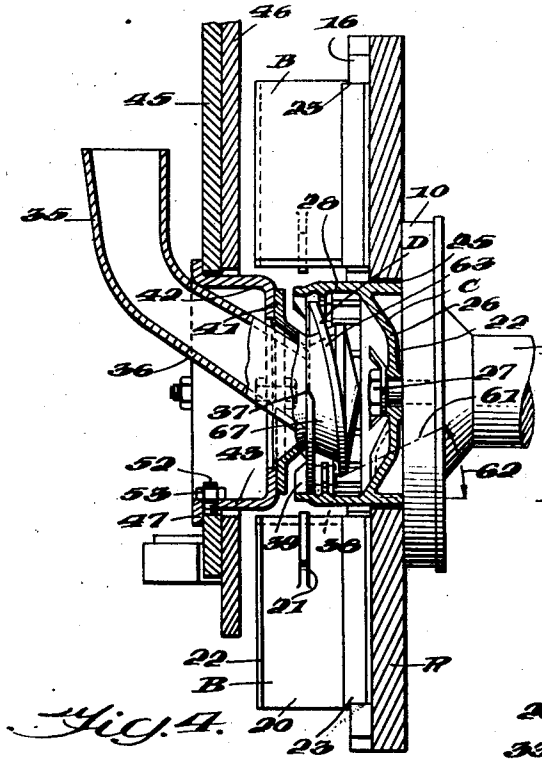


Fig. 4.

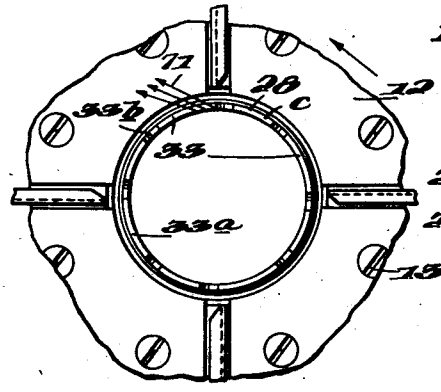


Fig. 3.

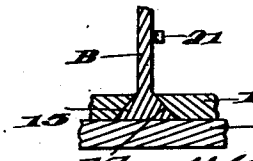
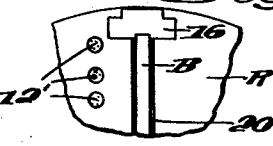


Fig. 15.



Fig. 16.



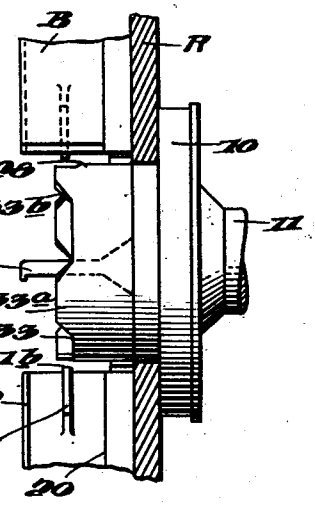


Fig. 5.

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Fig. 2.

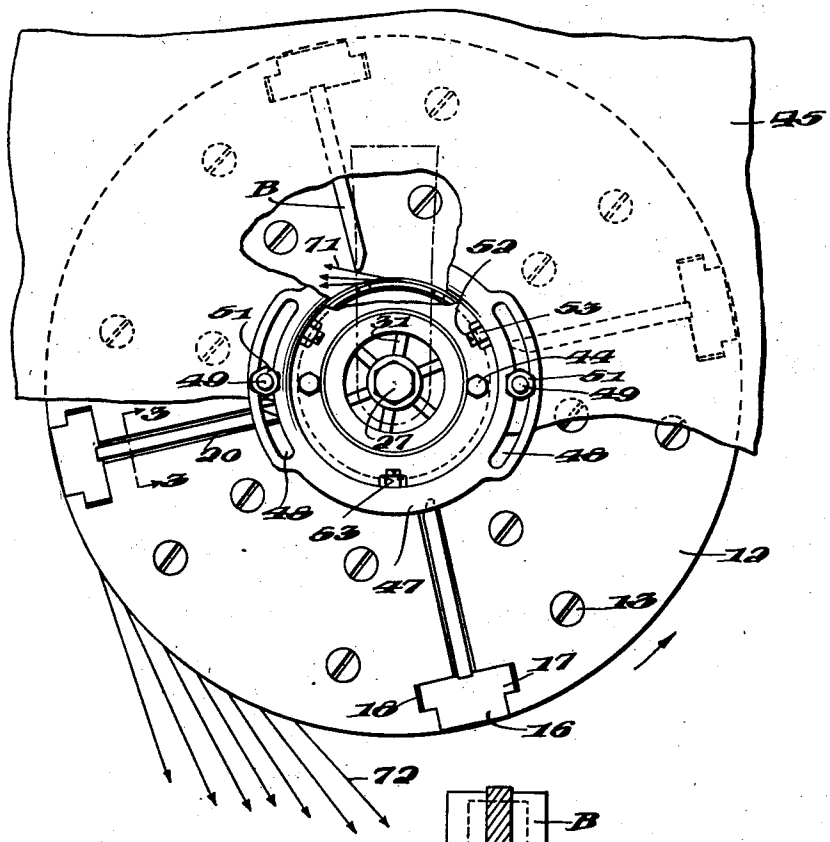


Fig. 7.

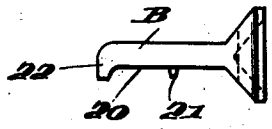
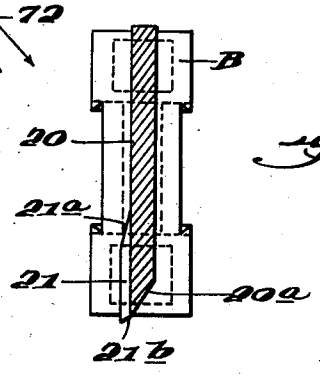


Fig. 6.



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Fig. 8.

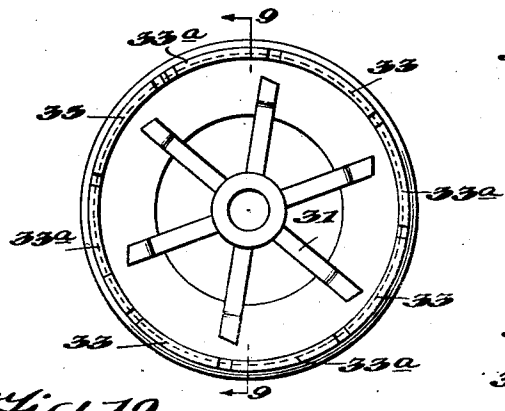


Fig. 9.

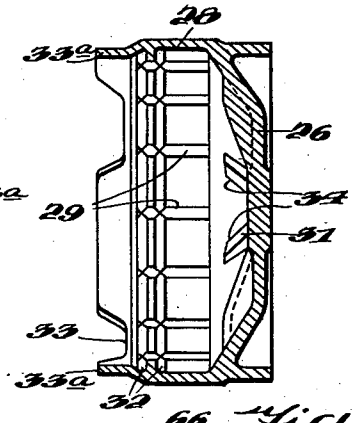


Fig. 10.

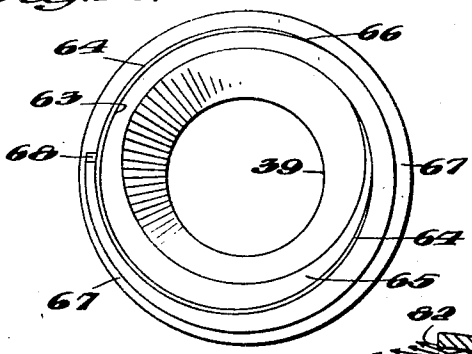


Fig. 11.

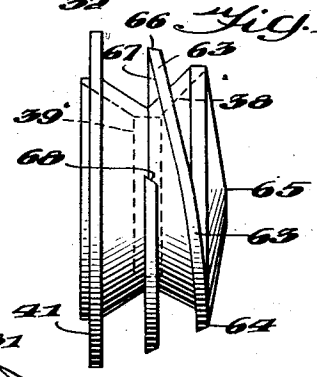
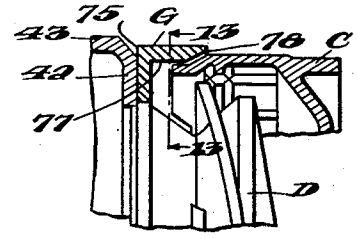


Fig. 12.



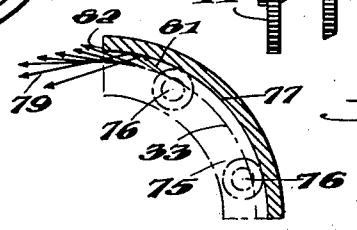
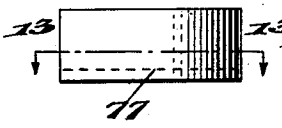


Fig. 13.

Fig. 14.



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UNITED STATES PATENT OFFICE

2,368,664

ABRADING APPARATUS

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Original applications March 10, 1938, Serial No. 195,138, now Patent No. 2,246,522, dated June 24, 1941, and June 21, 1941, Serial No. 399,184, now Patent No. 2,329,203, dated September 14, 1943. Divided and this application April 30, 1943, Serial No. 485,197

3 Claims. (Cl. 51—9)

The present invention relates to abrading apparatus and more particularly to machines embodying a bladed rotor for propelling abrasive particles at high velocities against articles to be blasted. This application relates specifically to the balancing of the rotors of such abrading apparatus, and is a division of my copending application Serial No. 399,184, filed June 21, 1941, now Patent No. 2,329,203.

An object of the present invention is to provide a bladed centrifugal abrading machine including a transfer mechanism for supplying abrasive particles to the blades of the rotor, and a more specific object of the invention is to provide novel balancing means for the rotor employed in centrifugal abrading machines.

Further objects will become apparent as the specification proceeds in connection with the annexed drawings, and from the appended claims.

In the drawings

Figure 1 is a longitudinal section of abrading apparatus embodying the invention;

Fig. 2 is a front elevation of the apparatus shown in Fig. 1 as it appears when viewed from the left of that figure, with the housing partially broken away and the feed spout shown in phantom lines to more clearly illustrate the structure involved;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a front elevation of a portion of the rotary cup and the rotor of Figs. 1 and 2;

Fig. 5 is a fragmental side elevation of the cup and rotor of Fig. 4;

Fig. 6 is a longitudinal section of a form of blade for the rotor;

Fig. 7 is an end elevation of the blade shown in Fig. 6;

Fig. 8 is an enlarged front elevation of the cup of the device of Figs. 1 and 2;

Fig. 9 is a section taken on the line 9—9 of Fig. 8, looking in the direction of the arrows;

Fig. 10 is an enlarged front elevation of the deflector assembly employed in the apparatus of Figs. 1 and 2;

Fig. 11 is a side elevation of the structure shown in Fig. 10;

Fig. 12 is an enlarged fragmental view of the structure shown in Fig. 1 taken partly in section, and illustrating an abrasive guard element cooperating therewith;

Fig. 13 is a section taken along the line 13—13 of Figs. 12 and 14 looking in the direction of the arrows;

Fig. 14 is a top plan of the abrasive guard element shown in Fig. 13;

Fig. 15 is a view similar to Fig. 3 but of a cast or one-piece rotor having means for balancing the rotor;

Fig. 16 is an elevation of the structure of Fig. 15 showing the manner of positioning the balancing holes with reference to the rear face of the blade.

With continued reference to the drawings, wherein like reference characters have been employed to designate like parts throughout the several views thereof, the rotor which includes the blade assembly may assume any desired form, but I have shown a rotor R secured to the hub portion 10 of a shaft 11 by means of a plurality of screws (not shown). A plurality of sector-shaped plates 12 are detachably secured to the face of the rotor R by a plurality of screws 13.

As seen more in detail in Fig. 3, plates 12 are spaced apart on the rotor and their neighboring edges are beveled as at 14 so that they cooperate with the face of the rotor to define outwardly extending dovetail-shaped guideways. Blades B are provided with dovetailed shaped bases 15 which slidably cooperate with the guideways, and they are locked against outward movement by a plurality of detachable keys 16 (Figs. 1 and 2) which are provided with lug portions 17. As seen in Fig. 2, keys 16 slidably fit into correspondingly shaped openings 18 provided in plates 12.

Each blade B is provided with an abrasive propelling face 20 having a raised portion or ridge 21 (for a purpose to be later described) and an abrasive guiding flange 22 for preventing the abrasive from escaping over the free edge of the blade during operation. As seen in Fig. 1, each blade is provided with a shoulder 23 so that when a blade is moved inwardly slightly from the position shown, key 16 may be moved to the left and removed from the rotor, and blades B may then be freely slid outwardly and removed from the apparatus for replacement. Therefore, when the blades are in place and are centrifugally urged outward during operation, shoulders 23 positively prevent the keys from being displaced.

The means I have provided for feeding abrasive over the inner ends of the blades will now be described. Rotor R is provided with a central opening 25 to receive the transfer mechanism. Seated in opening 25 is the base of what may be called a rotary cup C. The cup is provided with a closed bottom 26, and it is secured to hub 10 by means of a cap screw 27. As seen in Figs. 1, 4, and 5, cup C is also provided with an

axially extending generally cylindrical flange 28 which terminates closely adjacent a plane passing through the medial portion of the blade, for a purpose that will presently appear. Flange 28 is provided with a plurality of axially extending grooves 29 (Fig. 9) for the purpose of causing a stationary layer of abrasive to remain in engagement with the inner surface of the flange at all times during operation, and the edge of the flange is serrated or notched for effecting a discharge onto the inner ends of the blades in timed relationship thereto. A plurality of webs 31 (Figs. 8 and 9) are provided in the bottom of the cup for the purpose of strengthening it.

Cup C is also provided with a pair of annular grooves 32 which function to assist the abrasive in lying centrifugally on the flange at its angle of repose, and to prevent it, in cooperation with the adjacent portion of flange 28 of slightly reduced diameter, from prematurely discharging from the cup. Abrasive is supplied to the cup by means of a feed spout 35 which is stationarily supported in a permanent position by any suitable means (not shown). Spout 35 is provided with an inclined portion 36 which terminates in a cylindrical portion 37.

Portion 37 of the feed spout, which is the third element of the assembly, projects into a deflector assembly D, which is provided with an inner generally cone-shaped opening 38 and a cylindrical throat 39. Throat 39 is of a diameter slightly greater than terminal portion 37 of the spout, with the result that they fit sufficiently closely to prevent abrasive leakage between the parts, and yet permit the deflector assembly to be adjusted to vary the direction of discharge from the mechanism in a manner to be hereinafter pointed out. The deflector assembly is, accordingly, provided with a flaring mouth through which the abrasive is discharged to the interior of cup C.

The deflector assembly is provided with a flange 41 which is secured to a flange 42 of a support 43 by means of a pair of nut and bolt assemblies 44. Support 43 extends through aligned apertures in a wheel housing 45 and a liner 46, and is provided with a flange 47. Flange 47 is provided with a pair of arcuate slots 48 which fit over a pair of studs 49 secured to housing 45, and a pair of nuts 51 are threaded on studs 49 and cooperate with flange 47 to rigidly maintain the latter in contact with housing 45. If desired, nuts 51 may be loosened and support 43 rocked about the axis of the mechanism to dispose the deflector assembly in various angular positions to thereby vary the direction of the discharge from the rotor in a manner to be hereinafter pointed out.

In order to properly center the support and accurately position the deflector assembly within the feed chamber, a plurality of set screws 52 are threaded into the support and are adapted to be locked in place by nuts 53. Accordingly, by loosening nuts 53, set screws 52 may be threaded in or out to shift the support transversely of the axis of rotation (assuming nuts 51 have been loosened for this purpose) and the proper position accurately attained.

Spout 35 is supplied with abrasive in any suitable manner, but preferably metered and from a gravity drop to impart the desired initial velocity to the abrasive. The abrasive fed into the spout is quickly conveyed to the center of cup C and promptly attains the full peripheral speed of the cup. After a predetermined quantity of abrasive has accumulated in the cup, it builds up to its angle of repose therein. If the feed of abrasive to the cup be arrested at this point, it will remain on the wall of the cup and will not discharge over edge 33. In Fig. 1, the surface of the abrasive when the cup is full is indicated by the line 61, and the angle of repose, which is the angle between this line and a line parallel to the axis of rotation of the mechanism, is designated as 62.

The deflecting assembly may assume various forms, and in Fig. 1 it assumes the shape of a flange 63 which is so shaped at its outer periphery as to generally conform to the surface of the cone-shaped layer of abrasive lying in the cup and is, accordingly, a helix of increasing radius toward the discharge edge of the cup.

As more clearly seen in Fig. 11, the outer edge 64 of flange 63 is bevelled to substantially conform with the angle of repose of the abrasive lying in the cup. Flange 63 extends for approximately three quarters of a revolution or about 270°, with the result that the abrasive starts to undergo an axial deflection at a point 65, and is finally deflected over the discharge edge of the cup when it attains the point designated as 66.

It has been found that it is not necessary to "plow" through the abrasive on the rim of the cup, but it is merely necessary to disturb or impart a slight initial movement thereto, because the cone of increasing radius compels the abrasive to continue moving down the incline until it is discharged over the edge of the cup. Therefore, the abrasive does not produce severe wear on flange 63.

At point 66, flange 63 merges with a substantially cylindrical flange 67 which has little, if any, "pitch" and which may be termed a splash deflector. As seen in Fig. 1, flange 67 lines substantially in the plane of the discharge portion of the edge 33, and it functions to prevent abrasive which may inadvertently or prematurely be started down the incline from discharging over the edge of the cup before the proper discharge point is attained. Flange 67, accordingly, terminates at the point 68 to permit the discharge at point 66 of the abrasive that is being properly propelled down the incline by flange 63. The abrasive lying on the interior of the cup is, accordingly, deflected over the edge thereof at a predetermined point in the rotation of the wheel and stray abrasive is prevented by flange 67 from leaving the cup elsewhere.

The deflector in Figs. 1, 2, 10, and 11 is shown as being adjusted to cause the abrasive to be dislodged from the rim of the cup at approximately the twelve o'clock position. The abrasive is thrown substantially tangentially, as indicated by the arrows 71 in Fig. 4, by reason of the fact that the abrasive possesses substantially no radial velocity and is traveling at the peripheral speed of the cup at the instant of discharge.

The abrasive discharges over the inner edges 33 of the cup C in a fan-shaped stream which is cut by the inner ends of the blades as they successively pass the pick-up point. With the serrated or notched edge, the discharge from cup C is intermittent or interrupted by providing the discharge edge 33 with a plurality of axially projecting portions or baffles 33*a*, which preferably merge into discharge edge 33 along inclined surfaces 33*b*. As seen in Fig. 4, surfaces 33*b* are disposed forwardly of each blade a considerable distance so that shortly after the abrasive stream, indicated by the arrows 71, is cut off by the inner ends of the blades, members 33*a*

will effect a cut-off of the stream itself in approximately 45° of rotation later. In other words, the blades are supplied with abrasive only over an arc of 45°, and the abrasive stream is then cut off to prevent it from discharging into the remainder of the large space behind each blade.

It is also apparent that as the abrasive discharging from the rim is traveling in the same general direction as the inner ends of the blades, it is picked up with a minimum impact. The abrasive picked up is smoothly and continuously accelerated by the blades and is discharged from the outer ends thereof in a downward direction as indicated by the arrows **72** (Fig. 2). If it is desired to change the direction of discharge, nuts **51** are loosened and support **43** is rocked so as to simultaneously rock the deflector assembly in the proper direction to effect the desired direction of discharge. The degree of adjustment afforded by the slots **48** (Fig. 2) allows the discharge stream to be adjusted through approximately 90°.

If it is desired to direct the discharge upwardly, the support **43** may be removed, inverted and replaced in the mechanism so as to locate the deflector assembly 180° from the position shown in Figs. 1 and 2, to effect an upward discharge of abrasive from the wheel. Also, in special installations, where it is desired to discharge the abrasive horizontally, the deflector may be secured to support **43** at an angle of 90° to that shown, to effect discharge of the abrasive either to one side of the machine or the other. It is, of course, understood that housing **45** may assume various shapes depending upon the direction it is desired to throw the abrasive, and other factors peculiar to the particular installation involved.

When the parts have become so worn as to require replacement, nuts **51** are removed and the deflector and spout assembly is removed from the machine. Nut and bolt assemblies **44** may then be loosened to permit the deflector assembly to be removed and replaced. Also, if the cup C requires replacement at this time, screw **27** may be loosened to allow the cup to be removed.

In some installations where it is desired to direct a concentrated stream of abrasive upon the work, means may be employed to restrict the arcuate length, measured in degrees, of the discharge from the cup designated by the arrows **71** in Fig. 4, and in Figs. 12, 13, and 14 I have shown one form of means that may be employed for this purpose.

With continued reference to these figures, flange **41** of the deflector D is cut away for a portion of its periphery to allow a guard assembly G to be bolted securely to flange **42** of support **43**. The guard assembly comprises a base portion **75** which is provided with a pair of openings **76**. Bolt and nut assemblies cooperate with openings **76** and a pair of corresponding openings in flange **42** (not shown) to secure the guard assembly in place on support **43**. Formed on base **75** is a generally cylindrical main guarding surface **77** which overlaps the outer periphery of cup C and is provided with a bevelled surface **78** so as to allow it to fit closely to the cup.

In Fig. 13 the discharge edge **33** of the cup is indicated by a broken line and the main discharge of abrasive from the cup is designated by the arrows **79**. Also illustrated in this figure are arrows **81** which indicate a small spray or premature discharge of the abrasive, and it is apparent that with guard **77** in place the stray abrasive indicated by arrows **81** is restrained from discharging into the blades and possibly being prematurely discharged therefrom. The stray abrasive particles rebound from the inner surface of guard **77** to join the concentrated stream being discharged from the edge of cup C.

As pointed out in connection with Figs. 1 to 6, inclusive, the splash deflector or flange **67** prevents any abrasive that is prematurely dislodged from the surface of the abrasive lying in the cup from being discharged onto the blades, and the action of the flange is enhanced by locating it some distance rearwardly of the discharge edge **33** so that it directly cooperates with the surface of the abrasive lying on flange **28**, with the result that the abrasive can only escape from the cup where the flange **67** is discontinued, namely, between points **66** and **68** (Fig. 11). As the angle of repose assumed by the abrasive is constant for any given set of operating conditions, and cannot build up beyond this angle between the discharge edge and flange **67**, the latter, accordingly, prevents stray abrasive from escaping from the cup.

It has been found in practice that all of the parts of the deflector assembly function cool in operation and wear thereof is slow. Flange **67** only lightly bears against the surface of the abrasive, and as previously pointed out, deflector flange or helix **63** serves to initially dislodge the abrasive, and the fact that the cone is of increasing radius in the direction of the discharge edge causes the abrasive to tend to continue more down the incline. However, the full length of helix **63** controls the movement of the abrasive across the conical surface until it is finally discharged at edge **33**. Wear of the helix is slow, however, because the major force impelling the abrasive toward the discharge edge is supplied by centrifugal force, and the helix merely exerts a minor or light following action upon the abrasive.

As already described, a raised portion or ridge **21** is provided on blade B, and as seen in Fig. 6, it tapers off at **21***a* and merges into the blade surface **20** inwardly of the mid-portion of the blade. Ridge **21** is also provided with a sharpened inner end **21***b* which constitutes an elongation of the bevelled inner end **20***a* of the blade.

When a deflector assembly as shown in Figs. 10 and 11 is used, the abrasive is discharged substantially parallel to the longitudinal axis of the blades and along the center portion of the blade surface. Ridge **21** causes the abrasive to be divided and distributed evenly on both sides of the ridge, thereby diffusing or lessening the intensity of wear on the central portion of the blade.

In Figs. 15 and 16 I have shown a portion of a modified form of rotor. The rotor R' in this modification is cast in one piece with dovetailed shaped slots **14'** for receiving the blade bases **15** in generally the same manner as shown in Fig. 3, like securing means **16** being provided for the blade adjacent the outer end of the slot.

To provide means for readily and cheaply balancing the rotor, I provide a series of apertures **12'** in the blade face of rotor R' immediately adjacent the rear face of the blade (the face that does not propel the abrasive). To effect balancing, different sized plugs of materials of different densities, such, for instance, as plugs of lead and wood, are inserted in apertures **12'**.

While it would seem that it would be sufficient to use varying quantities of a single material such as lead in apertures **12'**, it has been found that this is unsatisfactory as some of the holes

may not be entirely filled and others may not have any material in it at all. In any hole which is not filled so that the surface of the contained material is flush with the rotor disc surface, a gripping or stop surface for the abrasive that is continually flying about such a wheel is provided with the result that there is a rapid wear of the surface of the disc in the form of an elongated groove leading from the unfilled hole in a direction contrary to the direction of rotation of the disc. This wear on the disc is such that its balance may be seriously thrown out in less than twenty-five hours operation, requiring that the wheel be removed from service and rebalanced.

While it may seem strange that by filling any empty or partially filled apertures with a relatively soft material such as wood, this wear can be prevented, this can be explained by the fact that the wood glazes rapidly and because it is flush with the rotor disc surface, it eliminates any cavity or shouldered spot which might afford a purchase for the abrasive traveling thereover. The abrasive that would otherwise abrade the disc surface now slides freely thereover and does no damage.

The invention may be modified in other specific forms without departing from the spirit of essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

I claim:

1. A rotor for a centrifugal abrading mechanism comprising a disc having a series of apertures therein, and materials of different densities in said apertures to balance said disc for rotation, sufficient material being placed in each aperture to form a flush surface with the surface of said disc whereby no purchase surface is provided for flying abrasive.

2. In apparatus for propelling abrasive at an abrading velocity, a disc shaped rotor arranged to rotate about the axis thereof, a plurality of blades on one side of said rotor extending outwardly with respect to said axis to receive and impart an abrading velocity to said abrasive, said rotor being formed with at least one hole therein rearwardly of each blade on the same side of the rotor, and inserts of material in all of said holes to balance said rotor for rotation and having their outer faces flush with the adjacent face of the rotor whereby no purchase surface is provided for flying abrasive.

3. In apparatus for propelling abrasive at an abrading velocity, a disc shaped rotor arranged to rotate about the axis thereof, a plurality of blades on one side of said rotor extending outwardly with respect to said axis to receive and impart an abrading velocity to said abrasive, said rotor being formed with at least one hole therein rearwardly of each blade on the same side of the rotor, and materials of different densities filling all of said holes to balance said rotor for rotation and flush with the rotor surface adjacent said holes whereby no abrupt change is provided on the surface of the rotor for engagement by flying abrasive.

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