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Goff

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[54] ABRASIVE BLASTING MACHINE

[76] Inventor: **James R. Goff,** 6601 Shawnee Dr., Oklahoma City, Okla. 73116

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[52] **U.S. Cl.** ..... **51/9 R,** 241/275

[51] **Int. Cl.** **B24c 5/06**

[58] **Field of Search** ..... 51/9 M; 241/275, 300

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Primary Examiner—Donald G. Kelly

[57] **ABSTRACT**

An improved abrasive blasting machine comprises radially extending throwing blades mounted on a wheel by means of blade blocks. Each blade block has a first groove near an inner end of the block and a second groove near an outer end. Each blade includes lugs for insertion in the grooves. The improved blasting machine includes a centrally disposed impeller which restricts the movement of the blades, particularly in a radial direction. Preferably, this is accomplished by employing an impeller having a shoulder which contacts the inner ends of the blades.

10 Claims, 6 Drawing Figures

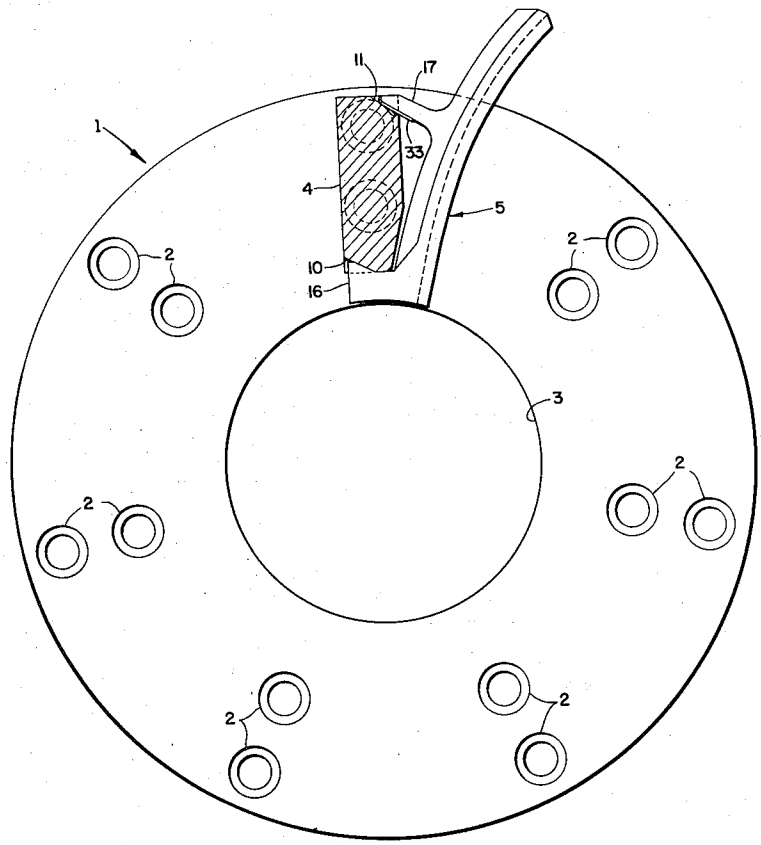
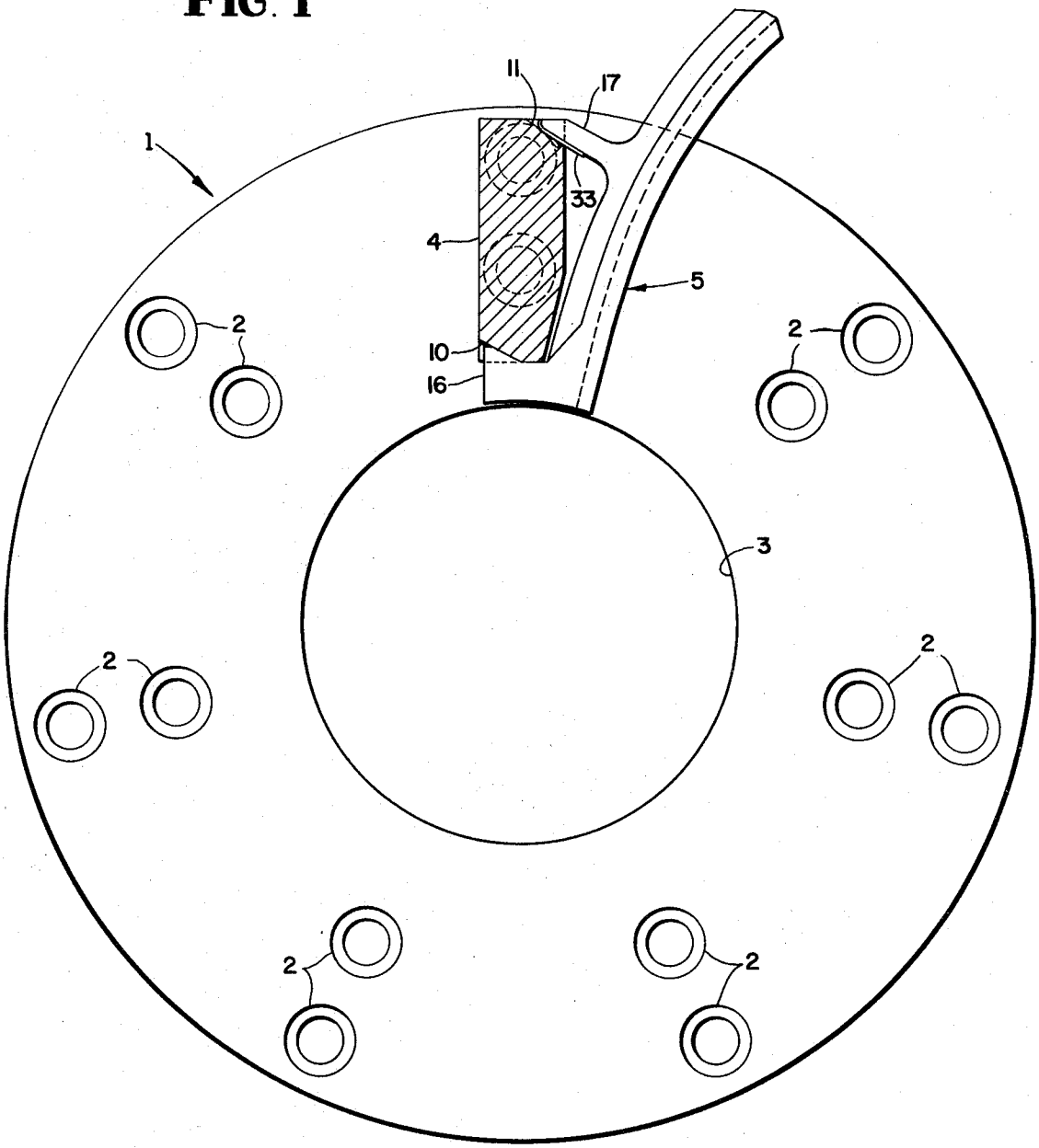


FIG. 1



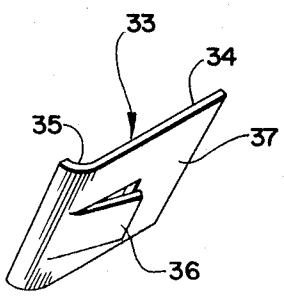


FIG. 5

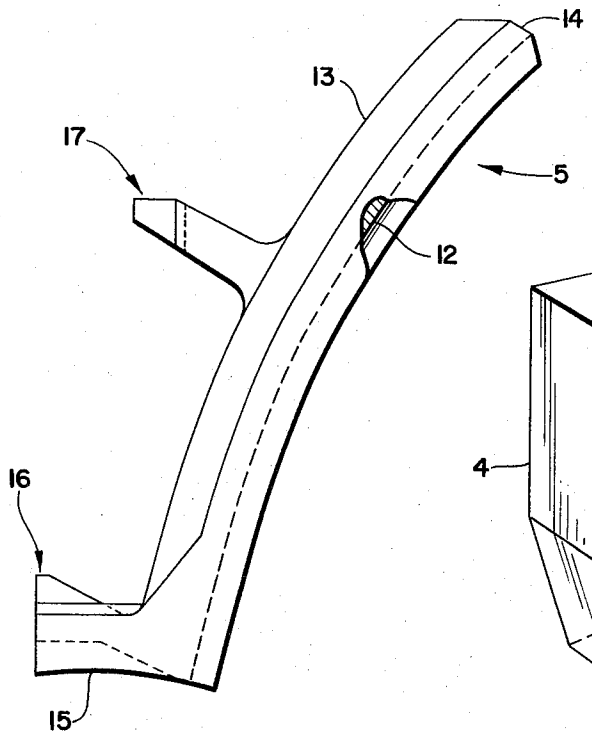


FIG. 3

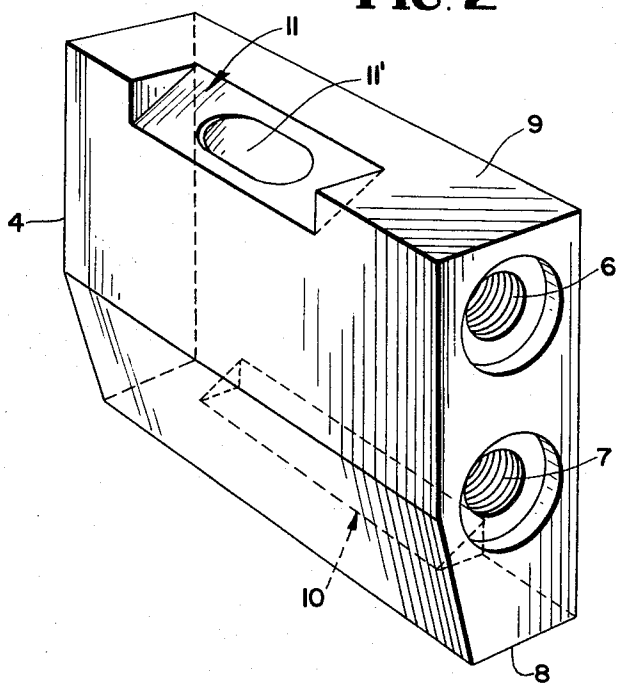


FIG. 2

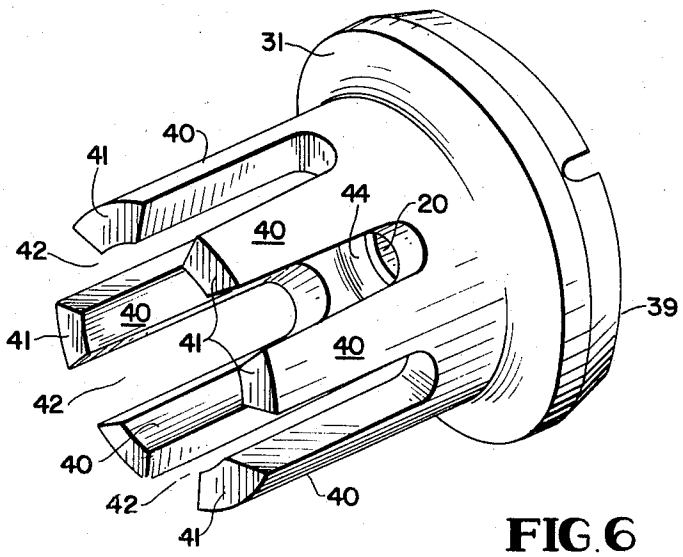


FIG. 6

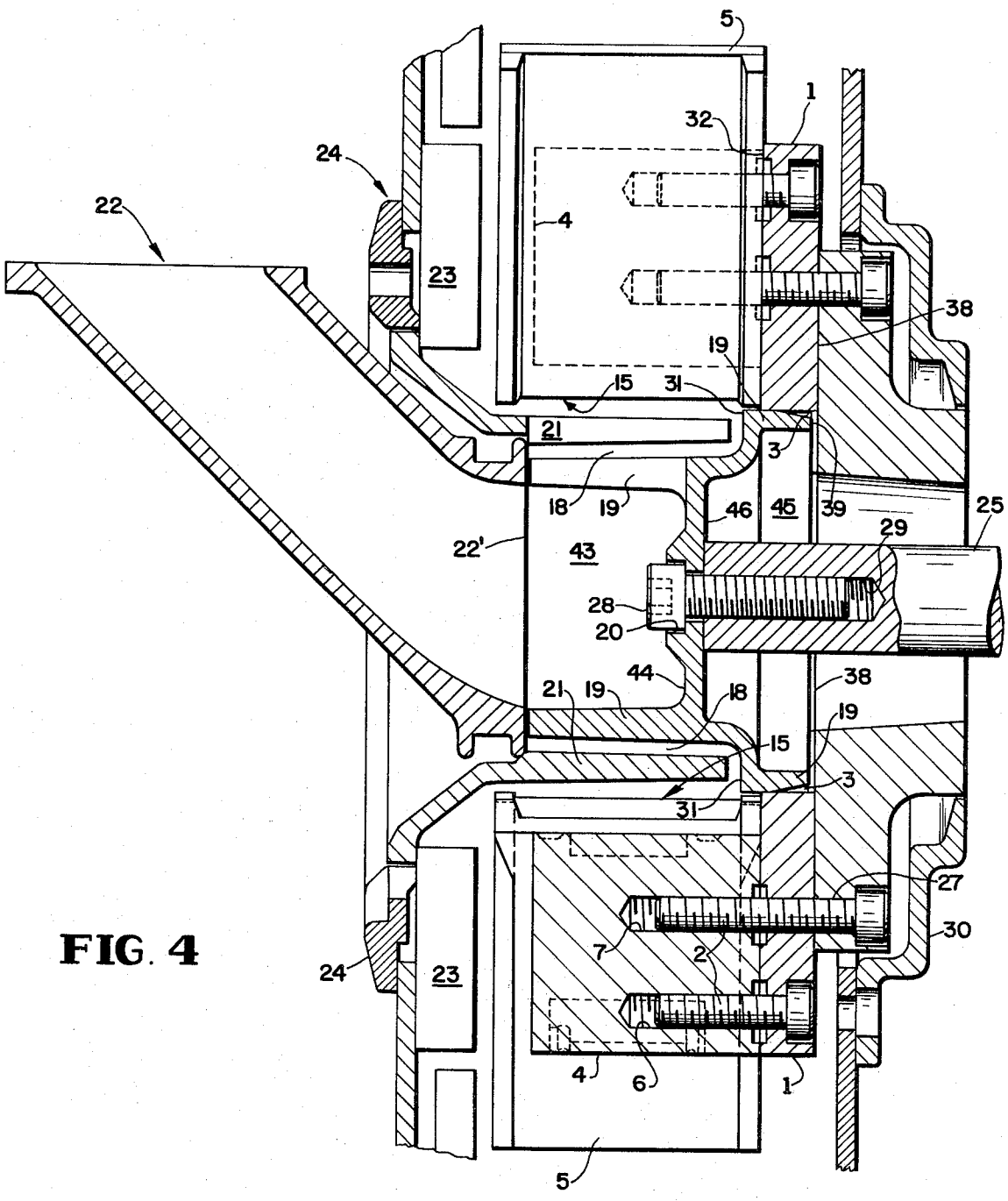

5
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31
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22'
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FIG. 4

ABRASIVE BLASTING MACHINE

This invention relates to a rotatable abrading device, and more particularly, to a mechanical device for propelling abrasive materials at abrading velocities. Such devices are commonly known as centrifugal blasting machines or abrasive throwing wheels.

Centrifugal blasting machines comprising rotors having a plurality of blades installed thereon have been known in the art for many years. The blades propel an abrasive material against a work surface. Thus, they are sometimes referred to as throwing blades. Due to the action of the abrasive material on the throwing blades, the blades exhibit considerable wear over a period of time. Attempts have been made to fabricate the blades from abrasion resistant alloys. In other cases, special blade configurations are employed to minimize the effects of the abrasive material.

Notwithstanding these attempts to minimize wear and extend the life of the throwing blades, periodic blade removal and replacement is necessary. This results in a loss of valuable operating time. Furthermore, while the blades must be removable, they must also be held so securely that they will resist the tremendous centrifugal forces exerted on them when the wheel is operating.

There are two common methods for securing the blades in a removable manner to the throwing wheel. The first method involves securing the blades to the front side of a wheel disk, usually by means of a bolt or by means of radial grooves, usually of a dovetail shape. The second method employs two wheel disks which are maintained in a spaced apart relation. Longitudinal narrow edges of the throwing blades are generally inserted into radial grooves arranged in opposing surfaces of the two disks. Auxiliary means, such as bolts, pivotal locking means, eccentrics, etc., can be employed to secure the blades against radial displacement.

The conventional methods for blade removal, therefore, involve the use of a separate securing element, typically a bolt, or relative movement between surfaces by sliding a blade into or out of a groove in a wheel disk. The exposed portions of the securing elements in these devices are susceptible to abrasion and disfiguration by fine particles of the abrasive material. This abrasive material can also enter open cracks and crevices, and within a relatively short time jam or "freeze" the securing elements or throwing blades in their grooves. In such instances, removal of the blades can only be accomplished with considerable effort and loss of production time.

Thus, there exists a need in the art for an improved centrifugal blasting machine in which the throwing blades are securely mounted on the throwing disk or disks to prevent movement of the blades, especially in a radial direction. The improved centrifugal blasting machine should also provide for easy removal and replacement of the throwing blades without the need for special tools and auxiliary securing elements. The blades should be easily removable even after extended use in an atmosphere containing fine particles of the abrasive material.

Accordingly, this invention provides an improved rotatable, centrifugal, abrasive blasting device. The device comprises a driven wheel and a plurality of circumferentially spaced, radially extending blades mounted on the wheel. The blades have inner and outer ends and front and rear surfaces. The inner ends of the blades define a central opening when mounted on the wheel. A hollow, vaned, driven impeller is mounted in the central opening for rotation with the wheel. A stationary control cage surrounds the impeller. The control cage has an opening therein for the discharge of abrasive material from the impeller onto the throwing blades. The device also comprises means for feeding particulate, abrasive material to the impeller. The improvement comprises mounting the blades on the wheel by means of blade blocks. The blade blocks have inner and outer ends. Each of the blade blocks has a first groove proximate its inner end and a second groove proximate its outer end. Each of the blades has a first lug on its inner, rear surface for insertion in said first groove of a blade block. Each blade also has a second lug on the rear surface and intermediate the ends of the blade. This second lug is adapted for insertion in said second groove of a blade block. Radial movement of the blades is substantially prevented by the impeller. This is conveniently and preferably accomplished by employing an impeller having a shoulder which contacts the inner ends of the throwing blades.

This invention will be more fully understood from the detailed description which follows, and by reference to the accompanying drawings which depict a centrifugal blasting machine according to this invention and detailed views of its various parts. In the drawings:

FIG. 1 is a plan view of a throwing wheel having a blade block and throwing blade installed thereon;

FIG. 2 is a view of a preferred configuration for a throwing blade block;

FIG. 3 is a view of a preferred configuration for a throwing blade;

FIG. 4 is a detail view of the central portion of a blasting machine;

FIG. 5 is a view in perspective of a preferred, but optional, blade retainer clip; and

FIG. 6 is a view in perspective of a preferred impeller.

Referring to FIG. 1, there is depicted a wheel or disk generally designated as 1. The wheel has a plurality of holes 2 uniformly spaced circumferentially. Holes 2 are adapted for the insertion of bolts employed to secure blade blocks to the wheel 1. Preferably, the wheel 1 has an opening 3 centrally disposed therein and of a size sufficient to accommodate a portion of the impeller. Shown in FIG. 1 is a blade block 4 and blade 5 in a typical position on the wheel 1. The blade block 4 and blade 5 will be described in greater detail hereinafter.

The portion of the device depicted in FIG. 1 is adapted for rotation in a clockwise direction. The blade 5 shown in the FIGURE is curved in the direction of rotation. Other blade configurations can be employed. For example, a substantially straight blade or blade having a different curvature would be satisfactory.

Referring to FIG. 2, there is depicted a preferred blade block employed in the device of this invention. The blade block, generally designated as 4, has two drilled and tapped holds 6 and 7 therein. Blade block 4 can be secured to wheel 1 by inserting bolts through holes 2 in wheel 1 into holes 6 and 7 in blade block 4. Blade block 4 has an inner end 8 and an outer end 9. A first groove 10 is provided in the blade block proximate the inner end 8. Proximate the outer end 9 there is provided a second groove 11 and a cavity 11'.

In FIG. 3, there is depicted a preferred blade employed in the device of this invention. The blade, generally designated as 5, comprises a throwing surface 12 which corresponds to the front surface of the blade. The blade also has a rear surface 13, an outer end 14 and an inner end 15. The inner end 15 is depicted as a curved surface. Preferably, the curvature of inner end 15 is such that its entire surface will substantially correspond to the curvature of the impeller against which it abuts after the blasting machine has been assembled.

The blade 5 has a lug 16 near its inner end 15. Intermediate the outer end 14 and inner end 15 of blade 5 is a second lug 17 on the rear surface 13 of the blade. Lug 16 aids in preventing the movement of the blade radially outward once the blasting machine has been assembled. Lug 17 aids in the assembly of the device, and provides support in a direction substantially normal to the length of the blade. The lug 16 is adapted for insertion into the first groove 10 in blade block 4. The lug 17 is adapted for insertion into the second groove 11 in blade block 4.

Referring next to FIG. 4, there is depicted a detailed view of the central portion of a blasting machine of this invention. The wheel 1 has mounted thereon throwing blades 5 by means of blade blocks 4. The inner ends 15 of the blades 5 define a central opening 18. Inserted in the opening 18 is a hollow, vaned impeller 19 having a bolt hole 20 therein. Surrounding the impeller 19 is a control cage 21 having an opening (not shown) therein for the passage of abrasive material from the impeller 19 onto the blades 5. The device also includes means for feeding particulate, abrasive material to the impeller. This feeding means is shown in FIG. 4 as a feed spout 22. A cage retainer 23 and cage adapter 24 secure the control cage 21 within the blasting machine in a conventional manner.

The wheel is driven by a motor (not shown) having a motor shaft 25. A hub 26 is mounted on shaft 25 by means of a conventional center taper-lock bushing (not shown in the FIG). The hub 26 includes bolt holes shown as 27 in the FIGURE. The wheel 1 is installed on the hub 26, and bolt hole 27 on the hub is aligned with a bolt hole 2 on the wheel. Blade blocks 4 are then installed so that holes 6 and 7 in the blade block are aligned with holes 2 in the wheel 1. The blade blocks 4 can then be bolted to the hub-wheel assembly.

Blades 5 are installed on the blade blocks 4. The impeller 19 is inserted in the central opening 18. Preferably, a wheel 1 having an opening 3 is employed, and the impeller 19 projects at least partially into this opening as shown in FIG. 4. The impeller 19 preferably has a slot cast into its face, which interfaces with a pilot hole machined in the vertical surface 38 of the hub to thereby center the impeller 19 within wheel 1 and opening 3. A pin can be inserted in the hub pilot. The pin projects from the face of the hub and aligns with the slot cast into the impeller 19. This pin not only aligns the impeller slot with the hub pilot, but also provides a positive means of driving the impeller with the hub-wheel assembly. The pilot holes and pin are not shown in the FIGURES. To complete the assembly, a bolt 28 is inserted through opening 20 in impeller 19 and into a threaded opening 29 in motor shaft 25. A hub seal and retainer 30 can be installed in a conventional manner.

In the device of this invention, the impeller retards radial movement of the blades. FIG. 4 depicts the preferred embodiment in which the wheel 1 has a central opening 3 into which a portion of the impeller 19 projects. As shown in the FIGURE, a shoulder 31 locks the blade in position. Each blade 5 is thereby prevented from moving radially inward toward the impeller. Because the lug 16 on blade 5 (see FIG. 3) engages the groove 10 in blade block 4 (see FIG. 2), the shoulder 31 on impeller 19 effectively locks the lug 16 in groove 10 thereby preventing movement of each blade 5 in a direction radially outward from the impeller. Thus, it will be apparent that blade 5 is securely locked in position.

While the impeller 19 is shown with a shoulder 31 which obstructs movement of blades 5, it will be apparent that other modes of construction are possible. For example, the impeller could be mounted on the surface 32 of the wheel 1; that it, wheel 1 would not have a centrally disposed opening 3. In this event, the impeller would still obstruct the movement of blades 5.

In a preferred embodiment of this invention, assembly of the blades to the blade blocks can be facilitated by employing a blade retainer clip. A preferred clip is shown in FIG. 5. The clip in FIG. 5 is generally designated as 33. Blade retainer clip 33 comprises a substantially flat portion 34 which terminates in a curved portion 35. The clip 33 has a lug 36 protruding from its rear surface 37. The lug 36 can be conveniently provided by stamping or punching it out of the substantially flat portion 34 so that at least one end of the lug is still secured to the flat portion.

The blade retainer clip 33 is secured to lug 17 of blade 5 (see FIG. 1). This can conveniently be accomplished by means of an adhesive or a tape. The lug 36 of retainer clip 33 is inserted in cavity 11 of blade block 4. While the use of a blade retainer clip is an optional embodiment of this invention, the clip is an assembly convenience which enables the worker to temporarily retain the blade on the blade block until the remainder of the blades are installed. Once the device of this invention has been assembled, the blade retainer clips are no longer required. Thus, should they inadvertently become detached from the device, no harm will generally be done since the blades are locked on the wheel by means of lugs (16 and 17) and the interference provided by the impeller (e.g., shoulder 31). When a blade retainer clip is not employed, it is not necessary to provide blade block 4 with a cavity 11' since the function of cavity 11' is to provide a recess for lug 36 of blade retainer clip 33.

When a blade retainer clip such as 33 is employed, the blade 5 is assembled to the blade block 4 by inserting the lug 16 in the groove 10, and then pivoting the blade rearward until lug 17 of the blade is within groove 11 and the lug 36 of the retainer clip is inserted into cavity 11'.

As previously noted, use of the blade retainer clip is an optional embodiment. If a blade retainer clip is not employed, the lug 17 can be temporarily secured in groove 11 in blade block 4 by the use of an adhesive or a tape. The blade retainer clip is preferred, however, since it not only retains the blade in position, but aids in the alignment of the lug 17 and groove 11.

To remove the blades 5 from the device, first the feed spout 22 is detached from the machine or otherwise moved free of the central opening 18. Control cage 21 is then withdrawn. The impeller 19 can then be removed after loosening and removing bolt 28. A sharp

blow from a hammer or other tool will break the small retainer clip, thereby entirely freeing the blade **5.**

While centrifugal blasting machines can be driven by means of a belt connected to a motor, direct connection to a motor shaft is now the more common method. Standard commercially available motors generally have a floating motor shaft; that is, the shaft moves inward and outward in a longitudinal direction. Typically, the shaft will be capable of moving about 0.25 inches. When the motor is operating, longitudinal movement of the motor shaft will generally be inward. When the motor is off and the shaft is in a relaxed position, the shaft will generally be extended outward. In centrifugal blasting machines of the prior art, it was generally necessary to provide the motor shaft with a locked bearing which would prevent longitudinal movement of the shaft. The use of a locked bearing adds to the cost of the machine. The locked bearing was required to prevent longitudinal movement of the impeller because the control cage at least partially surrounded or wrapped around the impeller, and movement of the motor shaft in a longitudinal direction would cause the control cage to interfere with the impeller when the impeller was directly connected to the motor shaft.

These problems are alleviated by the preferred impeller and control cage employed in this invention. Referring to FIG. **4,** it is seen that the control cage **21** does not wrap around the surface **39** of the impeller **19.** Thus, when the impeller **19** and motor shaft **25** move inward and outward in a longitudinal direction, there is no interference between the control cage **21** and impeller **19.** Thus, a standard commercial motor with a floating motor shaft can be employed in the device of this invention.

In prior art centrifugal blasting machines, a centering plate was required between the impeller and bare wheel. In the preferred device of this invention, however, the centering plate and impeller comprise one piece. This is advantageous because the control cage and impeller can be molded separately using simple foundry practice. Casting techniques are simpler because the parts can be cast without the use of cores.

A preferred impeller **19** employed in this invention is shown in FIG. **6.** It comprises a plurality of fingers **40** which extend in a longitudinal direction. The outer most ends **41** of the fingers **40** are not connected to each other, thereby forming openings **42** between the fingers **40.** This is advantageous because the fingers are immediately adjacent the feed spout when the centrifugal blasting machine is assembled. This is readily apparent from FIG. **4** where it is seen that the space between the impeller **19** and the feed spout **22** is very small. This makes it possible to feed relatively large quantities of abrasive material to the impeller since the fingers on the impeller pick up the abrasive material as soon as the material leaves the feed spout. Tnat is, the abrasive material from the feed spout drops directly onto the fingers, and the fingers then project the abrasive onto the throwing blades. This feature should be contrasted with impellers shown in the prior art in which the fingers are connected at their outer most ends **41.** In such prior art devices, the fingers will generally be about ¾ to about 1 inch from the end **22'** (see FIG. **4**) of the feed spout. The abrasive material must traverse this ¾ – **1** inch distance before it is picked up by the fingers of the impeller. This interferes with the gravity flow of abrasive material.

A further preferred embodiment of this invention can be seen in FIG. **4.** The fingers of the impeller **19** define a central opening **43** into which abrasive from feed spout **22** falls. The floor **44** of this central opening **43** separates opening **43** from a second central opening **45.** This second central opening **45** is such that motor shaft **25** can be inserted therein. When the centrifugal blasting machine is assembled, motor shaft **25** abuts floor **46** of central opening **45.** Since standard, commercial motors of a given size have motor shafts of the same length, an impeller having a second central opening **45** makes it possible to mount the impeller closer to the motor. Typically, motor shaft **25** can project into the second central opening **45** about 1 inch. It will immediately be apparent that this arrangement brings the mass of the impeller closer to the bearing in the motor. This reduces the overhung load on the bearing, thereby reducing the stress on the bearing. This minimizes bearing wear.

There are a number of advantages associated with the device of this invention. First of all, means are provided for rigidly securing a throwing blade to a blasting wheel. Movement of the blades in a radial direction is substantially prevented. Equally important, the blades can still be removed relatively easily. Special blade retainers and blade securing means need not be used each time the blades are changed. Special assembly and disassembly tools are not required. The blades do not become wedged or frozen in the wheel, such as will frequently occur when dovetail or other grooves are employed. The ease of assembly and disassembly minimizes the time required to change worn blades, thereby minimizing lost production time. The blades can be removed easily even after extended use in an atmosphere containing fine particles of the abrasive material. The preferred impeller in which the impeller and centering plate comprise one piece can be cast in a relatively simple manner. The preferred impeller comprising a plurality of discrete fingers provides for the uniform flow of abrasive material to the throwing blades. The preferred impeller which has an opening therein for insertion of at least a portion of the shaft of the blasting machine drive motor minimizes wear on the bearing for the motor shaft.

What is claimed is:

1. In a rotatable centrifugal abrasive blasting device comprising a driven wheel; a plurality of circumferentially spaced radially extending blades mounted on said wheel, said blades having inner and outer ends and front and rear surfaces; said inner ends of said blades defining a central opening; a hollow, vaned, driven impeller mounted in said central opening rotatable with said wheel; a stationary control cage around said impeller, said control cage having an opening therein for the passage of abrasive material from said impeller onto said blades; and means for feeding particulate, abrasive material to said impeller; the improvement wherein said blades are mounted on said wheel by means of blade blocks on said wheel; said blade blocks having inner and outer ends; each of said blade blocks having a first groove proximate its inner end and a second groove proximate its outer end; each of said blades having a first lug on its inner, rear surface for insertion in said first groove of said block, and a second lug on the rear of each blade, said second lug intermediate the ends of the blade for insertion in said second groove of said block; and further wherein said impeller obstructs

movement of said blades in a direction radially inward.

2. A centrifugal blasting device according to claim **1** in which the wheel has an opening centrally disposed therein and said impeller protrudes into said opening in said wheel, and further wherein said impeller has a shoulder which locks the blades to the blade blocks.

3. A centrifugal blasting device according to claim **1** in which each of said second grooves is provided with a cavity, and a blade retainer clip is secured to said second lug, said clip being secured in said cavity.

4. A centrifugal blasting device according to claim **2** in which the impeller abuts a surface of a hub which connects the wheel to the shaft of a motor, said hub having a pilot hole machined in a surface thereof for alignment with a pilot hole in the impeller, and a pin connects the pilot hole in the hub to the pilot hole in the impeller.

5. A centrifugal blasting device according to claim **1** in which said device includes a centering plate which together with the impeller comprise one piece.

6. A centrifugal blasting device according to claim **1** in which the impeller has a plurality of discrete fingers having openings therebetween, said fingers defining a central opening for receiving abrasive material from said feeding means.

7. A centrifugal blasting device according to claim **1** in which said device is driven by a motor having a motor shaft, said impeller is connected to said motor shaft and said impeller has an opening therein for insertion of a portion of said shaft.

8. A centrifugal blasting device according to claim **3** in which said device includes a centering plate which together with the impeller comprise one piece.

9. A centrifugal blasting device according to claim **8** in which the impeller has a plurality of discrete fingers having openings therebetween, said fingers defining a central opening for receiving abrasive material from said feeding means.

10. A centrifugal blasting device according to claim **9** in which said device is driven by a motor having a motor shaft, said impeller is connected to said motor shaft and said impeller has an opening therein for insertion of at least a portion of of said shaft.

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