United States Patent

[11] 3,629,975

[72] Inventor **Harper W. Good**
Waynesboro, Pa.

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[73] Assignee **The Carborundum Company**
Niagara Falls, N.Y.

[54] **PARTICLE-THROWING APPARATUS**
25 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **51/9**
[51] **Int. Cl.** **B24c 3/00**
[50] **Field of Search** 51/9

[56] **References Cited**
UNITED STATES PATENTS

2,286,754	6/1942	Minich	51/9
3,242,615	3/1966	Physioc	51/9
3,290,827	12/1966	Bowling et al.	51/9
3,319,383	5/1967	Bowling et al.	51/9
3,348,339	10/1967	Bowling	51/9

Primary Examiner—Lester M. Swingle
Attorneys—David E. Dougherty and Robert E. Walter

ABSTRACT: A particle-throwing apparatus comprises a runnerhead having a plurality of radially mounted throwing vanes which are inclined with respect to the planar support surface of the runnerhead. An impeller case is mounted at the center of the runnerhead with a slotted impeller disposed in the impeller case. Each impeller slot includes a particle projecting edge which is inclined parallel to a corresponding vane in the runnerhead.

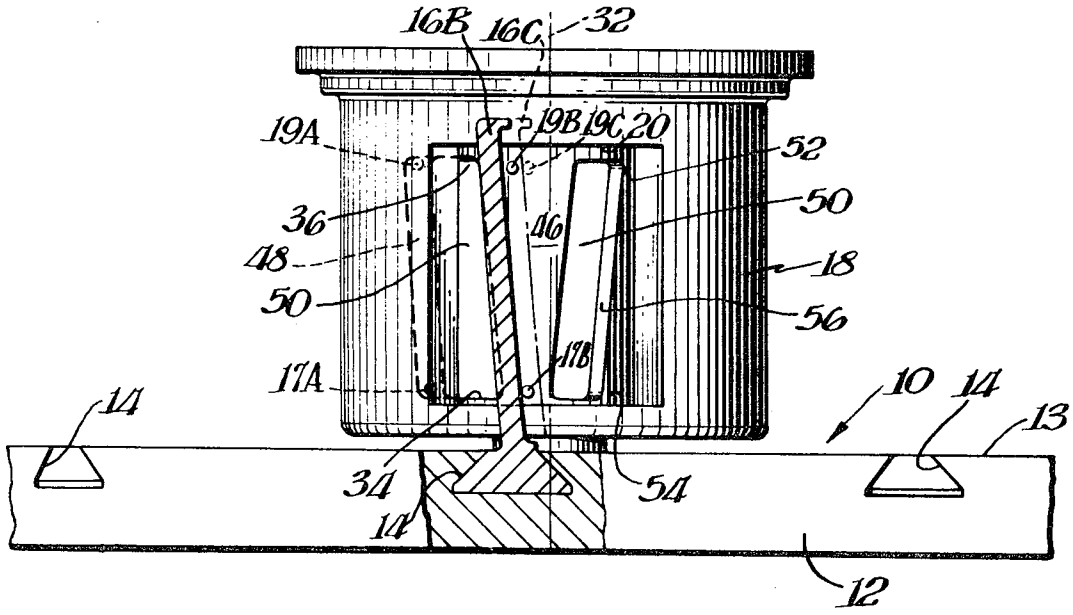


Fig. 2. (Prior Art)

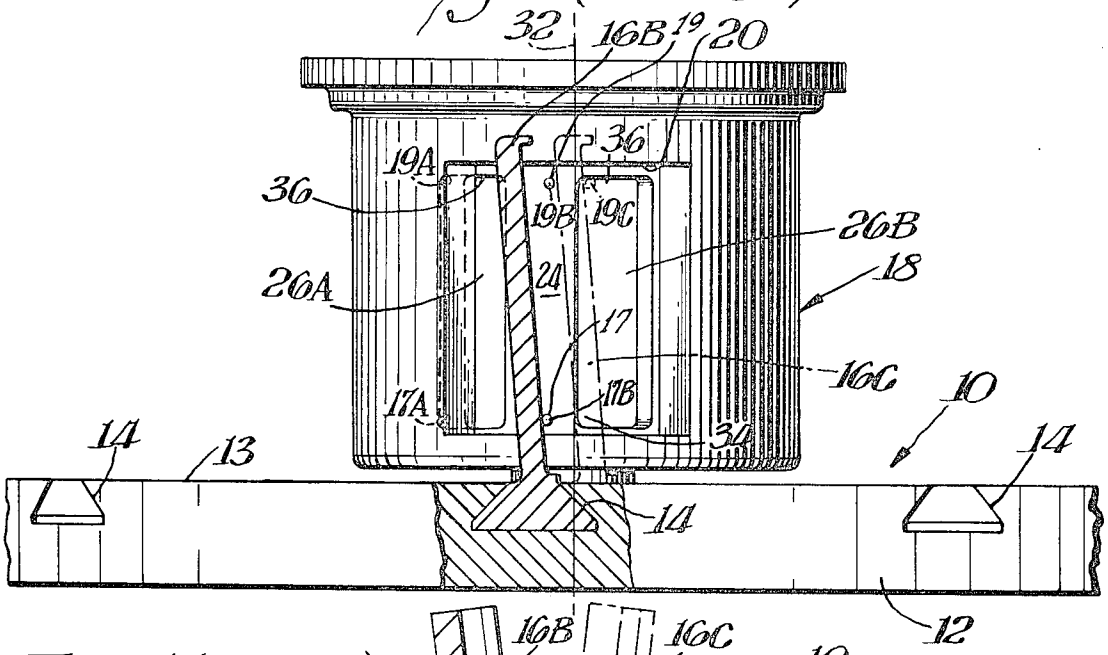


Fig. 1. (Prior Art)

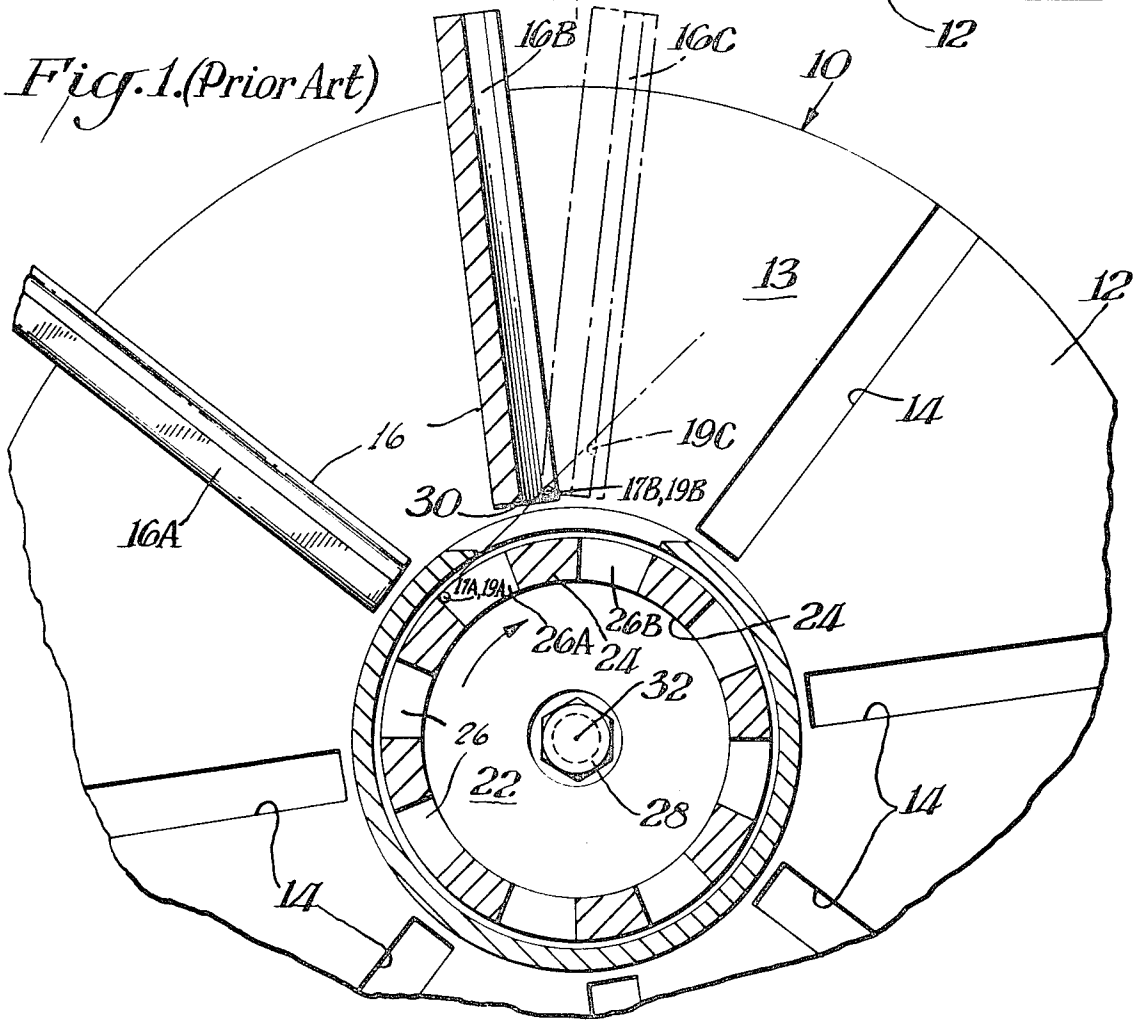


Fig. 4.

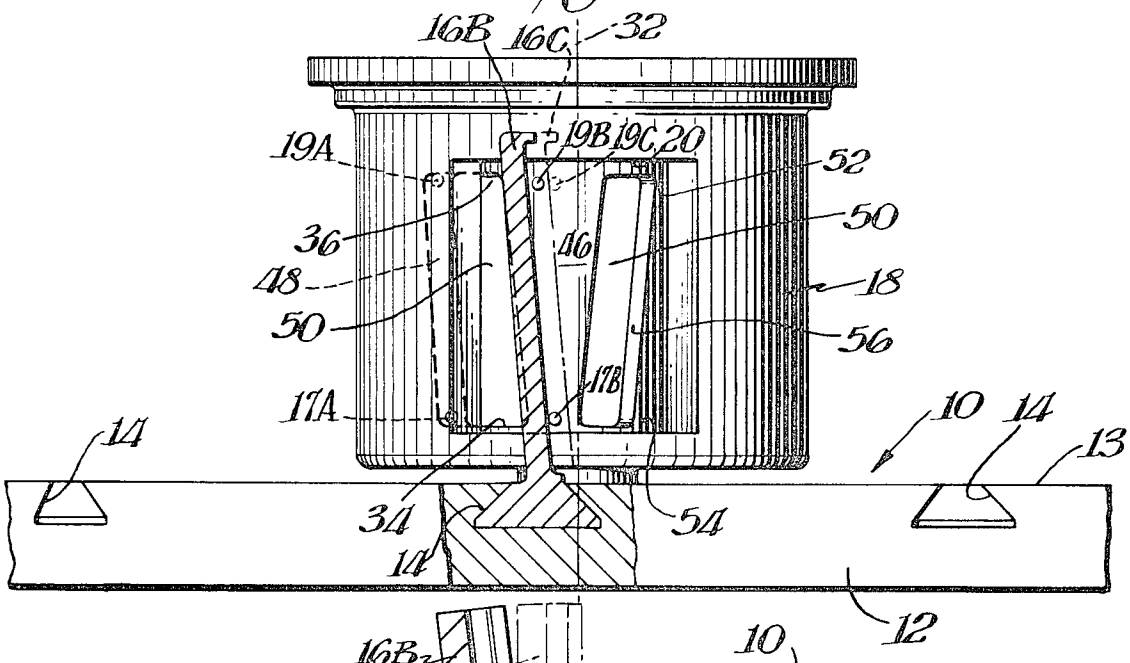

16B
16C
32
19A
19B
19C
20
52
50
36
46
48
18
50
56
17B
17A
10
14
14
13
34
54
14
12

Fig. 3.

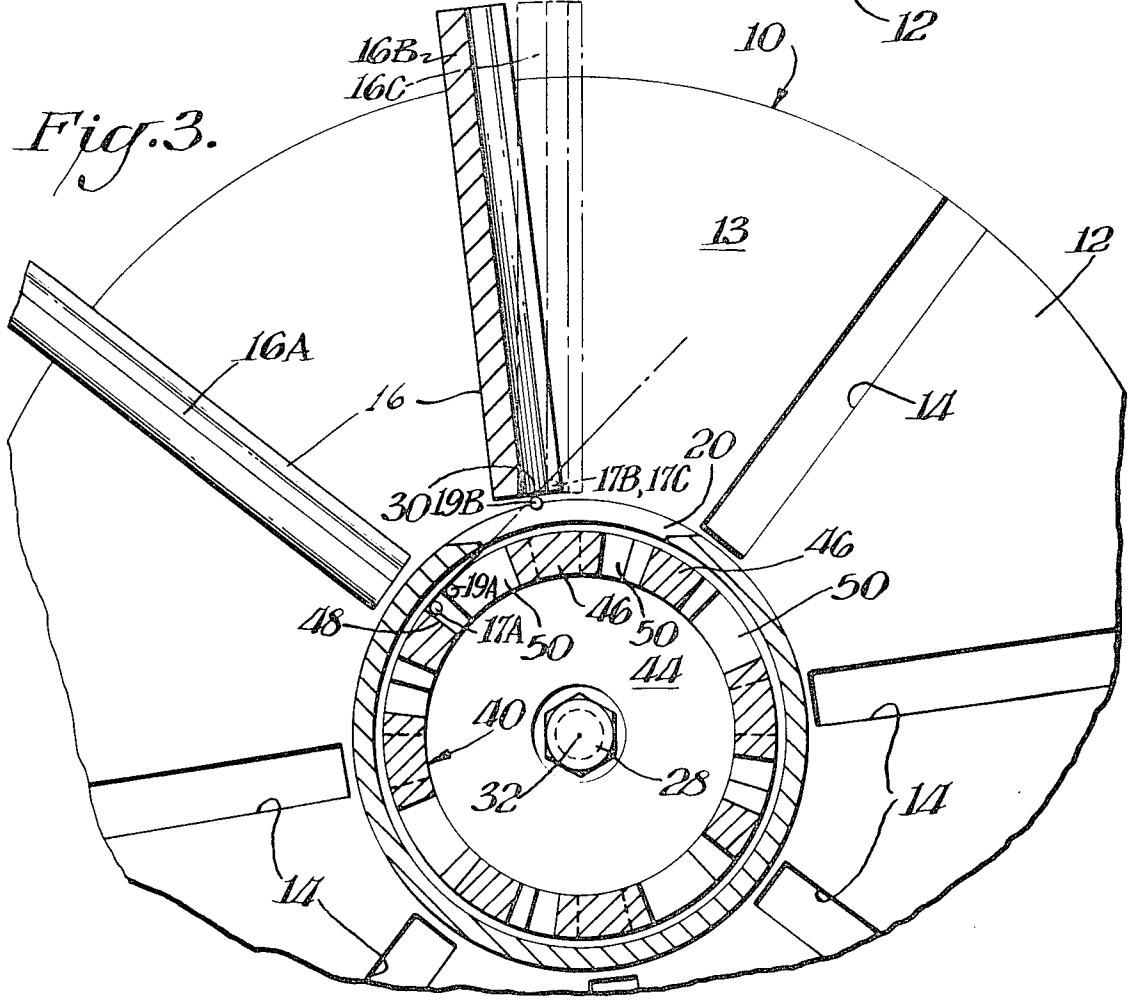

16B
16C
10
13
12
16A
16
14
20
30
19B
17B, 17C
46
19A
50
48
17A
50
46
50
44
40
28
32
14
14
14

Fig. 5.

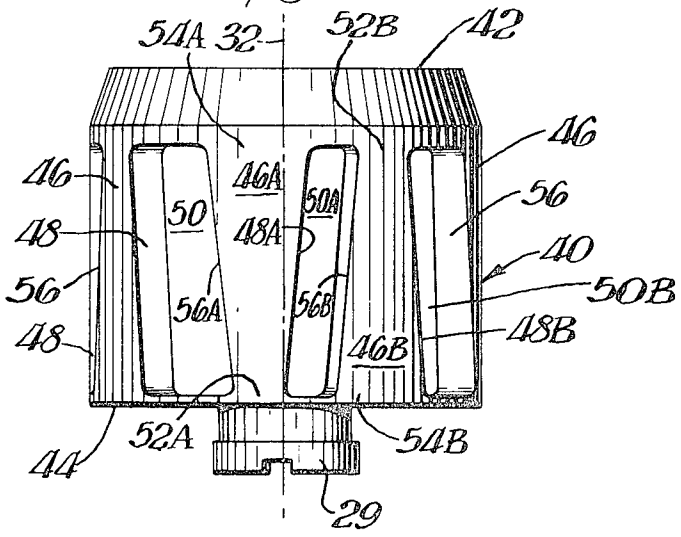

54A
32
52B
42
46
46
46A
56
48
50
50A
48A
40
56
56A
56B
50B
48
48B
46B
52A
54B
44
29

Fig. 6.

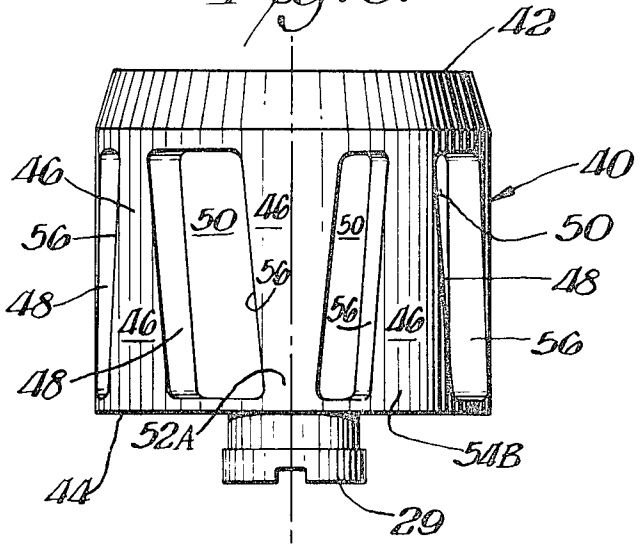

42
40
46
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56
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56
48
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56
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52A
54B
44
29

Fig. 7.

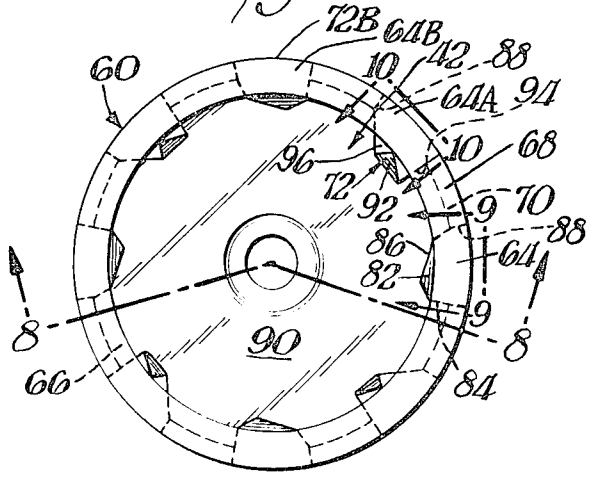


Fig. 10.

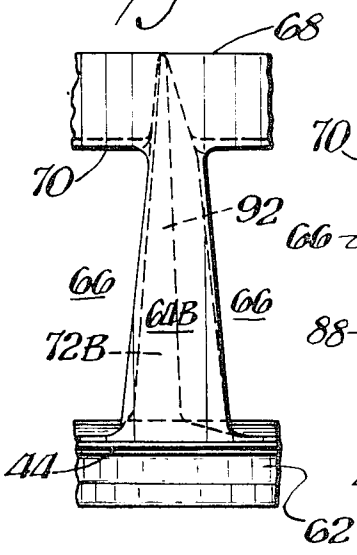


Fig. 8.

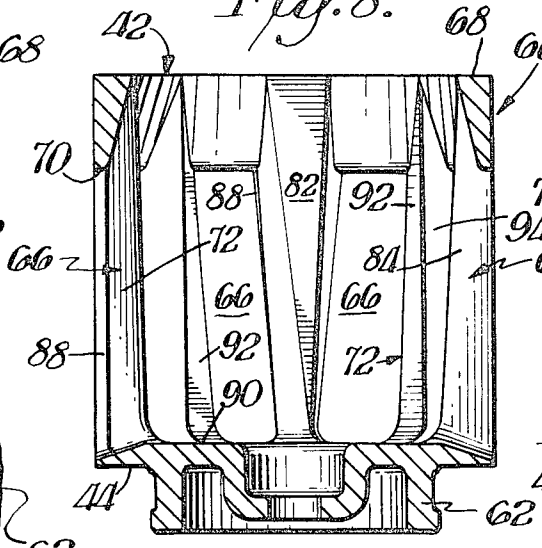


Fig. 9.

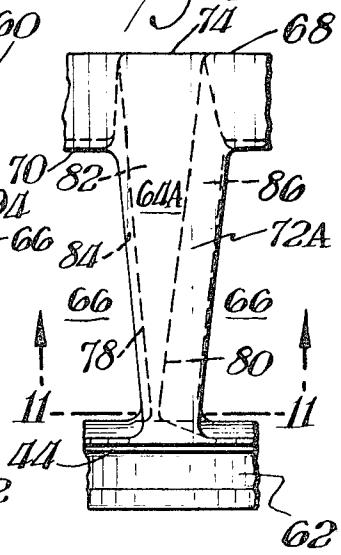
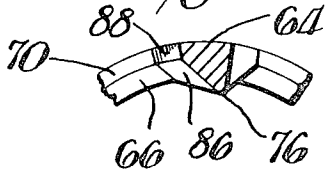


Fig. 11.



PARTICLE-THROWING APPARATUS

BACKGROUND OF THE INVENTION

In the abrasive blasting or particle-throwing field there is a constant search for machines which maximize the effectiveness of the blast stream. A recently developed arrangement which is described in U.S. Pat. Nos. 3,242,615 differs from the standard throwing wheel arrangement in that the vanes of this patent are disposed at an angle or inclined with respect to the runnerhead support surface. Specifically alternate vanes are inclined at an acute angle while intermediate vanes are inclined at a complementary obtuse angle. This arrangement represented a notable departure.

Subsequent to the development of U.S. Pat. No. 3,242,615, a still more effective arrangement was found which is described in U.S. Pat. No. 3,348,339. In this arrangement the vanes were not only inclined with respect to the runnerhead but also the discharge end of each vane was flared. Specifically, each backwardly inclined vane included a top edge which flared away from the runnerhead while each forwardly inclined vane included a bottom edge which flared toward the runnerhead. While the arrangement of this patent was also a notable improvement over the prior patent, as later described the vanes in both arrangements were not as effective in propelling the abrasive particles to maximize the efficiency of the blast stream and optimize wear life of the individual vanes.

SUMMARY OF THE INVENTION

An object of this invention is to provide a particle-throwing apparatus of the above type having canted or inclined vanes therein with an improved impeller structure.

A further object of this invention is to provide such an apparatus which increases the wear life of the vanes.

A still further object of this invention is to provide a new and novel impeller.

In accordance with this invention the particle-throwing apparatus comprises a runnerhead having a plurality of radially mounted throwing vanes which are inclined with respect to the planar support surface of the runnerhead. An impeller case is mounted at the center of the runnerhead with a slotted impeller disposed in the impeller case. Each impeller slot includes a particle-projecting edge inclined parallel to a corresponding vane in the runnerhead.

The impeller may advantageously have the slots of uniform width by utilizing trapezoidal blades wherein each trapezoid includes a short parallel side and a long parallel side joined by intermediate inclined sides which are mirror images of each other. One of these intermediate sides corresponds to the particle-projecting edge of its slot, in accordance with the direction of rotation of the runnerhead. Since such impellers are particularly designed to be used with throwing wheels wherein adjacent vanes alternate in the direction of inclination the trapezoidal blades are arranged with the short parallel side of one blade being disposed adjacent the long parallel side of the trapezoid of the adjacent blade.

THE DRAWING

FIG. 1 is a plan view partly in section of a portion of the prior particle throwing apparatus;

FIG. 2 is a side view in elevation and partly in section of the prior art arrangement shown in FIG. 1;

FIG. 3 is a plan view similar to FIG. 1 of a particle throwing apparatus in accordance with this invention;

FIG. 4 is an elevation view similar to FIG. 2 of the apparatus shown in FIG. 3;

FIG. 5 is a side view in elevation of the impeller used in the apparatus of FIGS. 3–4;

FIG. 6 is a side view of the impeller shown in FIG. 5 after it has been rotated to a different position;

FIG. 7 is a plan view of a modified impeller in accordance with this invention;

FIGS. 8–10 are cross-sectional views taken through FIG. 7 along the lines 8—8, 9—9 and 10—10, respectively; and

FIG. 11 is a cross-sectional view taken through FIG. 9 along the line 11—11 of FIG. 9.

DETAILED DESCRIPTION

This invention is directed to improvements in particle-throwing apparatus, particularly abrasive blast wheels. Such high horsepower abrasive blast wheels which use fine shot or grit have proved to be ineffective. A considerable improvement has been realized with such blast wheels by spreading the width of the blast stream pattern through the use of angled or canted vanes, such as described in U.S. Pats. No. 3,242,615 and No. 3,348,339. FIGS. 1–2 for example show a blast wheel of the above wherein the vanes are angled. As indicated therein the blast wheel **10** includes a runnerhead **12** having dove tail openings **14** in its planar support surface **13** for receiving a plurality of radially mounted vanes **16** which rotate with the runnerhead **12**. The inner ends or heels **30** of the vanes **16** are spaced from each other to accommodate an impeller case **18** having an impeller slot **20**. Within the impeller case is mounted impeller **22** which includes a plurality of spaced blades **24** creating a plurality of slots **26** therebetween. The number of blades and slots in impeller **22** correspond to the number of vanes **16**. Thus during operation particles received by any particular vane **16** are always projected from a single corresponding slot **26**. Impeller **22** is mounted by suitable securing means or fastener **28** to runnerhead **12** while its case **18** is relatively stationary therewith. Thus during rotation of the runnerhead and its vanes and impeller, particles fed into the impeller **22** are discharged by centrifugal force through impeller case slot **20** against vanes **16** and from vanes **16** the particles are blasted against the work piece being treated. Since the details of the drive means, wear housing and other details are well known in the art, a detailed description herein is not necessary. It is noted, however, that such details are found for example in U.S. Pats., No. 3,319,383 and No. 3,290,827.

Although the arrangements in U.S. Pat. No. 3,242,615 and No. 3,348,339 included angled vanes the impellers and cases were left unchanged. Because of this the improvements obtained with the angled vanes were not actually optimized. Specifically, the optimum location at which the abrasive particles should be deposited on the vane is at the heel **30** or inner end of the vane because at this location the radial vane velocity is at its minimum while the velocity correspondingly increases in accordance with the increasing distance from the center of rotation of the runnerhead **12**. Where the radial vane velocity is at a minimum the resultant impact and batting action of the abrasive particles against the vane is also at a minimum. Thus by depositing the particles at the heel of the vane the wear life of the vane is maximized.

FIGS. 1–2 illustrate the action that takes place with such angled vanes utilizing the conventional impeller structure wherein the impeller blades **24** and slots **26** are vertical or parallel to the axis of rotation **32**. As shown in FIG. 2 since the vane **16B** is angled with respect to the wheel axis or axis of rotation **32** the corresponding particle feeding slot **26B** is further from the vane **16B** at its upper end **36** than it is at its lower end **34**. Moreover, since consecutive vanes are angled in opposite directions with respect to axis **32** (as described in greater detail in U.S. Pat. No. 3,242,615 and No. 3,348,339), this difference in advancement from one impeller slot **26** to the other alternates with each vane. Thus for example the lower end of the slots adjacent to slot **26B** would be closer to the vanes adjacent to vane **16B**, while the upper end of the adjacent slots would be further from the adjacent vane.

For the sake of clarity FIGS. 1–2 illustrate the advancing positions of one vane **16** only; corresponding results, however, will occur with the remaining vanes. As indicated in FIGS. 1–2 particle **17A** leaves the bottom of impeller slot **26A** and particle **19A** leaves the top of impeller slot **26A** when its corresponding vane **16A** is in the position indicated therein. During rotation of both the impeller and vanes the particles have progressed to the positions indicated as **17B** and **19B**. At this time the vane **16** has also rotated to the position indicated at **16B**. In this B position because the lower end **34** of the slot **26** is closer to the angled vane **16**, particle **17** is picked up at the

heel 30 of vane 16B. As shown in FIG. 2, however, particle 19B is still not yet contacted by vane 16B. As the wheel and its impeller and vanes continue to rotate, particle 19 is finally picked up by the particle projecting face of vane 16 when the vane is in the position indicated in phantom as 16C and the particle is in the position indicated as 19C. As shown in FIG. 1 particle 19C is thus picked up by vane 16C at a distance from heel 30.

Although particle 17 reaches its vane at the optimum location at heel 30, particle 19 is not contacted in the optimum position and is struck harder by the faster advancing vane surface. This contributes to greater vane wear than necessary and causes particle 19 to bounce more than particle 17 which, in turn, contributes to an uncontrolled blast stream pattern. Obviously, the result would be even more extreme when there is a greater inclination of the vanes.

It is noted that particles 17 and 19 represent the extreme conditions and that other particles intermediate these particles are of course projected from the impeller with the difference in results depending on their specific position of projection.

FIGS. 3–4 illustrate the arrangement of this invention which is particularly designed to overcome the above disadvantages by having all of the particles reach the vane as close as possible to the vane heel despite the location of the individual particles with respect to the projecting edge of the impeller slot. The apparatus 10 illustrated in FIGS. 3–4 is similar to the apparatus illustrated in FIGS. 1–2 in the inclusion of a runnerhead 12 having its planar support surface 13 with radially mounted throwing vanes disposed in dove tail slots 14 and with the vanes having angled particle throwing faces. As illustrated therein the vanes are designed for rotation in only one direction. Obviously, however, the vanes may be modified so that the direction of rotation can be reversed. Apparatus 10 further includes impeller case 18 having its impeller slot 20. Incorporated in this impeller case, however, is the improved impeller 40 which is illustrated in greater detail in FIGS. 5–6.

As shown in FIGS. 5–6 impeller 40 is generally of cylindrical form and includes an open top 42 for receiving abrasive particles therein and a closed bottom wall 44 having a boss 29 for securement to runnerhead 12 by fastener 28. The cylindrical side wall of impeller 40 is formed by a plurality of spaced blades 46. FIG. 5 illustrates the impeller in one position, while FIG. 6 illustrates the impeller after it has rotated to a slightly different position. As indicated therein the impeller slots 50 are of uniform width but are alternately inclined to correspond to the degree of inclination of the canted vanes 16. Thus a side of each blade 46 forms a particle projecting edge 48 for the resultant spaced slots 50 and this particle projecting edge 48 is inclined so as to be parallel with its respective vane 16. The degree of inclination of the vanes and the particle projecting edges may advantageously be about 6° to each side of axis 32. Thus a pair of adjacent slots would be inclined in complementary angles to each other in that one slot would be inclined at an acute angle of about 84° with respect to bottom wall 44, while the adjacent slot would be at the obtuse angle of about 96°.

As clearly shown in FIGS. 5–6 the resultant slots 50 are formed by blades 46 being in the form of a trapezoid. For example the trapezoid formed by blade 46A includes a short parallel side 52A and a long parallel side 54A interconnected by intermediate sides 48A, 56A with, of course, side 48A constituting a particle projecting edge of the slot 50A. The adjacent blade 46B similarly includes a short parallel side 52B and a long parallel side 54B interconnected by intermediate sides 48B and 56B with side 48B being the particle projecting edge. Since vanes 16 are alternately canted the short side 52A is adjacent to the long parallel side 54A, while sides 48A and 56A are mirror images of each other and are of substantially equal length.

Referring again to FIGS. 3–4 since the impelling surface or particle projecting edge 48A is angled so as to be parallel to the throwing face of vane 16 particle 17A leaves the impeller case at position 17A ahead of particle 19A when its vane is in position 16A. Thus at position 17B the particle reaches the heel 30 of vane 16 which is now rotated to position B, while particle 19B is emerging from impeller case slot 20 and is thus not yet out far enough to be on the vane. In other words the vane surface for particle 19 had not yet caught up to the particle. Contact takes place at position 19C and the contact is made by the heel 30 of vane now in position 16C which is at the same radius from axis 32 as was true of particle A.

FIGS. 7–11 show a modified form of impeller 60. As indicated therein the impeller again has the open top wall 42 and a boss 62 on bottom wall 44 for attachment to a runnerhead. The cylindrical side wall also includes spaced peripheral trapezoidal blades 64 to thereby create the alternately inclined slots 66 of the type illustrated in FIGS. 5–6. As shown in FIG. 8 the interior of the sidewall of impeller 60 tapers from its top 68 to edge 70 which constitutes the top of slot 66. Advantageously each blade 64 includes an integral rib 72 which represents a smooth extension of the sides of slot 66. FIG. 9 for example shows one blade 64A which has the small side of its trapezoid adjacent the base 44 of the impeller. As indicated therein the rib 72A of blade 64A generally assumes the trapezoidal shape of its blade in that it includes a long edge 74 which begins at the top 68 of the impeller and is disposed generally parallel to a short edge 76 adjacent the bottom 44 of the impeller. Edge 76 can be small enough to essentially approach a point as indicated by the cross-sectional view in FIG. 11. Intermediate edges 78 and 80 are mirror images of each other. As shown in FIG. 8 these edges 78, 80 taper inwardly from the floor 90 of impeller 60 to the upper edge 68 whereby the cross-sectional thickness of the rib decreases in thickness toward edge 68.

Rib 72A is thus formed of three exposed sides; the inner side 82 facing the impeller interior and connecting sides 84, 86. As shown in FIG. 9 inner side 82 is of generally triangular or trapezoidal shape (since lower edge 76 is so small that it almost comes to a point). FIG. 7 shows side 84 to be a smooth extension of the blade or slot edge while side 86 is also a smooth extension of the blade edge although a portion 88 of the blade edge is disposed at a different angle thereto.

Adjacent blade 64B, as shown in FIG. 10, is an inverted image of adjacent blade 64A. Thus blade 64B includes a rib 72B having triangular inner face 92 and side faces 94, 96 which are similar to but in inverted form with respect to sides 82, 84 and 86 of rib 72A.

The ribs function not only as reinforcement means for the blades but also to present extended impelling or particle projecting edges for each slot.

Accordingly, with the new impeller design all of the shot particles are presented correctly across the entire width of the vane. Since all particles contact the vane as near to the heel as possible, batting action is reduced to a minimum. Consequently, wear on the vane is considerably reduced. Moreover, the entire length of the vane is used in propelling the abrasive particles. Since bouncing of the slot is reduced due to an improved radial velocity relationship between the particles and vanes, the vanes contact the shot or particles over a greater distance thereby exerting better control over the particles with accompanying improvement in the wheel stream pattern. Virtually no area of the vane throwing surface is wasted as was true with prior arrangements.

What is claimed is:

1. A particle-throwing apparatus comprising a runnerhead mounted for rotation about its central axis, said runnerhead having a planar support surface normal to said central axis, a plurality of throwing vanes radially mounted on said runnerhead support surface for rotation with said runnerhead, each of said vanes having a particle-throwing face inclined with respect to said planar support surface, each of said vanes having a heel, the heels of said vanes being spaced from each other to create an open area at the center of said support surface, an impeller case disposed in said open area, a feed slot in the wall of said impeller case, an impeller mounted in said im-

peller case, said impeller being connected to said runnerhead for rotation therewith, said impeller having an upstanding wall, said impeller having spaced longitudinal blades which create peripheral slots therebetween about said wall of said impeller whereby particles fed into said impeller are projected therefrom through said impeller case slot and against said vanes, each of said peripheral impeller slots having a particle-projecting edge formed by the edge of its adjacent blade, and each particle projecting edge being inclined with respect to said planar support surface.

2. A particle-throwing apparatus as set forth in claim 1 wherein each of said peripheral impeller slots is disposed for projecting particles to a respective vane, and the particle projecting edge of each impeller slot being parallel to the throwing face of its respective vane.

3. A particle-throwing apparatus as set forth in claim 2 wherein the throwing face of every other vane is inclined at the same first angle with respect to said planar support surface.

4. A particle-throwing apparatus as set forth in claim 3 wherein the vanes intermediate said every other vane are inclined at the same second angle with respect to said support surface.

5. A particle-throwing apparatus as set forth in claim 4 wherein said first angle is an acute angle and said second angle is a complementary obtuse angle.

6. A particle-throwing apparatus as set forth in claim 5 wherein each impeller blade is in the shape of a trapezoid having a short parallel side and a long parallel side interconnected by a pair of intermediate sides.

7. A particle-throwing apparatus as set forth in claim 6 wherein the short parallel side of each trapezoid is disposed adjacent the long parallel side of the trapezoid of the adjacent impeller blade.

8. A particle-throwing apparatus as set forth in claim 7 wherein all of said impeller slots are of uniform width.

9. A particle-throwing apparatus as set forth in claim 8 wherein the intermediate sides are substantially equal in length.

10. A particle-throwing apparatus as set forth in claim 1 wherein each impeller blade is in the shape of a trapezoid having a short parallel side and a long parallel side interconnected by a pair of intermediate sides.

11. A particle-throwing apparatus as set forth in claim 10 wherein each short parallel side is disposed adjacent the long parallel side of the trapezoid of the adjacent impeller blade.

12. A particle-throwing apparatus as set forth in claim 11 wherein the intermediate sides are disposed at complementary angles with respect to the parallel sides.

13. A particle-throwing apparatus as set forth in claim 12 wherein the intermediate sides are substantially equal in length.

14. A particle-throwing apparatus as set forth in claim 13 wherein all of said impeller slots are of uniform width.

15. A particle-throwing apparatus as set forth in claim 14 wherein a tapered rib is connected to each blade in said impeller.

16. A particle-throwing apparatus as set forth in claim 15 wherein each rib assumes the generally trapezoidal shape of its blade, each rib having a substantially triangular face disposed toward the interior of said impeller, and the sides of each rib being integral extensions of the sides of its blades.

17. An impeller for use in a particle-throwing apparatus, said impeller being in the form of a hollow cylindrical body having a central axis, said body being open at its top whereby throwing particles may be fed therein, said body having a closed bottom wall, means on said bottom wall for securing said impeller to a rotatable runnerhead of a particle-throwing apparatus whereby said impeller may rotate with the runnerhead, said body having a cylindrical sidewall formed by a plurality of spaced-apart blades, the spacing of said blades creating a plurality of slots in said sidewall, each of said slots having a particle-projecting edge formed by the edge of its adjacent blade, and each projecting edge being inclined with respect to said bottom wall and said central axis.

18. An impeller as set forth in claim 17 wherein each particle projecting edge is inclined in a direction opposite to the direction of inclination of the particle-projecting edge of its adjacent slot.

19. An impeller as set forth in claim 18 wherein the particle-projecting edge of each slot is inclined at an angle with respect to said bottom wall which is complementary to the angle of inclination of the particle-projecting edge of the adjacent slot.

20. An impeller as set forth in claim 17 wherein each blade is in the form of a trapezoid having a short parallel side and a long parallel side interconnected by a pair of intermediate sides.

21. An impeller as set forth in claim 20 wherein each short parallel side is disposed adjacent the long parallel side of the trapezoid of the adjacent blade.

22. An impeller as set forth in claim 21 wherein the intermediate sides are mirror images of each other and are of substantially equal length.

23. An impeller as set froth in claim 22 wherein all of said slots are of uniform width.

24. An impeller as set forth in claim 23 wherein a tapered rib is connected to each blade in said impeller.

25. An impeller as set forth in claim 24 wherein each rib assumes the generally trapezoidal shape of its blade, each rib having a substantially triangular face disposed toward the interior of said impeller, and the sides of each rib being integral extensions of the sides of its blades.

* * * * *