

United States Patent

Barnthouse

[15] 3,660,943

[45] May 9, 1972

[54] SHOT BLAST CHAMBER AND IMPELLER LINERS

[72] Inventor: Carl W. Barnthouse, 29243 Southgate Drive, Southfield, Mich. 48076

[22] Filed: Jan. 26, 1970

[21] Appl. No.: 5,726

[52] U.S. Cl. 51/9, 51/15

[51] Int. Cl. B24c 3/14

[58] Field of Search 51/8, 9, 15

References Cited

UNITED STATES PATENTS

469,642	2/1892	Nehr.....	51/9
859,863	7/1907	Young et al.	51/9
1,400,585	12/1921	Washburn.....	51/8
1,423,128	7/1922	Liedtke.....	51/15
1,849,895	3/1932	Walters.....	51/15

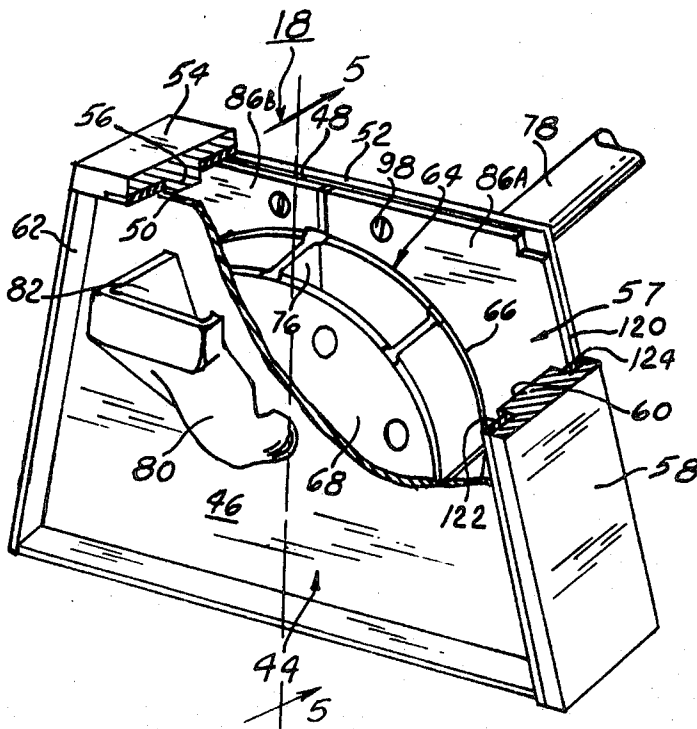
1,918,653	7/1933	Martin.....	51/9 X
2,178,728	11/1939	Schneible.....	51/8
2,276,345	3/1942	Rosenberger.....	51/9
3,309,818	3/1967	Brown.....	51/8
3,319,383	5/1967	Bowling et al.	51/9

Primary Examiner—Lester M. Swingle
Attorney—Hauke, Gifford and Patalidis

[57] ABSTRACT

A shot blast cleaning unit having an abrasive throwing unit of the rotating impeller type, wherein the sides of the impeller housing are lined with an impact deadening material such as urethane rubber to lengthen their life. The parts to be cleaned by the abrasive are placed upon a rotatably mounted work holding table and rotated into the cleaning chamber formed around a portion of the table. The top surface of the table and the inner surface of the side and top walls of the chamber are also lined with the deadening material to protect the table and walls from the abrasive.

16 Claims, 12 Drawing Figures



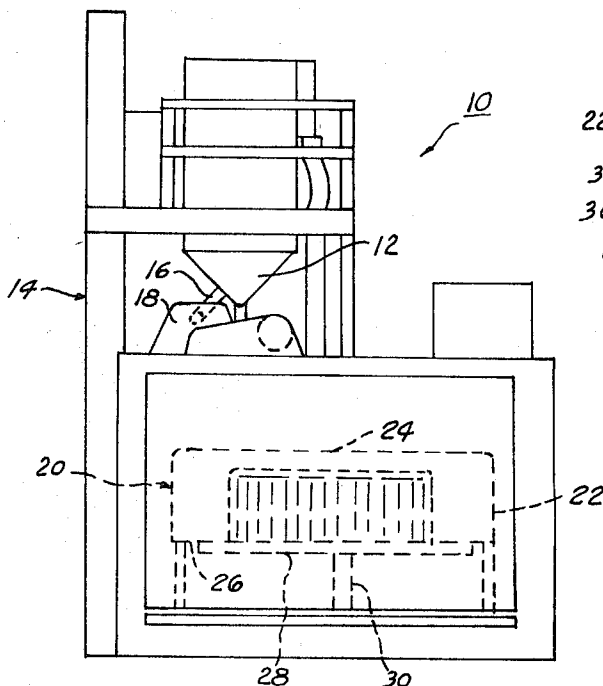


FIG-1

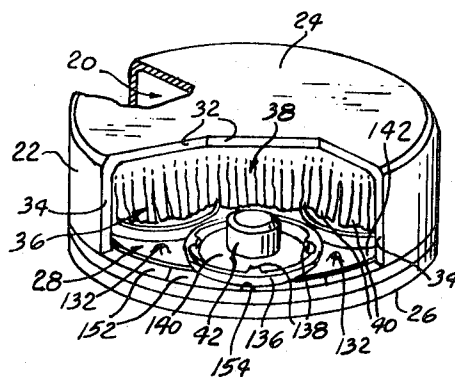


FIG-2

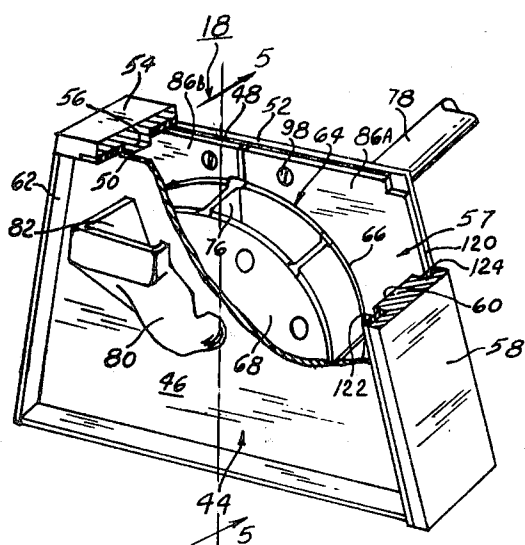


FIG-3

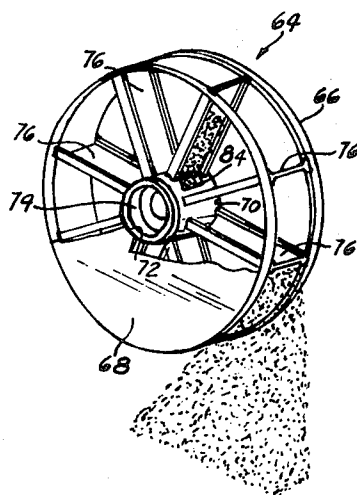


FIG-4

INVENTOR

CARL W. BARNTHOUSE

By Hauke, Gifford &
Patalidis

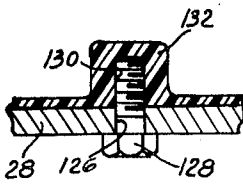


FIG-8

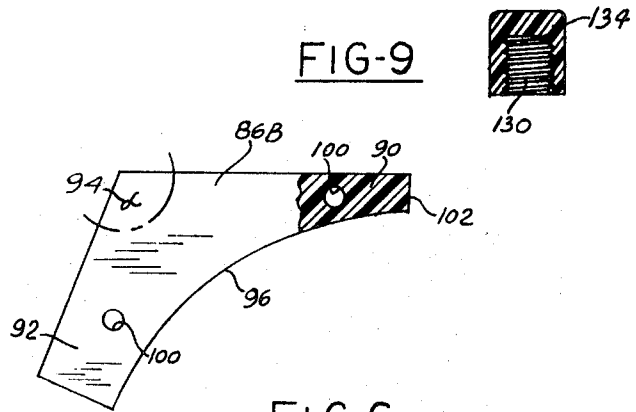


FIG-9

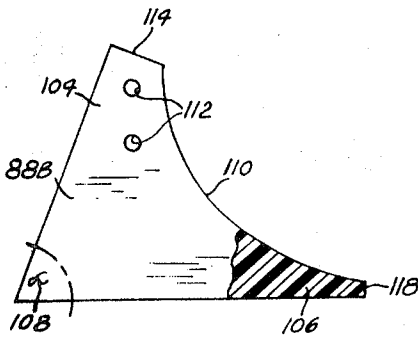


FIG-7

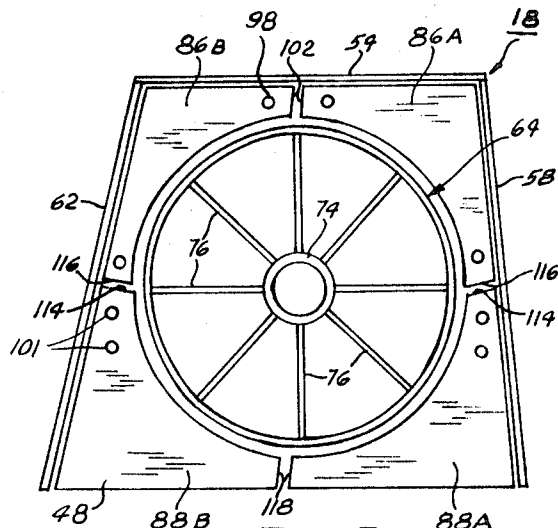


FIG-5

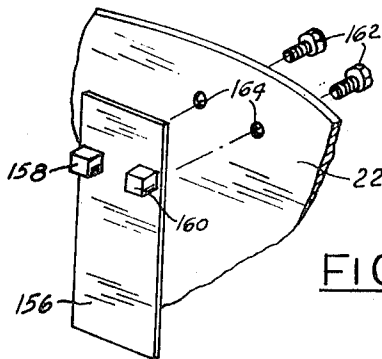


FIG-11

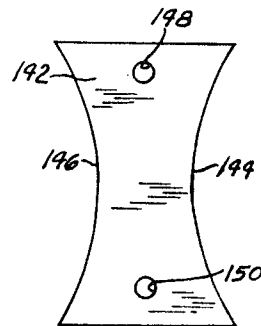


FIG-10

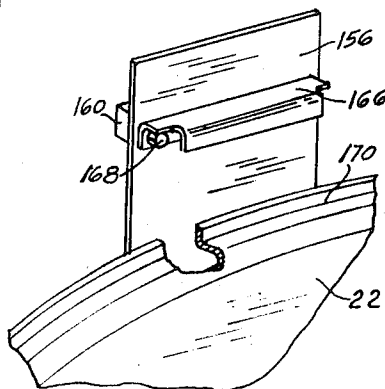


FIG-12

INVENTOR
CARL W. BARNTHOUSE

By Hauke, Gifford &
Patalidis

SHOT BLAST CHAMBER AND IMPELLER LINERS

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to blast cleaning machines and more particularly to a blast cleaning machine wherein the semipermanent parts in the impeller unit and the cleaning chamber subjected to the abrasive are formed with an outer surface of an impact deadening material such as urethane rubber to lengthen their life.

2. Description Of The Prior Art

In the prior art, various types of blast cleaning machines have been used wherein the abrasive, which is usually in shot or pellet form is thrown from an impeller unit toward the workpiece to be cleaned. The impeller unit includes a rotatably mounted impeller wheel surrounded by an outer housing. The impeller wheel includes a pair of parallel disks secured at their center onto a drive shaft and has impeller blades disposed between the disks extending radially outwardly from the shaft. The abrasive is fed through a bore formed in the shaft to the impeller blades, which throws the abrasive toward the workpiece to be cleaned. The impeller unit includes a set of metal liners disposed within the outer housing adjacent the outer edge of each disk, protecting the outer housing from the abrasive. The continued barrage of abrasive eventually destroys the liners, necessitating their replacement.

The workpiece to be cleaned is placed in a cleaning chamber, where it is cleaned by the thrown abrasives. The inner surfaces of the chamber are covered with replaceable metal liners to protect the walls from the abrasive. When the liners are worn out by the abrasive, they are replaced.

SUMMARY OF THE INVENTION

The impeller unit and blast cleaning chamber liners of the present invention have a longer life than the conventional metallic liners by being completely formed from an impact deadening material such as urethane rubber or by having the surfaces that are subjected to the abrasive covered with a layer of such material.

The impeller unit, which is preferably formed as previously described, is provided with liners disposed adjacent the periphery of each of the impeller disks and extending radially outward therefrom. Each of the liners has a layer of impact deadening material such as urethane rubber covering its inner surface. As the abrasive bounces around between the inner surfaces of the liners, the layer of material absorbs some of the energy of the abrasive, retarding the destruction of the liners and thereby lengthening their life.

The liners used to cover the inner surfaces of the cleaning chamber may have the surfaces that are subjected to the barrage of abrasive lined with the deadening material, but, preferably, the liners are formed entirely from such material. The material acts to absorb a portion of the energy of the thrown abrasive, retarding the destructive force of the abrasive and, thereby, increasing the life of the liners. Furthermore, by absorbing part of the energy of the abrasive, the abrasive does not bounce around the cleaning chamber as much as when purely metallic liners are used, further reducing the destructive force of the abrasive. Finally, the use of such impact deadening material increases the useful life of the abrasive shot by reducing the amount by which it is broken up each time it is used. The material provides a relatively soft surface for the shot as compared to conventional metallic liners.

DESCRIPTION OF THE DRAWINGS

The description refers to the accompanying drawings wherein like reference characters refer to like parts throughout the several views, and in which:

FIG. 1 is a front elevational view of a blast cleaning machine according to the present invention;

FIG. 2 is a perspective view of the loading zone and cleaning chamber of the blast cleaning machine shown in FIG. 1;

FIG. 3 is a perspective, partly in section view, of the impeller unit of the present invention;

FIG. 4 is a perspective view of the impeller wheel of the present invention;

FIG. 5 is a cross-sectional view taken on line 5—5 of FIG. 3;

FIG. 6 is an elevational view of an upper inner side liner of the impeller unit;

FIG. 7 is an elevational view of a lower inner side liner of the impeller unit;

FIG. 8 is a fragmentary cross-sectional view of a liner and wall showing the liner secured to the wall;

FIG. 9 is a cross-sectional view of a nut constructed according to the present invention;

FIG. 10 is a plan view of the liner used on the table in the cleaning chamber;

FIG. 11 is a perspective view of a cleaning chamber liner showing its connection to the top or side walls of the chamber; and

FIG. 12 is a perspective view of a cleaning chamber liner showing an alternative type of connection to the side walls.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a blast cleaning machine, generally indicated at 10, includes an abrasive storage and feed chamber 12 secured to the upper portion of a support structure 14. Abrasive from the chamber 12, which is preferably in shot or pellet form, flows through a conduit 16 into an impeller unit 18. The impeller unit 18 hurls the abrasive into a cleaning chamber 20, which, as indicated in FIG. 2, is formed with a cylindrical side wall 22, a generally flat circular horizontal top wall 24, and a generally flat circular horizontal bottom wall 26. The bottom wall 26 includes a central circular table 28 fixedly secured to one end of a shaft 30, (FIG. 1) which has its other end rotatably mounted on the support structure 14 of the machine 10. Appropriate driving means (not shown) are secured to the shaft 30 to rotate the table 28.

As illustrated in FIG. 2, a portion of the top wall 24 is cut away forming edge 32. A portion of the side wall 22 is cut away forming edges 34, which extend downwardly from edge 32 to expose a portion of the top surface of the table 28 and to form a loading zone generally indicated at 36. The loading zone 36 is separated from the cleaning chamber 20 by a flexible shield 38 having its upper edge secured to the top wall 24 adjacent the edge 32 by any convenient means. The lower portion of the shield 38 is cut into strips as at 40. Although only a single shield 38 has been shown it should be pointed out that it is common to provide at least two shields like the one at 38 in spaced relationship to insure that none of the abrasive will escape from the cleaning chamber 20.

As the table 28 is rotated by the shaft 30 and the appropriate driving mechanism, successively different portions of the table 28 pass under the shield 38 and into the loading zone 36. As the table 28 rotates, a workman standing in front of the loading zone 36 places parts to be cleaned, as indicated at 42, on the table 28, allowing the parts to be rotated with the table 28 under the shield 38 and into the cleaning chamber 20, where the parts are cleaned by a barrage of abrasive from the impeller unit 18. As the table continues to rotate, the parts again pass under the shield 38 and into the loading zone 36, where the workman removes the cleaned parts and places more parts to be cleaned on the table 28.

Referring to FIG. 3 the impeller unit 18 comprises an outer housing 44 that includes a pair of opposed generally parallel side wall members 46 and 48 that are narrower at their top edges, 50 and 52, respectively, than at their bottom edges. The housing 44 includes an elongated member 54, which is generally T-shaped in cross section, disposed across the top edges 50 and 52 along the length of the members 46 and 48 and having a downwardly extending projection 56 disposed between the side members. Thus, the member 54 forms the top wall of a chamber 57 formed by the housing 44. A second elongated member 58, similar to member 54, is disposed

across the side edges of the members 46 and 48 along their height and includes an inwardly extending projection 60 disposed between the side members, forming a side wall of the chamber 57. A third elongated member 62, shown partially in FIGS. 3 and 5, similar to the member 58, is disposed across the other side edges of the members 46 and 48, forming a side wall of the chamber 57. The bottom edges of the side members 46 and 48 and the members 58 and 62 define a downwardly facing opening out of the chamber 57 for reasons to be described.

An impeller wheel 64, as shown in FIGS. 3 and 4, for throwing the abrasive into the cleaning chamber 20 is rotatably mounted in the chamber 57 and includes a pair of opposed substantially parallel disks 66 and 68 having central circular apertures 70 and 72, respectively, formed therein. A cylindrical support member 74 disposed between the disks 66 and 68 and secured in the apertures 70 and 72 is rotatably mounted between the housing side members 46 and 48. Several impeller blades 76, which are generally rectangularly shaped are secured between the disks 66 and 68 in planes substantially perpendicular to the planes of the disks and extend radially outward from the cylindrical member 74.

A rotatably mounted shaft 78 (FIG. 3), driven by any convenient source of power, has one end extending through member 48 and is secured to one end of the cylindrical member 74 by any convenient means for rotating the impeller wheel 64. A chute 80 secured to the outer surface of the side member 46 has its upper opening 82 registering with the conduit 16 for receiving abrasive therefrom. The lower end of the chute 80 opens into the free end of the cylindrical member 74 for depositing abrasive therein. The abrasive deposited in the member 74 passes through apertures 84 (only one of which is shown in FIG. 4) formed in the member 74 between the disks 66 and 68, allowing the abrasive to flow between the disks and be thrown outwardly by the blades 76. Thus, as the impeller wheel 64 is rotated by the shaft 78, abrasive from the storage chamber 12 flows down through the conduit 16 into the chute 80, where it flows into the member 74 and out the apertures 84. From the apertures 84 the abrasive is thrown by the blades 76 out of the downwardly facing opening in the housing 44 into the cleaning chamber 20.

During the cleaning operation, much of the abrasive bounces around within the chamber 57, thus, necessitating the use of replaceable inserts within the chamber to prevent the abrasive from destroying the housing 44. Referring to FIGS. 3, 5, 6 and 7, there is shown replaceably impeller housing upper inner side liners 86A and 86B and lower inner side liners 88A and 88B. Each of the upper inner side liners 86A and 86B is generally flat and L-shaped having two arms 90 and 92 with a central angle 94 slightly greater than 90° to provide for the outwardly sloping housing 44. The liners 86A and 86B include an inwardly curved arcuate edge 96 formed between the two arms 90 and 92 opposite the angle 94. Two of the upper side liners 86A and 86B are secured to the upper portion of the inner surface of each of the side members 46 and 48 by means of screws 98 projecting through apertures 100 formed in the liners. The liners 86A and 86B, secured to the inner surface of the member 48, are disposed in substantially the same plane as the disk 66 and have their arcuate edges 96 lying immediately adjacent the periphery of the disk 66. The two liners have their edge 102 formed on arm 90 abutting each other and extend downward therefrom, as illustrated in FIGS. 3 and 5. The member 46 has a corresponding pair of liners secured thereto.

As can best seen in FIGS. 5 and 7, each of the lower inner side liners 88A and 88B is generally flat and L-shaped having two arms 104 and 106 with a central angle 108 slightly less than 90° to provide for the outwardly sloping housing 44. The liners 88A and 88B include an inwardly curved arcuate edge 110 formed between the two arms 104 and 106 opposite the angle 108. Two of the lower side liners 88A and 88B are secured to the lower portion of the inner surface of each of the side members 46 and 48 by means of screws 101 projecting through apertures 112 formed therein. The liners 88A and 88B, secured to the inner surface of the member 48, as shown

in FIG. 5, are disposed in substantially the same plane as the disk 66 and have their arcuate edges 110 lying immediately adjacent the periphery of the disk 66. Each of the two liners 88A and 88B has its edge 114 formed on an arm 104 abutting the edge 116 formed on each of the liners 86A and 86B, and the edges 118 of the liners 88A and 88B abut each other, as shown in FIG. 5. The member 46 has a corresponding pair of liners secured thereto. Thus, two liners 86A and 86B and two liners 88A and 88B are required for each of the members 46 and 48.

The replaceable liners 86A and 86B and 88A and 88B protect the housing side members 46 and 48 from the destructive action of the abrasive during the operation of the cleaning machine. The inner surface of the metal liners that are subject to the abrasive are covered with a layer of impact absorbing and deadening material. A material which has been found to be especially suitable for this purpose is urethane rubber. The layer of urethane rubber may be secured to the metallic portion of the liners by any convenient means well known in the art. The layer of material absorbs some of the energy of the abrasive, thereby reducing the attack of the abrasive on the liners, increasing the life of the liners, which results in a decrease in down time due to liner failure. The layer of urethane rubber, which is formed from the reaction of polyhydroxyl materials such as polyesters, polyethers and the like with isocyanates, may be of any desired thickness, but preferably is in the range of one-eighth to one-half of an inch thick.

During operation of the machine, the abrasive in the chamber 57 attacks the joint formed between the outer edges of the liners and the elongated members 54, 58 and 62, as indicated at 120 in FIG. 3. The inner surfaces of the T-flanges, as indicated at 122 and 124 on member 58, are provided with a layer of the deadening material such as urethane rubber, to form a tight seal with the edges of the liners, thereby resisting the attack of the abrasive at the joint. As shown in the preferred embodiment in FIG. 3, the inner surfaces of the projections 56 and 60 on members 54 and 58 are not formed with a layer of the deadening material. Although the abrasive does attack the projections 56 and 60, a layer of such material provided on the projections would absorb an excessive amount of energy of the abrasive, inhibiting the proper operation of the cleaning machine.

Referring to FIGS. 1, 2 and 8, the table 28 is provided with apertures 126 formed therein for receiving bolts 128 therethrough. The top surface of the table 28 is covered with pads preferably formed from the deadening material such as urethane rubber, to prevent the abrasive from destroying the table during the cleaning operation. As illustrated in FIG. 8, the pads are secured to the table 28 by means of the bolts 128 engaging threaded bores 130 formed in parallelepiped member 132 formed on the pads. Referring to FIGS. 8 and 9, the member 132 may be formed from urethane rubber integrally with the pad, or, alternatively, a number of urethane rubber closed end nuts 134 may be provided for this purpose. When the nuts 134 are provided, the urethane pads may be formed with an aperture therein for the bolt 128.

The pads secured to the top of the table 28 include a ring 136 (FIG. 2), that may be formed entirely from the material such as urethane rubber or, alternatively may have an outer layer of such material formed around a metallic base structure. The ring 136 includes a plurality of parallelepiped members 138 extending inwardly therefrom and having threaded bores formed therein for securing the rings to the top of the table 28. A disk 140 formed from the deadening material is disposed within the ring 136 for protecting the table 28 from the destructive action of the abrasive. During operation of the cleaning machine, the part 42 to be cleaned is placed on the disk 140 and rotated into the cleaning chamber 20, with the ring 136 maintaining the part 42 in position.

Referring to FIGS. 2 and 10, an elongated flat pad 142 having opposed inwardly curved arcuate edges 144 and 146 is disposed between adjacent rings 136 with the arcuate edges

lying adjacent the rings. The pad 142, preferably formed entirely from the deadening material, includes a pair of apertures 148 and 150 for receiving bolts therethrough to secure the pad to the top of the table 28. The nuts 134 may be screwed over the end of the bolts.

Referring to FIG. 2, flat arcuate sections 152, preferably formed entirely from the deadening material, have their outer edges secured to rim 154 of the structure 14, with their inner edge loosely engaging the outer edge of the table 28, preventing abrasive from being thrown through the space between the structure 14 and the table 28.

In operation, as the table 28 is rotated, parts are placed on the pads 140 and rotated into the chamber 20 for cleaning by the abrasive. The table 28 is protected from the barrage of abrasive by the pads 140 and 142 and the rings 136. The arcuate member 152 prevents the thrown abrasive from passing down through the space between the table 28 and the rim 154 at a high speed, thus preventing damage of the machine components disposed beneath the table 28. Furthermore, the components formed in the manner of the present invention increase the useful life of the abrasive, which is usually in shot or pellet form. The components provide a relatively soft surface as compared to an equivalent metal pad, thus, reducing the amount of abrasive break-up that occurs, lengthening the life of the abrasive.

Referring to FIGS. 2, 11 and 12, a pad 156 is provided for covering the inner surface of the side wall 22 and the top wall 24 of the cleaning chamber 20. The pad is formed of the impact deadening material and is a generally flat rectangular member having a pair of parallelepiped members 158 and 160 integrally formed therewith. The members 158 and 160 include threaded bores formed therein, as illustrated in FIG. 8, for securing the pad 156 to the side and top walls 22 and 24. As shown in FIG. 11, the pad 156 may be secured to the walls 22 and 24 by means of bolts 162 passing through apertures 164 formed in the walls and screwed into the threaded bores formed in the members 158 and 160. Alternatively, a downward opening U-shaped channel 166 may be secured to the rear side of the pad 156 between the members 158 and 160 by means of bolts 168. The channel 166 may then be hooked over a Z-shaped flange 170 that is secured to the side wall 22. The pads 156 may be formed entirely from the material such as urethane rubber, or, alternatively, an outer layer of such material may be secured over a metal base. The members 158 and 160 may be formed integrally with the pad 156 or may be provided separately, as shown in FIG. 9. The pads 156 prevent the abrasive from attacking the side wall 22 and the top wall 24 of the chamber 20 during the cleaning operation.

Thus, an improved shot blast cleaning machine 10 is described wherein some of the replaceable liners and inserts are formed with an outer layer of material such as urethane rubber or are formed entirely from such material, increasing the life of the liners and inserts, thereby reducing down time and expense resulting from machine repair. Furthermore, the improved liners and inserts increases the life of the abrasive, further reducing the cost of the cleaning operation.

I claim:

1. In a blast cleaning machine including an abrasive storage and feed container and a cleaning chamber, an improved impeller unit receiving abrasive from the storage container and hurling the abrasive into the cleaning chamber, comprising:

a first housing;

an impeller wheel rotatably mounted in said housing for hurling the abrasive into said cleaning chamber;

a first replaceable liner secured to the inner surface of said housing adjacent said wheel, said liner formed from an impact absorbent material for absorbing a portion of the energy of the abrasive to lengthen the service life of said liner;

said cleaning chamber comprising:

a second housing;

a second replaceable liner secured to the inner surface of said second housing and having an inner surface formed from an impact absorbing material for absorbing a portion of the energy of the abrasive to lengthen the service life of said liner, said second housing including a substantially horizontal circular part supporting surface, the central portion of said supporting surface being formed by a rotatably mounted circular table and said second liner including a substantially flat elongated arcuate member having its outer arcuate edges secured to the outer edge of said part supporting surface and its inner arcuate edge loosely engaging the periphery of said table.

2. The impeller unit as defined in claim 1, wherein a plurality of said first replaceable liners are secured within said housing.

3. The impeller unit as defined in claim 1, wherein said first liner is substantially flat and includes an arcuate edge disposed immediately adjacent the periphery of said wheel.

4. The impeller unit as defined in claim 1, wherein the inner surface of said first liner is formed from urethane rubber.

5. The impeller unit as defined in claim 1, wherein said first liner includes a metallic base member having a layer of urethane rubber secured thereto forming the inner surface of said liner.

6. The impeller unit as defined in claim 1, wherein a plurality of said first liners are secured within said housing, each of said first liners including a generally flat L-shaped member with an inner arcuate edge disposed adjacent the periphery of said wheel with said member disposed radially outward therefrom.

7. The impeller unit as defined in claim 1, wherein said first liner includes a generally flat member disposed in a plane substantially perpendicular to the axis of rotation of said wheel, and including a third replaceable liner secured to said first outer housing and having a portion engaging the outer edge of said first mentioned liner and forming substantially a right angle therewith, said portion of said third liner having its surface engaged with said first mentioned liner formed from an absorbent material for resisting the destructive action of the abrasive.

8. The impeller unit as defined in claim 7, wherein said absorbent material is urethane rubber.

9. The blast cleaning machine as defined in claim 1, wherein said impeller unit includes a pair of opposed parallel circular disks;

a plurality of said first replaceable liners, each of said first liners including a generally flat L-shaped metallic member with an inner arcuate edge disposed adjacent the periphery of one of said disks, each of said first liners being disposed radially outward from one of said disks in substantially the same plane as the disk, each of said metallic members having a layer of impact absorbing material secured thereto forming the inner surface of said first liners; and

at least one metallic elongated member secured to said first outer housing and having a portion disposed between at least two of said first replaceable liners having their arcuate portions adjacent opposite disks, said elongated member including an outwardly extending flange formed along each side thereof parallel to the axis of elongation of said elongated member, the inner surface of each of said flanges engaging an outer edge of one of said first replaceable liners and having a layer of impact absorbing material secured thereto for forming a seal with said edges.

10. In a blast cleaning machine including an abrasive storage and feed container and an impeller unit, an improved cleaning chamber for receiving the abrasive hurled by the impeller unit to clean the parts disposed therein, comprising:

an outer housing; and

a replaceable liner secured to the inner surface of said outer housing and having an inner surface formed from an im-

pact absorbing material for absorbing a portion of the
 energy of the abrasive to lengthen the service life of said
 liner, said outer housing including a substantially horizon-
 tal circular part supporting surface, the central portion of
 said supporting surface being formed by a rotatably
 mounted circular table and said liner including a substan-
 tially flat elongated arcuate member having its outer arc-
 uate edges secured to the outer edge of said part sup-
 porting surface and its inner arcuate edge loosely engag-
 ing the periphery of said table.
 11. The cleaning chamber as defined in claim 10, wherein a
 plurality of said replaceable liners are secured within said
 housing.
 12. The cleaning chamber as defined in claim 10, wherein
 the inner surface of said liner is formed from urethane rubber.
 13. The cleaning chamber as defined in claim 10, wherein
 substantially all of the liner is formed from urethane rubber.
 14. In a blast cleaning machine including an abrasive
 storage and feed container and an impeller unit, an improved
 cleaning unit for receiving the abrasive hurled by the impeller
 unit to clean the parts disposed therein, said cleaning unit
 comprising:
 an outer housing;
 a replaceable liner; and
 means securing said liner to the inner surface of said outer
 housing, said liner formed from an impact absorbing
 material for absorbing a portion of the energy of the abra-
 sive to lengthen the service life of said liner, said means
 for securing said liner to the surface of said housing com-
 prising a downwardly opening U-shaped channel secured
 to one surface of said liner and a flange member secured
 to said inner surface of said housing to receive said U-
 shaped channel.

15. In a blast cleaning machine for cleaning an article, said
 machine including an abrasive storage and feed container and
 a cleaning unit, an improved impeller unit receiving abrasive
 from the storage container and hurling the abrasive into the
 cleaning unit, said impeller unit comprising:
 a housing;
 an impeller wheel rotatably mounted in said housing for
 hurling the abrasive into said cleaning unit;
 said housing having a pair of side walls substantially normal
 to the axis of rotation of said impeller wheel and end walls
 joining said side walls;
 replaceable liners formed of an impact absorbent material
 secured to the inner surface of said side walls for absorb-
 ing a portion of the energy of the abrasive to lengthen the
 service life of the liner; and
 the areas of said end walls adjacent said side walls being
 provided with impact absorbent material engaging with
 said liners to form a seal at the joint between said side
 walls and said end walls with an intermediate portion of
 said end walls being free of said impact absorbent materi-
 al.
 16. In a blast cleaning machine including an abrasive
 storage and feed container and an impeller unit, an improved
 cleaning unit for receiving the abrasive hurled by the impeller
 unit to clean the parts disposed therein, said cleaning unit
 comprising a housing, a table carried within said housing, a
 plurality of rings secured to said table for maintaining the po-
 sition of the parts to be cleaned on said table, and including at
 least one generally flat replaceable liner formed from impact
 absorbing material secured to said table between a pair of said
 rings, said liner being formed with a pair of concave arcuate
 edges disposed adjacent the periphery of said rings.

* * * * *

35

40

45

50

55

60

65

70

75