SHOT BLASTING DEVICE
Helen H. Walker, 607 Charlton St., Valdosta, Ga. 31601, and Raymond Lightsey and William T. Olin, Valdosta, Ga.; said Lightsey and Olin assign to said Walker.
Filed Mar. 15, 1967, Ser. No. 623,418
Int. Cl. B24e 3/00

U.S. Cl. 51—9
11 Claims

ABSTRACT OF THE DISCLOSURE

Paddle blade shot blasting machine having hoppers for catching spent shot and feed chutes adjustable both longitudinally and angularly for redirecting shot onto the blades; and a vacuum dust elimination system using dual cyclone separators for reclaiming reusable shot and returning it to the machine.

This invention relates to shot blasting devices and more particularly it concerns improvements to shot blasting devices of the type which employ rotating blades to impel abrasive shot at workpieces to be cleaned or surface finished.

The present invention provides improvements to shot blasting machines of the type shown and described in U.S. Pat. 2,752,732 to L. M. Walker. These machines incorporate a housing or enclosure in which workpieces are held and in which a rotating paddle-like impeller hurl's an abrasive substance such as sand, steel shot etc., at the workpiece.

The aforementioned Walker patent incorporates special collection hopper means arranged to collect the spent abrasive shot after it has been thrown up against the workpiece. This collected shot is thereupon directed through a feed chute and is fed from the chute back to the rotating impeller from the side thereof. The action of the impeller on the shot gives the shot a very high velocity as well as good directivity so that it impinges upon the workpiece with maximum effectiveness.

The present invention resides in certain features which improve the operating characteristics of Walker type shot blasting machines and which increase their versatility. More particularly, the present invention adapts a Walker type machine to more effective use of so-called "light" abrasives. "Light" abrasives are to be distinguished from "heavy" abrasives in that they are of softer materials and thus produces a finer and smoother final surface finish on various workpieces. They do not, however, have the hardness necessary to produce heavy cleaning or scaling action obtained by "heavy" abrasives. "Light" abrasives include such items as glass shot, walnut shells, corn husks, peach pits etc., whereas "heavy" abrasives include such items as steel, chilled iron and various refractory materials such as aluminum oxide, etc.

Light abrasives cannot tolerate excessive impacts without breaking down into useless powder or dust. Thus the action of whirling impeller blades is deleterious on light abrasives. One technique for avoiding or reducing impeller blade impact is to feed the abrasive in toward the axis of blade rotation where the linear blade velocity is minimal. This however tends to spread the path of throw so that only a small portion of the material actually contacts the workpiece after leaving the impeller blade.

The present invention, in one aspect, permits the placement of light abrasives on a rotating impeller in such a manner that the abrasive is not severely impacted by the impeller and yet at the same time is not unduly spread so as to miss the workpiece. The present invention is based in part on the discovery that the spreading action of a rotating impeller which occurs as a result of feeding the impeller near its center of rotation can be considerably reduced if both the angle and position of the chute which feeds the material to the impeller are properly coordinated. The optimum relationship between these two variables depends upon a number of factors such as blade width and length as well as the number of blades on the impeller. Impeller speed and the abrasive material used also affect this relationship. Nevertheless, for any particular operating conditions one can achieve a narrow throw path with a feed close to the center of the impeller rotation simply by providing a proper angle and position for the feed chute. This is achieved, according to the present invention, by the provision of an abrasive feed chute which is adjustable both in position and in angle or tilt.

The present invention in another aspect provides for the effective removal of dust and powder which results from the use of light abrasives without, however, also removing any of the reusable abrasive. Past vacuum systems which were effective to remove dust from the workpiece region also extracted large amounts of reusable abrasive. This is overcome by the present invention by means of a novel separation and return system which operates in conjunction with a vacuum dust removal system. This novel separation and return system comprises a separator, such as a cyclone device, to remove the heavier, reusable particles while permitting useless dust and powder to be eliminated. The reusable particles are then directed out through an air lock in the bottom of the cyclone and are returned to the collection hoppers in the machine.

According to a still further feature of the invention, there are provided novel means for holding the workpieces so that they will be maintained within the narrow throw path of the abrasive material. This novel device means comprises a cylindrical basket formed of an open mesh material and mounted between two discs within the outer housing of the machine. The basket is positioned closely adjacent the top of the impeller blade path and is locked in this position to the discs so that it will not be rotated by them over the impeller. The basket is readily removable from the unit simply by releasing it from the discs.

There has thus been outlined rather broadly the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the full contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of the invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of the invention.

A specific embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings forming a part of the specification, wherein:

FIG. 1 is a side elevational view showing in cross section, a shot blasting machine embodying the present invention;
FIG. 2 is a front elevational view, partially in section, of the machine shown in FIG. 1;
FIG. 3 is an enlarged fragmentary perspective view showing a feed chute and impeller arrangement constituting one portion of the machine of FIG. 1;
FIG. 4 is a further fragmentary perspective view illustrating a feed chute adjustment arrangement forming one portion of the machine of FIG. 1; and
FIG. 5 is a section view taken along line 5-5 of FIG. 1. As shown in FIGS. 1 and 2, a shot blasting machine of the present invention comprises an outer housing 10 of generally rectangular configuration and formed of any suitable material such as steel sheet. The outer housing 10 is made up of upstanding front and back walls 12 and 14, upstanding side walls 16 and 18 and a horizontal top wall 20. An outer door 22 is arranged on the front wall 12 and is hingedly connected thereto as indicated at 24. The outer door 22 is provided with a handle 26 by which it operates a door latch 28 to hold the outer door 22 in closed position as shown in FIG. 1 during operation of the machine.

An impeller casing 30 is provided inside the outer housing 10 toward the bottom center thereof. The impeller casing 30 is formed of parallel upwardly extending lower side walls 32 and 34 and upper side walls 36 and 38 which form continuations of the lower side walls 32 and 34. An impeller shaft 40 extends through the lower side walls 32 and 34 in a generally horizontal direction. The shaft 40 is supported by means of bearings 42 located outside the impeller housing 30. An impeller pulley 44 is mounted on one end of the impeller shaft 40 and is driven by means of a belt 46 from a drive motor 48 located at the bottom of the device. A plurality of impeller blades 50 are mounted to extend in a generally radial direction from the impeller shaft 40 within the impeller housing 30. The blades 50 are secured by means of blade attachment plates 52 to the impeller shaft 40. The blades 50 are of a length to extend close to the top of the upper side walls 36 and 38 as illustrated in FIGS. 1 and 2.

As shown in FIG. 3 the impeller blades 50 are of channel-shaped configuration, the direction of their rotation, i.e. the direction of the arrow A. This serves to control the flow of abrasive material after it has been deposited on the blades and is being impelled toward the blade tips so that the abrasive material will all move completely to the blade tips before being thrown off. This ensures that all of the abrasive particles will be thrown off at the same velocity and after having traveled substantially the same distance along the blade. As a result, the trajectory of the abrasive particles can be maintained within a closely defined path.

As shown in FIGS. 1 and 2 there are provided front and rear hopper walls 54 and 56 which extend slantwise respectively from the top of the lower side walls 32 and 34 of the impeller casing 30 to the front and back walls 12 and 14 of the outer housing 10 at locations slightly above the top of the impeller housing. The front and rear hopper walls 54 and 56 merge at the ends thereof with hopper side walls 58 as shown in FIG. 2. It will be noted that the upper side walls 36 and 38 of the impeller housing 30 cooperate with the front, rear and side hopper walls 54, 56 and 58 to define collection trough regions 60 which extend over the entire lateral expanse within the outer housing 10 except for the region of the impeller casing 30. Thus nearly all of the abrasive material which is present in the region above the hoppers and impeller housing fall into the collection regions.

A pair of feed openings 62 are formed in the upper side walls 36 and 38 of the impeller housing 30 toward the bottom of the collection regions 60. A pair of adjust and each one of the collection regions 60 from the feed openings 62 and into the impeller housing 30 to direct abrasive material from the collection regions 60 in a desired manner onto the rotating impeller blades 50 so that these blades will cause the material to be thrown upwardly along a prescribed trajectory or path, as illustrated by dotted lines 66. As shown in FIG. 3 the tips of the feed chutes 64 are located adjacent the impeller blades 50 so that abrasive material, indicated at 67, will be directed onto each blade in a manner permitting maximum directivity of throw.

As shown in FIG. 4, each feed chute 64 is provided with special mounting means which permit the chute to be adjusted both longitudinally, so that the tip thereof may be displaced relative to the plane of impeller blade rotation, and angularly, so that the angle of the chute may be varied with respect to the plane of impeller blade rotation. This adjustable mounting is made up of a wedge block 68 of tapered configuration which is positioned on the front or rear hopper wall 54 or 56 and under the adjustable feed chute 64. The feed chute 64 and the wedge block 68 are each provided with a hole 70 through which a mounting bolt 71 extends. The mounting bolt 71 passes through an opening 72 in the hopper wall and is tightened down on the feed chute 64, the wedge block 68, and the hopper wall 54 or 56 by means of a tightening nut 74. It will be appreciated that when the nut 74 is loosened, the feed chute 64 may be moved back and forth to position its tip away from or closer to the impeller blades 50. Similarly, with the nut 74 loosened, the wedge block 68 may be moved back and forth to change the tilt of the feed chute.

Reverting to FIGS. 1 and 2 it will be seen that there is provided a workpiece container basket 76, of generally cylindrical shape and mounted within the outer housing 10 with its longitudinal axis extending horizontally a short distance above the top of the impeller casing 30. The basket 76 is formed of a pair of solid end plates 77 which are interconnected by a plurality of reinforcing rods 78. An open mesh cast of expanded metal or similar material is positioned between the end plates 77 and is secured by means of brackets 80 to the reinforcing rods 78. A portion of the cage 79 is constructed to form a basket door 81 connected along one side to the rest of the basket by means of a hinge 82. The door 81 is lockable in closed position by means of latches 83 so that workpieces may be retained within the basket during rotation thereof.

It will be noted that the end plates 77 of the basket 76 extend radially beyond the cage 79 to form flange regions 84. These flange regions are provided with slots 86. The slots 86 permit the basket 76 to be hung on horizontal basket support rods 88 which extend across the length of the basket 76. A removable locking bracket 89 holds the basket 76 securely to the support rods 88 during operation of the device. The support rods 88 extend between a pair of basket support discs 90 arranged parallel to and on the outside of each of the end plates 77. The support discs 90 are themselves provided with support disc shafts 92 which in turn are rotatably mounted in support bearings 94 located on the outside surfaces of the side walls 16 and 18 of the outer housing 10. A drive sprocket 96 is mounted on the outside end of one of the support disc shafts 92 and is driven by means (not shown) from the drive motor 48. This driving movement of the drive sprocket 96 causes the support discs 90 and the basket support rods 88 to turn and this in turn produces rotation of the basket 76.

In order to evacuate the dust which forms within the outer housing 10 during operation of the device, there is provided a vacuum elimination system. As shown in FIG. 1 this system includes a cyclone conduit 100 leading from the interior of the outer housing 10 through its top wall 20 to the feed inlet of a cyclone separator 102. A dust conduit 104 leads from the cyclone separator 102 to a wet dust storage tank 108. A dry dust conduit 110 leads from the cyclone separator 102 to the wet dust storage tank 108. An air-lock 110 comprising a housing 112 having therein a closely fitted multiblade rotatable gate 114, is connected to the bottom of the cyclone separator 102. A shot return conduit 116 extends from the air-lock 110 back through the back wall 14 of the outer casing 10 to the collection trough region 60.

As can be seen in FIGS. 2 and 5, the cyclone separator 102 is actually made up of two separate separator
units 102a and 102b. These units are positioned side by side so that their inlets both merge into the common cyclone conduit 100. As indicated in dotted outline in FIG. 2, the lower ends of the separator units 102a and 102b merge into the common air-lock 110. Additionally, the dust conduit 104 is divided at the top thereof into two branches 104a and 104b each of which extends to the top of one of an associated one of the separator units 102a and 102b.

In operation of the above described device, workpieces to be treated are contained within the basket 76 while it rotates and while the impeller blades 50 hurl abrasive material through the sides of the basket and against the workpieces while preventing the components from the basket simply by opening the outer door 22 and the basket door 81. The basket itself may be removed for repair or replacement simply by loosening the locking bracket 89 and lifting the basket up off the support rods 88.

In operation of the device abrasive shot is hurled at the workpiece basket 76 by the impeller blades 50. This abrasive material then falls back into the collection trough regions 60 and is redirected via the feed chutes 64 through the feed openings 62 and onto the rotating impeller blades 50. As explained above, the position and angle of the feed chutes 64 are both separately adjustable. This permits the abrasive shot to be returned to the impeller blade through a very closely controlled path. It has been found that by proper control of both the feed chute angle and tip position, the spreading effect which occurs when the abrasive material is supplied toward the center of blade rotation can be significantly reduced. The adjustment of course will differ for the various abrasive materials and blade speeds used. However, the adjustment is easily made simply by loosening the tightening nut 74 and moving each feed chute 64 and wedge block 68 longitudinally with respect to the mounting bolt 71.

When using light abrasives in the machine of the present invention a considerable amount of dust or powder is formed which must be removed from the workpiece region. Conventional vacuum elimination systems are inefficient in this regard however, for they remove along with the dust and powder, a rather high percentage of the light, though still reusable, abrasive material.

The cyclone arrangement of the present invention overcomes this problem. Both dust and reusable abrasives are withdrawn from the housing 10 through the cyclone conduit 100. This material then passes one-half to each of the separate cyclone separator units 102a and 102b. The material is fed in tangentially to these units and is caused to rotate very rapidly therein. As a result the lighter unuseable particles are carried toward the center of rotation while the heavier, useable particles remain about the periphery of the unit. The lighter particles are drawn up centrally of the unit and out through the dust conduit 104 to the dust collection bin 106. Meanwhile, the heavier separated particles pass through the air lock 110 and the return conduit 116 to the collection trough region 60 for reuse.

The air lock 110 serves to permit the return of solid abrasive materials to the collection troughs while preventing the vacuum system from sucking material out from this region. This is achieved by virtue of the rotatable gate 114 which is driven by means of a chain 120 from a sprocket 122 on one of the support disc shafts 92. As the gate rotates it permits the interrupted flow of solid abrasive material preventing the continuous flow of air. As a result the vacuum system sees a closed passage-way back to the housing 10.

It has been found that for a given degree of vacuum, which must be provided in accordance with the amount of dust to be removed, the selectivity of abrasive recovery can be improved by providing two cyclone units in parallel. This permits of an evacuation capacity sufficient to remove all of the dust generated inside the housing 70 and at the same time it permits a lower velocity within each cyclone. As a result, less of the heavier particles are swept back into the dust collection bin. This was found to be quite surprising since a faster velocity within the cyclone would be expected to produce greater separation between the lighter and the heavier particles.

Having thus described my invention with particular reference to the preferred form thereof, it will be obvious to those skilled in the art to which the invention pertains, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit and scope of my invention, as defined by the claims appended thereto.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a shot cleaning device, the combination of an outer housing, impeller means including an impeller blade, means for mounting said blade for rotation about a horizontal axis within a lower portion of said housing, means for holding workpieces within said housing above said impeller blade, shot recovery means including recovery hopper means arranged beneath said means for holding workpieces and above said horizontal axis to catch spent shot hurled at such workpieces, at least one feed chute leading out from said recovery hopper means and directed into the plane of rotation of said blade from the side thereof at a location adjacent said horizontal axis and means mounting said feed chute in a manner permitting adjustment of both the angle of said feed chute with respect to the plane of rotation of said impeller blade and the distance of said feed chute from said impeller blade.

2. A combination as in claim 1 wherein said mounting means includes a wedge block mounted between one wall of said hopper means and said feed chute.

3. A combination as in claim 1 wherein said feed chute is connected to said hopper means by means of a bolt passing between a wall of said feed chute and a wall of said hopper means, at least one of said walls having a slot therein for relative longitudinal adjustment of said feed chute and hopper means.

4. A combination as in claim 3 wherein said mounting means further includes a wedge block mounted between said hopper and said feed chute walls with said bolt passing through a longitudinal slot in said wedge block.

5. A combination as in claim 1 wherein said impeller means comprises a plurality of radially extending blades mounted in a common rotative plane.

6. A combination as in claim 5 wherein said impeller blade has a channel shaped cross section opening in the direction of blade movement.

7. A combination as in claim 1 wherein said shot recovery means includes a vacuum exhaust system for removing dust from inside said outer housing, separator means arranged in conjunction with said vacuum exhaust system to separate reusable shot from unusable dust and a return conduit extending from said separator means for conveying reusable shot thereto, said return conduit leading into said hopper means.

8. A combination as in claim 1 wherein said means for holding workpieces within said housing comprises an elongated workpiece support member, rotatable support elements located at opposite ends of said workpiece support member, bearing means securely mounting each of said support elements to said outer housing for rotation in fixed locations and readily releasable means interconnecting said rotatable support elements and said workpiece support member.

9. A workpiece support arrangement suitable for use in shot cleaning devices, said support arrangement comprising a pair of support discs arranged parallel to each other and interconnected by support bars, means mounting said support discs for rotation about an axis passing through them, a workpiece support basket, flange elements mounted on opposite ends of said workpiece support basket, said flange elements having slots which fit...
over said support bars and readily releasable means for securing said support bars in said slots.

10. In a shot cleaning device which comprises an outer housing, means for supporting workpieces within said outer housing, an abrasive shot reservoir and means for impelling abrasive shot from said reservoir against said workpieces, the combination of vacuum means including a conduit connected to said outer housing for withdrawing dust therefrom, separator means arranged along said conduit for extracting reusable shot from said conduit, said separator means including a cyclone device for centrifugally separating said reusable shot, and a return conduit extending from said separator means to said reservoir for returning the reusable shot extracted by said separator means to said reservoir, said separator means including an air lock between said cyclone device and said reservoir, said air lock being constructed to admit the passage of solid material while preventing the continuous flow of air therethrough.

11. In a shot cleaning device which comprises an outer housing, means for supporting workpieces within said outer housing, an abrasive shot reservoir and means for impelling abrasive shot from said reservoir against said workpieces, the combination of vacuum means including a conduit connected to said outer housing for withdrawing dust therefrom, separator means arranged along said conduit for extracting reusable shot from said conduit, said separator means comprising a pair of cyclone devices connected in parallel between said outer housing and said reservoir, and a return conduit extending from said pair of cyclones to said reservoir for returning the reusable shot extracted by said cyclone devices to said reservoir.

References Cited

UNITED STATES PATENTS

1,715,711 6/1929 Kosian 51—13
631,133 8/1899 Starke 51—164
2,752,732 7/1956 Walker 51—9
2,770,924 11/1956 Mead et al. 51—8
2,843,979 7/1958 Lupo 51—164
3,286,406 11/1966 Ashworth 51—8
3,341,979 9/1967 Davidson 51—164

HAROLD D. WHITEHEAD, Primary Examiner