ABRASIVE THROWING MACHINE

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6 Claims.

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This invention relates to centrifugal throwing equipment for propelling abrasive grit and the like at a high velocity against objects to be cleaned and is more particularly concerned with cleaning equipment used in foundries for removing any moulding sand which tends to cling to castings after they have been removed from the moulds.

Abrasive throwing machines employing a rotating wheel with throwing surfaces thereon to centrifugally cast abrasive against the work are old. There has however, been considerable difficulty in feeding abrasive to the throwing surfaces of machines built prior to my invention.

Therefore, a primary object of the present invention has been to provide a machine of novel construction of which an air-supply system is utilized to feed abrasive to the throwing blades and which overcomes the feeding difficulties here-tofore encountered.

An additional object of my invention has been to invent apparatus of the class described in which I provide improved protection against wear due to the abrasive action, both as the same is thrown and as it rebounds from the work. Still another object has been to devise an equipment in which the parts susceptible to the most wear and subject to frequent replacement may be removed from the machine and new ones substituted therefor with a minimum of labor.

Other objects of the invention will become apparent from the following description when read in the light of the accompanying drawings, and the novel features are summarized in the claims.

In said annexed drawings:

Fig. 1 is a side elevation partly in section of my improved blasting equipment;

Fig. 2 is a transverse section through Fig. 1 as indicated by the lines 2—2 thereon;

Figs. 3 and 4 are sections through Fig. 2 as shown by the lines 3—3 and 4—4 respectively; and

Fig. 5 is a detailed fragmentary section through Fig. 2, showing the blade construction and mounting.

In general my invention is adapted to be mounted on flooring situated at two levels. The lower level supports a base which in turn carries a driving motor connected to the impeller wheel, which is preferably mounted on the casing of the blasting chamber and discharges through an opening therein against the work to be cleaned. Supported by flooring above the impeller wheel is a blower connected by suitable piping to discharge a column of air adjacent the hea of the impeller blades. An abrasive hopper discharges downwardly in the path of the air column. The abrasive is discharged through an enlarged Pitot tube into the air column and thus the abrasive is blown into the path of the blades and discharged thereby against the work. I provide a Venturi nozzle to guide the air column at the point where the abrasive is discharged therein and find that this increases the rate of feeding and aids in drawing the abrasive into the air column. Adjustments, as hereafter described, are provided to control the angle of blast through an arc of approximately 120°.

Referring to Fig. 1, I provide a motor stand 10 carried by the flooring 12, in which is mounted a power control cabinet for the driving motors of the equipment. The upper portion of the stand is provided with an angular face 14 disposed as shown in Fig. 1. This angle is determined by the angle of discharge at which it is desired to project the abrasive blast against the work. As shown in Fig. 1, the equipment is mounted to project such blast at an angle normal to the face 14 and on the opposite side of the impeller from that there seen.

A driving motor to rotate the impeller wheel is bolted to the face 14 and is of the enclosed fan-cooled type, driving the impeller shaft designated at 15 through several strands of V-belt 17 passing over a motor sheave 18 and a shaft sheave 19.

The impeller shaft is journaled in roller thrust bearings carried by pillow blocks 21 and sealed against the ingress of abrasive dust in the surrounding atmosphere. The pillow blocks are mounted on a steel base 22 which is bolted as at 24 to the side of the abrasive blast chamber. The impeller case, designated generally as 25, is also bolted to the walls defining the abrasive chamber, as best shown in Fig. 2. As there shown, the casing comprises a casting 30 fitting over the abrasive discharge opening 32 formed in the walls of the blast chamber 34 and suitably bolted thereto as at 35.

A sheet steel casing proper is pivotally mounted on the casing 30 at 31 and at the other side is held down on the casting by a hook 32 which is adjustable and pivotally carried by the casting at 33. This sheet steel casing comprises a pair of sides 35 and 36 to which is welded an annular outer shell 37 conforming to the periphery of the impeller. The side 35 is provided with an opening 37 for the impeller shaft 15 and the side 36 is recessed at 35 to provide an opening.
to receive the abrasive feed pipe as hereafter described.

A discharge pipe leading to the impeller and indicated at 46 is bolted at 43 to a plate 45. The plate is pivotally mounted on a bolt 46 threadingly received in a boss 46 of the casting 30 such that the bolt and wheel blade shafts are in line. The plate 45 (Fig. 4) is slotted as at 49 to accommodate a bolt 50 which in turn is threadingly secured in the side 36 to lock the discharge pipe in any adjusted position. A retainer plate, indicated at 52, through which the bolt 45 passes, is utilized to axially retain the plate 45 in position at its lower portion.

With many impeller wheels of the type generally known, abrasive is discharged from a central stationary feeding cage opening outwardly into the path of the rotating blades. The result is a marked wiping effect of the abrasive against the outer portion of the cage as the abrasive is pushed thereover by the blades. This results in very rapid wear of the cage and the heels of the impeller blades, thus requiring frequent replacement. Fig. 6, shows my positive means in the form of a small impeller within the large impeller is employed in these machines to move the abrasive mass into position to be picked up by the throwing blades. Here again wear is a very important factor, as well as the necessity for additional moving parts.

With my improved impeller wheel the blades extend inwardly until adjacent blades are in contact at the axis and abrasive is fed thereto from the nozzle 43 spaced axially thereof. The air column used for feeding abrasive into the heel of the blades of my improved machine results in a much improved pattern without the wear or any necessity for the additional moving parts of prior construction.

Adjustment of the discharging position of the feed pipe 40, necessary to control the angle of blast from the wheel, is obtained by loosening the bolt 50 and shifting the plate 45 about its pivoted mounting on the bolt 46. Thus, as shown in Fig. 4, the discharge of the feed pipe may be varied through an arc of approximately 120° and may, for example, occupy, in addition to the solid line showing, a position indicated in the dotted lines on that figure. To permit setting of the discharge at any convenient point, a scale plate 58 is mounted on the plate 45 and a corresponding pointer finger is carried by the plate 45.

Abrasive is supplied to the discharge pipe 40 by means of an abrasive hopper and a motor-driven blower. Referring again to Fig. 1, the hopper comprises a funnel 57 which forms the lower portion of a storage hopper for cleaned abrasive. The hopper discharges through a nozzle 58 into a second funnel 60 and by reason of the air space surrounding the nozzle 58, which is open to the atmosphere, there is no formation of vacuum in the feed line. As abrasive passes through the funnel 60 it is guided by a curved pipe 62 into a removable hardened steel sleeve 64 from whence it is discharged into the air passage.

Air for feeding abrasive is blown past the outlet of the sleeve 64 through a Venturi nozzle formed in the injection chamber 70 to combine with the Pitot tube action of sleeve 64. Air is supplied by a blower 66 driven by an electric motor direct couple thereto. A flexible connection 68 connects the blower with the injection chamber to permit adjustment of the parts.

As air is blown through the injection chamber and past the discharge of the sleeve 64 it increases in velocity by reason of the Venturi action and picks up abrasive fed through the sleeve and blows the same against the heel portion of the impeller wheel, from whence it is then picked up on the sides of the blades that are in line. The impeller wheel proper is best shown in Figs. 2 and 3 and is mounted for rotation on the shaft 15. The wheel comprises a disk 75 terminating in a collar 71 fixedly secured to a sleeve 78 by suitable screws 79. The sleeve in turn is mounted for rotation on the shaft 15.

Carried by the disk are four impeller blades spaced 90° apart and each extending inwardly to overlie the end of the shaft and to contact each other adjacent the disk axis. Each blade, designated at 80, is shaped as shown in cross-section in Fig. 5 and includes a pair of locking flanges 82 and 84 which coat to form with the blade edge a roughly triangular projection. These portions of the blades are angularly engaged by overlapping retaining plates 86. The flat edge of each blade has transverse ribs 87 each adapted to be a corresponding tooth of the disk 75. The blades extend outwardly and the abrasive carrying face is slightly concaved to place the unsupported edge slightly above the supported edge, as shown in Fig. 5. The unsupported edge terminates in an upstanding lip 88 by which abrasive is prevented from sideward discharge from the machine. A cooperating lip 89 is provided as shown in this figure to form, with lip 88, an abrasive path to carry the same to the outer periphery of the wheel.

The blades are retained in position against the disk 75 by the aforementioned retainer plates 86 acting to hold ribs 87 in the cooperating slots of the disk 75. The retainer blades are bolted as at 91 to the disk 75, and by drawing the bolts tightly the ribs are supported in the disk slots and the blades are secured in outwardly extending position to receive and throw abrasive. As the bolts 91 are loosened the blades free themselves from the slots and move outwardly under the impetus of leaf springs 93 interposed between disk 75 and respective blades (Figs. 2 and 5). This makes for easy blade retention. Referring to Figs. 2 and 3, it will be seen that the lip portion 88 inwardly terminates at 92 on the plate 38 to prevent interference of the lip with the abrasive fed through the discharge pipe 40.

In operation the apparatus described functions as follows. A supply of abrasive drops by gravity from the hopper 61 into the feed pipe 62 and sleeve 64, and from whence it discharges to the Venturi nozzle of the injection chamber 70. At this time the column of air created by the fan 65 blows the abrasive into position to be picked up on the sides of the blades and, due to the high rotative speed thereof, is discharged centrifugally with great force against the articles to be cleaned.

The adjustment by which the discharge point of the pipe 40 is controlled is adapted to permit circumferentially shifting the pipes through an arc of 180°. This makes it possible to change the location of the centrifugal discharge 180° from the feeding position and it is thus possible to closely control the dis-
charge pattern by the adjusted position of the abrasive feed pipe.

Throughout my specification I have referred to the Invention as handling abrasive, and by this is meant sand or crushed steel grit and the like, such as is used for cleaning castings and similar articles due to the abrasive action therewith. The wear of the abrasive traveling at high speeds on the parts of the equipment with which it comes in contact is enormous. A feature of my invention, as elsewhere indicated, is to incorporate a design eliminating as much as possible the excess wear occasioned by rapidly traveling abrasive over the parts. It has also been a feature of my invention to permit ready replacement of those parts which wear rapidly and which particularly include the blades and the feeding means closely allied therewith. Other portions of the equipment may be protected to decrease the wear and these protecting elements are also subject to frequent replacement and have been worked out with that in view. Thus the steel sleeve 64, the Venturi nozzle section indicated at 72, the injection nozzle or feed pipe 48, as well as the various parts of the impeller contacted by the abrasive are subject to replacement, although some parts wear out much more rapidly than others. The two parts most frequently replaced are the Injection nozzle 48 and the blades 89. In order to decrease wear on these parts as much as possible they should be made of hard ferrous metal or very hard alloys which are highly resistant to abrasion. In any event, the blades wear so rapidly that they must be replaced very often and in many cases as frequently as once a day.

Not all of the abrasive thrown by the impeller or wheel is discharged against the work. There is a small fraction discharged from the wheel at all points about the periphery thereof and to protect the case, a removable guard member is provided to line the same. This member, indicated at 95, is best shown in Figs. 2 and 3 and comprises an annular ring extending completely around the impeller and conforming in contour therewith. The ring is made in two parts, 96 and 97, carried by the case and the casting 30 respectively. The part 96 extends the entire width of the case and is removably fastened thereto by bolts 99 and is spaced from the case by rings 100 interposed between the parts. The lower segment 97 is fastened to the angle member 101 and this in turn is bolted to the downwardly extending skirt 103 of the casting 30. The segment 97 extends outwardly unsupported from the angle 101 far enough to prevent rebouncing abrasive from reaching the shaft 15 and not far enough to interfere with the pattern of abrasive discharged from the impeller.

Abrasive is discharged from the impeller, as above stated, in a definite pattern determined by an angular location of the discharge pipe 40. This pattern, which may be roughly varied through 120° of arc, tends to be ineffective at its outer edges parallel to the impeller axis and because there is a relatively small amount of abrasive contacts the work. This limitation is inherent in any blasting machine throwing a pattern, and because the tumbling equipment must be strong enough to support the weight of casting the surface extent of the material to be cleaned is limited to the effective pattern of the machine. As a result a portion of the tumbling equipment is normally exposed to the action of stray abrasive, which results in rapid wear of the parts and frequent replacement of the exposed portions of the equipment. To obviate this difficulty I have provided adjustable baffle plates by which the outer extremities of the pattern parallel to the axis are definitely controlled and thus I direct the entire effective abrasive charge onto the work, at the same time protecting the tumbling equipment from the blast.

These baffles are indicated at 105 and 107 in Fig. 4 and are pivotally mounted to permit their adjustment as the angle of blast is varied. Each baffle comprises a plate extending below the outer periphery of the impeller and terminating at its other end in a flange portion perpendicular to the impeller axis. The flange portion of each baffle is secured as by welding to a plate 110, which is roughly triangular in cross-section, as indicated in Fig. 4, and is pivotally mounted on an inwardly extending boss of the shoulder 48 of the casing 30. To lock the plate 110 and the baffle supported thereby in any adjusted position an angle plate 112 is provided secured to the under side of the casing 34 by bolts 113. The angle member is drilled to accommodate a bolt 114 surmounted by a nut 115 and which slidingly occupies a slot in the plate 112. This slot is about 120° in length (corresponding to the variation in the angle of discharge desired) and lies in the radius about which the plate 110 is free to swing.

Thus the baffles may be located in any adjusted position and securely held there by tightening the clamping nut 115 on this bolt. To reduce wear on the baffles the same are preferably coated with a rubber wear plate on the abrasive adjacent side, since the rubber when subjected to the abrasive blast wears much less rapidly than does the steel plates from which the baffles are formed.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In an abrasive throwing machine, a shaft mounted for rotation, a disk with a flat radial face mounted on said shaft, an abrasive throwing blades adapted to be mounted on said disk each comprising a relatively flat portion adapted to receive and propel abrasive, an upturned lip at one edge of said propelling face extending from the outer end to but not beyond substantially the mid-point of the blade length, said lip being substantially parallel with the radial face of the disk, means to mount said blades on said disk and an abrasive discharge feed pipe mounted to discharge beyond the outer radial edge of said blades and within a circle formed by the inner rotating edges of said lip closely adjacent to the disk axis of rotation and directly from said discharge feed pipe onto said blades.

2. In a machine of the character described a rotary impeller mounted for rotation about an inclined axis, said impeller carrying a plurality of blades thereon intersecting at the axis of rotation to form a plurality of abrasive receiving pockets, said blades boiling the pockets and providing throwing faces of a length substantially equal to the radius of the impeller, and an abrasive discharge tube in axial alignment with the axis of the impeller and discharging abrasive into the bottom of said pockets.

3. In a machine of the character described a
rotary drive shaft inclined with respect to the horizontal and carrying a disk thereon having a radial face inclined in the opposite direction, blades on said radial face intersecting at the axis of the disk to form inclined pockets bounded by substantially radial throwing faces, and means to feed abrasive to the pockets adjacent the axis of the disk but above a horizontal line extending therethrough.

4. In an abrasive throwing machine, a shaft mounted for rotation, a disk with a flat radial face mounted on said shaft, a plurality of abrasive throwing blades adapted to be mounted on said disk, each comprising a relatively flat portion adapted to receive and propel abrasive, an upturned lip at one edge of said propelling face extending from the outer end to but not beyond substantially the mid-point of the blade length, said lip being substantially parallel with the radial face of the disk, a plurality of retaining plates secured to said disk to hold said blades in position on said disk, and an abrasive discharge feed pipe mounted to discharge beyond the outer radial edge of said blades and within a circle formed by the inner rotating edges of said lips closely adjacent to the disk axis of rotation and directly from said discharge feed pipe onto said blades.

5. In an abrasive throwing machine, a shaft mounted for rotation, a disk with a flat radial face mounted on said shaft, a plurality of abrasive throwing blades adapted to be mounted on said disk, each comprising a relatively flat portion adapted to receive and propel abrasive, an upturned lip at one edge of said propelling face extending from the outer end to but not beyond substantially the mid-point of the blade length, said lip being substantially parallel with the radial face of the disk, shoulders formed in said disk and engaging with shoulders formed on said blades, respectively, to limit the outward radial movement of said blades with respect to said disk, and an abrasive discharge feed pipe mounted to discharge beyond the outer radial edge of said blades and within a circle formed by the inner rotating edges of said lips closely adjacent to the disk axis of rotation and directly from said discharge feed pipe onto said blades.

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