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SHOT PEENING APPARATUS

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This invention pertains to centrifugal blasting apparatus, and particularly to a centrifugal propelling machine for selective shot peening.

Heretofore centrifugal throwing apparatus has been designed for accelerating and throwing particulate materials from the periphery of a wheel against an object to be worked, cleaned or abraded. The particulate materials which are impinged against an object can take the form of metallic shot or grit, sand and similar nonmetallic abrasives. Moreover, it has been proposed to control the direction in which the particulate material is thrown and the length of the path swept by the particulate material. However, in some instances it is desirable to work harden a given area of an object to varying degrees, that is, to work harden a portion of the area of an object to a predetermined degree of hardness and graduate the work hardening on other portions of the object. The present invention relates to apparatus for automatically selectively shot peening an object to concentrate the work hardening in a particular area and graduate the work hardening over other portions of the object. Accordingly, among my objects are the provision of means whereby thrown particulate material will be distributed over a path of predetermined area with a concentration at a portion of the area of the path; the further provision of a throwing wheel having a plurality of radially arranged slots with peripheral discharge openings of different cross-sectional areas; the still further provision of throwing apparatus including means for regulating the rate of flow of particulate material therethrough; and the still further provision of a centrifugal blasting machine having a throwing wheel with a plurality of peripheral discharge openings of graduated cross-sectional area so as to concentrate the particulate material thrown thereby against a particular area of the object.

The aforementioned and other objects are accomplished in the present invention by accelerating the particulate material through a wheel having a plurality of radially extending slots which terminate in peripheral discharge openings of different size. Specifically, in the preferred embodiment the throwing wheel comprises a pair of spaced plates, or discs, one of the discs having a plurality of integral, radially extending vanes disposed between the two discs. The vanes terminate short of the axis of rotation of the wheel so as to form a central space, or inlet, through which the particulate material is supplied. The vanes are spaced from each other by slots which are arranged to receive removable inserts. Each insert has a blade portion and a relieved portion which cooperates with the upper disc to form a slot. Each slot terminates in a peripheral discharge opening of different cross-sectional area. A conical insert is disposed in the central recess of the wheel for distributing the particulate material to the several slots therein.

The throwing wheel is drivingly connected to a tubular shaft having a plurality of slots in the lower end thereof which are aligned with the slots in the throwing wheel at a high velocity.

The particulate material is supplied to the throwing wheel through a stationary tube coaxially disposed within the tubular drive shaft. The supply tube is supported by a stationary hopper, and the rate of flow of particulate material is controlled by an orifice disposed at the discharge opening of the storage hopper.

In a modified embodiment, the throwing wheel comprises a pair of spaced discs, one of the discs having a plurality of radially extending vanes thereon constituting throwing blades. The vanes are separated by radially extending tapered slots which terminate in peripheral discharge openings of graduated cross-sectional area. The slots communicate with a central recess in the wheel within which a conical insert is adjustably supported. By varying the position of the conical insert the rate of flow of particulate material through the wheel can be controlled.

In operation the stationary fixture is suitably attached to a propeller hub, with the throwing wheel disposed within a hub socket having an integral thread relief machined therein. When shot is supplied to the throwing wheel, it is accelerated in radial movement as it travels outwardly along the throwing vanes, or blades, and is thrown at blasting velocity by centrifugal force from the peripheral discharge openings of the wheel so as to impinge the entire area adjacent the thread relief. However, by reason of the graduated size of the peripheral discharge openings the shot is concentrated in the predetermined area of the thread relief and graduated over the other portions of the area adjacent thereto.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred forms of the present invention are clearly shown.

In the drawings:

Figure 1 is a sectional view of shot peening apparatus constructed according to this invention.

Figure 2 is a view, partly in section and partly in elevation taken along line 2—2 of Figure 1.

Figure 3 is a chart indicating the axial width of the peripheral discharge openings in the throwing wheel shown in Figure 1.

Figure 4 is a perspective view of one of the inserts used in the preferred embodiment.

Figure 5 is a sectional view of a modified embodiment of shot peening apparatus constructed according to this invention.

With particular reference to Figure 1, the shot peening apparatus is attached to an annular fixture 10 having a recess 11 adapted to receive a socket 12 of a propeller hub. The fixture 10 is connected to a supporting bracket 13 by means of a plurality of bolts 14, the bolts 14 also having threaded engagement with a second fixture 15 having a frusto conical flange 16. The propeller hub socket 12 has machined therein an integral thread relief designated by numeral 17 disposed immediately below a threaded portion 18. A nut 19 engages the threads 18, the nut 19 having a frusto conical inner surface for receiving the frusto conical flange 16 of the fixture 15. In addition, the nut 19 has a flanged portion to which a spacer ring 20 is connected by a plurality of pins 21. The fixture 10 is secured to the propeller hub socket 12 by a plurality of studs 22 having rounded ends which engage a radiused portion of the hub socket whereby when the studs 22 are tightened the frusto conical flange 16 of the fixture 15 will be forced into wedging engagement with the frusto conical surface of the nut 19.

The fixture 15 has a central through bore 23 and has mounted therein a pair of spaced ball bearing assemblies 24 and 25. The outer races of the ball bearing assemblies

24 and 25 are maintained in vertically spaced relation by a bearing sleeve 26. A vertically arranged tubular drive shaft 27 is rotatably supported by the ball bearing assemblies 24 and 25 in the fixture 15. As shown in Figure 1, the upper end of the drive shaft 27 may have attached thereto a pulley 28 which receives a belt 29 whereby the shaft 27 can be rotated by a suitable rotary driver, such as an electric motor, not shown. The lower end of the shaft 27 is press fitted into a central aperture of an upper disc 30 of a throwing wheel, or rotor, designated generally by the numeral 31. A bushing 48 is interposed between the inner race of the ball bearing assembly 25 and the upper surface of the disc 30. The disc 30 is drivingly connected with the shaft 27, and the lower end of the shaft 27, and the lower end of the shaft 27 has a plurality of radially extending slots 32 therein.

With particular reference to Figure 2, it can be seen that the lower end of the shaft 27 has six equidistantly spaced slots 32 formed therein. One wall 33 of each slot extends on a radius from the axis of the shaft 27, and the other wall 34 of each slot is substantially tangential to the inner diameter of the tubular shaft so as to form a knife edge 35 at its intersection with wall 33 on the inside diameter of the shaft. The knife edges 35 prevent the particulate material which is fed through the slots 32 from deforming the inside diameter of the shaft which would cause clogging and thereby restrict the flow of particulate material, such as shot, to the throwing wheel 31. The throwing wheel 31 also includes a lower disc, or plate 36 having a plurality of upstanding vanes 37 formed integrally therewith which maintain the discs 30 and 36 in spaced relation. The discs 30 and 36 may be held in assembled relation by means of set screws 38 which extend through the disc 30 and engage threaded openings in the vanes 37. The vanes 37 terminate short of the center of the rotor 31 and extend in a substantially radial direction so as to form a central recess, or inlet, 39 for the particulate material. In addition, one edge of each vane is beveled as indicated by numeral 49 to coincide with the wall 34 of the slots 32 on the shaft 27.

The vanes 37 are circumferentially spaced so as to form slots 40 therebetween. An insert 41 is removably secured within each slot 40 by a pair of set screws 42*a*. With particular reference to Figure 4, each insert 41 is substantially pie-shaped and includes a blade portion 43*a* and a relieved portion, or groove, 44*a* which together with the upper disc 30 forms a slot having a peripheral discharge opening. The peripheral discharge openings are indicated by numerals 42 through 47 in Figure 2. The relieved portions 44*a* of five of the inserts 41 are formed by upwardly inclined, or tapered, surfaces of different slope. The relieved portion 44*a* of the sixth insert is substantially flat as shown by the left hand insert 41 in Figure 1. The axial width of each discharge opening 42 through 47 is different, and thus the cross-sectional area of each discharge opening is different. In the particular embodiment disclosed, the axial width as indicated by A in Figure 1 of the discharge opening is shown in the chart of Figure 3, from which it can be seen that the axial width of the discharge opening 42 is .125", and the axial width of each successive discharge opening increases by .075".

As seen in Figure 1, a central insert 50 for distributing the shot to the several slots in the rotor is disposed within the central recess 38 of the rotor. The insert 50 is substantially cone-shaped as seen in Figure 1 and is secured in place by a bolt 52. The particulate material is supplied to the central recess 39 of the rotor through a stationary tube 53 coaxially disposed within the tubular drive shaft 27. The upper end of the stationary tube 53 is suitably attached to a stationary storage hopper 54, having a removable orifice insert 55 at the discharge opening thereof. By substituting inserts 55 having different size orifices, the rate of flow of a particulate material from the hopper 54 into the supply tube 53 can be varied and controlled.

Operation of the preferred embodiment of the centrifugal shot peening apparatus is as follows. As the particulate material is fed through the hopper 54 it flows through the orifice of the insert 55 and falls through the vertical supply tube 53. The particulate material drops on the cone-shaped insert 50 carried by the rotor 31 and is distributed thereby through the slots 32 in the lower end of the drive shaft 27. The particulate material is then picked up by the blades 43*a* of the rotor and thrown outwardly by centrifugal force due to rotation of the rotor 31 so as to impinge the area adjacent the thread relief designated by numeral 17 of the propeller hub socket 12. However, by virtue of the fact that the discharge openings 42 through 47 in the rotor are of different cross-sectional area, or of graduated size, the particulate material thrown by the rotor 31 is concentrated in the area of the thread relief 17. Thus, the shot peening apparatus automatically selectively work hardens the thread relief area so as to concentrate the work hardening in the thread relief and graduate the work hardening on other portions adjacent this area.

With particular reference to Figure 5, a modified embodiment of a shot peening apparatus constructed according to this invention will be described, similar numerals depicting similar parts as described in conjunction with the preferred embodiment. In the modified embodiment, the rotor 60 comprises an upper disc, or plate, 61 and a lower disc, or plate 62 suitably connected thereto. The lower disc 62 is formed with a plurality of integral vanes, or blades, which form slots 63 therebetween. The slots 63 likewise terminate in peripheral discharge openings, such as indicated by numerals 64 and 65, of different cross-sectional areas. As in the preferred embodiment, the rotor 60 can be formed with six radially extending slots which terminate in discharge openings of graduated cross-sectional area such as shown in the chart of Figure 3. The axial width of the discharge openings in the rotor 60 is determined by the inclination of the lower surface of each slot machined in the disc 62.

In the modified embodiment the drive shaft 66 has a plurality of slots 67 spaced inwardly from the lower end thereof, each slot connecting with one of the slots 63 in the rotor 60. The lower end of the drive shaft 66 is press fitted into the disc 60 and has a threaded portion arranged to receive a screw 68 having a conical end portion 69 disposed within the tubular shaft 66. The screw 68 can be adjusted relative to the drive shaft 66 to control the flow of particulate material from the interior of the drive shaft 66 through the slots 67 to the central area 70 of the rotor 60. After the screw 68 is adjusted to obtain the desired rate of flow, it is locked into position by a nut 71. Operation of the modified embodiment is substantially the same as that of the preferred embodiment in that particulate material supplied to the drive shaft 66 is thrown outwardly by the rotor and impinges the area adjacent the thread relief 17 of the hub socket 12 with the particulate material being concentrated in the thread relief.

From the foregoing it is readily apparent that the present invention provides centrifugal blasting apparatus wherein the particulate material thrown by the apparatus can be concentrated at a particular portion of the area in which the particulate material is distributed. In this manner where the apparatus is used to work harden an object, different areas of the object can be work hardened to different degrees with the degree of work hardening being graduated from an area of maximum work hardening.

While the form of embodiments of the invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotatable throwing wheel having a plurality of radially extending vanes terminating short of the axis of rotation to form a center inlet, said vanes having slots therebetween which terminate in peripheral discharge openings in said wheel, each peripheral discharge opening being of different cross-sectional area, and means for feeding particulate material into the center inlet of said wheel whereby the particulate material thrown from said wheel will be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

2. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotor mounted for high speed rotation including a plurality of spaced throwing vanes extending inwardly toward the axis of rotation, said vanes having slots therebetween which terminate in circumferentially spaced peripheral discharge openings in said rotor, each discharge opening having a different cross-sectional area, and supply means for particulate material communicating with the inner ends of said slots whereby the particulate material thrown from said wheel will be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

3. A centrifugal throwing wheel comprising, a pair of spaced discs having a plurality of radially extending particulate material propelling vanes therebetween, said vanes having slots therebetween which terminate in peripheral discharge openings, each discharge opening being of different cross sectional area whereby the particulate material thrown from said wheel will be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

4. A centrifugal throwing wheel comprising, a pair of spaced discs having a plurality of radially extending particulate material propelling vanes therebetween, said vanes having slots therebetween, and a removable insert secured in each slot, each insert having a blade portion and a groove which forms a peripheral discharge opening, each peripheral discharge opening being of different cross-sectional area whereby the particulate material thrown from said wheel will be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

5. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotatable throwing wheel having a plurality of radially extending vanes terminating short of the center of said wheel to form a center inlet, said vanes having slots therebetween which terminate in peripheral discharge openings in said wheel, each peripheral discharge opening being of different cross-sectional area with the cross-sectional area of said discharge openings being graduated around the periphery of said wheel, a tubular shaft supporting said wheel and having a plurality of slots communicating with said center inlet, and means for feeding particulate material into said tubular shaft whereby the particulate material will be thrown from said wheel and distributed over a path of predetermined area with a concentration at a portion of the area of said path.

6. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotatable throwing wheel having a plurality of radially extending vanes terminating short of the center of said wheel to form a center inlet, said vanes having slots therebetween which terminate in peripheral discharge openings in said wheel, each peripheral discharge opening being of different cross-sectional area, a tubular shaft supporting said wheel and having a plurality of slots therein communicating with said central inlet, said slots having intersecting tangential and radial walls forming knife-like edges on the inside diameter of said tubular shaft, and means for feeding particulate material into said tubular shaft whereby the particulate material will be thrown from said wheel and distributed over a path of predetermined area with a concentration at a portion of the area of said path.

7. The centrifugal blasting machine as set forth in claim 6 wherein said last recited means comprises a stationary tube coaxially disposed within said tubular shaft.

8. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotatable throwing wheel having a plurality of radially extending vanes terminating short of the center of said wheel to form a center recess, said vanes having slots therebetween which terminate in peripheral discharge openings in said wheel, each peripheral discharge opening being of different cross-sectional area, a cone-shaped insert disposed within said central recess, and means for supplying particulate material to said center recess, which particulate material is distributed by said insert and thrown from said wheel so as to be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

9. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotatable throwing wheel having a plurality of radially extending vanes terminating short of the center of said wheel to form a center recess, said vanes having slots therebetween which terminate in peripheral discharge openings in said wheel, each peripheral discharge opening being of different cross-sectional area, a conical insert disposed in said center recess, a tubular shaft supporting said wheel and having a plurality of slots communicating with the inner ends of the slot in said wheel, and means for supplying particulate material to said wheel through the slots in said shaft whereby the particulate material thrown from said wheel will be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

10. The centrifugal blasting machine set forth in claim 9 wherein said conical insert is adjustably supported in said wheel within said tubular shaft so as to control the rate of flow of particulate material through the slots in said tubular shaft.

11. A centrifugal blasting machine designed for throwing particulate material at blasting velocities including, a rotatable throwing wheel having a plurality of radially extending vanes terminating short of the center of the wheel to form a center inlet, said vanes having slots therebetween which terminate in peripheral discharge openings in said wheel, and means for feeding particulate material into the center inlet of said wheel, said peripheral discharge openings being of different cross sectional area so that the particulate material thrown from said wheel will be distributed over a path of predetermined area with a concentration at a portion of the area of said path.

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SHOT PEENING APPARATUS

Filed June 10, 1957 2 Sheets-Sheet 1

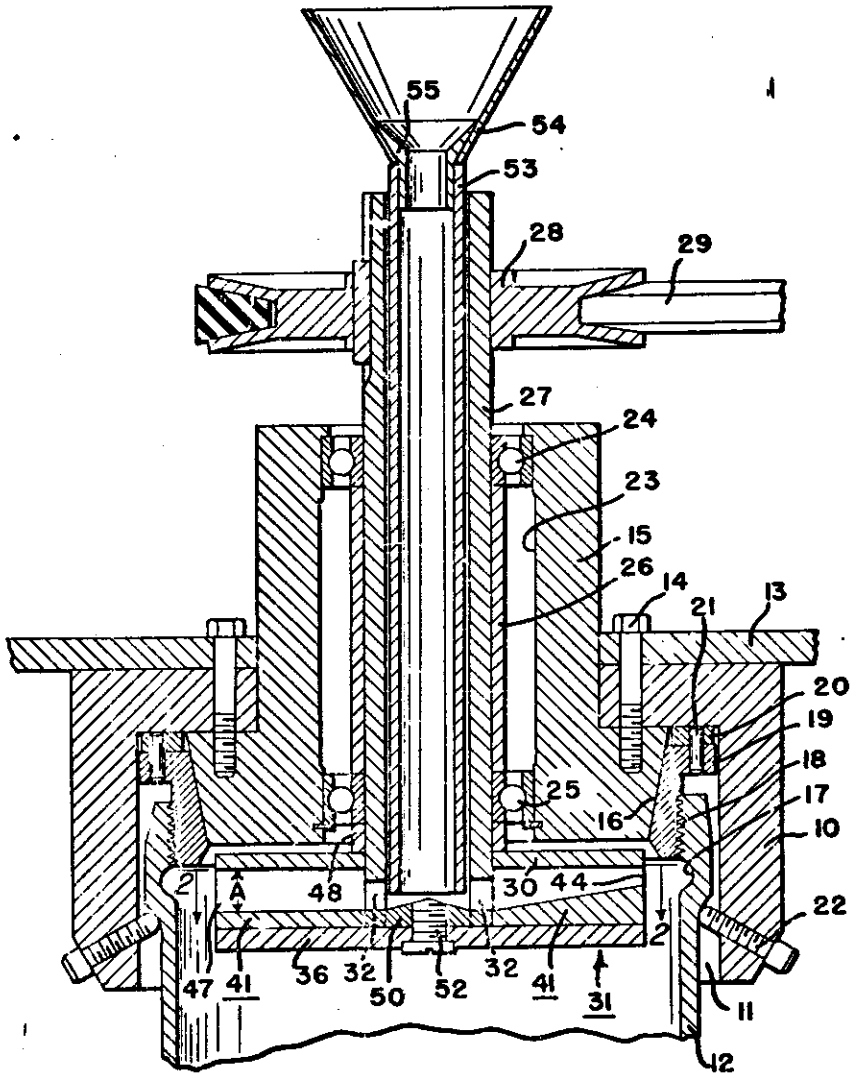

Fig. 1

"A" Inches	Discharge Opening
.125	42
.200	43
.275	44
.350	45
.425	46
.500	47

Fig. 3

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Aug. 25, 1959 M. O. BLACKBURN 2,900,765

SHOT PEENING APPARATUS

Filed June 10, 1957 2 Sheets-Sheet 2

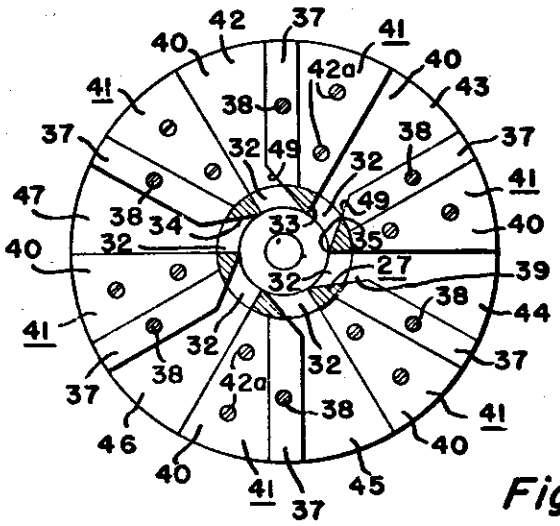

Fig. 2

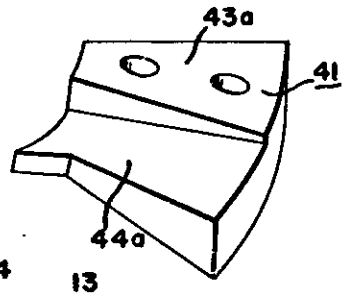

Fig. 4

Fig. 5

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