

CONFINED PENCIL BLASTING APPARATUS

BACKGROUND

[0001] The present disclosure relates generally to sand-blasting devices, and, more particularly, to a confined pencil-type sand-blasting device.

[0002] Foreign object damage (FOD) is a significant issue to aircraft engine operation. Damages caused by FOD incur direct and indirect cost to the engine operator in terms of flight delays, unscheduled maintenance, etc. Furthermore, FOD also affects flight safety and reputation of the engine manufacturer. Foreign objects can come from many sources, such as hail, ice on the wings and ash clouds in volcanic eruptions. Unfortunately, one of the source of FOD may be engine maintenance. During engine maintenance, grit or sand blasting is widely used to remove sulfur corrosion (sulfidation) on surfaces of various engine components. Conventional grit blasting discharges grit from a nozzle at high velocity without containment. The discharged grit scatters to surrounding areas, and may adhere to engine components unnoticed by repair personnel. Then during a subsequent engine run/test, adhered grit will fall off and cause FOD to the engine.

[0003] As such, what is desired is a blasting apparatus that can effectively contain discharged grit.

SUMMARY

[0004] Disclosed and claimed herein is a blasting apparatus. In embodiments, a blasting apparatus includes a first conduit for directing an abrasive stream to a workpiece, and a second conduit for providing a suction force at an outlet of the first conduit and for sucking away particles, the second conduit being disposed

substantially surrounding and in parallel to the first conduit. In one embodiment, an opening of the second conduit at an end thereof is circumferential to the outlet of the first conduit. In one embodiment, an opening of the second conduit at an end thereof is circumferential to the outlet of the first conduit. In one embodiment, the opening of the second conduit is an elastic material. In one embodiment, the second conduit is concentric to the first conduit. In one embodiment, the second conduit has an elongated portion configured for handheld operation. In embodiments, the blast apparatus includes a stream generator connected to the first conduit for generating the abrasive stream, and a dust collector external to the workpiece for providing the suction force to the second conduit and for collecting the particles sucked in by the second conduit. In one embodiment, a valve is equipped for adjusting abrasive stream. In one embodiment, a valve is equipped for adjusting the suction force of the dust collector. In one embodiment, a switch is equipped for controlling the abrasive stream.

[0005] The foregoing features and elements may be combined in various combinations without exclusivity, unless expressly indicated otherwise. These features and elements as well as the operation thereof will become more apparent in light of the following description and the accompanying drawings. It should be understood, however, the following description and drawings are intended to be exemplary in nature and non-limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The drawings accompanying and forming part of this specification are included to depict certain aspects of the present disclosure. A clearer conception of the present disclosure, and of the components and operation of systems provided with the present disclosure, will become more readily apparent by referring to the exemplary, and therefore non-limiting, embodiments illustrated in the drawings,

wherein like reference numbers (if they occur in more than one view) designate the same elements. The present disclosure may be better understood by reference to one or more of these drawings in combination with the description presented herein. It should be noted that the features illustrated in the drawings are not necessarily drawn to scale.

[0007] Fig. 1 is a cross-sectional view of a blasting apparatus according to one embodiment of the present disclosure.

[0008] Fig. 2 illustrates operation of a blasting apparatus according to one or more embodiments of the present disclosure.

[0009] Fig. 3 is a block diagram illustrating a grit-blasting system according to one or more embodiments of the present disclosure.

DESCRIPTION

[0010] One aspect of the disclosure relates to a blasting apparatus. In one embodiment, a cylindrical suction channel surrounding a nozzle of the blasting apparatus is proposed for collecting discharged grits. Embodiments of the present disclosure will be described hereinafter with reference to the attached drawings.

[0011] Fig. 1 is a cross-sectional view of a nozzle of a blasting apparatus 100 according to an embodiment of the present disclosure. The blasting apparatus 100 is a long pencil-like grit-blasting apparatus, which includes a central tube 102 and a conduit 110 concentric to the central tube 102. In other aspects the conduit 110 has a different outside geometry (facing away from the central tube 102) versus the inner geometry (facing toward the central tube 102) when taken across a cross-section perpendicular to the center line of the central tube 102. In one other aspect a cross-section of inner geometry of the conduit 110 is substantially circular. In another aspect, a cross-section of the outer geometry of the conduit 110 is also

substantially circular. In other aspects the conduit 110 may possess other geometric cross sections such as generally square or rectangular or oval. The central tube 102 is a conduit for blasting out grits at an outlet 104 which can be about the diameter of a pencil lead for fine work on engine components. The conduit 110 maintains a hollow space 112 surrounding the central tube 102 for sucking away discharged grits. An opening 115 of the conduit 110 is circumferential to and extends further than the central tube outlet 104. In other words, the central tube outlet 104 may be recessed in the conduit opening 115.

[0012] Fig. 2 illustrates an operation of a blasting apparatus, such as apparatus 100 of Fig. 1. An exemplary grit 202 is blasted through the tube 102 as indicated by an arrow 204. Once hitting a surface 210 of a workpiece, the grit 202 loses its forward momentum, and then is sucked away by a constantly present vacuum force in the conduit 110 as indicated by an arrow 225. The conduit opening 115 comes into contact with the workpiece surface 210, and substantially seals off the space surrounding the tube outlet 104, so that the discharged grit 202 is inhibited from scattering to outside of the blasting apparatus 100. Thus the conduit 110 and the tube 102 form a confined nozzle of the blasting apparatus 100.

[0013] For better sealing, the conduit 110, particularly close to the opening 115 can be made of an elastic material, such as rubber, so that the conduit opening 115 can better conform to a contour of the workpiece surface 210.

[0014] As shown in Fig. 2, while the conduit opening 115 reaches the workpiece surface 210, the tube outlet 104 still has a small distance S to the surface 210. The distance S 232 is in the range of a few millimeters to allow the discharged grit 202 to scatter away without clogging the tube outlet 104. The distance S 232 can be adjusted by sliding the conduit 110 up or down in relative to the tube 102. In one

embodiment, the conduit 110 and the tube 102 can be fastened to each other by vanes (not shown) placed in the hollow space 112 of Fig. 1.

[0015] According to embodiments of the present disclosure, the grit's in-flow through the tube 102 and the grit's out-flow through the conduit 110 are monitored. In case the in-flow outpaces the out-flow, there must be grits left in the conduit 110, on the workpiece surface 210 or escaped to the environment, in response, more suction force should be applied to the conduit 110. In case the out-flow outpaces the in-flow, then the blasting effect may be nullified by the suction force, in response, the suction force applied to the conduit 110 should be reduced. In both cases, adjusting blasting force to the tube 102, instead of the suction force, can also achieve the goal of substantially equalizing the grit's in-flow and out-flow. In other embodiments, the blasting force and the suction force are synchronized, i.e., increasing the blasting force will automatically cause a proportional increase of the suction force.

[0016] Fig. 3 is a block diagram illustrating a grit-blasting system 300 that supports the presently disclosed blasting apparatus 100. In one embodiment, the grit-blasting system 300 includes an air dryer 312, a stream generator 318, abrasive media container 320, the confined blasting apparatus 100 and a dust collector 330. The air dryer 312 provide dried air to the stream generator 318 for preventing power problems. The stream generator 318 pressurizes dry air and supplies it to the tube 102 (shown in Fig. 1) of the confined blasting apparatus 100. Before reaching the confined blasting apparatus 100, the pressurized air picks up grits from abrasive media container 320 to form an abrasive stream to be blasted out through the tube 102 onto a workpiece 210. The stream generator 318 is equipped with an exemplary pressure control valve 319 for adjusting the grit's in-flow into the blasting apparatus 100. The dust collector 330 is connected to the conduit 110 (shown in Fig. 1) of the confined grit blast 100, for sucking away and collecting the

discharged grits. The dust collector 330 is also equipped with an exemplary pressure control valve 331 for adjusting the out-flow of grits. When the pressure control valves 319 and 331 are properly set, the grit's in-flow and out-flow can be substantially equalized, so that there will not be significant amount of the discharged grits being left on the workpiece surface or escaped to the environment. Because the discharged grits are substantially confined to the blasting apparatus 100 according to the embodiment of the present disclosure, the dust collector 330 does not have to enclose the workpiece 210 and can still maintain a clean working environment.

[0017] In one embodiment, blasting apparatus 100 can be made of flexible materials or a structure so that a shank of the blasting apparatus 100 can be bent so that an abrasive stream can be directed to more restricted areas. The blasting apparatus 100 may also be equipped with an on-and-off switch to be easily controlled by an operator.

[0018] While this disclosure has been particularly shown and described with references to exemplary embodiments thereof, it shall be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit of the claimed embodiments.

WHAT IS CLAIMED IS:

1. A blasting apparatus comprising:

a first conduit for directing an abrasive stream to a workpiece; and

a second conduit for providing a suction force at an outlet of the first conduit and for sucking away particles, the second conduit being disposed substantially surrounding and in parallel to the first conduit.
2. The blasting apparatus of claim 1, wherein an opening of the second conduit at an end thereof is circumferential to the outlet of the first conduit.
3. The blasting apparatus of claim 2, wherein the outlet of the first conduit is withdrawn from the opening of the second conduit by a predetermined distance.
4. The blasting apparatus of claim 2, wherein the opening of the second conduit is an elastic material.
5. The blasting apparatus of claim 1, wherein the second conduit is concentric to the first conduit.
6. The blasting apparatus of claim 1, wherein the second conduit has an elongated portion configured for handheld operation.
7. The blasting apparatus of claim 1, further comprising:

a stream generator connected to the first conduit for generating the abrasive stream; and

a dust collector external to the workpiece for providing the suction force to the second conduit and for collecting the particles sucked in by the second conduit.

8. The blasting apparatus of claim 7, further comprising a valve for adjusting the abrasive stream, so that an in-flow of the abrasive stream is substantially equivalent to an out-flow of collected particles.

9. The blasting apparatus of claim 7, further comprising a valve for adjusting the suction force of the dust collector, so that an in-flow of the abrasive stream is substantially equivalent to an out-flow of collected particles.

10. The blasting apparatus of claim 1, further comprising a switch for controlling the abrasive stream.

11. A blasting apparatus comprising:

a first conduit for directing an abrasive stream to a workpiece; and

a second conduit for providing a suction force at an outlet of the first conduit and for sucking away particles,

wherein the first conduit is disposed inside the second conduit with an opening of the second conduit at an end thereof being circumferential to the outlet of the first conduit, and the first conduit and the second conduit run substantially parallel to each other.

12. The blasting apparatus of claim 11, wherein the outlet of the first conduit is withdrawn from the opening of the second conduit by a predetermined distance.

13. The blasting apparatus of claim 11, wherein the opening of the second conduit is an elastic material.

14. The blasting apparatus of claim 11, wherein the second conduit is concentric to the first conduit.

15. The blasting apparatus of claim 11, wherein second conduit has an elongated portion configured for handheld operation.

16. The blasting apparatus of claim 11, further comprising:

a stream generator connected to the first conduit for generating the abrasive stream; and

a dust collector for providing the suction force to the second conduit and for collecting the particles sucked in by the second conduit, wherein the dust collector does not enclose the workpiece.

17. The blasting apparatus of claim 16, further comprising a valve for adjusting the abrasive stream, so that an in-flow of the abrasive stream is substantially equivalent to an out-flow of collected particles.

18. The blasting apparatus of claim 16, further comprising a valve for adjusting the suction force of the dust collector, so that an in-flow of the abrasive stream is substantially equivalent to an out-flow of collected particles.

19. The blasting apparatus of claim 11, further comprising a switch for controlling the abrasive stream.