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AIR BLOW NOZZLE FOR CLEANING ENCLOSED SPACES

Field of the Invention

The present invention relates to air blow nozzles and methods of removing
5 particulate material from enclosures, and especially although not exclusively
for dust removal from the inside of a cathode ray tube bulb.

Background to the Invention

During the production of cathode ray tubes (CRT), it is important that the CRT
10 bulb or glass enclosure is properly cleaned of dust or particulate matter prior
to gas evacuation and insertion of the electron gun. This is necessary as dust
particles present in CRT can cause arcing of the electron gun, and hence
either rejection of the produced CRT or its early failure.

Dust particles arise in newly formed CRT bulbs due to coating of the inside of
15 the screen, particles present in the aperture grill from fabrication (e.g.
welding), handling prior to evacuation and insertion, and particles caused by
glass soldering process of the screen to the funnel part of the CRT bulb using
Frit glass.

Conventionally these dust particles are extracted on the production line by
20 inserting air hoses having nozzles which blow air into the CRT bulb. The air
dislodges the dust particles and it is hoped that the air flow out of the CRT
bulb will also carry out the dislodged particles. It is important to both
maximise the number of dust particles removed and minimise the time taken
to do this. Prior-art air blow nozzles have concentrated on higher pounding
25 forces on the CRT (eg for 0-10 seconds) and higher air flow rate (0-18



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seconds) to dislodge and remove respectively the dust particles. However this approach has met with only limited success in efficiently removing dust particles.

Summary of the Invention

- 5 It is an object of the present invention to provide an improved or at least alternative air blow method and apparatus for removing particulate material from enclosures.

A first aspect of the invention proposes in general terms that a suction force is created about an opening of an enclosure into which an airflow is introduced.

- 10 This suction force which helps the airflow back out of the enclosure and in doing so aids removal of particulate material from inside the enclosure. This suction force is created by forcing a second airflow out of the opening which cause a Venturi-effect within the (preferably narrow) opening to create the suction.

- 15 Specifically, the first aspect of the invention proposes a method of removing particulate material from an enclosure, comprising forcing a first air flow into said enclosure, and forcing a second air flow out of said enclosure, the second air flow causing a suction effect which encourages evacuation of at least a part of said first air flow.

- 20 In the case where the enclosure is a CRT bulb, the second air flow should be generated about the neck or funnel of the CRT bulb to maximise the suction effect.

Whilst the enclosure preferably has only a single opening, enclosures with further openings may also have particulate material removed using the above
25 method, especially if the or each additional opening has a short neck.

Whilst this method is preferably for removing dust or other particulate material from an enclosure, the method may also be used to remove non-particulate material such as a vapour or the existing gas composition from an enclosure, and replacing it with another gas, that of the first airflow.

- 5 In addition to CRT's, other enclosures such as bulk pressure vessels could also have the above method applied.

A second aspect of the invention proposes in general terms that a nozzle which causes a suction force is introduced into an opening of an enclosure into which an airflow is introduced. This suction force helps the airflow back
10 out of the enclosure and in doing so aids removal of particulate material from inside the enclosure.

Specifically, a second aspect of the invention proposes an apparatus for removing particulate material from an enclosure, and comprises a nozzle for connection to an air tube, the nozzle having an orifice at its distal end for
15 directing a first air flow in a forward direction, and a second orifice at a proximal end for directing a second air flow in a rearward direction.

The nozzle is attached to the air tube and placed in an entrance to the enclosure such that the forward airflow flows into the enclosure and the rearward airflow flows away from the enclosure. The rearward airflow creates
20 a suction force about the entrance to the enclosure which cause a Venturi-effect suction force which helps increase the air flow out of the enclosure, and therefore the removal of particulate material from the enclosure.

The nozzle may be used just to provide the second airflow, the first airflow being produced by a second nozzle or other device, perhaps introduced into a
25 second opening in the enclosure. Therefore the nozzle may only comprise an orifice at a proximal end for directing an air flow in a rearward direction.

In the case where the enclosure is a CRT bulb, the nozzle should be located inside the neck or funnel of the CRT bulb in order to maximise the suction effect.

5 In a further aspect the invention provides an apparatus for removing particulate material from an enclosure, and comprising an air generation means arranged to direct a first airflow in a forward direction into the space, and a second airflow in a rearward direction out of the space.

Brief Description of the Drawings

10 Preferred embodiments of the invention will now be described with reference to the following drawings, by way of example only and without intending to be limiting, in which:

Figure 1 shows a prior art method of cleaning a cathode ray tube bulb;

15 Figure 2 shows a method of cleaning a CRT bulb according to an embodiment of the invention;

Figures 3a, 3b and 3c show respectively section, top and bottom views of a nozzle apparatus according to an embodiment of the invention; and

Figures 4a and 4b show respectively graphs of air exchange efficiency and duct removal.

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Detailed Description of the Embodiments

Figure 1 shows a prior art dust removal method using dust pounding and air exchange. An air tube 1 and nozzle 2 are introduced into a cathode ray tube bulb 3 via the bulb's funnel or neck 3a. Air is pumped into the air tube 1

creating an airflow A out of the distal end of the nozzle 2 into the main body of the CRT bulb 3. The airflow A pounds or dislodges dust particles and carries them along, hopefully out of the funnel 3a. It can be seen that vortices are created within the CRT bulb 3 which hinder the extraction of dust particles.

- 5 A detailed side and top view of a prior art nozzle 2 is shown in detail A of figure 1.

Figure 2 illustrates a method of dust removal according to an embodiment of the present invention. A nozzle 20 is attached to the air hose 1 which is inserted into the funnel 3a of a CRT bulb 3. In addition to the forward airflow
10 A from the distal end of the nozzle 20, a rearward airflow B flows from the proximal end of the nozzle 20. The rearward flow B generates a suction force caused by the venturi effect of the airflow B within the constricted funnel space 3a. This suction force helps draw out the air flow A from within the main body of the CRT bulb 3. This assists removal of the dust carried by the
15 forward air flow A, including reducing vortices and increasing the magnitude of the airflow out. The airflow in is preferably hammered to assist dislodging of particles. Preferably the nozzle is held at 50-80 mm from the neck funnel core joint.

Figures 3a, 3b and 3c show respectively section, top and bottom views of the
20 nozzle 20. The nozzle 20 comprises forward air flow orifices 21 in the top of the nozzle 20 to allow a first airflow A into the CRT bulb 3, and rearward air flow orifices 22 to allow a second airflow B back out of the bulb along the funnel 3a. The air flow tube coupling orifice 23 is also shown.

Preferably, the rearward air flow orifices 22 are half the diameter of the
25 forward air flow orifices 21. In an alternative arrangement the rearward orifices may be angled so that they do not necessarily direct airflow parallel to the air tube.

Because of increased airflow out of the funnel 3a, there is no need to turn the CRT bulb upside-down to encourage dust removal, as is necessary in some prior art methods. The embodiment provides a simple, low cost, versatile and efficient apparatus and method for removing dust and other particulate material from a CRT bulb 3.

Referring to figures 4a and 4b, it can be seen that the embodiment provides improvements in air exchange efficiency and dust removal over prior art nozzles. In particular air exchange efficiency is increased from 13% to 18%, a 39% improvement. It can be seen that the volume exchanged is much greater earlier on in cleaning, hence dust is extracted earlier during use of the method of this embodiment. There is also a 42% improvement in dust removal. Because of the increased efficiency of cleaning using the nozzle 20, the time of cleaning can be reduced. This allows CRT bulb production speed to be increased.

In use, the nozzle 20 is attached to an air hose 1 and is used to blast air A into the CRT bulb 3, whilst at the same time creating a back-blast B which creates a venturi effect suction which assists air exchange and dust removal. In tests carried out on production lines, a 39% increase in air exchange amount for 21 inch CRT's, and a 44% increase in air exchange amount for 25 inch CRT's have been achieved. The embodiment also provides improved dust removal thereby reducing the rejection rate of finish tubes and reducing early failures.

In addition to particulate material removal, the embodiment could also for removing one gas within an enclosure and replacing it with another, for example removing the normal nitrogen-oxygen atmosphere from a glass flask and replacing it with an inert gas. In this example different gases may be used in the forward and rearward airflows.

The present invention has been described with respect to a preferred embodiment thereof. Alterations and modifications as would be obvious to those skilled in the art are intended to be incorporated within the scope hereof.

CLAIMS

1. A method of removing particulate material from an enclosure, comprising forcing a first air flow into said enclosure, and forcing a second air
5 flow out of said enclosure, the second air flow causing a suction effect which encourages evacuation of at least a part of said first air flow.
2. A method as claimed in claim 1, wherein the first and second airflow are generated about an opening to said enclosure.
3. A method as claimed in claim 1 or 2, wherein the first and second
10 airflow are generated within a funnel forming an opening to said enclosure.
4. A method as claimed in any preceding claim, wherein the enclosed space is a cathode ray tube bulb and wherein the first and second airflow are generated within a funnel portion of the bulb.
5. A method as claimed in any preceding claim, wherein the first and
15 second airflows are produced by a nozzle located about an opening to the enclosure.
6. An apparatus for removing particulate material from an enclosure, and comprises a nozzle for connection to an air tube, the nozzle having an orifice at its distal end for directing a first air flow in a forward direction, and a second
20 orifice at a proximal end for directing a second air flow in a rearward direction.
7. An apparatus as claimed in claim 6 further comprising an air tube coupled to said nozzle.