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APPARATUS FOR DETECTING SURFACE DISCONTINUITIES

Original Filed Oct. 7, 1946

Fig. 1

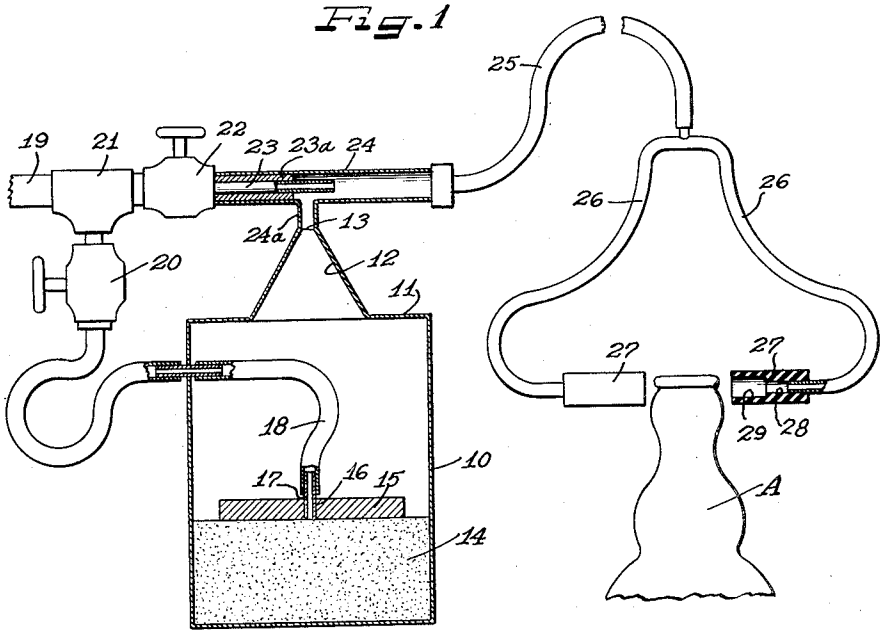


Fig. 2

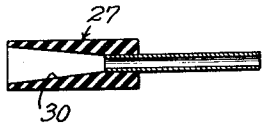


Fig. 3

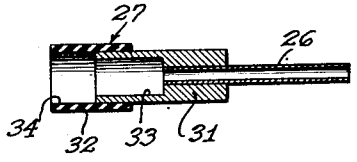
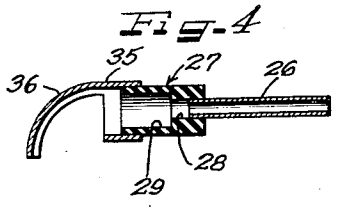


Fig. 4



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APPARATUS FOR DETECTING SURFACE DISCONTINUITIES

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1 Claim. (Cl. 317—3)

The present invention relates to an apparatus for detecting surface discontinuities and more particularly to means for producing a finely particulated cloud of electrostatically charged particles suspended in a fluid medium.

This application is a division of our application of the same title, Serial No. 701,704, filed October 7, 1946, now U. S. Letters Patent 2,515,396, issued July 18, 1950, and a continuation-in-part of our application Serial No. 648,234, filed January 18, 1946, now U. S. Letters Patent No. 2,499,466, issued March 7, 1950, both of said applications being assigned to the assignee of the instant invention.

We have found, as fully disclosed in the above identified applications, that surface discontinuities may be detected in poorly conductive articles, such as glass bottles, or the like, by first wetting the bottles with water or a water-miscible liquid; drying the surface superficially; introducing finely particulated electrostatic particles onto the superficially dried surface; and finally observing any concentration of particulated material at the surface of the article. Under the conditions above outlined, electrostatically charged particles accumulate at or on any surface discontinuities, or cracks in the article in well-defined comparatively dense conglomerations which are coextensive with the cracks. The resulting definite visual indication not only indicates the presence of cracks, but indicates the extent of such defects.

The present invention now provides an improved apparatus for forming an electrostatically charged cloud consisting of finely divided particulated material suspended in a fluid medium, preferably air. The device disperses finely particulated material in a gaseous medium by the utilization of an aspirator, operating in accordance with the Bernoulli effect. The fluid suspension of finely divided particles is then conveyed by suitable means to its point of use, an electrostatic charge being imparted to the particles, as by passing the particle clouds through a suitable rubber hose and nozzle or the like.

It is, therefore, an important object of the present invention to provide an improved apparatus for the detection of surface discontinuities by the formation of a finely divided cloud of electrostatically charged particles and means for introducing the particles onto an article to be tested.

Another important object of the present invention is to provide aspirator means for forming a suspension of finely particulated solid material in a fluid and imparting an electrostatic charge to the particles while so suspended.

It is a further important object of the present invention to provide an apparatus for the detection of surface discontinuities in an electrically non-conductive material, including means for utilizing the Bernoulli effect to form a suspension of finely particulated solid material in a fluid, directing the suspension against an article to be

tested, and imparting an electrostatic charge to the suspension particles.

It is a still further important object of the present invention to provide an improved apparatus for forming a suspension of electrostatically charged solid particles in a fluid, including aspirator means for forming the suspension of solid material in a fluid stream, and a nonconductive nozzle for directing the suspension against an article to be tested, the nozzle serving to impart to particles passing therethrough an electrostatic charge.

Other and further important objects of this invention will be apparent from the disclosures in the specification and accompanying drawings.

On the drawings:

Figure 1 is a side elevational view, with parts broken away and in section of apparatus of the present invention;

Figure 2 is a longitudinal sectional view of a modified form of nozzle for use with the apparatus of Figure 1;

Figure 3 is an additional modified form of nozzle; and

Figure 4 is a sectional view of still another modified form of nozzle.

As shown on the drawings:

In Figure 1 reference numeral **10** refers generally to a container of suitable shape provided with closed bottom and side walls and communicating through its upper wall **11** with an upwardly diminishing passage **12** communicating with a reduced outlet orifice **13**. The container **10** has disposed therein a body **14** of finely particulated solid material. In general the material **14** may be any finely divided solid, but we have found it preferable to employ non-hygroscopic inorganic substances capable of being highly charged electrostatically. Calcium carbonate, or precipitated chalk, has thus far been found to be one of best materials. However, it is possible to employ talc, powdered mica, diatomaceous earth, clays such as kaolin, calcium sulfate, iron oxide, carbon black, aluminum powder, and many others.

The body **14** of particulated solid material within the container **10** is surmounted by a float plate **15** centrally apertured, as at **16**, to receive a conduit or tube **17** which in turn telescopically receives an upwardly extending flexible conduit or hose **18** formed of rubber or the like which extends through one of the side walls of the container **10** for communication with a source of fluid, such as air, under pressure through a supply pipe **19** and a valve **20**. The valve **20** communicates with a T-fitting **21** in the supply line **19**, and it will be seen that upon opening the valve **20** a charge of fluid under pressure is introduced into the container **10** directly upon the material **14** therein so that the material is agitated and will become suspended in fluid entering the container through the line **18**. The supply line **19** is provided with a second valve **22** located therein beyond the T-fitting **21**, and the valve **22** is adapted to admit air under pressure into a reduced conduit **23** coaxial with and interiorly of an adapter fitting **24**. The adapter fitting **24** is provided with an intermediate depending reduced diameter conduit **24***a* which communicates with the reduced orifice **13** of the outlet passage **12** of the container **10** hereinbefore described. The conduit **23** receiving air under pressure therethrough is supported in coaxial relation with the fitting **24** by means of a block **23***a* interposed therebetween, and the conduit **23** extends axially of the fitting **24** from the valve **22** to a point beyond the depending conduit **25**.

It will be appreciated by those skilled in the art that the cooperating conduit **23** and the fitting **24** will function as an aspirator to produce a reduced pressure at the orifice **13** in accordance with the Bernoulli effect, and this reduced pressure will serve to draw the suspension of

solids in fluid from the container **14** into the fitting **24**. The cloud of suspended, finely particulated solid matter thus formed in the fitting **24** is conducted through a flexible conduit **25** which may be rubber to a pair of branched conduits **26** which also may be rubber disposed immediately adjacent the upper portion of an article A to be tested. The branched conduits **26** each terminate in a nozzle **27** immediately adjacent the article A.

The nozzles **27** each comprise a pair of coaxial, axially extending stepped chambers **28** and **29**, the larger of the chambers (**29**) receiving the particulated cloud from the chamber **28** and the conduit **26**. The nozzles **27** are preferably constructed of hard rubber to produce an electrostatic charge in the suspended solid matter of the cloud introduced therethrough as hereinbefore explained. Alternately, the nozzles may be made of phenol-formaldehyde resin, wood, paper, ethyl cellulose resin, or other similar materials capable of so producing an electrostatic charge.

In that form of nozzle illustrated in Figure 2, the stepped bores **28** and **29** are replaced by a single tapering bore **30** of increasing diameter toward the article A. In Figure 3 the nozzle **27** is formed of a first nozzle block **31** receiving the conduit **26** and a second cylindrical block **32** telescopically fitted over the nozzle block **31**. The nozzle block **31** is provided with an interior, generally cylindrical recess **33** and the nozzle **32** is provided with an internal axial bore **34** of greater diameter than the recess **33**.

In Figure 4 of the drawings, the nozzle **27** is substantially identical with that hereinbefore illustrated and described in Figure 1 with the addition of a terminal deflector block **35** telescopically mounted on the nozzle block **27** and provided with the downturned deflector tip **36**.

The purpose of the stepped bores, or the frusto-conical bore of the embodiment of Figure 2, is to produce a spraying nozzle action to uniformly distribute the powdered cloud acting through the nozzle over the surface of the article A to be tested. In the embodiment of Figure 3, the telescoping adjustment of the nozzle sleeve **32** relative to the block **31** makes possible the adjustment of the angle of the spray, thereby accommodating the employment of this form of nozzle to various sizes and types of articles being tested. In the embodiment of Figure 4, the deflector plate **36** insures the direction of the electrostatic cloud either along the entire length of the article A to be tested or to a specific portion of the article. It will be appreciated that the deflector block **35** is telescopically mounted on the nozzle **27** for axial adjustment for varying the angle of the spray and the location to which it is deflected.

From the foregoing description, it will be appreciated that the present invention provides novel means for forming a cloud of electrostatically charged solid particles suspended in a fluid medium. Obviously, for most applications it is desirable to employ compressed air for economic reasons. However, any suitable fluid under pressure may be employed as desired.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

An apparatus for spraying electrostatically charged particles over a wetted surface of glass or the like to detect surface discontinuities, a conduit of electrical insulation material for a pressurized fluid medium having finely divided particulate material dispersed therein, and a nozzle also of electrical insulation material on said conduit for directing the fluid medium and particulate material against the surface of an article under test, said nozzle being formed of adjustable telescoping portions defining a cylindrical inlet chamber and a cylindrical outlet chamber having a diameter substantially greater than the diameter of said inlet chamber, for obtaining increased turbulence in the fluid medium and increased frictional contact of the particles with the interior surface of said nozzle while reducing the velocity of the fluid stream.

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