ELECTROSTATIC NOZZLE

Filed July 10, 1968

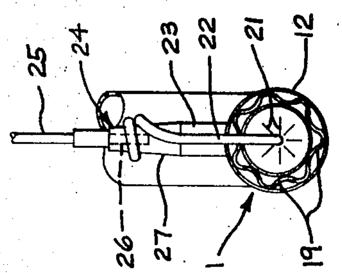

Fig. 2

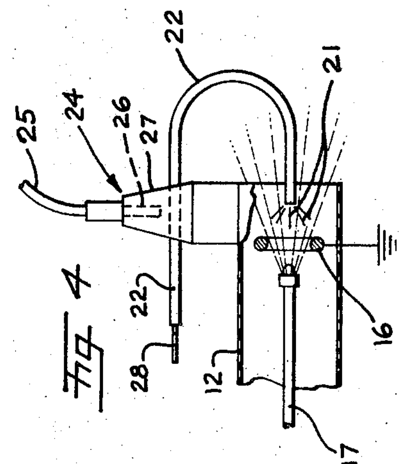

Fig. 4

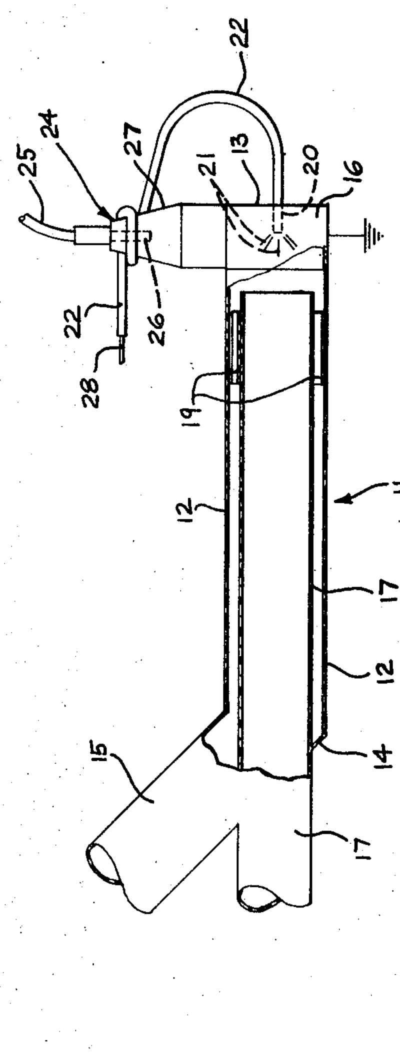

Fig. 1

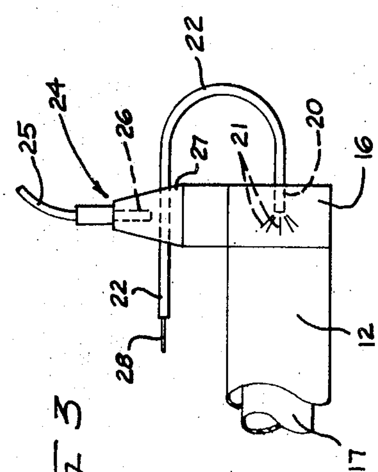

Fig. 3

HENRY D. BOWEN
WILLIAM E. SPLINTER
INVENTORS.

BY

ATTORNEY.

United States Patent Office

3,516,608
Patented June 23, 1970

1

3,516,608

ELECTROSTATIC NOZZLE

Henry D. Bowen, 2200 Charlotte Court, Raleigh, N.C. 27607, and William E. Splinter, 2120 S. 61st St., Lincoln, Nebr. 68506

Filed July 10, 1968, Ser. No. 743,786
Int. Cl. B05b 5/00
U.S. Cl. 239—15 12 Claims

ABSTRACT OF THE DISCLOSURE

In abstract, a preferred embodiment of this invention is an electrostatic charging nozzle used in conjunction with the application of coatings of liquid and powdered materials.

DESCRIPTION

This invention relates to material applicating devices and more particularly to electrostatic charging nozzles for applying materials in both dry powdered and atomized liquid forms.

For many years, electrodes have been placed in particle laden gas streams to electrically charge the particles so that they will be attracted to and deposited on the electrodes. Although the same broad principle is applied in the spray and dust application of paints, insecticides and the like, it is highly desirable to keep the field charging electrodes from becoming coated with any material which would reduce the surface resistivity thereof.

In the use of nozzles for electrostatically charging dust aerosols for agricultural and similar applications, it has been found that under low relative humidity conditions (40% or less) a coating of high resistivity will form on the electrodes, particularly the exterior electrode when this forms the end of the nozzle. The coating thus formed may cause reverse ionization of the electrostatic field thereby nullifying the charging effect.

To overcome this problem of reverse ionization at low humidities, nozzles have been designed so that the dust aerosol stream impinges off of the electrodes, particularly the outer electrode when it has been necked down, to cause more effective erosion of the deposited material. The advantages obtained by these designs, however, are at least partially off-set by the fact that the particles become discharged upon striking the electrode surfaces and may actually erode with an opposite sign.

Under high humidity conditions dust deposits do not build up on the electrodes, but a new problem arises. Voltage leakage between the power supply and the electrodes effectively reduces the efficiency of operation of the charging nozzles and can reach the point of complete cessation of charging. It has been noted that a direct short is not necessary to adversely affect proper operation of the system.

Because of the electrical leakage encountered under high humidity conditions, it has been deemed over the years not to be feasible to use charging nozzles designed for dust aerosols in the application of aqueous atomized sprays. This is a definite disadvantage in view of the fact that many materials for application, chemical properties, and air pollution reasons, preferably come in liquid form.

In recent years, non-wetting materials have been used at least experimentally in coating of leads between the power supply and the electrodes to reduce or eliminate current leakage due to grounding. These experiments have disclosed that no known non-wetting material will effectively prevent leakage from taking place under high humidity conditions created by either the ambient air or blow-back from atomized spray application.

2

The present invention has been developed after much research and study into the above mentioned problems and is designed to overcome the reverse ionization effect caused by low humidity conditions. It also effectively eliminates current leakages between power supply and electrodes under high humidity conditions created through the use of aqueous sprays or from the ambient air, thus allowing a single nozzle configuration to be used alternately, without extensive modification, for both dusts and sprays.

It is an object, therefore, of the present invention to provide an electrostatic charging nozzle having positive means of preventing deposit build-up on at least one of the electrodes in combination with positive means for preventing leakage in the high voltage line between the power supply and the high voltage electrode.

Another object of the present invention is to provide means for positively eliminating voltage leaks caused by high humidity conditions between the high voltage electrode and the power supply of an electrostatics charging device.

Another object of the present invention is to provide in combination with a voltage leakage preventing means a means for insulating, through the use of a clean air curtain, at least one of the electrodes from the fluid stream being charged.

An additional object of the present invention is to provide a line voltage leak preventing means including a heater having a surface temperature of between 200 to 300 degrees Fahrenheit.

Another object of the present invention is to provide in an electrostatic charging nozzle, a combination of voltage leakage eliminating means, fluid stream from electrode insulating means, and air straightening means for said insulating means.

Other objects and advantages of the present invention will become apparent and obvious from a study of the following description and the accompanying drawings which are merely illustrative of the present invention.

In the drawings:

FIG. 1 is a partially cutaway, side elevational view of a preferred embodiment of the electrostatic charging nozzle of the present invention;

FIG. 2 is an end elevational view of such nozzle;

FIG. 3 is a side elevational view of a modified heater unit for said invention; and

FIG. 4 is a side elevational view of a modification thereof.

With further reference to the drawings, an electrostatic charging nozzle indicated generally at **11** is formed of an elongated, generally cylindrical housing **12** which is open at its discharge end **13**.

The end **14** of housing **12** opposite discharge end **13** is enclosed with a clean air inlet conduit **15** communicatively constructed thereinto.

Sealingly mounted through inlet end **14** and extending longitudinally in spaced relation to cylindrical housing **12** to a point inwardly of the ring shaped outer electrode **16** is fluid inlet conduit **17**.

Adjacent the outlet end **18** of fluid conduit **17** are a series of baffle-like air straighteners **19** which also act as spacers and mounting supports between housing **12** and said conduit.

A second electrode **20** has its end centrally disposed in the discharge end **13** of housing **12** so that the outer electrode **16** is spaced an equidistance thereabout. A multiplicity of small wire-like probes **21** are included on the tip of the central electrode **20** to increase the corona effect during the charging process.

Fixedly secured to a portion of housing **12** is an insulator mounting block **23** upon which is fixedly mounted a heating unit indicated generally at **24**. This unit is composed of an electrical lead **25** which is operatively connected to a power source (not shown) at one end and is operatively connected to heating element **26** at the other end. A heating surface **27** surrounds the heating element and is so adjusted relative thereto that a temperature of between 200 and 300 degrees Fahrenheit may be maintained during operation of the nozzle as humidity conditions require.

From electrode **20**, electrode lead **22** curves outwardly from the discharge end **13** of housing **12** toward heating unit **24**. This lead then passes either around the heating surface **27** as disclosed in FIGS. 1 and 2 or through the heating unit as disclosed in FIG. 3. In any event, once central electrode lead **22** has passed around or through the heating unit **24**, such lead with its conducting wire **28** passes on to a high voltage source (not shown).

OPERATION

In actual operation of the nozzle of the present invention, the heater unit **24** is activated in the usual manner for electrical heating devices so that element **26** will heat surface **27** to a temperature of between 200 and 300 degrees Fahrenheit. From the high voltage power supply (not shown), a potential difference of between 10 kv. and 15 kv. is established between the central electrode **20** and the outer electrode **16**. It should be noted that although in the past most electrostatic nozzles using the general electrode arrangement of the present invention have applied the high potential (either positive or negative) to the central electrode, it has been determined by applicants that the center electrode needs only to be at a different potential than the outer electrode and the magnitude or sign of either is unimportant other than the possible consideration of safety and design. This, of course, indicates that either or both electrodes in the charging system may be at a potential other than ground.

Once the heating unit is at proper operating temperature and the potential difference is established between the electrodes, clean air is introduced into the nozzle through conduit **15**. Due to the spaced relation between fluid conduit **17** and housing **12**, this clean air completely surrounds said last mentioned conduit and after passing through the air straighteners **19** forms a boundary layer or air curtain along the interior edge of outer electrode **16**. The fluid to be charged is introduced into the nozzle through fluid conduit **17** and passes out of the nozzle through the center of the air curtain which insulates such fluid flow from contact with the outer electrode. Through initial experimentation, it has been found that better insulating qualities are obtained when the velocity of the air curtain is higher than that of the fluid. As the fluid passes through the area of the electrodes, the difference in potential between the outer electrode **16** and the inner or central electrode **20** places a charge on the individual dust particles or spray particles, as the case may be, so that when the same leaves the nozzle they will be attracted to nearby surfaces which are not be treated or coated.

Often enough moisture is in the air to cause leakage of current in the electrode lead **22** regardless of where the power supply is actually located. In addition, use of the aqueous sprays allows depostiion of spring droplets as the electrode leads, also leading to current leakage. This, of course, is because water is a good conductor and a small amount of moisture on the insulation of a lead will allow some bleeding of current. Even the slightest leakage will have a definite effect on the effectiveness of charging. In the present invention, however, regardless of the amount of moisture which strikes lead **22**, such leakage is effectively stopped and prevented from passing back along the exterior of such lead since heater **24** is of a sufficient temperature to maintain the insulating properties of the portion of said lead adjacent the heater unit.

Although not dealt with in great detail, the present invention may obviously be used with nozzles employing both of the well known electrostatic charging principles. The same solution overcomes both the problems encountered in using the pair of spaced electrodes creating an ionized field as well as the problems encountered in using the single electrode of the inductive method when a conducting fluid acts to create the desired electrical potential differential. This solution disclosed by applicants' invention, among other things, allows maintenance of proper active and passive electrode conditions in ionized field charging and also allows proper passive condition to be maintained during induction charging as is known by ones skilled in the art to be necessary for proper operation.

In view of the above, it is obvious that the present invention has the advantage of providing an electrostatic charging nozzle which does not allow insulating dust build-up on electrodes due to low humidity conditions and is not affected by voltage variations due to leakage under high humidity conditions. The present invention also has the advantage of being simple in construction, inexpensive to manufacture and yet sturdy in structure and capable of long, constant operation under adverse conditions.

The present invention may, of course, be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

What is claimed is:

1. In an electrostatic charging nozzle having a conduit through which a fluid stream to be charged passes, an outer electrode spaced adjacent the outlet end of said conduit, a second electrode disposed in the fluid stream adjacent said outlet end, means for creating an electrical potential differential between said electrodes, and electrically conductive lead means connecting said last mentioned means to at least one of said electrodes, the improvement comprising: a stream of air directed between the outer electrode and said fluid stream whereby material from said last mentioned stream will be prevented from building up on said outer electrode; and heater means disposed adjacent at least a portion of said lead means whereby current leakage caused by moisture on said lead will be effectively blocked.

2. The nozzle of claim **1** wherein the heater means maintain said lead at a temperature of between 200 and 300 degrees Fahrenheit.

3. The nozzle of claim **1** wherein the velocity of the air stream is greater than the velocity of the fluid stream.

4. The nozzle of claim **1** wherein the fluid stream is a dust aerosol.

5. The nozzle of claim **1** wherein the fluid stream is an atomized spray.

6. An electrostatic charging means comprising: at least one electrode; a high voltage power supply means; electrically conductive lead means connecting said electrode to said power supply means; and means for heating at least a portion of said lead means whereby said portion may be maintained in a dry condition to prevent electrical current leakage.

7. The charging means of claim **6** wherein the heating means maintains at least a portion of said lead means at a temperature of between 200 and 300 degrees Fahrenheit.

8. A means for electrostatically charging a fluid stream comprising: at least two spaced electrodes, at least one of which is disposed outside of said stream; a high voltage power supply means; electrically conductive lead means connecting at least one of said electrodes of said power means; means for heating at least a portion of said lead means whereby said portion may be maintained in a dry condtiion to prevent electrical current leakage therealong; and an air stream means disposed between said fluid stream and at least one of said electrodes whereby build-ups of material from said fluid stream may be prevented on said last mentioned electrode.

9. The charging means of claim **8** wherein the heating means maintains said lead means at a temperature of between 200 and 300 degrees Fahrenheit.

10. The charging means of claim **8** wherein the velocity of the air stream is greater than the velocity of the fluid stream.

11. The charging means of claim **8** wherein the fluid stream is a dust aerosol.

12. The charging means of claim **8** wherein the fluid stream is an atomized spray.

References Cited

UNITED STATES PATENTS

3,195,264	7/1965	Ward	239—15
3,212,211	10/1965	Bennett	239—15

EVERETT W. KIRBY, Primary Examiner

G. A. CHURCH, Assistant Examiner

U.S. Cl. X.R.

239—3, 118, 135