Nov. 10, 1964 H. SCHWERINER 3,156,847

IONIZING AIR GUN

Filed April 21, 1960

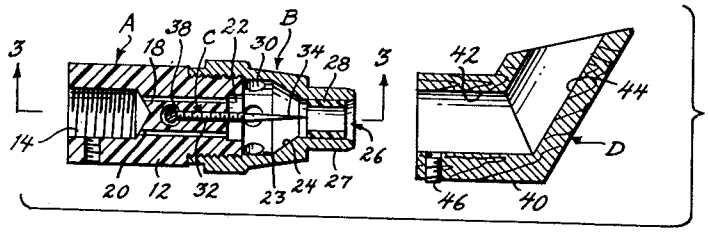


Fig. 2.

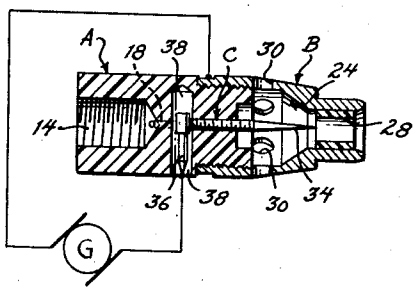


Fig. 3.

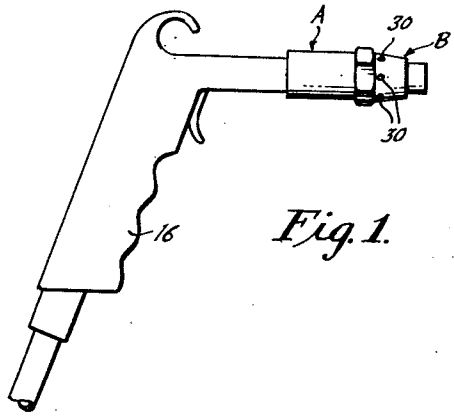


Fig. 1.

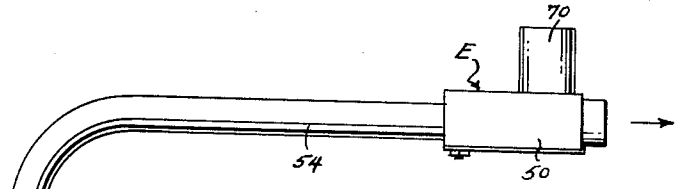


Fig. 4.

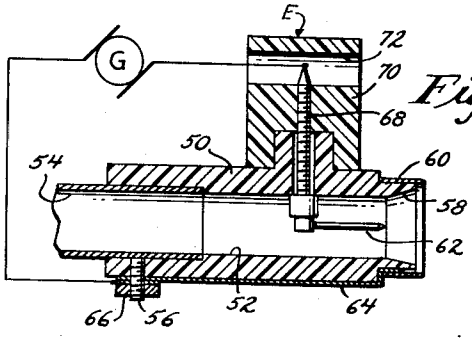


Fig. 5.

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IONIZING AIR GUN

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This invention relates to static eliminators, and more particularly relates to an ionizing air gun for simultaneously neutralizing and blowing electrostatically charged foreign particles from surfaces to which they are attractively adhered.

The proclivity of electrically non-conductive materials to pick up dust and other foreign particles upon their surfaces is experienced in almost all phases of industry and modern day technology. As is well known, electrostatic charges accumulating on the surfaces of plastic parts, plastic and paper sheets and films, textiles, rubber and leather, particularly in a dry atmospheric environment, cause dust and dirt particles to be attracted and held to the material faces. Endeavors to brush or wipe the surfaces clean only aggravate the situation since friction merely emphasizes and promotes a greater degree of electrostatic charging. Any attempt to merely blow the dust from the surface effects purely a temporary redistribution at best and usually stirs up more dust because the primary electrostatic forces still remain. Prior art proximity static eliminators, while effective in neutralizing the surface, where exposed, and the exposed surface of the foreign particles thereon, did not neutralize the charges between the particles and the surface so that neutralization was incomplete. Moreover, goodly portions of the particles with their insignificant mass, even assuming complete neutralization, still remained on the surface. Furthermore, static charges between any surfaces in intimate contact could not be easily removed with proximity eliminators of the well established type because the algebraic sum of positive and negative charges in close proximity on the contacting surfaces merely creates the illusion of a neutral condition. Lastly, corona discharge from the points of high voltage proximity neutralizers could cause fogging or exposure of photo-sensitive films and papers.

It is therefore an object of my invention to provide a static eliminator for simultaneously blowing off dust particles electrostatically attracted to a part and neutralizing the static charges on both the dirt and the part being cleaned.

Another object of my invention is to construct an ionizing air gun wherein dust particles electrostatically attracted to a surface may not only be completely removed, but also the electrostatic forces tending to re-attract them to the part are fully eliminated.

Another object of my invention is to provide a static eliminator which may be placed remotely from the part to be neutralized.

Another object of my invention is to provide a static eliminator for neutralizing the electrostatic charges intermediate surfaces in intimate contact.

Another object of my invention is to provide an air ionizing nozzle for instantly opening bags or instantly separating and neutralizing sheets in a pile.

Another object of my invention is to provide an air ionizing nozzle enabling the neutralizing and cleaning of light sensitive film without causing fogging or exposure thereof.

Other objects of my invention are to provide an improved device of the character described that is easily and economically produced, which is sturdy in construction, and which is highly efficient in operation.

With the above and related objects in view, my invention consists of the details of construction and combination of parts as will be more fully understood from the following description when read in conjunction with the accompanying drawing in which:

FIG. 1 is a side elevation view of a high pressure air gun having an air ionizing nozzle embodying my invention.

FIG. 2 is a longitudinal sectional view taken through the axis of the air ionizing nozzle and showing in exploded section a nozzle shield for preventing exposure of light sensitive film.

FIG. 3 is a sectional view taken along lines 3—3 of FIG. 2 and further showing schematically the external electrical diagram therefor.

FIG. 4 is a side elevational view of a low pressure air ionizing gun embodying my invention.

FIG. 5 is a longitudinal sectional view of the low pressure air ionizing nozzle and further shows, schematically, the external electrical diagram therefor.

Referring now in greater detail to the drawing in which similar reference characters refer to similar parts, I show, in FIGS. 1, 2 and 3, an air ionizing nozzle for a high pressure air gun comprising a barrel, generally designated as A, an orifice metallic tip, generally designated as B, and a metal needle, generally designated as C, longitudinally disposed within the barrel and axially extending within the tip and concentrically spaced therein.

The barrel A comprises a substantially cylindrical body portion **12** of suitable dielectric material such as plexiglass (i.e. an acrylic resin) or other plastic which can be easily molded or worked. One end of the body portion has an internally threaded bore **14** which engages upon a complementary threaded tip on conventional air gun **16**. A pair of small diameter ports **18** and **20** extend longitudinally through the barrel B from a circular recess **22** at the distal end of the body portion and communicate with the bore **14**.

The metal tip B has a longitudinal bore **23** therein and threadedly interfits about the distal end of the barrel A. The bore **23** is tapered at **24** which terminates in a small diameter orifice **26**. A plastic tube **28** is cemented within the orifice to reduce the longitudinal peripheral metal surface about the needle C, which would otherwise detract from the strength of the ionized field. Circumferentially spaced air ports **30** extend radially from the bore **23** through the shell of the tip B. These ports allow air to be drawn into the bore from the atmosphere without creating a partial vacuum at the tapered portion **24** behind the compressed air from the gun **16**.

The needle C has a threaded base **32** which is screwed into a tapped axial hole in the barrel A and a point **34** which projects beyond the tapered opening **24** and terminates concentrically within the orifice **26** immediately proximal to the tube **28**. A terminal jack **36**, fitting entirely within a transverse hole **38** in the barrel B, is threadedly mounted upon the end of the needle base **34** and permits the application of high voltage to the needle C by a suitable connector. As is shown in FIG. 3, the other side of a high voltage supply is connected to the metal tip B, whereby an ionized air field will be created in the peripheral gap about the point of the needle C. The application of the voltage is such that no dielectric breakdown occurs in the air space, although a corona glow is observed at the needle point. Because of the co-axial arrangement of the needle C within the tip bore, the air ions will radiate and cause a slight draft of air so as to urge the ions into and through the orifice. The compressed air stream from the gun **16** is discharged co-axially with the needle and reinforces the natural ion flow which enables the jets of free air ions to be blown into the atmosphere. These jets of ionized air may now simultaneously neutralize the dust and the surface to which it is electrostatically attracted and blow the deionized dust particles therefrom.

In FIG. 2, I show a cap D which is adapted to be inserted about the tip of the ionizing air nozzle whereby the ionized air stream discharged therefrom may be directed against light sensitive film without the film being exposed to the needle point corona glow. The cap D is preferably made of a non-conductive material such as polystyrene or hard rubber and comprises an L-shaped casing 40, having a pair of obtusely joined tubular passages 42 and 44 longitudinally extending therethrough. The casing 40 is secured to the nozzle by inserting the annularly reduced end 27 of the tip B into passageway 42 and tightening down set screw 46. The configuration of the passageway is such that no point exterior to the casing can "see" the corona discharge within the orifice of the nozzle.

In FIGS. 4 and 5, I show a low pressure air nozzle E for delivering a low pressure stream of ionized air against a part to be neutralized. The nozzle E comprises a non-conductive casing 50 of suitable plastic material such as plexiglass (i.e. an acrylic resin) and has a longitudinal bore 52 extending entirely therethrough. The bore 52 interfits about the end of an air delivery tube 54 and is secured by set screw 56. The distal end of the bore 52 is gently flared outwardly at 58 and the exterior periphery of the casing 50 thereabout is annularly reduced to accommodate a metal sleeve 60. The sleeve 60 is secured to, but overhangs, the distal end of the casing so that a bare metal ring surface may be "seen" by needle 62 beyond the flared portion 58. A metal grounding strap 64, in firm contact with the sleeve 60, extends rearwardly on the casing 50 to the set screw 56 about which the ground lead of a high voltage power supply is secured by nut 66.

The needle 62 is axially positioned within the bore 52 so that the needle point projects concentrically within and adjacent to the proximal end of the flared portion 58. An imaginary conoid may be projected forwardly from the point of needle 62 to the overhanging bare interior surface of the sleeve 60. The needle 62 is threadedly supported by a jack screw 68, which itself is supported within boss 70 transversely extending from the casing. A longitudinal hole 72 in the boss 70 communicates from either side thereof with the point of the jack 68 to which the high voltage lead of the power supply G is connected.

It is to be observed that with high voltage potential applied across the needle 62 and the sleeve 60, an ionized air field radiates conically from the needle point and extends slightly beyond the distal end of the nozzle. A low pressure air stream from the tube 56, discharged co-axially with the needle 62, directionally reinforces the field and expels free air ions into the atmosphere. Thus, neutralization of a remotely positioned electrostatically charged part may be effected and dust, electrostatically attracted to the part, simultaneously deionized and cleaned therefrom by the air stream.

Typical applications for my ionizing air gun are the neutralizing and cleaning of magnetic tapes before wind-up, neutralization of plastic parts after molding, extruding or calendering, treatment of leather after brushing and optical surfaces prior to assembly into sealed units, neutralization of paper or plastic sheets before printing or silk screening and of vials and containers before filling as well as the neutralization of surfaces of various types prior to printing or coating.

It is also to be noted that my ionizing air nozzles may be used to open bags efficiently or separate sheets in a feed pile. In addition, the shielding nozzle sleeve employed with my invention enables the efficient neutralizing and cleaning of light sensitive photographic film without causing exposure thereof resulting from corona or point glow at the needle tip.

Although my invention has been described in considerable detail, such description is intended as being illustrative rather than limiting, since the invention may be variously embodied, and the scope of the invention is to be determined as claimed.

I claim:

1. An ionizing air nozzle for connection to a source of air under pressure comprising a non-conductive barrel, an orificed conductive tip longitudinally extending from said barrel, a conductive needle supported within said barrel and having a point axially projecting within said tip, the point of said needle being concentrically spaced within said tip and insulated therefrom, means imposing an ionized air field of conical configuration intermediate said tip and said point, and means directing a stream of air co-axially with said needle whereby ionized air will be discharged from the nozzle.

2. An ionizing air nozzle for connection to a source of air under pressure comprising a non-conductive casing having a bore longitudinally extending therethrough, a pointed needle axially supported within the bore of said casing, a conductive ring air spaced concentrically with said needle and longitudinally distal to the point thereof, means imposing an ionized field conically radiating from the point of said needle to said conductive ring, and means directing a stream of air co-axially with said needle and unidirectionally therewith.

3. The invention of claim 2 wherein an electrically-insulative cap having longitudinally connected and obliquely joined passageways therein is inserted about said conductive ring, the passageways communicating with the bore of said casing, whereby light sensitive film having the ionized air stream directed thereagainst will be shielded from corona glow developed about the needle.

4. An ionizing air nozzle for connection to a source of air under pressure comprising a casing having a bore longitudinally extending therein, a conductive pointed needle axially supported within the bore and electrically insulated from said casing, a continuous conductive ring in co-axially spaced relationship with said needle and longitudinally spaced from the point thereof in a distal direction, a substantially cylindrical insulating surface co-axially disposed with said needle intermediate the point thereof and said conductive ring, and means for applying a high voltage across said needle and said conductive ring without causing dielectric breakdown of the air therebetween whereby an ionized air field will conically radiate from the needle point to said conductive ring and all air directed through the nozzle will pass through said field.

5. An ionizing air nozzle comprising a tubular casing having a bore longitudinally extending therein, air inlet means at one end of said casing for introducing air under pressure into the bore, a conductive needle co-axially supported within the bore and electrically insulated from said casing, said needle having a point directed toward the distal end of said casing and longitudinally spaced therefrom, a conductive ring at the distal end of said casing concentrically disposed with respect to the axis of said needle, a tubular insulator concentrically disposed with respect to the axis of said needle intermediate the point thereof and said conductive ring, and means for applying a high voltage across said needle and said conductive ring without causing dielectric breakdown of the air therebetween whereby an ionized air field will conically radiate from the point of said needle to said conductive ring and all air directed through the nozzle will pass through the field in synergistic support thereof so as to extend the range of ionization.

6. An ionizing air nozzle comprising a longitudinally bored casing having an air inlet and an air outlet, a conductive needle axially supported within said bored casing and having a point directed toward the outlet, a conductive ring adjacent the outlet and being concentrically disposed with respect to the axis of said needle, a tubular insulator concentrically disposed with respect to the axis of said needle and longitudinally extending between the point thereof and said conductive ring, means to direct a stream of air under pressure co-axially with said needle, and means for applying a high voltage across said needle and said conductive ring without causing dielectric break-

down of the air therebetween whereby the stream of air will synergistically reinforce an ionized air field conically radiating from the point of said needle to said conductive ring.

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