

March 7, 1967

H. W. SMITH ET AL

3,308,343

ANTISTATIC TREATMENT AND APPARATUS

Filed Nov. 12, 1964

2 Sheets-Sheet 1

FIG. 1.

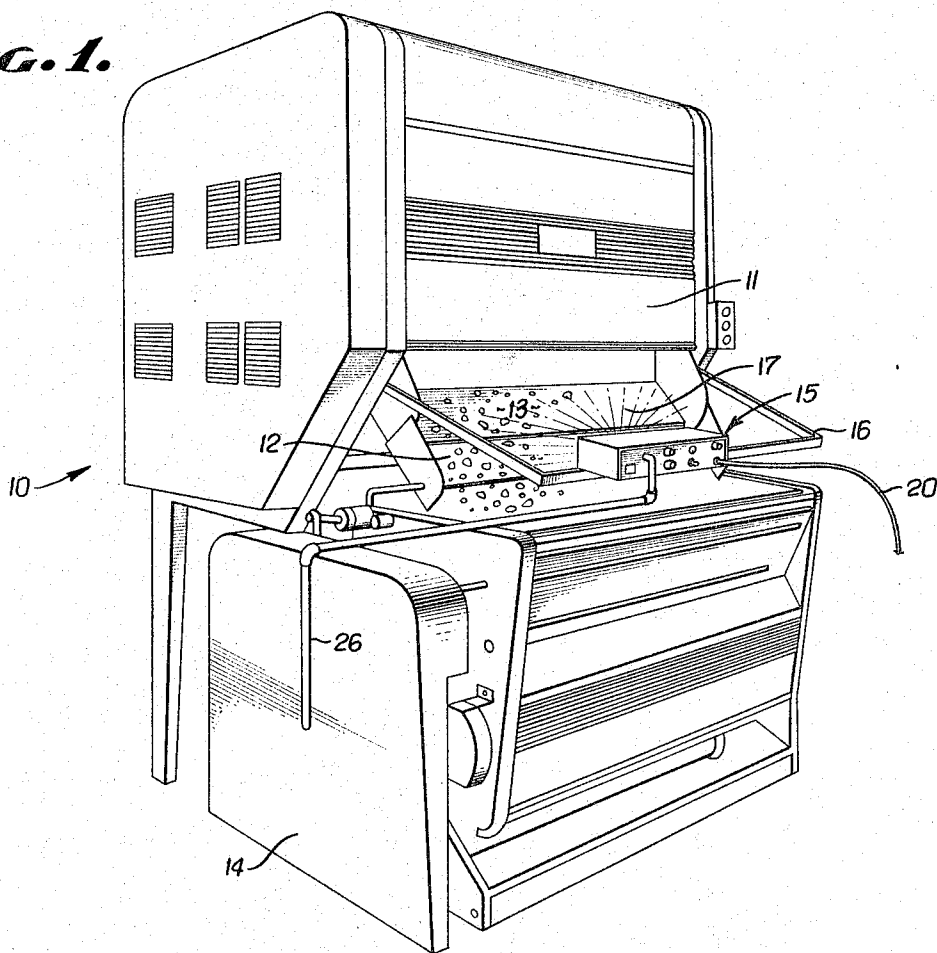
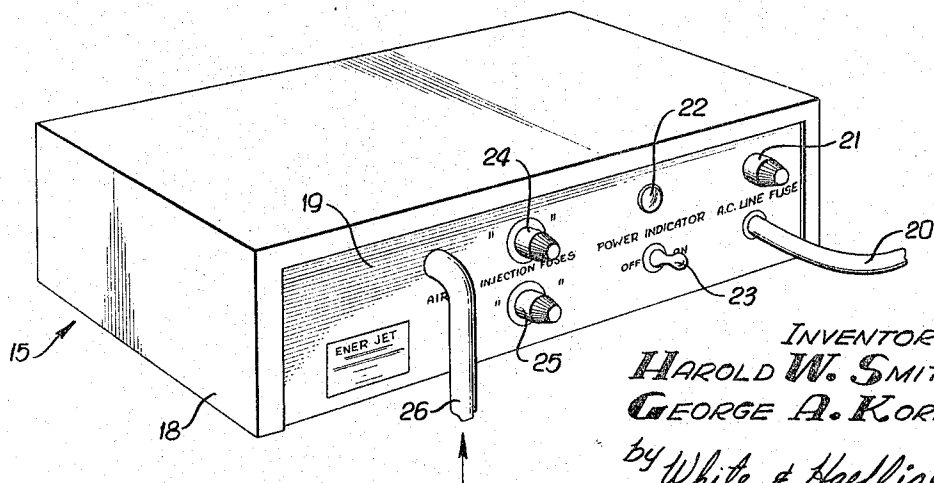


FIG. 2.



INVENTORS.
HAROLD W. SMITH
GEORGE A. KORKOS
by *White & Haefliger*
ATTORNEYS.

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2 Sheets-Sheet 2

FIG. 3.

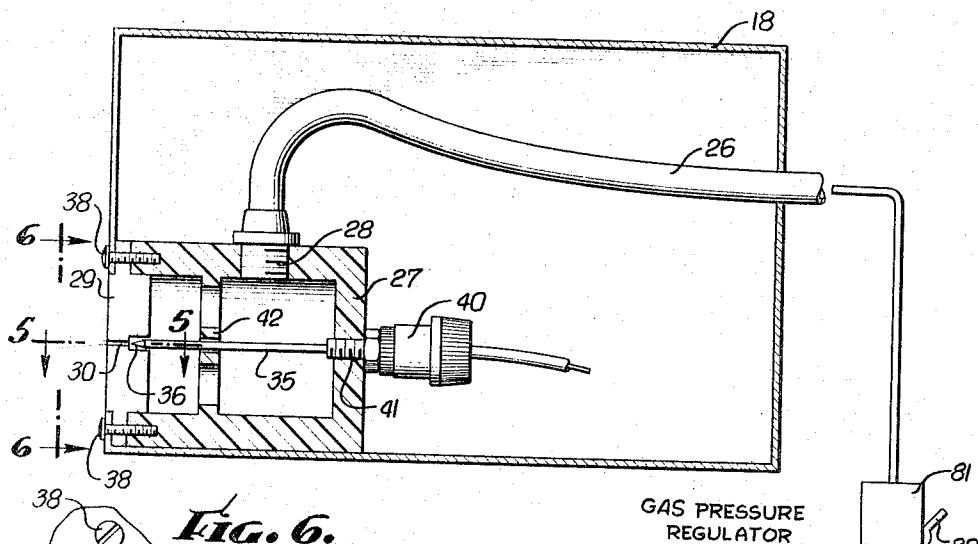


FIG. 6.

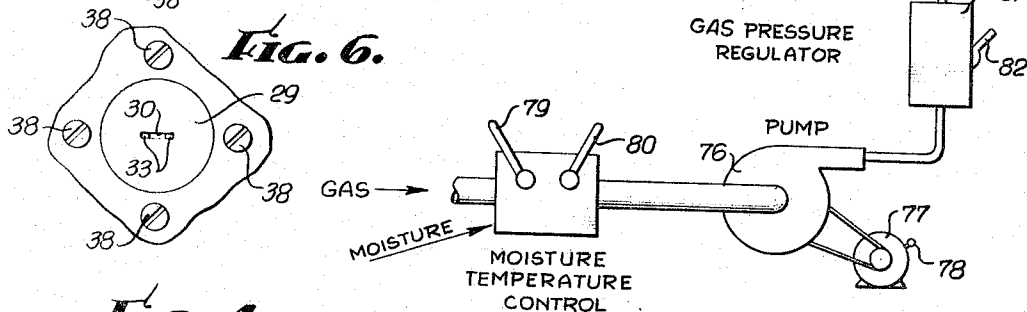


FIG. 4.

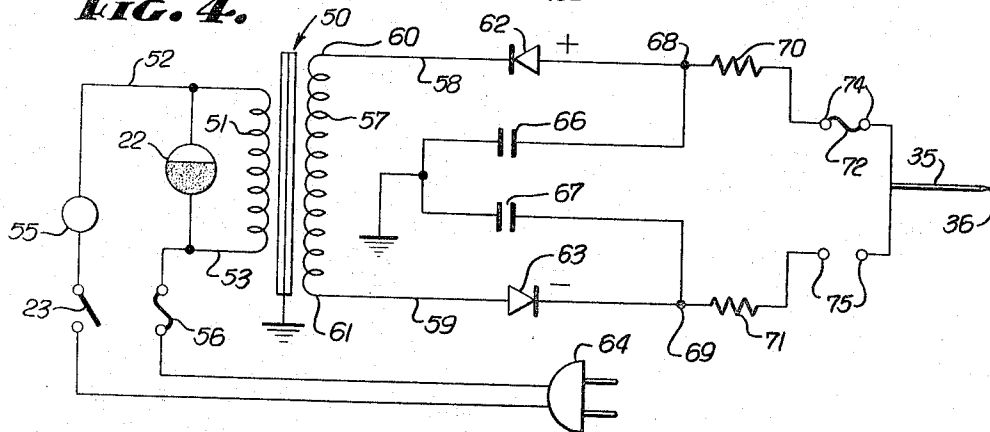
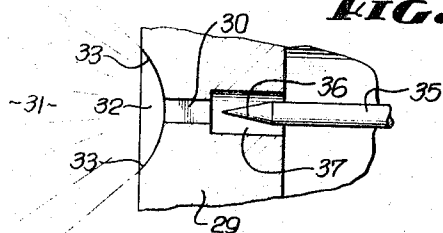


FIG. 5.



INVENTORS.
HAROLD W. SMITH
GEORGE A. KORKOS
by White & Hoefliger
 ATTORNEYS.

1

3,308,343

ANTISTATIC TREATMENT AND APPARATUS
Harold W. Smith, San Marino, and George A. Korkos,
Los Angeles, Calif., assignors to Ener-Jet Corporation,
Phoenix, Ariz., a corporation of California
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11 Claims. (Cl. 317-2)

This invention relates generally to antistatic treatment of electrically charged objects, and more particularly concerns ion generation and dispensing apparatus for altering the static charge on work surfaces.

In certain processing operations there has long been a need for removing static charge from work surfaces. Typical processing apparatus where static charge builds up on fiber or paper surfaces includes the following: feeder aprons in cotton gin stands, cotton gin lint cleaners, slides and overhead feed distributors, rollers in cotton roller gins, textile mill card webs, sliver and tow, and looms for processing either natural or synthetic fibers, paper handling equipment such as printing presses, and rug fiber manufacturing, process, handling and transporting equipment and hair treating apparatus. Such charge build-up often results in balling, sticking and jamming of the fiber, paper or hair being processed, inhibiting the efficiency of the processing operation. Past efforts to solve this problem have not proved to be entirely satisfactory, and do not offer the unusual features and advantages of the present invention, insofar as we are aware.

It is a major object of the present invention to overcome the charge build-up problems discussed above through the provision of unusually simple, compact and highly effective ion generation and dispensing apparatus for altering, as for example neutralizing, the static charge on work surfaces. Basically, the apparatus comprises a chamber having a gas inlet and a sonic orifice outlet, means presenting a pointed tip upstream of the orifice outlet and to supply sufficiently high voltage to effect production of ions in a corona at the tip, and means to supply a stream of pressurized gas to flow into the chamber and adjacent the tip to carry the bulk of the ions through the orifice, the latter being angled to jet the gas stream and ions in a wide angle discharge pattern. It is another object to achieve the wide angle ion discharge pattern in a highly effective and simple manner, in order that decay of ion concentration may be kept low while a large area of work may be treated. This objective is realized by providing a metallic front orifice plate having a rear recess into which the pointed tip projects in order that the corona may be swept by high velocity gas, the plate discharge orifice communicating with that recess and being formed as a narrow slot the opposite end walls of which diverge at a wide angle.

It is a still further object of the invention to provide a simple and efficient high voltage power supply for the pointed tip, the latter typically being formed by a needle. As will appear, the power supply basically comprises a circuit including a transformer to supply alternating current above 2,000 volts at the transformer secondary coil, and simple means electrically connected in series between the coil and said needle to effect supply of positive or negative ions at the needle corona. Typically, the circuit includes first and second branches respectively electrically connected between spaced taps of

2

the transformer secondary coil and the needle, a first rectifier connected in one branch to pass current away from the needle and a second rectifier connected in the other branch to pass current toward the needle. As a result, either positive or negative ions may be produced at the needle corona for distribution to the work. Further, each branch includes a pair of terminals located to removably engage a fuse to pass current between the terminals, so that the fuse may be selectively positioned to alternately electrically interconnect the needle with the positive or negative high voltage supply.

Further objects include the provision of simple and effective means to control the quantity of ions supplied to the work by controlling the pressure, temperature and moisture content of the gas which is supplied to the work via the ion producing corona, and the effective adaptation of the ion generating and dispensing apparatus to processing equipment such as a cotton gin.

These and other objects and advantages of the invention, as well as the details of illustrative embodiments, will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is an overall perspective view showing the combination of the ion generating and dispensing apparatus with a cotton gin;

FIG. 2 is an enlarged perspective view of the apparatus cabinet and controls;

FIG. 3 is a vertical cross section taken through the ion generating and dispensing apparatus;

FIG. 4 is a power supply circuit diagram;

FIG. 5 is an enlarged fragmentary section taken on line 5-5 of FIG. 3; and

FIG. 6 is a view taken on line 6-6 of FIG. 3.

Referring first to FIG. 1, a cotton gin is indicated generally at 10 as having a cotton feed 11, a slide 12 along which cotton fiber 13 descends, and a lower unit 14 containing saws or other apparatus to clean and process the cotton. Cotton fiber 13 tends to develop static charge and to ball up on the slide 12, preventing uniform delivery and distribution thereof to the lower unit 14, so that the latter functions less efficiently than is possible in the absence of the static charge build-up on the cotton. To solve this problem, the ion generating and dispensing apparatus shown at 15 is centrally mounted as by bail support bracket 16 directly facing the slide 12 so as to jet a high concentration of ions, as in an ionized gas stream, in a forward direction and over a wide angle discharge pattern 17 for continuously treating the cotton descending on the slide. Such treatment alters the static charge build-up on the cotton fibers, as for example by neutralizing the static charge, to stop balling, bunching or non-uniform delivery of the cotton to the lower unit. As a result a cleaner, more high grade cotton product is produced by the gin, enhancing its economic value.

Extending the description to FIGS. 2 and 3, the apparatus 15 is illustrated to comprise a cabinet 18 having a front plate 19 mounting the electrical power supply line at 20, a line fuse holder 21, a neon pilot or indicator bulb 22, an on-off switch 23, an active fuse holder 24, a dummy fuse holder 25, and an air or gas supply line 26.

Apparatus 15 also includes a dielectric, as for example plastic, chamber 27 contained within the cabinet 18 and having a gas inlet 28 to which line 26 delivers. The

chamber 27 includes a metallic front plate 29 forming a sonic orifice outlet 30 at the front side of the plate. In accordance with an important aspect of the invention, the orifice is angled to jet the gas stream and ions forwardly in a wide angle discharge pattern as indicated at 31 in FIG. 5, the discharge pattern having reduced thickness as better seen in FIG. 3. This result is achieved by providing an orifice the outlet side of which has the form of a narrow width slot 32 bounded at opposite ends by plate walls 33 which diverge forwardly at a wide angle, typically obtuse. As a result, the ion discharge pattern encompasses the width of the slide 12 in FIG. 1, with ion delivery concentrated in a relatively thin zone across the span of the side and through which the cotton fibers descend successively, thereby realizing most effective anti-static treatment since ion decay is compensated for by higher ion concentration in a given unit area at the slide.

Referring back to FIGS. 3 and 4, the invention also includes first means presenting a pointed tip upstream of the sonic orifices outlet and to supply sufficient high voltage to effect production of ions in a corona at the tip. Typically, the first means comprises a needle 35 forming the pointed tip 36 in the chamber 27 and which projects into a recess 37 formed in the rear side of the plate 29 to communicate with orifice 30. In this regard the high voltage supplied to the tip serves to effect production of a corona in the recess 37 since the plate 29 is electrically conductive and is grounded to the cabinet 18 as by mounting fasteners 38. The voltage at the tip must be in excess of 2,000 volts, and typically lies between 4,000 and 6,000 volts. Also, the air or gas delivered into the chamber 27 via line 26 is pressurized to between 20 and 45 p.s.i. The size of the orifice 30 is about $\frac{3}{4}$ to $\frac{5}{4}$ inch, and the tip 36 is closely spaced to the orifice to produce the high ion concentration desired, a typical spacing being between 1.4 to 3.2 millimeters. The needle is mounted to a holder indicated at 40 and which has threaded adjustable connection at 41 to the chamber to vary the gap between the tip 36 and orifice 30. A dielectric cross piece 42 in the chamber acts to center the needle and tip 36 with respect to recess 37. Typically, air is delivered via line 26 to the chamber 27 at flow rates of around 350 c.f.m. Ion concentration of about 10^{10} to 10^{11} ions per cubic centimeter of positive or negative polarity leaving the orifice can be produced in this manner.

Referring to FIG. 4, the components of the simple and highly effective power supply circuit shown are typically contained within cabinet 18. The circuit includes a transformer 50 having a primary coil 51 with the input leads 52 and 53 across which the neon bulb 22 is connected. Lead 52 has switch 23 and a variac type resistance control 55 connected in series therewith, while the other lead has a fuse 56 connected in series with it. Fuse 56 is normally held by the removable holder 21 seen in FIG. 1. The primary typically connects via plug 64 with an A.C. 115 volt, 60 cycle source.

The secondary coil 57 of the transformer has branches 58 and 59 connected to its opposite end taps 60 and 61. A rectifier 62 is connected into branch 58 to conduct current away from the needle 35, thereby to place a positive voltage on the tip 36, whereas a rectifier 63 is connected into branch 59 to conduct current toward the needle 35, thereby to place a negative voltage on the tip 36. For example, the secondary coil may deliver 4,000 volts R.M.S. to two high voltage cartridge type selenium rectifiers 62 and 63, rectification taking place with conversion to about 5,000 volts D.C. filtered by two 500 μ fd. 10 kv. condensers 66 and 67. The latter are connected between ground and points 68 and 69 in the branches 58 and 59 respectively. Current limiting safety resistors 70 and 71, typically of 50 megohm 2 watt rating, are also connected in the respective branches 58 and 59.

Another feature of the invention is the provision for simple, direct and rapid selection of positive or negative

ion production at the needle tip, without arcing. In this regard, the circuit includes a cartridge-type fuse 72, and each branch 58 and 59 includes a pair of spaced terminals positioned to removably engage the fuse ends to pass current between the terminals. Fuse 72 is carried by plug-in holder 24 in FIG. 2 for quick interchange with dummy holder 25. Fuse receiving terminals in branch 58 are indicated at 74 in FIG. 4, while terminals 75 are in branch 59.

Finally, means to control the pressure of gas and air delivered to the chamber 27 may take the form of a pressure regulator 81 downstream of a pump 76 in FIG. 3, the concentration of ions in the jetted pattern 31 being changed by adjusting the regulator 81 at 82. Another way to control the ion concentration is to control the speed of the pump drive 77 at 78. Means to control the moisture content and temperature of the gas delivered to the pump is indicated at 79 and 80, these factors also affecting the ion concentration in the discharge 31. The variac 55 may also be adjusted to vary the input voltage and hence the voltage at the tip 36 for controlling the ion concentration. In this regard, the plate 29 need not be grounded to produce the corona, and it may comprise an insulator.

The apparatus 15 described above may be used for many different static charge altering purposes, as for example are listed in the introduction.

We claim:

1. Ion generation and dispensing apparatus for altering the static charge of work comprising a chamber having a gas inlet and a sonic orifice outlet at the chamber front, the orifice minimum cross dimensions having less than $\frac{1}{4}$ inch first means presenting a pointed tip in the chamber upstream of and toward the orifice outlet in close proximity thereto and to supply sufficiently high voltage to effect production of ions in a corona at the tip, and second means to supply a stream of pressurized gas to flow into said chamber and adjacent said tip to carry the bulk of the ions at high velocity through the orifice, said orifice being angled to jet the gas stream and ions forwardly in a wide angle discharge pattern.

2. Apparatus as defined in claim 1 in which said chamber includes a metallic front plate having a recess at the rear side thereof into which said tip projects, the plate forming said orifice outlet which communicates with said recess, the orifice having the form of a slot bounded at opposite ends by plate walls which diverge forwardly at a wide angle.

3. Apparatus as defined in claim 1 in which said first means comprises a needle forming said tip and a circuit including a transformer to supply alternating current above 2,000 volts at the transformer secondary coil, and rectifier means electrically connected in series between said secondary coil and said needle.

4. Apparatus as defined in claim 3 in which said circuit includes first and second branches respectively electrically connected between spaced taps of the transformer secondary coil and said needle, said rectifier means including a first rectifier connected in one branch to pass current flowing away from the needle and a second rectifier connected in the other branch to pass current flowing toward the needle.

5. Apparatus as defined in claim 4 in which the circuit includes a fuse, and each branch includes a pair of spaced terminals positioned to removably engage said fuse to pass current between the terminals, whereby the fuse may be positioned to alternately electrically interconnect the pair of terminals of one or the other branch in order to effect selective production of positive or negative ions at the needle tip.

6. Apparatus as defined in claim 5 including a cabinet containing said circuit and having a control plate containing first and second openings proximate each of which a pair of said terminals is located so that the fuse may be

5

manipulated between said pairs of openings from a position at the cabinet exterior.

7. Apparatus as defined in claim 4 in which each branch includes a current limiting resistor, and the circuit includes a first filter capacitor connected between ground and a point in the first branch in series between said first rectifier and the needle, and a second filter capacitor connected between ground and a point in the second branch in series between said second rectifier and the needle.

8. Apparatus as defined in claim 1 including means to control the pressure of the gas flowing to said chamber.

9. Apparatus as defined in claim 1 including means to control the rate of flow of gas to said chamber.

10. Apparatus as defined in claim 1 including means to control the temperature and moisture content of the gas flowing to said chamber.

11. Apparatus as defined in claim 1 including a cotton gin forming a zone through which cotton travels and tends to develop a static charge, and means to support

6

said apparatus with said orifice directed toward said zone and sufficiently proximate thereto to inject ions into the cotton for reducing the static charge thereon.

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15 MILTON O. HIRSHFIELD, *Primary Examiner*.

LEE T. HIX, *Examiner*.

J. A. SILVERMAN, *Assistant Examiner*.