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EFFECTING INTERCHANGE OF ELECTRIC CHARGES BETWEEN SOLID CONDUCTORS AND GASES.

APPLICATION FILED JULY 13, 1908.

945,917. **Patented Jan. 11, 1910.**

Fig. 1.

Fig. 2.

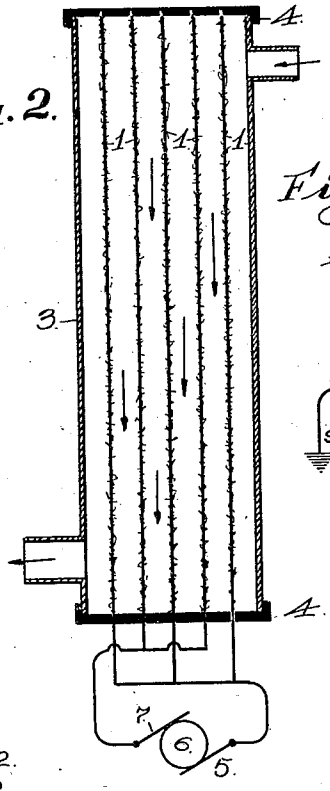


Fig. 3.

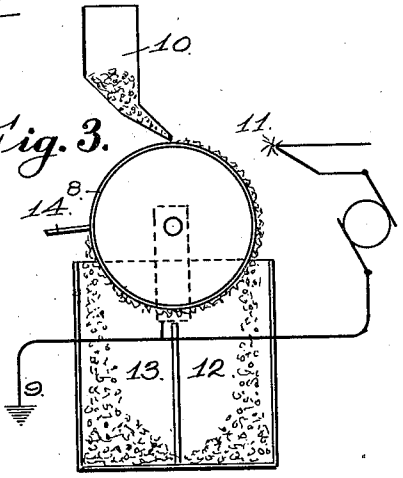


Fig. 5.

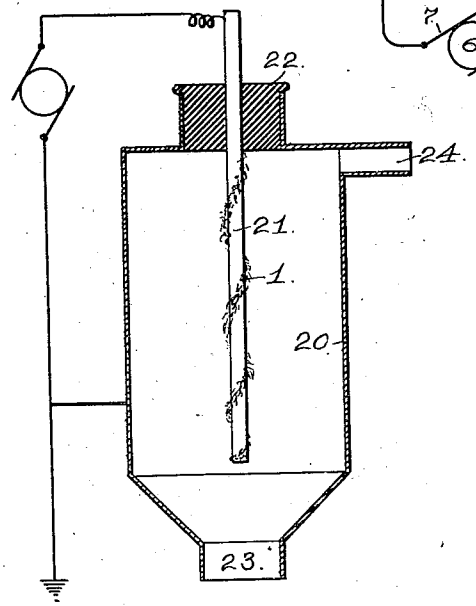
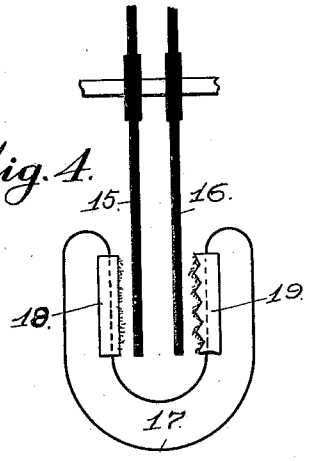


Fig. 4.



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UNITED STATES PATENT OFFICE.

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EFFECTING INTERCHANGE OF ELECTRIC CHARGES BETWEEN SOLID CONDUCTORS AND GASES.

945,917. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed July 13, 1908. Serial No. 443,284.

To all whom it may concern:

Be it known that I, FREDERICK GARDNER COTTRELL, a citizen of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented certain new and useful Improvements in Effecting Interchange of Electric Charges Between Solid Conductors and Gases, of which the following is a specification.

My invention relates to the art of transferring or interchanging electric charges between solid conductors and gases. It is applicable to a wide range of technical operations, as, for instance, electrostatic ore-separation; the manufacture of ozone; the operation of electrostatic generators or influence machines, and, as I have illustrated and described in a co-pending application, Serial Number 382,928 filed July 9, 1907, the precipitation of suspended matter from gases.

Operations of the above mentioned types have this in common, that while they all depend upon the passage of electricity between solids and gases, this passage must be prevented from taking the form of a disruptive spark or arc discharge. The aim in these operations is to facilitate, to the utmost, the so called silent or brush discharge and to avoid the disruptive types. To secure this result technically it has been the common practice to equip the solid conductor from which the discharge is to take place, with sharp metallic points, such as groups or rows of needles or serrated metallic edges. I have discovered that from a practical standpoint all the advantages usually sought by the use of such metallic points, viz. ease of discharge of the electricity into the gas, may be obtained in much higher degree by the use of fine filaments or hairs forming a pubescent surface between the solid conductors and the gas, even though these hairs or filaments may consist of materials not ordinarily classed as good conductors of electricity; for example, it is perfectly possible to employ for this purpose such materials as asbestos, cotton, wool, silk, etc. These, although relatively poor conductors, amply suffice, under the usual conditions, and, if necessary, the material may be so treated as to increase its conductivity.

My invention, therefore, consists in effecting the interchange of the electric charges between solid conductors and gases by bringing the conductors and gases into contact with one another at a pubescent surface.

It is to be understood that in the present specification and claims the term pubescent is not to be interpreted as including metallic wires or needles whose use in this connection is old, as I have above noted; but said term as herein used refers only to fine filaments of textile materials, such as are noted above by way of illustration.

In order to illustrate some of the practical forms in which my invention may be applied to industrial operations, I show in the accompanying drawings several kinds of apparatus capable of employing my improvement.

Figure 1 is a view of a simple form of a pubescent electrode. Fig. 2 represents, schematically, an ozone generator, to which the pubescent electrodes may be applied. Fig. 3 represents an electrostatic ore-separator, to which my invention is applied. Fig. 4 represents the application of my invention to the collectors of a Wimhurst influence-machine. Fig. 5 shows the application of my invention to the precipitation of suspended particles from gaseous bodies, as for example, the collection of zinc white in its ordinary manufacture, or the collection of fine dust produced by pulverizing mills with air elutriation.

In Fig. 1, the pubescent electrode consists of a strand of filamentous material 1, as for example an ordinary cotton string whose surface has, if necessary, been roughened by brushing or gently scraping, twisted or braided together with two strands of metallic wire 2, in such wise that even should a break occur in the cotton it would be impossible for it to unwind. The choice of material both for the metallic wires and for the filamentous or pubescent strand 1, will naturally depend upon conditions under which the electrode must operate; par-

ticularly the composition and temperature of the gas surrounding it. Thus at room temperature in the open air, the above cited cotton string might answer every purpose, whereas in a strongly acid atmosphere the cellulose fibers would undergo disintegration and become useless. In some such cases excellent results have been obtained by the substitution of asbestos for the cotton. In other cases it has proved better to subject the cotton to carbonization out of contact with the air, either before or after combining it with the metallic wires. This process may be so conducted, as to leave the structure of the cotton intact and still render it practically unaffected by even a strong acid reaction.

Fig. 2, which illustrates an ozone generator, consists of a tube 3, through which a current of air or oxygen is passed, as indicated by the arrows, and within whose interior are stretched between the two insulating heads 4, a plurality of pubescent electrodes 1 of the above description. Some of these are connected electrically to one terminal 5 of a source of high voltage electricity 6. The remainder are insulated from these by the heads 4, and are connected to the other terminal 7 of the same source. The tube 3 may be of either conducting or nonconducting material. In the former case it may also be connected to one of the terminals 5 or 7, and may even serve as the sole conductor for one side of the high voltage circuit. In this case all the pubescent electrodes 1 may be connected to the opposite terminal. Then the discharge will be practically unidirectional, *i. e.* from the pubescent electrode to the smooth surface of the tube.

In Fig. 3, which illustrates the application of my invention to an electrostatic ore separator, the metallic revolving roller 8 is electrically connected through its shaft and supporting bearing to earth at 9, and receives a steady supply of the finely divided ore from the hopper 10. In front and somewhat above the center of this roller, parallel with its axis and insulated from it is stretched a pubescent electrode in the form of a piece of cotton covered magnet wire 11. This takes the place of the metallic discharge points ordinarily employed, in the same relative position in machines of this type already in general use. The fibers of the insulation on the wire may be slightly roughened up, if necessary. The two terminals of the source of high voltage electricity are connected respectively to earth and to the wire 11. The receptacles 12 and 13 serve to catch the conductive and nonconductive particles respectively, or such as have different dielectric constants. The scraper 14 serves to remove from the roller all particles still adhering to it, at this point in its revolution.

Fig. 4 represents the application of the same principle at the collectors of a Wimhurst influence machine. In this device 15 and 16 are the oppositely rotating disks of the machine, and 17 is a U-shaped piece of sheet metal to which, and projecting slightly over whose edges toward the disks, are cemented two strips 18 and 19 of cloth whose free edges, *i. e.* the edges toward the disks are frayed out so as to present many fine filaments. These edges may in some cases be serrated to advantage as indicated in the strip 19. The system of pubescent strips takes the place of the metallic collecting points of the ordinary Wimhurst machine, being supported and connected in the same manner as this latter; the other details of the machine being as usual.

Fig. 5 illustrates the application of the above method to the precipitation of suspended particles from gaseous bodies as for example the collection of zinc white in its ordinary course of manufacture, or the collection of fine dust produced by pulverizing mills with air elutriation. The chamber 20 made of conducting material is connected to earth. The metallic rod 21 is held in place and insulated from the chamber by the bushing 22. The cord 1 of cotton, asbestos or similar material is wound spirally around the rod 21 and has its surface properly roughened as above described. The rod 21 is connected to one terminal of a source of high voltage electricity, the other terminal of the source being connected to the chamber. The particle laden gases enter the chamber through the pipe 23, receive the discharge from the pubescent electrode surface 1, deposit their burden of suspended matter upon the walls of the chamber and leave through the exit pipe 24 free of suspended matter.

In the above descriptions the specific forms and construction of the pubescent electrodes have been described in each case by way of illustration, but it is not to be understood that these forms are the only ones practical nor that they are of necessity associated with or limited to the particular application in connection with which each has been described. It is the application of a pubescent surface to the solution of certain technical problems on an industrial scale that is the intention herein to claim.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. The improvement in effecting the interchange of electric charges between electrified solid conductors and gases which consists in bringing said electrified solid conductors and gases into contact with one another at a

pubescent surface which forms a part of said solid conductor.

2. The process of interchange of electric charges between electrified solid conductors and gases which consist in bringing said electrified solid conductors and gases into contact with one another at a pubescent surface which forms a part of said solid conductor, and producing a difference of electrical potential between said solid conductors and the body of gas.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERICK GARDNER COTTRELL.

Witnesses:
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