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METHOD OF NEUTRALIZING STATIC ELECTRICITY.

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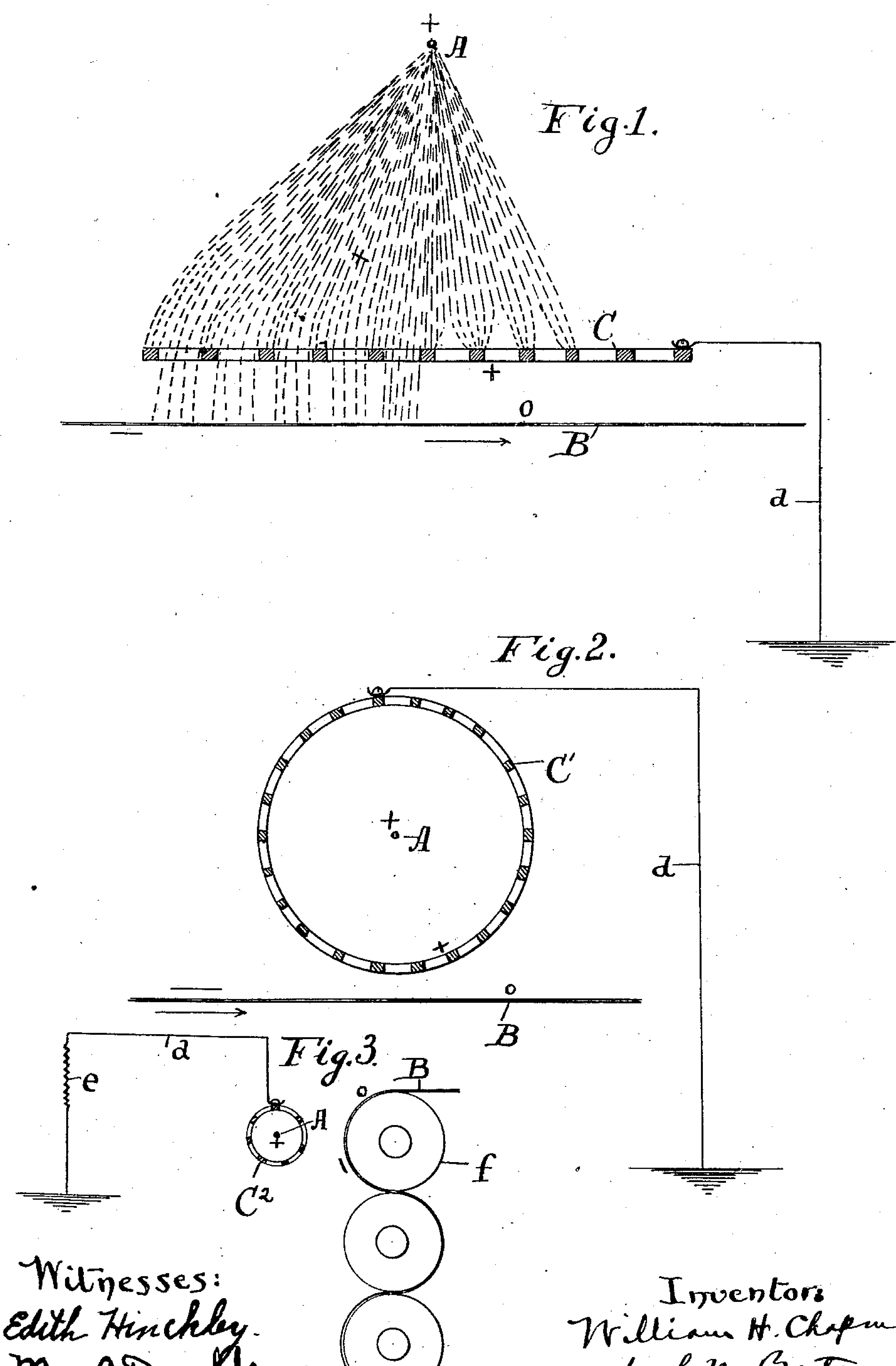
940,429. Patented Nov. 16, 1909.



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UNITED STATES PATENT OFFICE.

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METHOD OF NEUTRALIZING STATIC ELECTRICITY.

940,429. Specification of Letters Patent. Patented Nov. 16, 1909.

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To all whom it may concern:

Be it known that I, William H. Chapman, a citizen of the United States of America, and a resident of Portland, Maine, have invented certain new and useful Improvements in Methods of Neutralizing Static Electricity, of which the following is a specification.

My invention relates to the neutralization of static electricity such as is developed in paper, yarn, roving and the like in the process of manufacture or manipulation.

Substances like paper or fabrics are very persistent in the kind of electricity which they acquire by friction or compression. Paper passing through a set of calender rolls or through a printing press always acquires a negative charge while wool or mohair acquires a positive charge. This fact makes it entirely practicable to adopt any system of neutralization which shall depend on the delivery of just one kind of electricity continuously to the material to be neutralized, but in quantities varying with the varying charges usually found on such materials.

Heretofore it has been impossible to regulate automatically the supply of electricity fed to the material to be neutralized except by having two opposite kinds present to regulate and limit each other as in my previous patent No. 777,598 dated Dec. 13, 1904.

If a conductor of small surface *e. g.* a No. 36 steel wire be stretched across a web of paper and a few inches away from its surface and that conductor supplied with a constant charge of positive electricity of about 10,000 or 15,000 volts, the paper though previously negative will quickly acquire a charge of positive by the discharge of positively electrified particles or ions from the conductor. If, however, the web of paper is moving at just a certain rate of speed, and if it has on every square inch of its surface just the same amount of negative charge then it is possible to adjust the distance of the conductor and the voltage applied to it so as to have the paper come out neutral. It is apparent that such conditions are by no means practical of attainment in commercial service because of the infinite variety of hygroscopic conditions prevalent in the material and of resulting charges on its surface, variations of friction or pressure or speed affecting the quantity of these charges on different sections of the surface. It therefore becomes necessary to regulate the quantity of electricity delivered by the conductor to each square inch of the paper by throttling it with reference to the needs of each square inch, making each unit of surface self selective as to the quantity that it shall receive of the one kind needed to neutralize it.

The object of my invention is to effect the neutralization by use of a direct charge of opposite polarity to that of the material, automatically regulating the quantity at the various points on the surface according to the amount of the charge contained in the material at those points. I accomplish this object by interposing between the paper or other charged material and the charged wire a perforated screen of conducting material connected to earth, whereby only just sufficient electricity is attracted to the paper to neutralize the charge actually present there, the balance being carried away by the perforated screen.

I illustrate my process by the accompanying drawing which shows a diagram on a large scale illustrating the action of the perforated screen in regulating the discharge of electricity to the charged surface of the material to be neutralized.

Figure 1 shows the screen in the form of a flat plate Fig. 2 shows the same in tubular form surrounding the conductor and Fig. 3 shows a modification of the process when the paper is in contact with a body of metal.

In the drawing let A represent a fine wire or other suitable conductor charged continuously with a positive charge of 10,000 to 15,000 volts. B is a web of paper moving in the direction of the arrow. A is located near enough to B so that the discharge of positive ions from it in the direction of B will be more than sufficient to neutralize the highest negative charge on any section of B at the highest speed that it may run. This condition in practice would obtain when the distance from A to B is not over 4 inches and the speed of the paper anything up to 500 or 600 feet per minute and the voltage on the conductor A as above mentioned 10,000 or 15,000 volts. Under such conditions if the screen was not present it is evident that the paper would go away with a positive charge on all parts of its surface although it was previously negative. Now at any point between A and B, I place a perforated screen of metal or other good conducting material extending over as wide a surface as is within the operative influence of the discharges from A. The holes in C may be of any size but I prefer that they should not be larger than a diameter equal to the distance of the screen from the paper and the metal between perforations should be preferably as narrow and thin as consistent with mechanical strength.

Instead of a perforated screen a series of metal rods may be used preferably spaced apart so that their distance apart is not greater than their distance from the paper. The metal screen is connected to earth by a suitable connecting wire *d*. Under these conditions the discharge of positively electrified ions takes place toward B just the same or with somewhat increased force. Ordinarily these ions would not get past the screen but would discharge themselves on it in the absence of anything beyond to attract them. But each unit of surface of paper as it approaches brings with it a negative charge which exerts a strong attraction on the positively electrified ions and pulls them through the holes in the screen, and the tendency of the two opposite charges to come together being proportional to the square of the potential difference between them, it will readily be seen how much stronger is the tendency of the ions to reach the negatively charged paper than it is to reach the metal of the screen. For example let 10 represent the potential of a positively electrified ion coming from A and let the potential of the negative charge on the paper be 12, then the difference of potential between ion and paper is 22 while that between ion and screen is 10 and the force impelling the ion to the paper is the square of 22 or 484 while the force impelling it to the screen is only 10 squared or 100. Under these conditions it is easily conceivable, and in fact is verified by observation and measurement that the streams of charged ions are deflected from the solid parts of the screen through the holes, but as any given section of paper approaches neutrality the tendency of the ions to seek their discharge on the paper becomes less and less until at actual neutrality they find their freest path to the metal of the screen and they become deflected from the holes to the solid part of the screen. It therefore becomes impossible to communicate an overcharge of positive to any section of the paper however small may have been its previous negative charge or however slow the paper may be moving. The screen acts as a throttle on the stream of electrified ions and the throttling effect is determined automatically by the charge on each unit of surface of the material under treatment. The treatment of a web of paper in the open air is accomplished to perfection by the above method. A slight modification of this however, is needed in the case of paper treated while running in contact with metal rolls *f* as shown in Fig. 3. In this case the paper B may be strongly electrified with negative and show it but very little by any ordinary tests externally applied. It fails to show because of the condenser action between its surface and that of the metal roller and there is so little free charge on its outside surface that it is incapable of exerting sufficient attractive influence on the ions to determine their movement quickly enough to it rather than to the metal screen. Accordingly it is necessary under these circumstances to insert in the earth connection a very high resistance or equivalent device which shall allow the screen to assume a charge of the same kind as the wire A but of much lower potential. By this means the tendency of the ions is determined to some extent in favor of going to the paper and for any given thickness of paper this tendency is practically capable of a fixed adjustment, which will put the ions onto the paper fast enough to accomplish this purpose.

The screen may be in the form of a flat perforated metal plate as here shown or it may be bent around the wire in the form of a perforated tube or cylinder as shown in Fig. 2 when C′ represents the screen in tubular form.

It is to be understood that the wire may be charged with either positive or negative according to the kind of electricity in the material to be treated and it is also understood that the voltage in the wire may be varied so long as it is sufficiently high to cause a discharge from the surface of the wire into the air.

I claim:—

1. The herein described process of neutralizing static electricity in a charged surface which consists in charging a conductor embodying fine radiating surfaces with electricity of high voltage and of a polarity opposite to that of the surface to be neutralized and interposing between said conductor and surface to be neutralized a perforated screen of metal or other conducting material connected to earth.

2. The herein described process of neutralizing static electricity in a charged surface which consists in charging a conductor embodying fine radiating surfaces with electricity of high voltage and of a polarity opposite to that of the surface to be neutralized, interposing between said conductor and the surface to be neutralized a perforated screen of metal or other conducting material

connected to earth and causing an accumulation on said screen of the electricity of the same kind as radiated from said conductor.

3. The herein described process of neutralizing static electricity in a charged surface which consists in charging a conductor embodying fine radiating surfaces with electricity of high voltage and of a polarity opposite to that of the surface to be neutralized, interposing between said conductor and the surface to be neutralized a perforated screen of metal or other conducting material connected to earth and inserting a high resistance in the earth connection for causing an accumulation on the screen of the electricity radiated from said conductor.

Signed at Portland, Maine this 15th day of December 1905.

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Witnesses:

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