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GENERATION OF ELECTRICAL FIELDS

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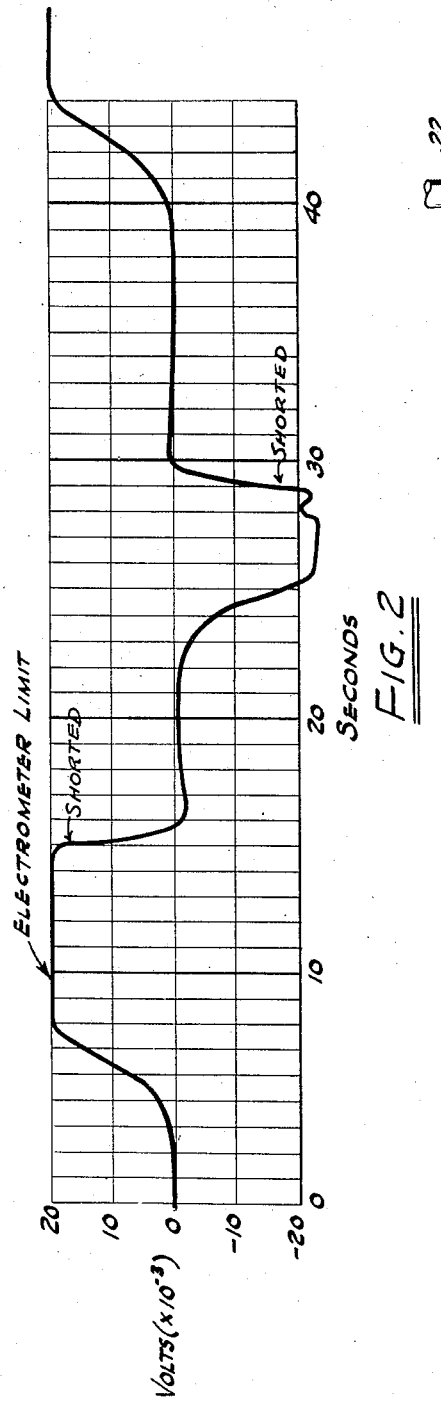


FIG. 2

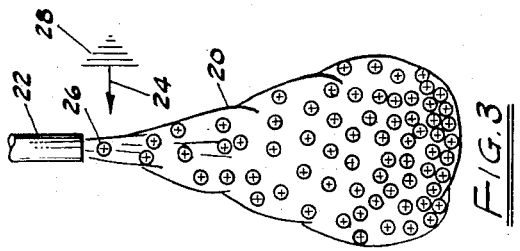
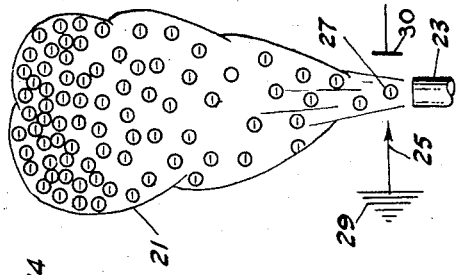


FIG. 3



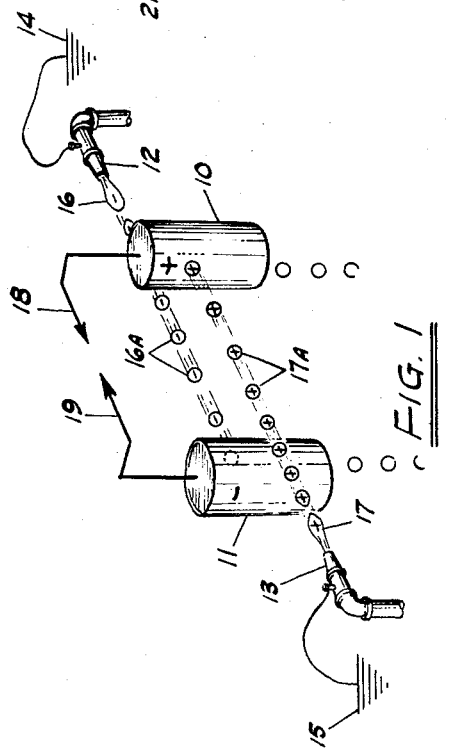


FIG. 1

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GENERATION OF ELECTRICAL FIELDS

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2 Claims. (Cl. 310—5)

This invention relates to the conversion of mechanical energy into electrical energy and more particularly to a regenerative system for charging bodies or clouds.

It is desirable in many processes to be able to control the charge on a stream or body of discrete particles such as fine liquid droplets, aerosols, dust particles, etc. It may further be desirable to concentrate such particles bearing like charges into isolated volumes and thus to build up an electrostatic field of high intensity between such isolated volumes of charge concentrations. For example, the establishment of two isolated volumes of charged particles, those in one volume being substantially all positive and those in the other volume being substantially all negative, offers the possibility of creating a high potential difference between such volumes of charged particles. Likewise depositing similar charges on a cloud or stream of aerosols or dust particles, for example, offers the possibility of directing the flow of such particles by means of electrical attraction to a target.

Various methods are known for charging particles or bodies, but they commonly involve the use of auxiliary power equipment or an outside source of electricity. Hence, these systems are generally not available for use where electrical power is not available.

It is therefore an object of this invention to provide a simple method for converting mechanical energy into electrical potential energy. It is another object to provide a means for regeneratively charging particles and bodies and to accumulate them in isolated volumes of like charges, thus creating an electrostatic field between the isolated volumes of accumulated charged particles. It is another object to provide a simple method for generating high voltages at locations where electrical energy or auxiliary power is not available. An additional object is to provide a simple method for generating high D.-C. voltages within a very short period of time. It is a further object to provide a method whereby the aqueous particles of cumulus clouds may be charged rapidly with a total charge sufficient to induce lightning and a subsequent rain storm.

The method for regeneratively charging particles according to this invention comprises directing first and second fluid streams of discrete particles past a positively charged electrode and a negatively charged electrode, respectively. The particles of the streams assume charges opposite in sign from the respective electrodes which they have passed and they carry and deposit these charges respectively in first and second isolated volumes in which charges are to be accumulated. The positive and negative charging electrodes may be identical with the volumes of accumulated negative and positive charges, respectively. Thus, there is provided in accordance with the teaching of this invention a method for amassing electrical charges which is regenerative in nature. The process of this invention will be presented in more detail in the following discussion and with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of an apparatus suitable for developing high voltages without the application of any outside energy source except that which is required to create two streams of liquid droplets;

Fig. 2 is an electrometer record for a generating device such as shown in Fig. 1 and constructed according to this invention; and

Fig. 3 illustrates the application of a partially regenerative system to the control of charges in clouds of particles.

In Fig. 1 there is illustrated a simple and effective means for generating very high voltages in a short time. The apparatus comprises two electrodes **10** and **11** and two sources **12** and **13** of streams of liquid droplets, the sources being grounded at **14** and **15**, respectively. Inasmuch as an object such as an electrode **10** or **11** always has a small charge on it, the system requires no priming. Assume, for example, that electrode **10** of Fig. 1 has a small residual positive charge on it. A stream of water **16** (for example) is directed from source **12** past electrode **10** onto electrode **11**. Because of the positive charge on electrode **10** the water stream which comes within the field of influence of electrode **10** will assume a negative charge before leaving source **12**. Because of surface tension the stream will be broken down into droplets **16***a* which carry on them the charge induced in the stream **16**. These negative charges will then be deposited on electrode **11** as the droplets **16***a* strike it. Likewise, water droplets **17***a* are formed by breaking off from stream **17**, which in turn arises from source **13**, and is charged by electrode **11**. Droplets **17***a* carry induced positive charges which they deposit on electrode **10**, the positive charges having been induced by the influence of negative electrode **11**. The charges on electrodes **10** and **11** are led off by means of leads **18** and **19**, respectively, to furnish a supply of high-voltage, D.-C. current. Although one stream may be started before the other one, this is not necessary to the efficient operation of the process. An alternative to grounding liquid sources **12** and **13** would be to connect these two sources, thus completing a circuit in the system.

From the above description, it will readily be seen that the process of this invention is a regenerative one and that once the streams are activated the build-up of electrical charges on both electrodes is very rapid; the greater the positive charge on electrode **10**, for example, the more rapid is the build-up of negative charges on electrode **11**, and likewise the greater the amount of positive charge build-up on electrode **10**. The rate of charge build-up is in fact exponential.

The quantity of charges which can be built up on electrodes **10** and **11** depends, of course, upon the design of the electrode and upon the force with which droplets **16** and **17** are expelled from the respective sources **12** and **13**. Thus, a situation may be reached where the mechanical energy of the liquid droplets is less than the energy required to cause them to strike the electrode. Thereafter, the droplets will be repelled and the charges on electrodes **10** and **11** will level off. Thus, the kinetic energy contained within each drop as it breaks away from the stream must be equal to or greater than the mechanical work which is required to carry that drop against the electrode.

In Fig. 2 there is reproduced an actual electrometer record which shows charge build-up in a device such as that illustrated in Fig. 1. As indicated in the record, the charge build-up is exponential and the flattening off is caused by the limits of the electrometer rather than by limits of the generator. A negative indicates an electrode was primed to go negative.

In Fig. 3 there is shown a modification of the process of this invention as it may be applied to controlling the

charges on particles making up clouds. Thus, cloud plumes 20 and 21 of Fig. 3 are comparable to electrodes 10 and 11 in Fig. 1 and stream sources 22 and 23 to stream sources 12 and 13, respectively, of Fig. 1. Some additional energy sources or priming charges are preferably used in this modification of my invention.

This additional energy may be in the form of a point discharge, such as obtained by corona discharge, or in the form of a radiation source. In the case of a point discharge type of arrangement, such as represented by points 24 and 25 of Fig. 3, an extremely high voltage would be required in order to ionize the surrounding air constituents and particles contained in the air in order to enable them to deposit their charges on the cloud particles 26 and 27. For this reason, it is preferable to "prime" one of the discharge points by using a second electrode, such as, for example, plate 30 to cause point 25 to go into point discharge. Once sufficient charged cloud particles 26 build up in cloud 20, priming may be discontinued.

The alternate method of furnishing additional energy, i.e., the use of a radiation source in place of point discharges 24 and 25 will not require priming because ionization of the air and particles contained in the air is more readily achieved.

The discharge points 24 and 25 may be grounded at 28 and 29, respectively, as illustrated in Fig. 3, or they may be connected as pointed out for the arrangement illustrated in Fig. 1.

The process may be further explained with reference to Fig. 2. To begin, a voltage is applied to plate 30 which creates an electric field and causes point discharge from point 25. A positive potential applied to plate 30 will cause point 25 to give corona discharge. The fast negative ions produced in the air by reason of discharge by point 25 are then drawn by plate 30 through the smoke or cloud stream as it emerges from source 23, where these ions become attached to the cloud particles. The movement of the air then carries these charged cloud particles, such as 27, out into the plume 21 away from plate 30. The accumulation of negative charges in the top of cloud plume 21 causes point 24 to give point discharge and to produce a stream of fast moving positive ions which become attached to the cloud particles in plume 20 as they emerge in the cloud stream from source 22. The accumulation of positive charges in cloud plume 20 then becomes sufficient to maintain point discharge from point 25. When this occurs the arrangement is self-exciting and high voltage need no longer be applied to plate 30.

In the case of the cloud plumes of Fig. 3, the fine cloud droplets or particles are so small that their movement is determined by the movement of the environmental air more than by the electric field as in the arrangement illustrated in Fig. 1. Thus, the force of the air (or other gas coming from sources 22 and 23 which may be natural air currents) carries the particles with it to build up the cloud plumes 20 and 21 shown.

Such methods of controlling cloud formations may be applicable to a number of various problems. First, for example, there is the application of this method of particle charging to the creation and control of thunderstorms. When the charges in clouds 20 and 21 become great enough to create a sufficiently intense field between them, there will be lightning across the clouds and a subsequent rainstorm.

Industrial applications of this method of charging a cloud of particles include such uses as the removal of particles from a fluid stream, the atomization of liquids, and the deposition of finely divided particles on areas or points not otherwise easily accessible for such disposition. Thus, if dust particles are present in a fluid stream, they may be charged and subsequently removed by permitting the stream to pass an electrode, oppositely charged, at a rate permitting attraction of the dust particles. Likewise, finely divided paint particles may be charged and charges of the opposite sign induced on the object to be painted. The paint particles would be attracted to the object, making it possible to introduce the paint into areas difficultly accessible to conventional methods of spraying, brushing or rolling. In such applications the stream or cloud not containing particles to be removed or to be deposited may be of a liquid or fluid such as water droplets or vapor which may be recycled within the system.

I claim:

1. A method for building up a first and a second cloud comprising particles bearing substantially all positive and negative charges respectively, which comprises directing a first stream of particles close to, but in out of contact relation with, the outer surface of a second electrode in a manner to deposit positive charges on said first-stream particles and to accumulate said positively charged first-stream particles into a first cloud of substantial density, directing a second stream of particles close to, but in out of contact relation with, the outer surface of a first electrode in a manner to deposit negative charges on said second-stream particles and to accumulate said negatively charged second-stream particles into a second cloud of substantial density.

2. A method in accordance with claim 1 wherein said second cloud serves as said second electrode after said first electrode has been primed by an outside voltage source, and said first cloud serves as said first electrode.

References Cited in the file of this patent

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