Experimental Results in Measuring Atmospheric Electricity

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Atmospheric electricity (AE) refers to the electrical phenomena occurring in the atmosphere of the Earth. There are many manifestations of AE, ranging the spectacular to the subtle. Lightning is one of the most visible phenomena, but AE also probably plays a key role in other major atmospheric disturbances such as tornadoes. The presence of AE can be also be measured even on clear days ("clear air electricity") by means of appropriate detecting devices. Benjamin Franklin and Lord Kelvin were two of the most notable people that studied these effects. Most importantly, it has been reported by quite a few people that AE can be used to power electrostatic motors. These amazing claims of AE derived electromotive power were first made at least one hundred years ago. These claims raise the tantalizing prospect that AE can be a viable source of alternative power. If these reports are true, why has this not already become commonplace in our society? It is the purpose of this paper to report on our preliminary work on verifying the existence of AE in quantities that may someday be sufficient to be a useful source of terrestrial power.

1. Introduction

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2. Background

The workings of AE include a global electrical circuit, which is the means by which an electrical potential difference is maintained between the upper layers of the atmosphere and the earth's surface. The details of the global electrical circuit are still speculative but certain overall facts are known. The main energy input into this system appears to be ionizing radiation, which creates a positively charged conducting layer in the atmosphere, the ionosphere. The earth's surface carries a net negative charge. Together, the ionosphere and the earth's surface constitute a vast spherical electrical capacitor. One "plate" of the capacitor is the ionospheric layer and the other is the earth's surface. As with any charged capacitor, there is an electric field existing between the plates. This electric field represents stored energy. Just as the terminals of a charged capacitor can be hooked together to create an intense flow of electrons (and a big spark), it should be possible in some way to connect these two bodies of charge to get electrons to flow, and work to be done.

The atmospheric electric field that exists as a consequence of the ionospheric positive charge and the earthly negative charge has been experimentally measured. Its magnitude is about 100 V per meter. The vector of the field, according to standard convention, points downward from the sky to the earth. This electric field can induce a force on electrons in a conductor placed vertically in this field, and electrons should therefore flow. The electron flow would be from the ground upward. If the electric field is strong enough, electrons will be pulled from the conductor at the conductor's top point. Leaving aside for a moment where these electrons go after being liberated from the conductor, it can be appreciated that it should possible to insert some work performing electrical device (e.g. an electrostatic motor) into this circuit and it should turn. Or, a neon bulb for example could be inserted into this circuit and it should glow.

There are two main figures in the past work in harnessing AE. These are Hermann Plauson and Oleg Jefimenko. Another important and trustworthy corroborating source is C.L Stong.

2.1. Hermann Plauson

In 1925, Hermann Plauson, an Estonian inventor, was granted a United States patent whose subject was the harnessing of AE. He described an entire system for doing this, including appropriate "antennas", transformers, electrical storage devices and appropriate motors. He claims to have extracted kilowatts of power in this way. This of course is an extraordinary claim. His patent goes into exhaustive detail in describing different sorts of energy collectors, safety spark gaps (in case of lightning strikes), various kinds of transformers and also several kinds of electrostatic motors. His discussion of the various technologies and many illustrations make this patent a real goldmine of ideas for this field.

2.2. Oleg Jefimenko

Jefimenko was a physics professor at the University of Virginia during the seventies. He authored a classic book on electrostatic motors", which sadly is out of print. The book is a detailed and scholarly examination and classification of all known electrostatic motors, going back to the time of Benjamin Franklin. His book is truly an encyclopedic compendium of all the various types of motors used throughout history. Of interest here, he also describes successful results in powering two different types of electrostatic motors by means of atmospheric electricity. One was an electret type motor and the other a corona discharge type motor. The electret motor was actually powered by a stationary antenna mounted atop a twenty foot pole. The corona motor was powered by a large helium balloon that lofted an wire connected to the motor. His book contains actual photographs of these motors and the AE gathering system.

2.3. C.L. Stong

Although not an originator of these ideas, Stong deserves credit for verifying some of this work experimentally and bringing to a wider audience. He was for many years the author of "The Amateur Scientist" column in Scientific American. The readership he reached was in the millions over the years. He enjoys a reputation for scientific integrity. Basically, he replicated work of Jefimenko, using helium balloons and a corona discharge electrostatic motor designed according to Jefimenko's principles. He was in fact able to get this motor to spin at about 500 rpm using a balloon lofted wire antenna. He provided extremely clear instructions for what he did, and consequently his work formed the basis for the experimental work described in this article.

3. Materials & Methods

A 36 inch diameter (uninflated diameter) metal-plastic foil balloon filled with commercial grade helium gas was used to the lifting means. This was a standard MylarTM balloon intended for use at parties or advertising or the like. The balloon used was "silver" colored without any printing on it. As is standard with these foil balloons, they are actually not Mylar but are a composite of a metal thin film which is vacuum deposited onto a thermoplastic polymer material. These balloons are made by heat sealing two sheets in the appropriate shape (in this case, a 36 inch diameter circle). A self sealing flap valve is incorporated into the design, so that the balloon can be conveniently filled by commercially available helium tanks equipped with a special nozzle that goes into the flap valve and also a pressure regulator that prevents over filling of the balloon.

The balloon lifted a tether which was a three "tows" of carbon fiber (CF) yarn that were woven together. Each tow is comprised of approximately 12,000 individual 5 micron fibers. This CF yarn is highly electrically conductive and also extremely light weight. The tether used was a single piece 300 feet in length of a special CF yarn. This yarn was purchased under the trade name of ION CORDTM from Fibraplex. It is designed to be used to draw off nuisance static electricity from equipment that generates high static voltages, such as printing presses. This yarn is different than other CF yarns which can be purchased, for example, from supplies of composite material for ultralight airplane construction. The difference is that this yarn is not treated with a coating which is intended to keep the individual fibers together. Without that coating, the tow will splay out into individual fibers and is difficult to handle when attempting to use it for weaving, for example. For ION CORD, the tows are physically braided together, which keeps the individual tows from splaying out. Crucially, the lack of the coating means that the tows are bristling with many thousands of 5 micron projections. The visual effect is similar to what one sees with ordinary textile yarn, which may have a fuzzy appearance when examined closely. These 5 micron projections constitute an ideal physical geometry for gathering static electricity, since these very fine projections maximize the electric field and hence the attracting power of the material for positive ions given off by the machinery the yarn is intended to de-static. We realized that this unique type of CF preparation would be ideal for acting as an emitter of electrons, under the influence of the Earth's electric field. The fiber was not insulated in any way along its length for our experiments.

One end of this CF tether was tied by a thin polyester string to the tie hole of the foil balloon. The other end was attached (tied) to a heavy mooring platform made of wood with five coats of varnish. The purpose of the platform was to keep the tether away from, and insulated from, the ground at all times. The tether was initially wound up on the this platform and then was reeled out by hand to let the balloon ascend.

A Keithley Model 414 picoammeter was used to obtain direct current measurements. The current sensing input terminal of the meter was connected (via a solenoid contactor- see below) to an 18 inch section of high voltage insulated wire (insulation was rated at 2000 V)n with an alligator clip at its distal end. The ground of the picoammeter was connected by a short section of copper wire to a metal stake driven into the ground. The picoammeter was powered by a DC to AC power inverter running off a 12 volt lead acid battery.

In order to isolate the picoammeter meter from transient effects picked up by the tether due to the proximity of our hands or bodies, a solenoid driven contactor was remotely actuated to effect closure of the circuit between the meter and proximal end of the wire bearing the alligator clip at its distal end.

To obtain measurements, the following procedure was done.

1. The tether was reeled out by fully unwinding it from the mooring stand by hand, until the maximum height of the balloon was reached.
2. The alligator clip on the end of the highly insulated wire to the picoammeter was then attached to the end of the tether that was tied to the mooring stand.
3. The solenoid contactor between the picoammeter and the proximal end of the highly insulated wire was remotely closed after our hands and bodies were removed from the immediate vicinity of the tether.
4. The reading on the picoammeter was observed and recorded. If necessary, the scale of the meter was adjusted. If the scale had to be adjusted, the meter was disconnected from the tether by opening the solenoid contactor.

Readings were obtained at various altitudes, as the balloon was reeled in.

4. Results

The data was recorded and plotted below. At 275 feet, 0.8uA was recorded, which is consistent with what others have measured at 300feet (1uA). A 2nd order polynomial curve can be fitted to the data. When extrapolated beyond 275 feet, the data shows a linear relationship on a log-log scale (see below). If conditions are linear, then the current is shown to escalate to 1000uA at the 10000 foot level.

Insert figures

5. Conclusion

Estimates on the total amount of atmospheric electrical power vary, but one written by C.L. Stong was a million to a billion k Watts If even a fraction of that power could be tapped successfully, it could open up a whole new chapter in non-polluting energy generation. Although only a micro-amp was drawn in this experiment, it stands to reason that scaling up the capability is possible. If Plauson's results are to be believed, then many kW of power could be extracted by this method.

One of the interesting aspects of our experiment was that we made no effort to provide insulation for the conducting CF tether going to the balloon. Previous experimenters have used insulated wire. We did not know if results could be obtained without insulation in this way, but in fact they were. The amount of current that we measured at our highest altitude is pretty much what was reported by others such as Stong.

The use of CF in the form of ION CORD is itself an interesting innovation. For one thing, the ION CORD has a perfect micro structure, with its numerous 5 micron projections, to intensify the electric field which is thought to be responsible for drawing the electrons from the tether. Also, the CF tether is extremely light weight compared to copper wire. This allows a much smaller balloon to be used.

In future work, we will use a non-contact electrostatic voltmeter to directly measure the voltage at the proximal end of the tether. The amount of current we have been able to obtain has so far been too small for us to measure without changing the measurement drastically. We also plan to try a more extensive (more surface area) version of the CF tether, perhaps a sort of woven CF cloth attached to the upper end of the tether.

References

[1] "Soaking in Atmospheric Electricity", http://science.nasa.gov/science-news/science-atnasa/1999/essd15jun99_1/.

[2] Hermann Plauson, "Conversion of Atmospheric Electric Energy", US Patent #1,540,998 (June 9, 1925).

[3] C. L. Stong, "Electrostatic Motors Are Powered By Electric Field of the Earth", *Scientific American* (Oct 1974).

[4] Oleg D. Jefimenko, **Electrostatic Motors: Their History, Types and Principles of Operation**. (out of print)

[5] Hugo Gernsback, "Power from the Air", *Science & Invention* **9** (10): 106 (Feb 1922).

[6] "Conversion of Atmospheric Electricity", www.rexresearch.com.

[7] ION CORDTM, www.fibraplex.com.

Atmospheric electricity is the study of electrical charges in the Earth's atmosphere (or that of another planet). The movement of charge between the Earth's surface, the atmosphere, and the ionosphere is known as the global atmospheric electrical circuit. Atmospheric electricity is an interdisciplinary topic with a long history, involving concepts from electrostatics, atmospheric physics, meteorology and Earth science. View Atmospheric Electricity Research Papers on Academia.edu for free.Â This sensitivity study examined the impact of natural aerosol on the results obtained by numerical cloud seeding experiments focused on hail suppression on the ground. A main concern was investigating the effects of the solubility of the more. This sensitivity study examined the impact of natural aerosol on the results obtained by numerical cloud seeding experiments focused on hail suppression on the ground. A main concern was investigating the effects of the solubility of the natural aerosol on unseeded and seeded cloud simulations. A numerical model with a two-moment bulk microphysical sc Special IssueI: Atmospheric Electricity and Biometeorology. Open Access. Published: 14 July 2020. Challenges in coupling atmospheric electricity with biological systems. Ellard R. Hunting. ORCID: orcid.org/0000-0002-8794-34521Â Interactions of atmospheric electricity with human health can be by characterizing anomalous electric environments where unusual biophysical responses in humans become visible (Cannon 1929), although it is difficult to define the personal limits of exposure to natural electric variations. Various atmospheric physical properties have been proposed to be potentially relevant.Â In practise, methodological challenges can be met when experimental protocols ideally necessitate strict controlling and manipulating of the electric fields involved.