
Direct Electrical Power From The Sun

Disclosed by

BRUCE A. PERREAULT

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DEDICATION

Dr. Thomas Henry Moray, of Salt Lake City, Utah, expanding on Nikola Tesla's concept to harness the intermolecular ions which surround our Planet Earth was probably the first to use them as a useful source of electrical power. His tireless effort, to gain recognition for this work, has been an inspiration to me.

The original concepts presented by the late Dr. Thomas Henry Moray, of Salt Lake City, from the year 1909 to 1974, have paved a road to our energy independence. He made history by drawing the attention of the scientific community to certain discoveries of far-reaching importance. His research involved the direct application of radiant energy, to the ultimate electric particles of the atoms and molecules of the universe. Dr. Moray's discoveries, when demonstrated, convinced large numbers of scientific men who had witnessed them in action. However, there were a few scientists in high places who prevented the commercial success of this technology.

If these eminent men, the supposed leaders of the scientific community, had the privilege of studying under Dr. Moray, they would have understood his discoveries and applauded them. But in their ignorance of radiant energy, they refused to believe or even listen politely to the facts that he often demonstrated.

One of his prototypes measured about 42 x 26 x 22 inches and weighed no more than sixty pounds. It generated around four kilowatts of electrical power and was demonstrated in front of too many witnesses to count. Unfortunately, these few people, knowing nothing of the truth, have done incalculable damage to Moray's discoveries over the years.

In its' widest form, radiant energy can be said to be the "Holy Grail of Free Energy." Those who wish to study this exciting subject will do well to give serious attention to Dr. Moray's original discoveries.

It should be as easy to accept the fact that a device can be built to collect and convert the ionized particles that are contained within the atmospheric envelop of our planet, as it is to accept a radio that receives and converts radio waves. The only difference being is that the former is electrostatic while the later is electromagnetic. One device transforms radio energy coming from a man-made transmitter to sound while the other transposes charged electrical particles that are coming mostly from our Sun, into heat, light, or electrical power.

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INTRODUCTION

Brooklyn Eagle
July 10, 1932
Nikola Tesla States:

“I have harnessed the cosmic rays and caused them to operate a motive device. ... I have advanced a theory of the cosmic rays and at every step of my investigations I have found it completely justified. The attractive feature of the cosmic rays is their constancy. They shower down on us throughout the whole 24 hours, and if a power plant is developed to use their power it will not require devices for storing energy as would be necessary with devices using wind, tide or sunlight. All of my investigations seem to point to the conclusion that they are small particles, each carrying so small a charge that we are justified in calling them neutrons. They move with great velocity, exceeding that of light. More than 25 years ago I began my efforts to harness the cosmic rays and I can now state that I have succeeded in operating a motive device by means of them. I will tell you in the most general way, the cosmic ray ionizes the air, setting free many charged ions and electrons. These charges are captured in a condenser [capacitor] which is made to discharge through the circuit of the motor. I have hopes of building my motor on a large scale, but circumstances have not been favorable to carrying out my plan.”

Philadelphia Public Ledger
November 2, 1933
Tesla ‘Harnesses’ Cosmic Energy

Inventor announces discovery to displace fuel in driving machinery. Calls Sun main source. A principle by which power for driving machinery of the world may be developed from the cosmic energy which operates the universe, has been discovered by Nikola Tesla, noted physicist and inventor of scientific devices, he announced today. This principle, which taps a source of power described as “everywhere present in unlimited quantities” and which may be transmitted by wire or wireless from central plants to any part of the globe, **will eliminate the need of coal, oil, gas or any other of the common fuels**, he said. Dr. Tesla in a statement today at his hotel indicated the time was not far distant when the principle would be ready for practical commercial development. Asked whether the sudden introduction of his principle would upset the present economic system, Dr. Tesla replied, “It is badly upset already.” He added that now as never before was the time ripe for the development of new resources. While in its present form the theory calls for the development of energy in central plants requiring vast machinery. Dr. Tesla said he might be able to work out a plan for its use by individuals. The central source of cosmic energy for the earth is the Sun, Dr. Tesla said, but “night will not interrupt the flow of new power supply.”

Clearly Tesla is not talking about an atomic reactor. He spoke about directly converting the ions contained within the confines of our Planet’s Atmosphere, where they are created from the Radiant Energy of the Sun and are directly converted to electrical power! Tesla believed that the Sun generates **cosmic rays** that strike the atmosphere of our planet which creates these highly charged particles. These charged particles (air ions) are the re-transmitters of Radiant Energy; it is this transfer of energy that could be used for practical purposes.

The mystery surrounding the direct conversion of the Radiant Energy of the Sun will unlock untold amounts of energy. Under the proper conditions, it can be rendered susceptible to the most incomprehensible changes caused by the oscillations, pulsation and surging throughout the Universe.

A unique ion-valve has been designed and constructed by the author of this paper to provide a dam to the ionic surging of the atmosphere of our planet. If an oscillating tank circuit is used in conjunction with this valve that has the correct impedance, reactance and inductance, it will absorb the energy which can be transformed into useful electrical power. The tank oscillations are kept alive by establishing resonance with the surging thought the Universe. Therefore, energy is not drawn from the transformer that powers the tank circuit. In the case of the radiant energy receiver, it becomes possible to draw energy from **cosmic energy** with the aid of specially constructed electrical plasma tubes (ion valves). The implication of this energy source is mind boggling. A properly constructed receiver will harness electrical power from the cosmic energy of the Sun, a glorified **radiant energy** receiver, and one that is designed to receive and convert the oscillations of the Universe which is being generated. This device locks onto the very wheelwork of nature. When properly constructed it should last for many years with very little maintenance, no more than is required for a good radio receiver.

It will be understood that the energy that is being harnessed is not perpetual energy. Everything in the Universe eventually returns from whence it came. What is claimed is a device that can extract energy from the charged intermolecular ions that surround our planet, otherwise referred as the radiant energy of the Sun. All that is needed is to build a receiver that will collect and convert it into useful electrical power.

Present day alternative energy researchers find hope in that, one day, power will be obtained from the energy that runs the Cosmos. In reality, this dream has only proved to be a lure to its followers, beyond the limits of credibility. A quagmire of unsubstantiated hypotheses exists that are bottomless and lack reality. The facts of many newly conceived energy concepts are wholly inadequate, lacking justification, and is incapable of throwing any light on the promise of an inexpensive, abundant sources of energy. The Earth is indeed bathed in a sea of untapped energy that can be transformed into useful electrical power.

I have succeeded in penetrating the secrets of Generating Electrical Power with the Radiant Energy of the Cosmic Rays. Because of this, we now have an obligation to honor its abundant miracle with care and respect. —Bruce A. Perreault

Atmospheric Electricity

Since the time of Benjamin Franklin's famous kite experiments not much has been learned about the nature of electrical charge and how to convert it into useful power. Certain people have discussed this to some extent. Some theoretical papers in the so-called "free energy" field have been written. Many of these theorists will even consider that ionizing particles can be utilized to produce usable amounts of electrical power.

Nevertheless, I have taken it upon myself, with great personal conviction, to find a solution to converting kinetically active ionized particles in the Earth's Atmosphere into useful electrical currents. I have found with the correct circuits and components, that ions can be efficiently transformed into useful electrical currents. It is my desire to be able to furnish irrefutable proof of this discovery. To begin this journey, scientists and researchers alike will have to snap out of their state of denial. The utilization of ionizing energy on completely new ground has to take place.

The production and utilization of energy obtained from natural sources for the well being of humankind has been the goal of scholars and researchers for countless years now. However, the implementation of a practical working device has remained only a pious desire. This is because well-intentioned researchers turn away from the simple fact that there is free electricity to be obtained from natural ionizing sources. I have come to realize through my investigations and observations that this form of energy can be collected in large enough quantities and that it can be converted into useful power.

Many researchers after investigating atmospheric electricity become astonished when they realize that there is nothing new in the world, they find out that this form of energy has been with us for a very long time, even before the knowledge of electricity.

When the study of meteorology first began there was a big interest in atmospheric electricity. Many in this field thought to use it. This is revealed through the patents of the time. The first relevant patent was granted to inventor Dr. Heinrich Rudolph of St. Goarshausen, according to the German Patent Office; **D.R.P. No. 98180 January 19, 1897.**

Benjamin Franklin in America made a few attempts to utilize static electricity obtained from the atmosphere. He once built a motor that implied a commercially significant amount of energy might be derived from the atmosphere of the earth. It has been observed that an average potential gradient of 150 volts per meter of height is always available.

There are three major causes of atmospheric ionization. The first one is due to the cosmic rays and the second cause is due to the solar winds. Over 95% of the particles in the solar wind are electrons and protons, in roughly equal numbers. Almost all of these high-energy particles interact with the earth's upper atmosphere causing it to become ionized. This is

why the upper atmosphere is called the ionosphere. However, the area where the reaction between the solar wind and the magnetosphere takes place is far outside of the earth's atmosphere. The charged solar wind particles rattle the magnetic cage of our planet long before its gas envelope neutralizes them. The third cause of atmospheric ionization is due to the content of radioactive gas contained in the air that we breathe. In the ground radioactive substances such as radium, thorium, and actinium are spread throughout the soil. These elements generate gaseous radioactive emanations that spread in the air and ionize its molecules. The actinium-emanation generated from the decay of U235 plays a major role because of its brief radioactive half-life of only 3.9 seconds.

Radio Ionics

There are not enough charged ions in the air to be converted into electrical power. This on the surface appears to be a correct calculation and assumption. There simply are not enough of them. However, these ions are in a state of constant surging motion. By studying this particular sea of energy, we can gather clues to obtaining power from its charged particles. The ions in our atmosphere are in constant motion. To obtain electrical current from a generator the magnets must also be in constant motion. Do you see the correlation here? What we learn is that charge in motion **induces** electrical current. By means of a properly tuned radio-ionic-circuit, a solution to harnessing this seemingly static charge presents itself. Hermann Plauson was successful in converting atmospheric energy into useful electrical currents. He was granted a patent titled "Conversion of Atmospheric Electric Energy" – **U.S. Patent No. 1,540,998**. In his patent he states, "St. Elmo's fire and the northern lights can be more or less absorbed in the same way as a receiver in wireless telegraphy absorbs waves coming from a far distance." It contains the foundation to building a powerful radiant energy power-receiving device.

Radiant Energy

Professor Langley showed that out of the total amount of radiation coming from the sun, that the visible portion represents only 19% of the total spectrum. He presented the theory that there is only one kind of energy radiated from sunlight. That, heat, and chemical effects depend entirely upon the state or condition which radiant energy may happen to fall on matter.

Professor Langley wrote that up until 1872 it was almost universally believed that there were three different kinds of **entities** – actinic, luminous, and thermal. These are what make up the spectrum. He reasoned that there is only one radiant energy that appears to us in the form of "actinic," "luminous," or "thermal" radiation, according to the way we observe it. Heat and light, therefore, cannot be things in themselves, but separate sensations to our bodily sensors. They are merely effects of this mysterious thing called "radiant energy."

The Italian physicist Melloni stated that, "light is merely a series of caloric indications sensible to the organs of sight, or vice versa, the radiation of obscure heat are veritable invisible radiation of light." Melloni wrote this in 1843, but it was not adopted until

Langley by his elaborate researches, more refined and complex, that proved it. The great physicists of society then adopted the doctrine of one radiant energy.

Only a few researchers know that the immediate effect of radiant energy is electromagnetic. The results of two centuries of observation all point to this conclusion. When a mighty tongue of white-hot matter darts across the abyss of a large spot or cavern on the sun, the equilibrium of the Earth's magnetic field is disturbed and the effect is a magnetic storm. The needle of any magnetograph throughout the world will quiver and oscillate. These vibrations pass from the sun to the surface of our planet that is closest to it. These impulses then pass to the most distant side, whether through or around the planet's surface.

After centuries of investigation from Gilbert to Tesla, this most wonderful research still holds admiration and mystery for all that study this vast science; electrodynamics. Power is cut out of the seemingly emptiness of space, and the hurrying waves are caught and chained to servitude in artificial light and electric appliances. The sun, being electromagnetic, emits waves that carry power, which beat and surge against the earth. A magnetic field is space that surrounds a magnet. This space might be filled with air, wood, stone, glass, or might be a vacuum. Nevertheless, the waves are not quenched. They flow through all of these things. A freely suspended magnet in a magnetic field will move, and the earth's surface is surrounded by a magnetic field, that is acted upon by the sun's magnetic field. Suspend a sewing needle by a silk fiber in the earth's magnetic field and it will come to rest parallel to the field's north and south poles. Now, if this field becomes disturbed, that is, if it becomes stronger or weaker, the needle will move. This is a magnetic storm. When a gas jet is hurled across a spot on the sun, the disturbance reaches the earth in the same time that light does. Therefore, the radiance travels at 186,000 miles per second reaching the earth in eight minutes and nineteen seconds.

The most memorable magnetic storm occurred on November 17, 1882. This was one of the most violent recorded. The daily press was burdened with accounts of widespread magnetic disturbance. In some places telegraphic communication was suspended. The turbulence stretched from New York to Yankton, Nashville, and Winnipeg. In Milwaukee, the carbons in the electric lamps were lighted, rendered incandescent by currents of electricity flowing on the wires. At other locations, switchboards in telegraph offices were set on fire and sending keys were melted, while electric balls were seen hovering on the telegraph lines in Nebraska.

The earth's aurora holds the key to harnessing the sun's daily pulsation. An aurora is the visible effect of obscure undulations from the sun, as they come dashing on the earth with a speed of 186,000 miles per second. In a six-month winter, say at the North Pole of the earth, where the sun is far south of the equator, and none of its rays can shine on the earth's northern pole, the aurora is very bright. It displays many colors, and these flash and glow with rapid variations. The light, although caused by the sun, does not come direct. It is caused by the turbulence set up in the earth's magnetic field by electromagnetic upheaval on the sun. The field of the earth is "tuned" with the sun's field, as was the coherer in the days of wireless telegraphy and telephony. The aurora is known to be electrical, magnets and

compass needles on ships are always affected. Could the coherer of the days of old teach us something new?

No magnet can be placed near a "current" of electricity or a static charge without making an oscillation. Every oscillation sends out a wave, like a stone falling in water. An electromagnetic wave from the sun disturbs the earth's magnetic field in the same way that an induction coil used in wireless telegraphy does. The earth and coherer are both doing the same thing with the same kind of electromagnetic waves. The coherer in a distant receiving station will react to natural electromagnetic wave fronts from the sun. It will likewise react to the artificial wave fronts coming from the induction coil. The electromagnetic wave makes the loose particles of metal between the knobs in the glass tube coherer generate dots and dashes.

Atmospheric Ion Generation

1. Cosmic particles are hurled at the earth from outer space.
2. The sun emits electrons and protons that are carried to the earth by the solar winds 24 hours every day.
3. The cosmic rays in the solar wind interact with the upper atmosphere of the earth causing it to become ionized.
4. The ionized atmospheric region of the earth is called the "ionosphere." It is sort of a half gas and half plasma.
5. A cloud (water vapor) becomes charged by induction as they travel parallel to the ionosphere.
6. When a cloud becomes sufficiently charged they will discharge according to Michael Pupin's theory on capacitive discharge. The energy is released in the form of light and electrical oscillations. There is a cloud discharge about one hundred times each second that is randomly located somewhere on the planet, generating a tremendous amount of natural oscillating electrical energy. The total energy per discharge is documented to be approximately "two million-million watts."
7. It was said by T.H. Moray that there is "Enough energy is coming to the Earth to light 1,193,600 one hundred-watt lamps for every human being alive today. No fuel of any kind will be taken. Energy can be "picked-up" directly by great ocean liners, railroads, airplanes, automobiles or any form of transportation. In addition, heat, light and power can be available for use in all kinds of buildings. ***The Sea of Energy In Which The Earth Floats, 1960 4th edition, page 1.**

On **page 303** in "ASTRONOMY" by Robert H. Baker, P.H. D. Professor of Astronomy, University of Illinois:

Another problem relates to the apparent lavish expenditure of this radiation. Of all the energy that pours forth from the sun, the planets and their satellites intercept less than one part in 200 million. The remainder spreads through interstellar space with little chance, so far as we know, of being recovered. The suggestion that the sun shines only in the direction of material that can intercept it may appeal from the point of view of economy, but appears to have little else to recommend it. It would seem that Nature is squandering its resources of energy so prodigally that it must end in bankruptcy. But, we doubtless have at present, an imperfect account of the situation.

On **page 17** of the "Nature of the World and of Men" (compiled by the technical staff, Chicago Institute of Technology), we learn that our planet is receiving energy from the sun continuously at the rate of 160,000 horsepower per inhabitant.

In the "Physical Review," Dr. Gunn of the U. S. Navy Research Laboratories states that the earth itself is a huge dynamo, producing 200,000,000 amperes of electrical current. For more detail, read **pages 334 - 344**, "Physical Review," July 15, 1939.

The Aurora Borealis definitely is considered an electrical phenomenon produced by the passage of electric charges through the rarefied gases of the upper atmosphere.

Similar to the reception of radio waves, a radiant energy power receiver can be tuned into resonance by the right arrangement of inductance and capacities. The components respond to the particular wave frequency "oscillations" of energy from our Sun. An ion valve dams the charge coming from the antenna and charges a bank of capacitors. The high voltage charge thus obtained can be stepped down into useful electrical power utilizing conventional electrical circuits.

All that is necessary to put the device into operation is to start electric oscillations in the circuit by inducing a surge of high potential between the antenna and ground connections of the device.

The frequency of the current is extremely high, as is shown by the brush discharge when either the antenna lead or the ground wire is disconnected from the device. Certain difficulties of insulation that is inherent with high frequency currents are avoided by reducing the frequency on the output side.

Standard electric light globes become exceedingly hot on one spot that is about the size of a dime when operated on this current. This is due to the fact that the gases in the globes become incandescent under the influence of the very high frequency current. The luminosity of the incandescent gas is also much higher and whiter than with ordinary current. A variation of the Tesla, high frequency, button type globe would be ideal for use with this device.

R.E. experiments are made at different places, many miles from all power lines. The locations for these experiments are selected by those making the test. These locations are not prearranged.

There is no sound coming from the machine when it is in operation, there being no moving parts, electrical oscillations, or prime mover operations. The current cannot be derived from batteries, as it can be shown, this current is high frequency. Batteries provide only direct current.

It cannot be induction from adjacent power lines, as an induced current is always the same frequency as the inducing current. There is no power line on earth carrying current of these frequencies. This current cannot be caused by radio signals alone; these are much too weak.

It is generally accepted now by science. The radiant energy receiver proves there is energy coming from somewhere, that such a field of energy does surround the earth. The receiver picks up the surging or oscillations of energy coming and returning to its source. It is tuned to oscillate in harmony with the oscillations of the source.

I do not claim that all of my theories are proven. Nevertheless, I do claim the device works. The results are certain.

Radio Electronics vs. Radio Ionics

The earth's electric field that exists between the surface and the ionosphere is charged to about 360,000 volts. It is estimated that the stored energy ranges from about one million to a billion kilowatts. This field provides a low current at a high voltage and will not power today's appliances because they use high current, low voltage electromagnetic power.

In 1748, Benjamin Franklin was the first to invent an electrostatic motor that could run on the energy field of the earth. Did this scientist of yesteryear point us in the right direction?

Thomas Edison's 1880 discovery of thermionic emission, the current of electron flow in a vacuum tube, created the first electronic device. Sir William H. Preece called this the "Edison Effect." Edison discovered the fundamentals of the electron tube and was granted **U.S. Patent No. 307,031**. Its' basic principle was to be used in radio communication for many years.

At the Paris Electrical Exhibition of 1881, Professor Amos Dolbear successfully demonstrated his electrostatic transducer for the telephone. He obtained **U.S. Patents No. 239,742 and No. 240,578** for this invention.

In 1887, Dolbear was forced to go to court against Alexander Graham Bell to establish that he was the inventor of the telephone. Dolbear lost this infringement case. The judge consequently ruled that Bell was the inventor of the telephone. This decision was the pivotal point of our electrical development. Because of this one decision by a court, inventors moved in the direction of electromagnetic driven components.

Conventional radio tubes to this day are based on electron emission. Electron flow through a vacuum tube is where we get the word "electronic." If science had gone the way of ionic emission instead of electron emission in radio tubes, I believe that our technology would be drastically different today.

I have designed radio tubes that carry ionic current instead of electron current. Vacuum tubes that carry electrons are called "electron valves." My tubes carry ions and therefore are called "ion valves." This changes everything about inductance and capacitance. Capacitance then becomes the essential element in electron transfer through the associated elements. It may be of interest to you that "ohm's law" only applies to conventional electron tubes. In conventional electric circuits the mean velocity of an electron is about 1 mm per second. In my ion valve, charge transfer is much faster. When using the ion valve as a rectifier or oscillator this changes the whole mathematical equation on its electrodynamics.

The Ion Valve

The ion valve shown here has an axial negatively charged rod, extends to the length of the cylinder, and is coated with _____, such as _____, that readily _____.

The cylinder consists of a _____ cylinder which is positively charged. This cylinder is capable of neutralizing onrushing negatively charged ions.

GRAPHIC ILLUSTRATION OMITTED IN THIS BETA DISCLOSURE

Ion Valve – Figure 1

Within a few milliseconds, the accumulated negative ions rush towards the positively charged atomic ions that are generated at the surface of the anode. When the negative and positive charges collide, they neutralize each other _____. The impinging _____ upon the surface of the cathode cause it to eject electrons from its _____, electron emitting substance. * U.S. Patent No. 7,800,286

The ion-valve provides a stable potential difference that prevents energy from flowing back to its high voltage external source. It is an "energy dam" for the lack of a better description. The valve has a charge blocking effect in one direction. There is valve action in stopping the "flow" of potential energy in one direction. Diodes used to change AC or radio frequencies to DC are current rectifiers. The ion-valve is a **charge separator**. Its function might be thought of as an oscillatory action similar to the waves of the sea, without rectification, preventing energy from returning to the energy source. ***The Sea of Energy In Which The Earth Floats**, 1978 5th edition, page 209.

Simple Radiant Energy Receiver / Charger

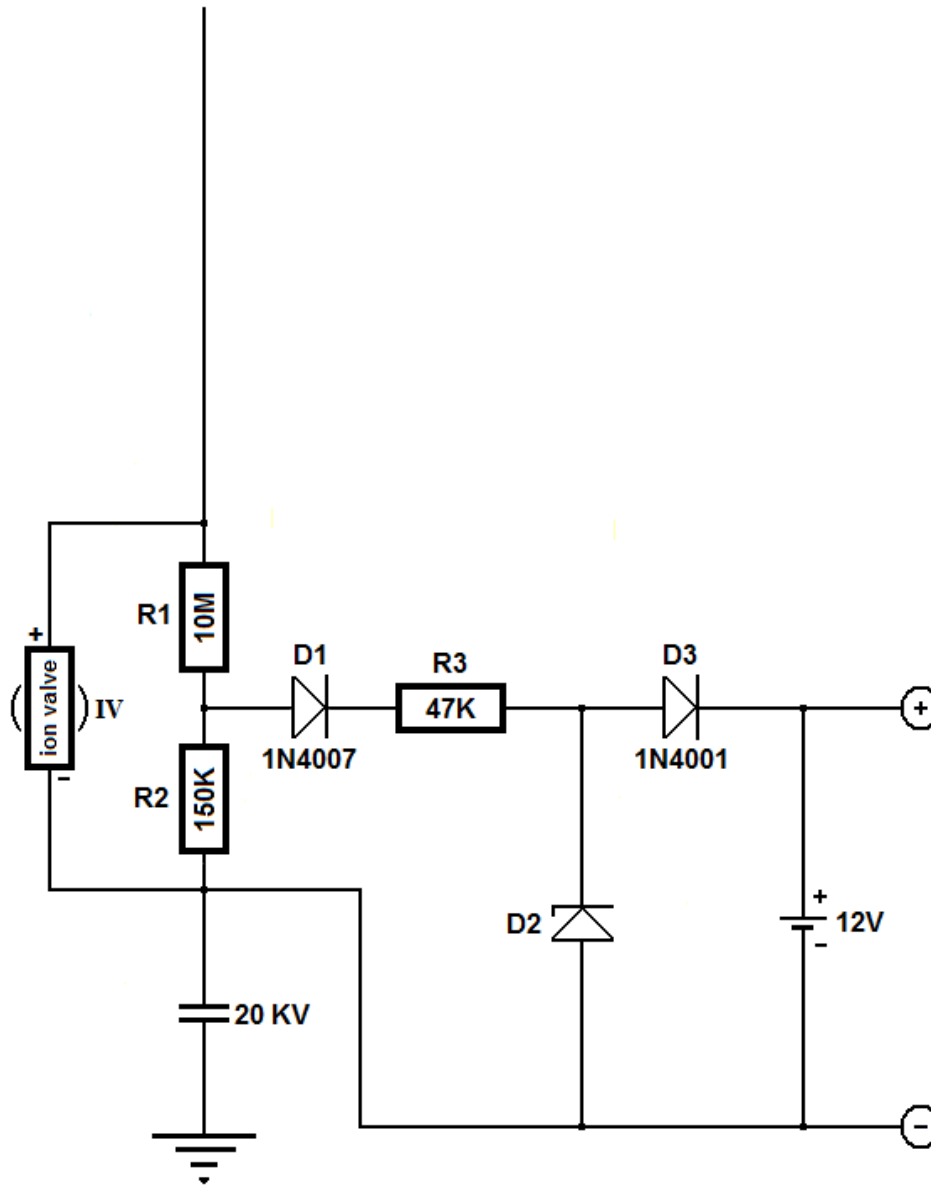


Figure 2

The ion valve **IV** limits the voltage across resistor **R1** and **R2** to around **1,000 volts**. These resistors are connected in a voltage divider configuration, providing around **15V** at the center tap; this is rectified and stabilized through **D1**, **R3** and **D2** which is a zener diode that is rated at **13 volts**. The **12V** storage battery is charged through **D3**. Circuit builders are advised that some of the components may become unstable.

Active Radiant Energy Amplifier

It is assumed that the average reader of this publication is familiar with the elementary principles of radio transmission. Granting this, it is of course reasonable to believe that such readers will understand how an oscillating current is set up in a circuit comprising an inductance or coil of wire, a capacitor and a spark gap.

GRAPHIC ILLUSTRATION OMITTED IN THIS BETA DISCLOSURE

Figure 3

The capacitor is charged with a high tension current from any convenient source such as a transformer or induction coil. When the potential stored in the capacitor reaches a critical value, the air in the gap between the spark gap electrodes can no longer stand the strain. The capacitor discharges across the gap in a succession of crashing sparks. As the current from the capacitor crosses the gap in one direction, it literally over-reaches itself just as a pendulum will swing past its neutral point when given a push by the hand. After the first rush of current passes in one direction, a reversal of the cycle occurs and a second rush in the opposite direction occurs. This operation is repeated many thousands of times per second. The discharge gradually dies down as all the energy is either completely radiated or used up in heat or in performing work. These oscillations cease once the potential across the capacitor has been lowered until the spark can no longer jump the air gap. The capacitor can immediately take a fresh charge from an electrical transformer that exceeds the voltage requirement to discharge the capacitor, and the entire cycle of operations is repeated. It will be understood that all of this passes in an infinitesimal fraction of a second. The charge and discharge of the capacitor takes place so rapidly that the observer can detect no change in the solid spark that appears continuously to fill the gap. It should also be understood that if this oscillating tank circuit has the correct impedance, reactance, and inductance, it can absorb energy from a source of oscillating ions with the correct conditions being met. The tank oscillations can be kept alive by establishing resonance with the external planetary ions. In the case of the radiant energy receiver, the ions are drawn from the field of radiant energy that the ion valve gates.



US007800286B2

(12) **United States Patent**
Perreault

(10) **Patent No.:** **US 7,800,286 B2**
(45) **Date of Patent:** **Sep. 21, 2010**

(54) **ALPHA FUSION ELECTRICAL ENERGY
VALVE**

(76) Inventor: **Bruce Alan Perreault**, 1072 NH Route
118, Dorchester, NH (US) 03266-6409

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 758 days.

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(52) **U.S. Cl.** **313/54; 313/574; 313/310;**
310/305

(58) **Field of Classification Search** None
See application file for complete search history.

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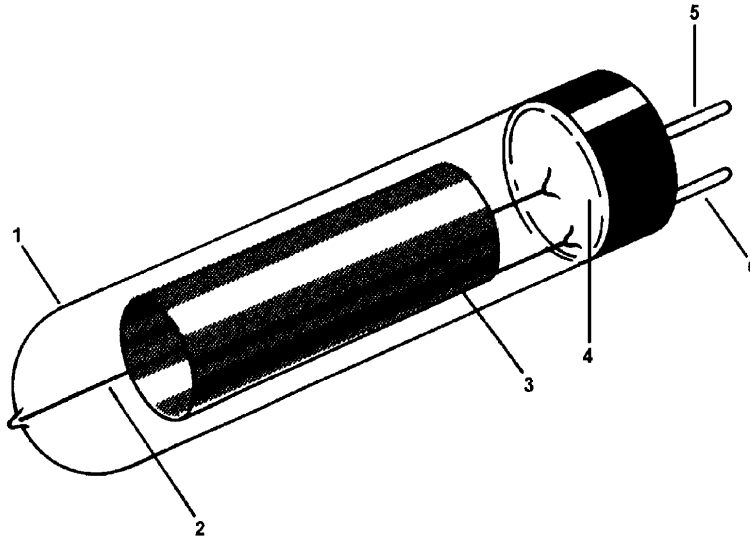
* cited by examiner

Primary Examiner—Ashok Patel

(57) **ABSTRACT**

Alpha particles are directed and focused onto a delta-ray
cathode target, where an alpha fusion reaction is generated.
Delta radiation or high-energy secondary electrons are gen-
erated from the said alpha reaction. The cathode also becomes
thermally active generating thermionic electrons. The elec-
trons flow in the direction of an anode that absorbs their
energy, generating electrical current in one direction, known
in the electrical field as direct current.

1 Claim, 2 Drawing Sheets



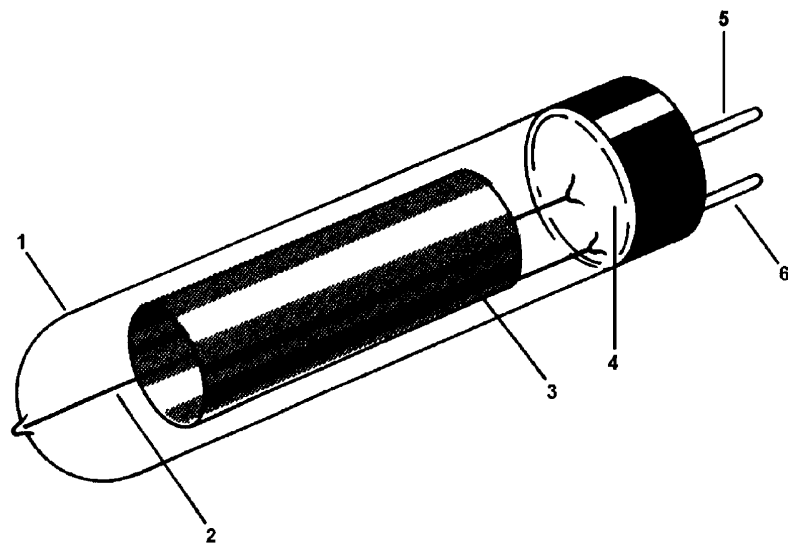


FIG. 1

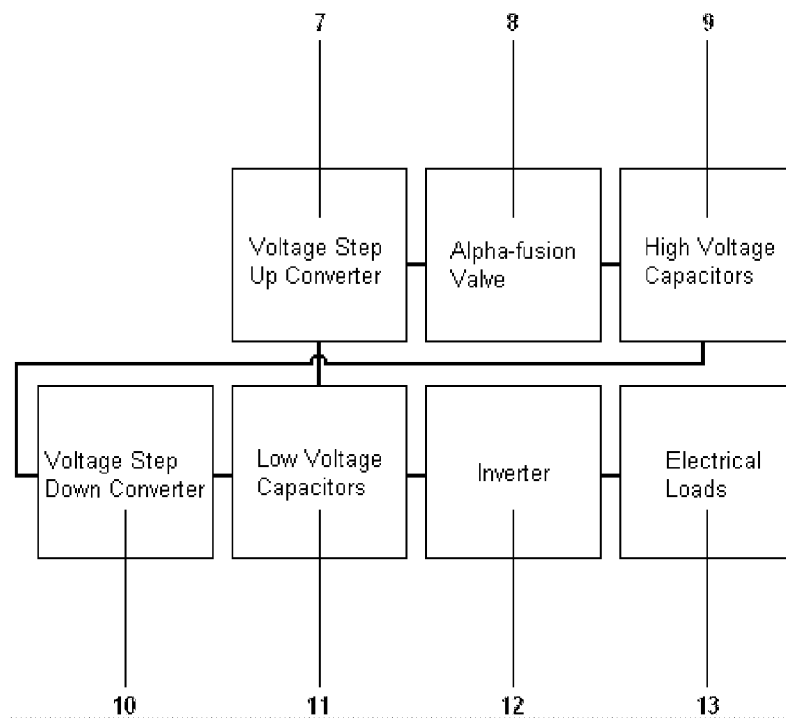


FIG. 2

1

ALPHA FUSION ELECTRICAL ENERGY
VALVE

FIELD OF INVENTION

This invention in general is related to atomic cells and nuclear batteries.

BACKGROUND OF THE INVENTION

Prior art atomic cells and nuclear batteries are limited because they generate low currents. Another drawback is that expensive radioisotopes are obtained from a nuclear reactor in their construction.

The present invention overcomes the aforementioned limitations by utilizing an alpha fusion reaction and radon emissive material. The alpha fusion reaction economically generates high power densities. The present invention provides a unique concept that offers improved performance over prior art direct nuclear conversion systems. The new and novel invention that will be described utilizes an alpha fusion reaction that generates practical and useful electrical current.

Devices that convert ionizing energy to electrical current have been used in prior art, but with poor results.

Atomic cells generate electric currents by utilizing charged particles that are ejected from radioactive substances. The Direct Conversion of Energy was published by the GPO in 1964. On pages 28-29 William R. Corliss discusses the direct use of charged particles that are ejected from radioisotopes. He states that high velocity beta particles ejected from $^{90}_{38}\text{Sr}$ generates a flow of electrical current. The negative charges on the particles become neutralized when they strike a metallic cylinder. The neutralized particles find their way back to the $^{90}_{38}\text{Sr}$ becoming again ionized. This cycle repeats itself so long as the $^{90}_{38}\text{Sr}$ remains radioactive.

U.S. Pat. No. 2,926,268 describes a self-powered electron tube that generates secondary electrons when high-energy radiations, primarily from beta particles strike a semi-conductive material.

The power generated by the above two cited examples generate high-voltage but produce extremely low amperage. There are numerous patents issued world wide relating to the direct conversion of charged atomic particles that generates electrical current but all produce low power densities in the millionth of a watt range.

Despite the prior art that exists in this technology, it is believed that there has not previously existed a small, compact electrical device capable of generating a high power output. It is the object of this invention to provide a method embodying a new and novel device to furnish an efficient and economical source of electrical power. The present invention resolves limitations of the prior art.

The primary object of the present invention is to provide a method that directly utilizes charged particles to produce electrical current, and a new and novel device for utilizing an alpha-fusion nuclear reaction to generate the charged particles.

SUMMARY OF THE INVENTION

The present invention relates to a method that generates electrons which can be converted to electrical energy and more particularly, to electrical power generation through the fusion of alpha particles with carefully chosen target elements, compounds, or alloys.

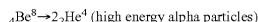
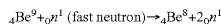
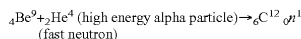
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The present invention may serve as a source of electrical current that is consistent a full 24 hours per day which is safe and non-polluting.

The present invention is an original approach to the generation of electrical current, which relies upon an alpha fusion reaction. It is the main object of the present invention to provide a method and device for generating electrical energy that result from the reaction of alpha particles with specific materials.

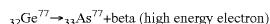
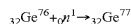
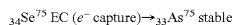
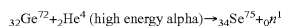
It is generally accepted that helium gas will not form compounds in any chemical combination. This gas generally is believed to be chemically inert. What is not readily realized is that helium will react with a few substances when sufficiently excited. It is a well-established fact; helium is a gas that accompanies all radioactive minerals in an excited state. The name for a high-energy helium atom is called an "alpha particle" in the scientific literature. Until now, its role in nuclear transformations has not been fully realized. The quantity of energy that is released under certain conditions is considerable. This conclusion was reached by the early scientific community because the small amount of ejected particles coming from radioactive matter possesses an enormous velocity, carrying with them enormous amounts of energy. The alpha particle reaction is a liberator of an enormous reserve of stored atomic energy.

An example of an alpha fusion reaction can be demonstrated by depositing radon gas onto a beryllium wire. The resulting reaction was used to generate neutrons in the early days of atomic energy to initiate a fission reaction using fissile $^{235}_{92}\text{U}$. The reaction is expressed in the following equations;



In these equations, beryllium reacts with an excited alpha particle generating a fusion reaction with neutrons as its by-product. Enrico Fermi describes this reaction in his U.S. Pat. No. 2,206,634 Process for the Production of Radioactive Substances. The atoms are not fragmented in the above expressed reaction as is the case when a fission reaction is created. A fusion reaction can produce non-radioactive stable by-products, along with a supply of useful electrons, unlike a fission reaction that creates a number of radioactive deadly waste products.

In the present invention a germanium plated, negatively charged corona cathode wire or thin rod, used in conjunction with a palladium or graphite positively charged anode concentric cylinder, can be utilized in its construction. Other materials can be used and this will not depart from the spirit of the present invention. Germanium used as a target material is a good choice because $^{72}_{32}\text{Ge}$ will react with alpha particles generating stable $^{77}_{34}\text{Se}$ and high-energy electrons within the process, in which:



It takes at least 6.06 MeV of energy to generate a $^{72}_{32}\text{Ge}$ alpha fusion reaction. Alpha particles are ejected from Po^{212}

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with the energy release of 8.78 MeV, Po^{214} with the energy release of 7.68 MeV, and Po^{216} with the energy release of 6.78 MeV; these elements can be used to generate ${}_{32}\text{Ge}^{72}$ alpha fusion reactions. Therefore, Po^{218} with the energy release of 6.00 MeV cannot be used to generate a ${}_{32}\text{Ge}^{72}$ alpha fusion reaction. Po^{210} with the energy release of 5.30 MeV cannot be used to generate a ${}_{32}\text{Ge}^{72}$ alpha fusion reaction. These two later radioisotopes cannot be used to generate a ${}_{32}\text{Ge}^{72}$ alpha fusion reaction because their energy levels are below the threshold of 6.06 MeV that is required to initiate the reaction. Rn^{220} with the energy release of 6.29 MeV of energy and can also be used to generate a ${}_{32}\text{Ge}^{72}$ alpha fusion reaction. It is a good choice because it is the daughter product of Th^{228} , which is abundant on the earth. It is a daughter product of Th^{232} , which is said to be more abundant than lead. The sited equations are a few theoretical examples from whence the present invention obtains its energy. Numerous reactions are possible. Other radioisotopes, than what is sited herein, might also be used and this will not depart from the spirit of the present invention.

A number of electron emitting and electron collecting materials can be used and this will not depart from the spirit of the invention. Other cathode and anode geometries may also be used and this will not depart from the spirit of the invention. However, the target material or cathode must be a delta-ray emitter. In the scope of the present invention, "a delta ray is characterized by very fast electrons produced in quantity by alpha particles. Collectively, these electrons are defined as delta radiation when they have sufficient energy to ionize further atoms through subsequent interactions on their own."

In the present invention, a new and novel improvement in the art of the direct conversion of nuclear energy is made apparent. The present invention generates electrons that are the result of atomic reactions that are efficiently converted to electrical current, which is novel in the field. Converted atomic energy within the scope of the present invention is directly available for driving motors, lighting, production of heat, and can be used in electrochemistry, etc. . . .

It is a further object of this invention to provide a device for generating electrical current that results from a self-generating electron source that is simple in construction and compact.

Thus, in accordance with the present invention there is provided a method of generating delta rays, or secondary electrons through the prescribed fusion reaction. The present invention provides a method and device that gives improved performance over prior art that utilizes the direct conversion of atomic reactions to obtain electrical power.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiment of the present invention, with references to the attached drawings, in which:

FIG. 1 is an embodiment in its most basic form illustrating the alpha fusion valve which is unique in the present art of generating electrical power; and

FIG. 2 is a block diagram that illustrates the invention in a useful embodiment. The diagram shows an electronic high voltage, low amperage, high frequency power supply. A means to rectify the output of the high frequency power supply is provided. The output of this power supply is coupled to the invention which activates the alpha fusion valve. The polarized current coming from the output of alpha fusion

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reaction vessel charges a storage capacitor. The stored charge is then connected to a voltage step-down circuit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method to generate electrical energy includes a cathode which reacts with alpha particles generating electrically charged particles.

The device that will be described includes an electron generating cathode and alpha source that allows for a practical and compact power supply. Atomic reactions are converted to electrical energy with extreme efficiency within the scope of the present invention.

Furthermore, it will be understood that the generated electrical current can be directly converted into a useful voltage and amperage.

The conversion of the electrons that are emitted from said cathode generates useful electrical current that will be made apparent and that the alpha fusion valve is unique in generating electrical power. It will be made apparent in the following descriptions;

Referring now to FIG. 1 of the drawings, the said invention consists of a vessel 1 that is made out of an electrically insulating airtight material, such as glass, ceramic, plastic or the like.

It is preferred that a natural alpha source be used but an artificial alpha source might also be used and this will not depart from the spirit of the present invention.

Vessel 1 includes a corona wire 2, made out of a delta-ray emissive element, compound, or alloy, such as germanium, silicon, or lead-sulfide, etc. . . . delta-ray emissive substances emit delta-ray electrons when bombarded with alpha particles.

The vessel 1 contains a high work function electron-collecting cylinder 3, preferably made out of palladium because this metal can absorb a large volume of gas. After a period of time, the alpha particles lose their charge, become helium gas, build up, and the present invention eventually becomes electrically blocked. This is because helium gas is electrically non-conductive. A high work function material that has the ability to absorb gas will delay this process. Other alternative electrical collector materials, such as activated carbon, which has the ability to absorb large volumes of gas, may be used and this will not depart from the spirit of the invention.

Radon gas emissive radioactive material 4 is placed at the base inside vessel 1. The radioactive material 4 can be placed in a number of locations within vessel 1 and still not depart from the spirit of the invention. The electron emitter 2 can take the form of a wire, rod, cylinder, disc, plate, etc. . . . The electron collector 3 can also take the form of a wire, rod, cylinder, disc, plate, etc. . . . I do not stake my claim on the form or geometry of the electron emitter or electron collector. I stake my claim on the method used to generate electrical power using an alpha fusion reaction.

In the instant invention a negative charge of one-thousand volts or higher is applied to pin 5, which is electrically connected to corona wire 2. Respectively, a positive charge is applied to pin 6 which is electrically connected to a high work function electron collection cylinder 3. This has the effect of attracting and concentrating radon gas onto the corona wire 2 which becomes an abundant supply of alpha reactive particles. A lower voltage may also be applied across pin 5 and pin 6. The applied voltage will depend on the parameters of the wattage design of the present invention, which are too numerous to mention.

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Electrically conductive pin 5 and pin 6 exit through an airtight seal at the bottom of vessel 1, not shown. There are a number of sealants that are available in the field. The inner cavity of vessel 1 is evacuated of air at a low pressure of about 1/10th of an atmosphere. The amount of air that is evacuated is not critical but care must be taken not to obtain too low of a vacuum because this can result in the generation of undesirable x-ray emission. There are a number of high voltage sources that can be used to apply the required activating potential through pin 5 and pin 6 and this will not depart from the spirit of the present invention. I stake my claim to my new and novel method that directly generates electrical power which results from the alpha fusion process and I do not stake my claim to the activating external voltage source thereof.

The speed in which the present invention will build up power depends on the potential difference that is applied to it and type of radon gas that it contains. The quantity of the alpha particle source determines the amount of amperage that is generated. The target material 2 is also a determining factor of how much current will be generated. When the target material 2 temperature rises, a greater number of electrons are emitted from its surface. The heated cathode 2 increases the odds of alpha particles hitting head on with its atoms, thus, producing a greater number of alpha fusion reactions, which further increases the surface heat boiling off additional thermally generated electrons. The surface area of the cathode 2 and anode 3 is also a determining factor of how much electrical current will be obtained.

The present invention generates a high voltage direct current. The present invention also generates a greater amperage per given density from what has been obtained from any previously known method or device in the prior art.

The instant invention described can be slightly modified to convert high voltage, high frequency, and radio frequency currents into a direct current. This feature is accomplished by adding an electrically conductive substance such as mercury, not shown, into the electrically non-conducting vessel 1. Any number of electrically conductive substances that will form a vapor or gas when heated can be used and this will not depart from the spirit of the invention. Said modification can also be utilized without the use of the radioactive substance 4, if the input source has enough energy to excite the vapor or gas into its electrically conductive state. The present modification of the primary invention is more efficient than the prior art in converting alternating or oscillating currents because there is less electrical resistance in the conversion process. Therefore, energy can be more efficiently received and converted into a direct current.

Referring now to FIG. 2 of the drawings;

The present invention is named alpha fusion valve 8 in the block diagram that follows:

The block diagram shown illustrates an example of how an alpha fusion valve 8 can be utilized in a practical application. Many differing types of systems are made possible using the present invention and will not depart from the spirit of the invention.

The alpha fusion valve 8 must be energized by an external potential difference to function if it is initially inactive or is allowed to become inactive after it has been producing power, not shown. This can be accomplished by applying a high voltage charge obtained from an electronic power supply 7. The reactions will build up within the alpha fusion valve 8 to the point where the surface of its internal electron emitter is totally bathed with radon gas. The alpha fusion valve 8 has to

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be primed with a potential difference to begin generating electrical power. The alpha fusion valve 8 produces a high voltage direct current. The output of the alpha fusion valve 8 can be used to charge a high voltage capacitance 9. The high voltage is then lowered to twelve volts through a step-down converter 10. The twelve volts then charges a low voltage capacitance 11 which can be a set of parallel-connected twelve-volt storage batteries. A set of parallel-connected high farad capacitors could also be used. The stored energy in capacitance 11 can be used to provide power to electrical loads that require a twelve-volt direct current or it can provide a twelve-volt power supply to an inverter 12. The output of the inverter 12 can be designed by methods known in the art to provide a voltage and frequency that is required by specific electrical loads 13. It is preferable that an electronic voltage source be used to keep the alpha fusion valve 8 in a constant energized state, which can be alternating or non-alternating. Numerous electronic circuit designs may be used to supply the potential difference required to energize the alpha fusion valve 8. Such electronic circuits are known in the field and are not what I stake my claim to. Alternatively, a strong enough source of alpha, beta, gamma radiation or a combination thereof may also be used to energize the alpha fusion valve 8.

A simple earth ground and antenna raised to a suitable height can be used to take advantage of the potential difference that exists between the planet and its atmosphere, although this is not always practical. Charging capacitance 9 with this method is unpredictable and slow. Any suitable circuit may be used to supply the required potential difference to energize the alpha-fusion valve 8 and this will not depart from the spirit of the invention.

Having thus described the invention, what is claimed is:

1. An electrical energy generator for generating electric energy comprising:

- a vessel constructed of an airtight, electrically insulating material, said vessel including a base and an inner cylindrical wall defining a cavity, the vessel further including:
 - (a) a negatively charged corona wire made of a low work function delta-ray emissive material which functions as an electron emitter, and including germanium, silicon or lead-sulfide for emitting delta ray electrons when bombarded with high energy alpha particles;
 - (b) a high work function electron collector having a cylindrical shape and made of palladium (Pd) or an activated carbon and located coaxially inside the vessel;
 - (c) a radon gas that decays to a radio isotope having an energy level greater than 6.06 MeV, which expands and thereby fills the cavity of the vessel; and
 - (d) first and second electrically conductive pins being attached to the base through airtight seal and facing away from the cavity, the first pin being electrically connected to the corona wire and the second pin being electrically connected to the high work function electron collector,
- wherein the corona wire is initially charged through an external negative charge applied at the first pin, and the high work function electron collector is initially charged through an external positive charge applied at the second pin, and
- wherein, after charging of the corona wire and the high work function electron collector, the first and second pins act as cathode and anode respectively of the electrical energy generator.

* * * * *

PATENT SPECIFICATION.



Application Date : Jan. 3, 1924. No. 163 / 24.

231,247

Complete Left : Sept. 23, 1924.

Complete Accepted : April 2, 1925.

PROVISIONAL SPECIFICATION.

Improvements in and relating to Improved Means for Utilizing Electro-magnetic Radiation and Atmospheric Electricity for Transmitting and Generating Power.

I, SERAFINO ORLANDO, O.D.C., subject of the King of Great Britain, of Birchircara, Malta, do hereby declare the nature of this invention to be as follows:—

We were accustomed to combine the idea of electricity with that of wire conductors, and everybody knew that for the transmission of electrical energy it was necessary to make an exclusive use of metallic wires. But at the present time it is no longer thought necessary to use these means for the transmission of electrical energy, so much so that both electrostatic and electro-magnetic inductions are actions which are transmitted through the air, and although their fields of action are very limited, nevertheless they are clear proof that electricity can be transmitted not only through wires, but also through the ether, which is to be found in the air, and, as a proof of this, we may adduce the phenomenon of wireless telegraphy. It is known that this phenomenon is due to electrical current most rapidly alternated produced by apparatuses in which oscillatory electrical discharges are produced.

These oscillatory discharges, which are the reciprocating motions of electricity, are not only limited to the system of the apparatuses in which they are produced, but, as the electrical spark causing them explodes in the air, they are a phenomenon which occurs in the ether met with in the air, consequently, wherever the spark occurs, it produces in the ether periodical motions which get spread spherically all round in all directions so far as they are not obstructed by some obstacle, and, therefore, it is inferred that the electrical waves are nothing but an electromotive

force transmitted from one point to another by means of the ether.

Above all, it is clear that the action of these oscillations at a distance is bound to be greater, the greater the energy employed in this oscillatory motion happens to be.

We know that the quantity of electrical energy which can be communicated to a conductor or to a system of conductors depends on its capacity. The smaller the conductor is, the less is its capacity, and, therefore, the smaller is the energy of the oscillations which are produced in it when, after having been charged, it is discharged through the medium of the spark.

In fact the period of these electrical oscillations increases proportionately to the square root of the capacity of the oscillatory system.

Consequently the above consideration warns us to use a system of conductors of great capacity in order to obtain extremely long waves, for the latter set in motion a quantity of energy greatly superior to that induced by short waves.

Now as these waves are propagated spherically all round in space in all directions, however much one tries to render the apparatuses powerful, it always remains true that the electrical energy transmitted in space is an electromotive force dispersed in all directions, in a similar way to the luminous waves issuing from a lighted splinter, which spread through the ether in all directions, and in the same way as these, their intensity decreases as the distance increases, and, however great the energy sent forth by the generating station of wireless telegraphy to the receiving station may be, only a very slight

fraction of the transmitted energy reaches it; first on account of the loss of intensity due to the distance from the source, and, secondly, because the electrical energy employed in these apparatuses is due to a pure phenomenon of resonance.

The same thing happens here as when a tuning fork, tuned to A (1st) pitch, is sounded in the vicinity of a pianoforte note having the same A sound, when the latter in its turn is caused to vibrate and emit sound.

Nobody, of course, refuses to recognise the great difference existing between the intensity of sound emitted by the tuning fork and that felt by vibration.

Therefore in order to succeed in solving the problem of wireless traction, setting aside the apparatuses in which the phenomena of resonance are produced, it is necessary to have recourse to other contrivances, having the property of intercepting, or of better absorbing, in great quantities, the electrical energy dispersed in space, causing it to flow in a desired direction, or to flow towards a required point, which amounts to saying that it is necessary to construct an invisible conductor in space which may serve as a path to these waves, and to concentrate them at any point that may be required. The possibility of constructing such an apparatus results from the scientific proofs I am about to submit whilst unfolding my idea.

Röntgen rays, among other marvellous properties, possess one which is of great physical interest, that is, these rays discharge very rapidly the electrified bodies they meet with.

In order to prove in a simple way this fact, it will suffice to use a gold-leaf electroscope whose leaves are electrified with an ebonite rod, or with rubbed glass. As soon as the Röntgen rays are produced in its vicinity, the gold leaves, at first ready to diverge and retain this position, now instantaneously fall down, which is a sure proof that the air loses its insulation properties and becomes a conductor.

The fact that the air traversed by these rays becomes a conductor, says Professor Gräetz, is explained by admitting that owing to them, the molecules of air split up, giving origin to very small particles, some of which are charged positively, and others negatively. It is therefore asserted that the air is ionised by these rays; the free ions in the vicinity of a charged body can become united to this electricity, and, therefore, can discharge it, and, consequently, this ionised air possesses a certain conduc-

tivity in such a way that if from any cause there is a difference of potential existing between two points in the air, an electric current is bound to pass, same as happens in a saline solution. Another property of great importance was observed when it was rendered possible to conduct to the outer side of a Crookes' tube cathodal rays, the negative electrons, which in electrolytic phenomena are inseparable from matter, are freed from the latter and subside free; from which reason, owing to the high tension obtained in Crookes' tubes, they depart from the cathode with a velocity of about $\frac{1}{3}$ that of light, and they act as if they carried away with them negative electricity, and, consequently, every body met with by the cathodal rays becomes electrified negatively.

The apparatus proposed by me to intercept, or rather absorb in great quantities, the electric waves and to profit by it in its application to electrical power generation, will consist of an assemblage of fine copper wires, in several layers, one inside the other, laid out in the form of a flat rhombus, of which one diagonal is remarkably greater than the other. The wires of the several layers, are relatively staggered. The two extremities of all these wires are placed in communication with the central main wire the latter to have such a section as to allow of a resistance which may correspond exactly to the one offered by all the wires, taken as a whole. Underneath in the centre of this apparatus, is placed a Crookes' tube capable of producing rays in great quantities. The position of this tube is determined so as to allow of the copper wires being traversed by the rays throughout all their extension. The superficies of the apparatus will be proportioned to the extent to which the rays are projected, which extension will depend on the form and size of the platinum cone existing at the centre of the tube.

The above-mentioned tube if of Thomson model, would be highly suited to the predetermined object; here the negative charge is transmitted to two diametrically opposed points, and, in the inner part, the cathodes are represented by two specular and concave aluminium conductors, whilst in the centre of the tube is to be found the anode formed by the platinum cone receiving the positive charge.

When the current is discharging towards the tube, the cathodal rays strike the platinum cone at their focus respectively on each side, and thus large

quantities of rays are projected in straight lines perpendicularly to the superficies of the tube.

The phenomena to be verified in this apparatus are the following:—

The rays emanating from the tube, when it is placed in the above-mentioned position, whilst they strike the surrounding air rendering it ionised and, consequently, conductive, must at the same time traverse the copper wires impregnating them with negative electricity. The extent of the layer of ionised air and the intensity of the negative charge will undoubtedly depend on the greater or lesser power of the apparatus in which the Röntgen and cathodal rays are generated.

The electric waves sent continually by the generating station with the rapidity of light in all directions, must, on their way through space, meet with the obstacle, so to say, wherever it may be, formed by the conductivity of the ionised air through the action of the Röntgen rays projected by the tube, and attracted and absorbed by this conductivity of the air, they produce in the space struck by the rays a true aerial conductor, which gets charged without interruption with electricity, for, as the air is a non-conductor, only the layer struck by the rays becomes charged with electricity, and the air which surrounds it must retain its insulating properties. With respect to electric waves absorbed by the ionised air, Professor Wimbledon Hill says:

“Electric waves suffer the least absorption when travelling through a non-conductor medium like ether. Marconi observed in 1902 that signals that carried 1500 or more miles at night-time, would not carry for about 700 miles in the day. The action of day-light is responsible for the greater absorption; sunlight produces partial ionisation of the atmosphere, and renders it conductive.”

From what we have said before, it is inferred that the air ionised by the Röntgen rays should absorb electric waves in a greater quantity, as its conductivity is extraordinarily greater than when it is ionised through the action of solar rays. In fact it has been proved above that electrified bodies when discharged in the vicinity of the Röntgen rays, whilst this never happens through the action of solar rays, for if such a thing could occur, as the sun's rays strike all day long the atmosphere, the properties of the static electricity would not have been discovered, because we should never

have been able to have a body charged with electricity.

The rays projected by the tube, in lines perpendicular to the superficies of the tube, present to our sight the form and size of the invisible conductor produced by the ionisation of the air which attracts and absorbs continually the electric energy; this electric energy, being bound to follow the course formed in the air by the projection of the rays, must necessarily come into contact with the wires charged negatively through the action of the rays themselves, and here then takes place the meeting of the two conductors charged with two kinds of electricity, for it is laid down as a law that two different conductors have always different potentials, namely a positive and a negative potential. The difference of potential causes the negative electrons of the ionised air to be urged on towards the positive conductor, whilst the positive ions are attracted by the negative conductor. In contact with the two conductors they give up their charges, thus originating the electric current.

The magnitude of this current will depend on the greater or lesser ionisation of the air. The greater the difference of potential between the two conductors, the quicker the electrons and ions will be displaced, thus communicating for each unit of time greater charges to the two conductors.

In the apparatus, the positive or highest potential corresponding to an excess of electricity ought to be found in the invisible conductor formed by the ionised air, because the potential of a conductor is inferred from the relation between the capacity of the conductor and the quantity of electricity it possesses, and therefore it follows as a consequence that the negative or lower potential corresponding to a deficiency of electricity ought to be found in the bundle of wires.

A difference of potential between two charged conductors has as a consequence that when these two conductors are put into communication a flow of electricity is produced through the bodies joining together the two points of different potential, that is, an electric current is produced, or rather, an electromotive force from the higher potential to the lower; therefore, according to this other law, the electricity found in the conducting air, which is at the highest potential, should pass over the metallic conductors of the apparatus, which are at the lower potential.

It has also been said that the current is produced through the wires uniting

together the two points at different potentials. In this apparatus, owing to the nature or one of the conductors, such as the ionised air, this joining wire is not required, because air by itself, as can very easily be understood, supplies this defect, as the electricity which it possesses is in continuous contact with the other electricity produced continually in the wire; therefore, as electricity flows with greater ease through metallic conductors, than through any other conductor, then the recombining of the two electricities, one of the ionised air, and the other of the wire, cannot occur through the medium of the air, but runs over the bundle of the metallic wires, and generates in these an electric current; the greater the difference of potentials, the greater will be also the flow of electricity from one point to the other. So long as the difference of potentials is maintained always constant, a true electric current is produced in the conductors, as can be experimented with an electrostatic machine.

In fact, through the rotation of the machine, to one of the conductors is communicated positive electricity, and to the other negative electricity, that is, a difference of potential is constantly maintained between them, whence the two electricities flow continuously in the wire, or in the wires, and an electric current is produced.

In the apparatus the two electricities, namely that of the air and that of the wires, both produced without interruption, through the action of the rays projected by the tube, finding themselves in continual contact the one with the other, the difference of potential is maintained constant, and provokes, as already proved above, the passage of electricity through the wires, or else the electric current.

ATMOSPHERIC ELECTRICITY.

In addition besides the electric waves, also atmospheric electricity, for the same reason, ought to take part in the phenomenon, and be absorbed by the apparatus. In fact the atmosphere is in an electric state always and everywhere, so much so that the differences of potential even between localities not very far from one another is sometimes considerable. When it is fine weather, the air is usually electrified positively, and the earth, naturally, by induction, is electrified negatively. The free electricity of the atmosphere is in greater quantity in high regions. It undergoes variations of a relative periodicity during day-time and the seasons.

With regard to what I state, what is

asserted by an American scientific journal, "Science and Invention," (May, 1921), is quite to the purpose.

It is said that Dr. Plauson, a German scientist, has successfully demonstrated that if we send up metal surfaced balloons and tap the electrical energy from the atmosphere at a level of 1000 feet or more, we shall be able to realise an average of 200 h.p. per square metre, an area equivalent to 3.28 square feet. It is even claimed that in his latest experiments, as great a quantity of electrical energy as 400 to 500 h.p. has been realised per square metre. Under normal conditions, the potential gradient, as it is called, of the atmosphere increases with comparative regularity as we rise above the surface of the ground, the atmospheric potential per foot or per metre varies also, as may be well imagined, with the season of the year, and the potential or voltage has been found to average 100 volts per metre (3.28 square feet) in the summer months, while during the cold winter seasons the potential gradient rises to as high as 300 volts per metre. . . .

The same scientific journal (March, 1922) makes the following remarks:—

"The amount of electrical power that resides in our atmosphere is astounding. Herr Plauson found in his experiments that a single balloon sent aloft at a height of 300 yards gave a constant current of 400 volts of 1.8 amperes, or, in 24 hours, over 17½ kilowatts! By using two balloons in connexion with a special condenser battery, the power obtained was 81½ kilowatts in 24 hours! The actual current delivered was 6.8 amperes at 500 volts. . . ."

Now it is well known that X rays are effective at a distance of almost thirty feet according to a statement by the French Academy of Arts and Sciences with the following words:—

"X rays produce electrons on their passage through the air; these electrons are definite entities, and as they leave atoms, they may traverse matter or pass through the air in a straight path, and by their coming in collision with the atoms of the air, they render it a conductor of electricity. It is true that screens of lead suffice to protect the operators from the evil effects of X rays, but operators are sometimes careless, and then the rays are effective at a distance of almost thirty feet."

Supposing, therefore, the air ionised by the rays to be five square metres, such an area at an altitude of 1000 feet, 130

according to the latest experiments by Dr. Plauson, should effect a force equivalent to $5 \times 200 = 100$ up to $5 \times 500 = 2500$ h.p. Therefore, whenever the apparatus at an altitude of several metres from the ground is capable of absorbing from an area of five square metres as much electric energy as is required to realise a force of 1% in comparison to that obtained at an altitude of 1000 feet from the earth, it should give a result of a force from 10 to 25 h.p.

INTENSITY OF ELECTRIC WAVES.

All physicists, among whom may be included Hertz and Faraday, admit that electric and luminous waves are identical, that is, oscillations of the ether of varying length. The luminous waves acting on sight, have a length varying from $\frac{1}{4}$ to $\frac{1}{2}$ ten thousandth of a millimetre, according to the various colours, whilst the longer wave of 40.50 ten thousands of millimetres show themselves only for technical properties in apparatuses suited to this object.

Electric waves are much longer, for they measure from several centimetres, to thousands of metres, but the difference between these two kinds of waves is only in length.

Taking this for granted, we may state that electric waves before a very short duration of oscillation appear to us as light; while electric waves of a great duration of oscillation do not manifest themselves to us as light, but owing to their effects of induction show themselves as electric waves. If all this be true; (and all consequences therefrom

can be verified) it can surely be possible to obtain by means of electric waves the same phenomena as with luminous waves, and the laws ruling the latter can be applied to the former.

And this Hertz proved by experiments.

Now physics teach us that the intensity of light is inversely proportional to the square of the distance from the source, that is to say, it decreases with the square of the distance from the source, that is from the distances 1, 2, 3, the intensity of light is proportional to the numbers $1, \frac{1}{4}, \frac{1}{9}$, etc., and this occurs because light gets spread in all directions over spherical surfaces of a radius increasing with the distance. Spherical surfaces with rays 1, 2, 3 etc. have a magnitude proportional to the numbers 1, 4, 9 etc., that is, spherical surfaces increase with the square of the rays.

Therefore as the intensity of the light has to be communicated to ether waves whose superficies increase at the square of the distance, each of them receives a part of the former (that is of light) whose magnitude decreases in the same measure.

Since luminous and electric waves, according to the above adduced proofs, are identical, the enunciated law of the intensity of light may be applied (taking into consideration the multifarious variations of the atmosphere) to the intensity of electric waves.

Dated this 3rd day of January, 1924.

SERAFINO ORLANDO,
Birchircara, Malta.

COMPLETE SPECIFICATION.

Improvements in and relating to Improved Means for Utilizing Electro-magnetic Radiation and Atmospheric Electricity for Transmitting and Generating Power.

I, SERAFINO ORLANDO, of 47, Church Street, Kensington, W. 8, British subject, late of Birchircara, Malta, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to an improved means of absorbing electro-magnetic energy from the ether.

The electro-magnetic energy may be of the form of electro-magnetic waves radiated from some radio transmitting

station or from the electrostatic charge in the atmosphere.

According to my invention I provide an arrangement of metallic conductors, preferably in the form of a network beneath which I introduce a source of X-rays and from this source I project the rays upwards through the conductors.

It is known that a beam of X-rays causes the air penetrated by such rays to become ionised and consequently conducting for a distance dependent on the strength of the rays.

I am aware that in conjunction with

the X-rays emitted by the X-ray tube are certain other rays called cathodal rays which carry with them negatively charged electrons which cause all bodies they meet to become charged with negative electricity.

According to my invention I find that when electromagnetic waves strike the region of the ionised air enveloping the network of conductors, produced by the X-rays projected into the network, the arrangement is found to be equivalent to a conductor of great height, but when the source of ionisation is removed practically no absorption of energy takes place in the conductors.

The function of the ionisation being to increase the small superficial area of metal exposed for the purpose of absorbing electromagnetic energy by rendering the air surrounding the conductors conductive to the passage of electromagnetic energy from a source of X-rays or other rays capable of producing ionisation.

In this invention it is found desirable to arrange the size of network to suit the strength of the source of ionisation or conversely to arrange the strength of the source of ionisation to suit the size of network; it being desirable to fill the field of ionisation with conductors up to an intensity of ionisation which may be determined by experiment.

It is also found desirable in the case of X-rays to prevent the rays scattering by shaping the electrode and surrounding the tube by a metal vessel with an adjustable aperture.

Should it be found desirable, the cathodal rays previously referred to may be prevented from striking the network of conductors by deflecting them by the aid of a magnet.

The invention is illustrated by way of an example in the accompanying drawing in which:—

Fig. (1) shows the network of conductors in plan and elevation.

Fig. (2) shows the electrical circuit.

In carrying my invention into effect according to the apparatus illustrated; the network of conductors shewn in Fig. (1) consists of a number of fine copper wires (a) communicating with a central conductor (b).

In Fig. (2) a source of X-rays (c) is shewn beneath the arrangement of conductors (a) the details of which are shewn in Fig. (1).

These conductors (a) may for convenience be connected to a terminal (d) to which the apparatus to be actuated may be connected through another terminal (e) to earth.

The magnet (m) may be introduced for the purpose of deflecting the cathodal rays (f) previously referred to.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A conductor or network of conductors which has been surrounded by an ionised gas for the purpose of increasing the power of the conductor to receive electromagnetic energy.

2. A conductor or network of conductors which has been surrounded by an ionised gas for the purpose of increasing the power of the conductor to transmit electromagnetic energy.

3. A conductor or network of conductors which has been surrounded by an ionised gas for the purpose of increasing the power of the conductor to absorb electrostatic charges from the atmosphere.

4. A system of absorbing electromagnetic energy from the ether substantially as described with reference to the drawings.

Dated the 2nd day of March, 1925.

SERAFFINO ORLANDO.

[This Drawing is a reproduction of the Original on a reduced scale.]

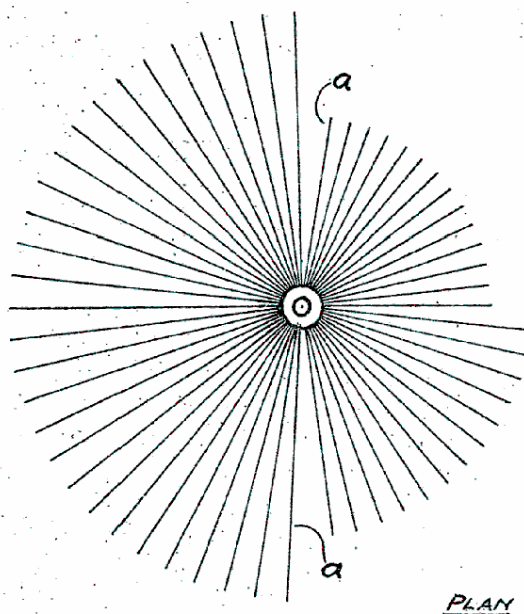
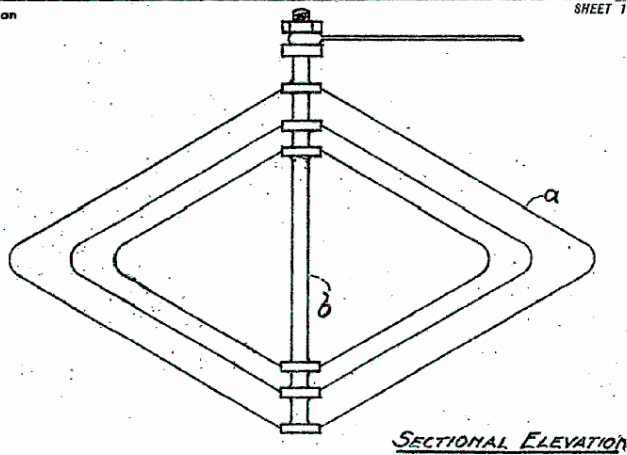
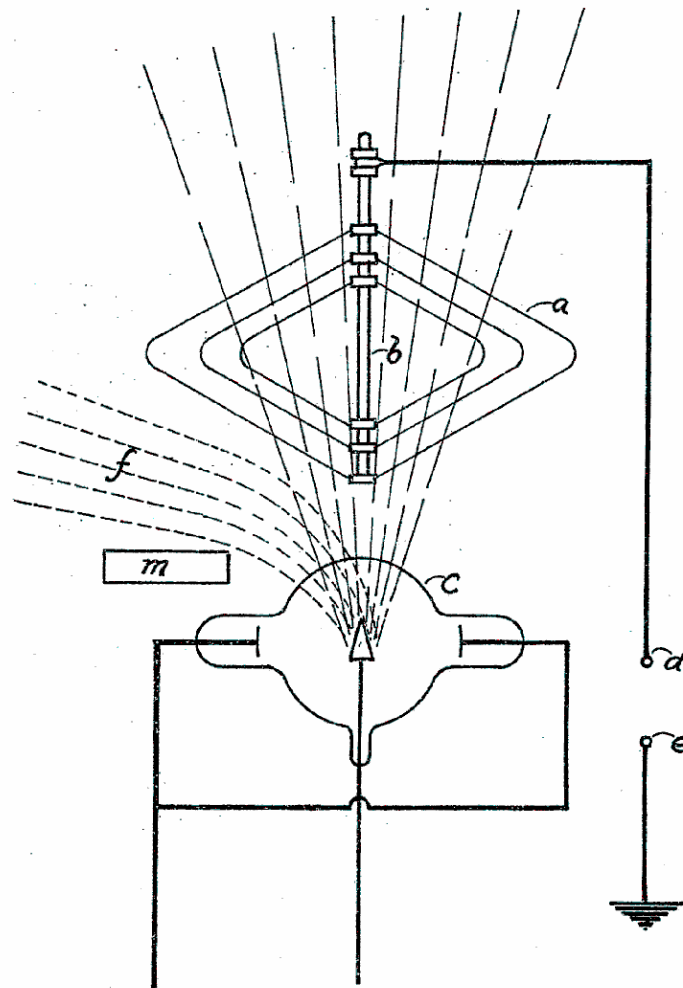
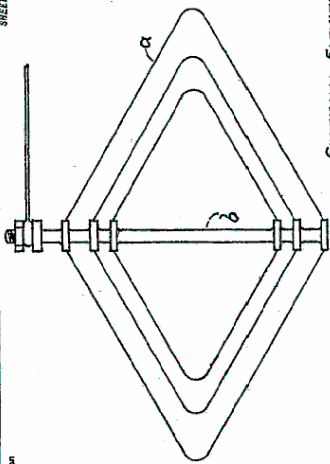


FIG. 1.

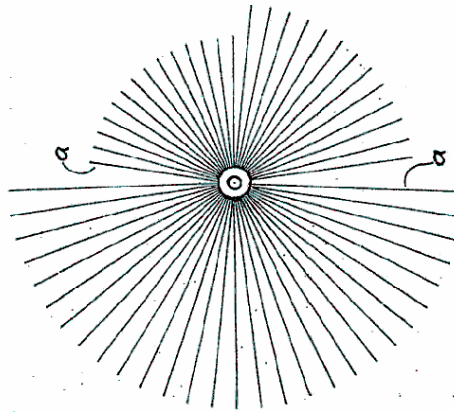
SECTION



Charles & Read Ltd. Photo Litho.

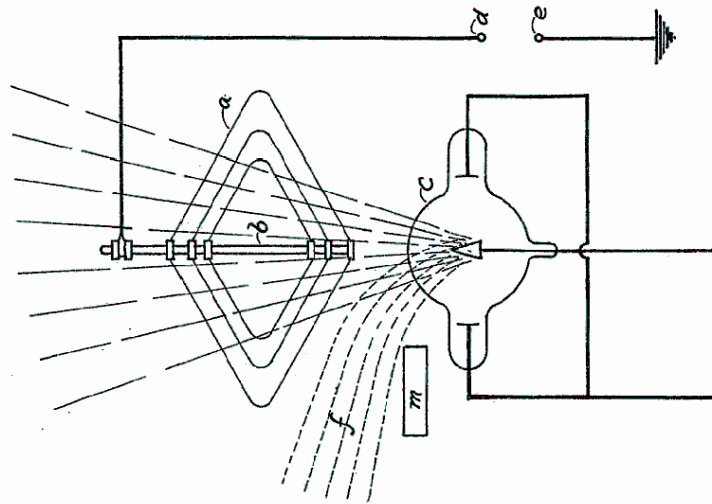


SECTIONAL ELEVATION



PLAN

Fig. 1



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H. PLAUSON

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Fig. 1.

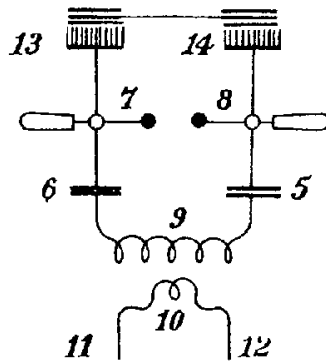


Fig. 2.

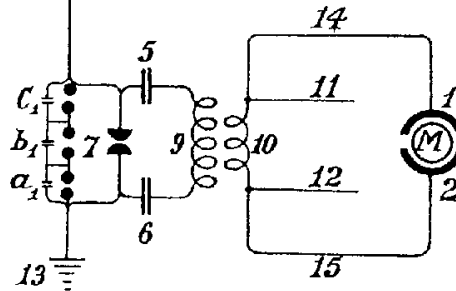


Fig. 3.

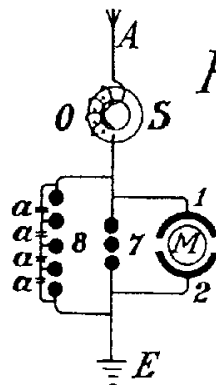


Fig. 4.

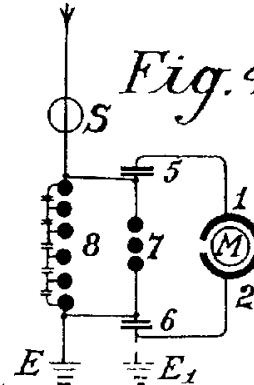


Fig. 5.

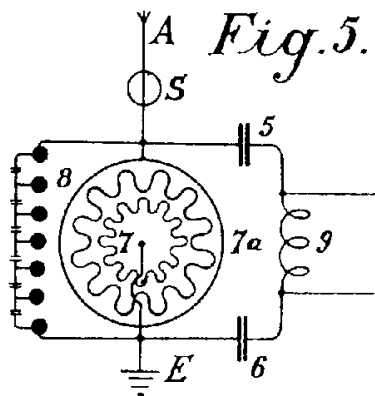
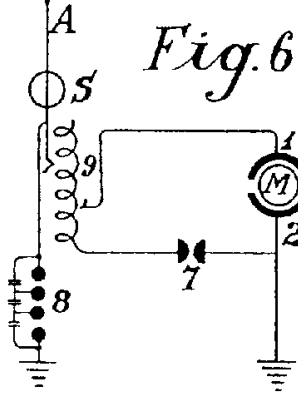


Fig. 6.



In Witness

Hermann Plauson

by *Knight Bros*
attorneys

June 9, 1925.

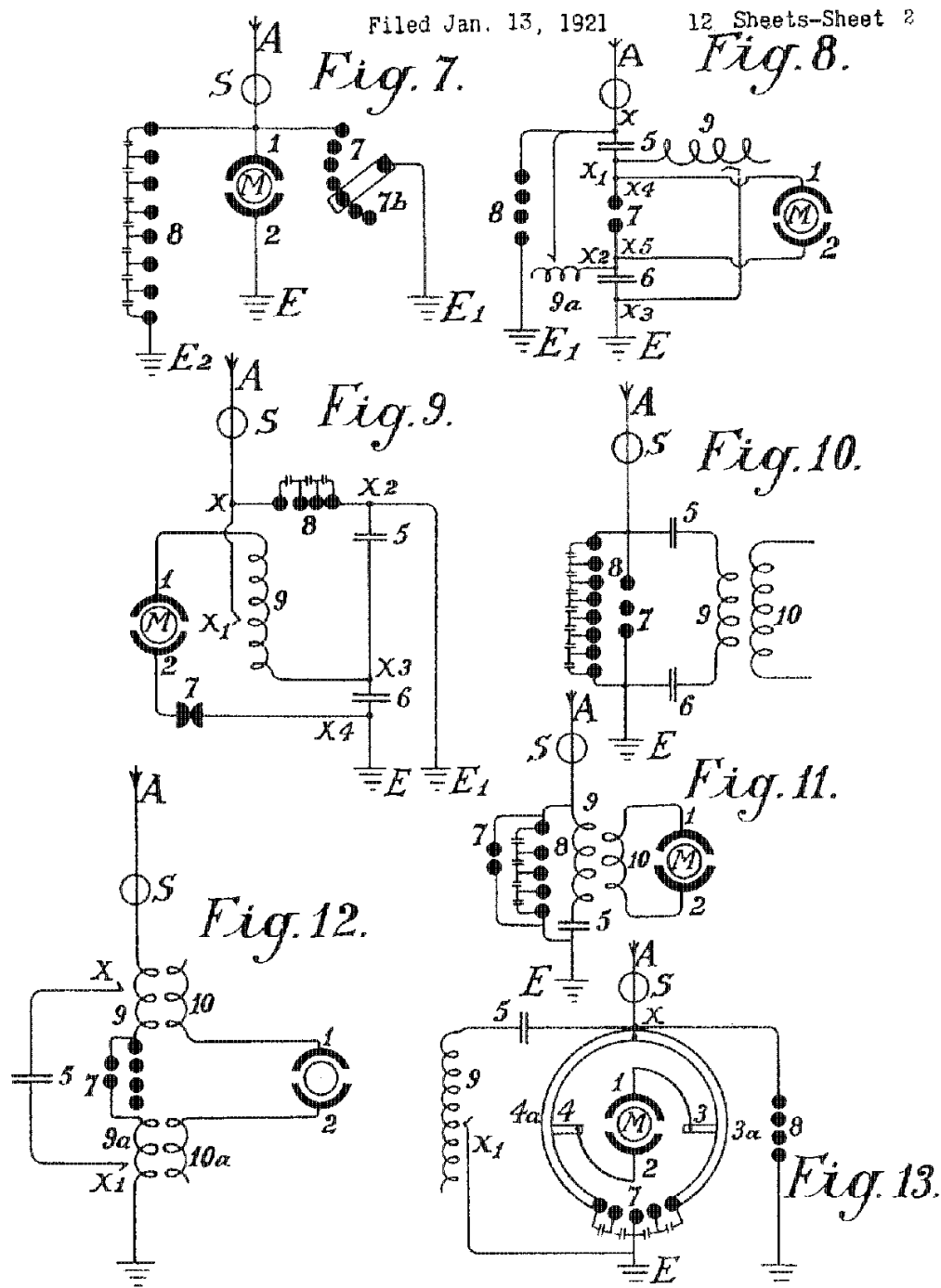
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H. PLAUSON

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12 Sheets-Sheet 2



Inventor

Norman Plauson

by Knight Bros.
attorneys

June 9, 1925.

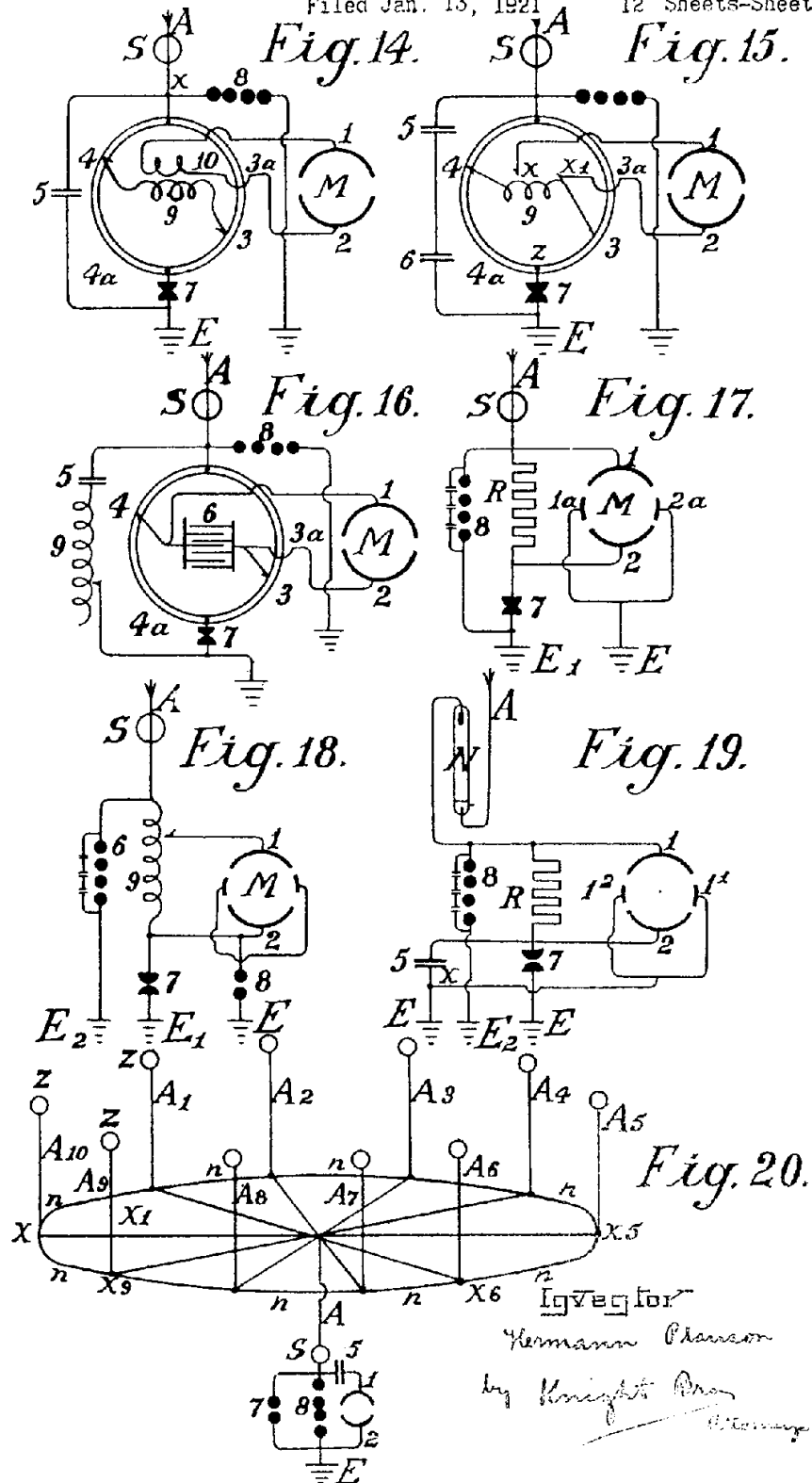
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CONVERSION OF ATMOSPHERIC ELECTRIC ENERGY

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Fig. 22.

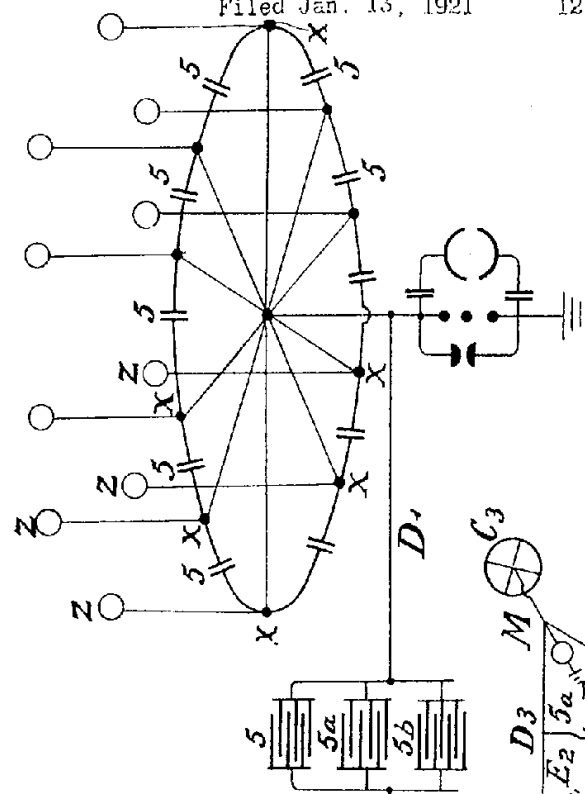


Fig. 21.

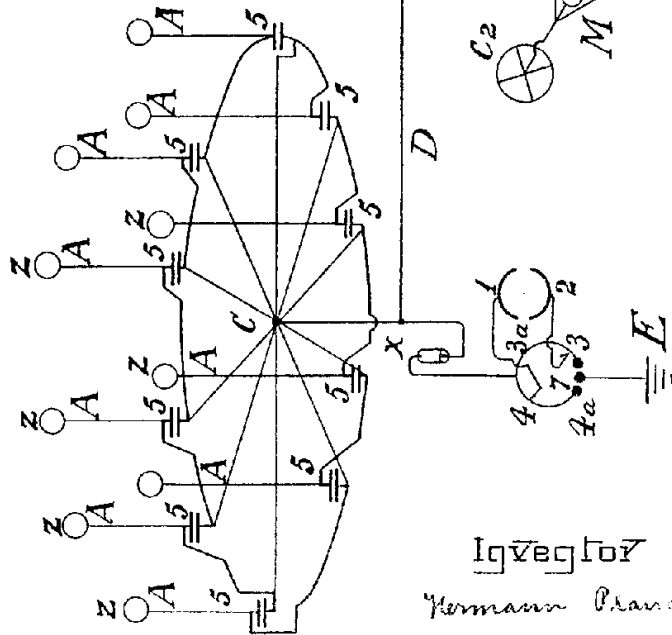
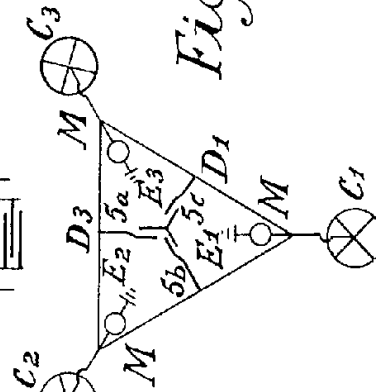


Fig. 23.



Inventor

Hermann Plauson

by Knight B.
 Attorney

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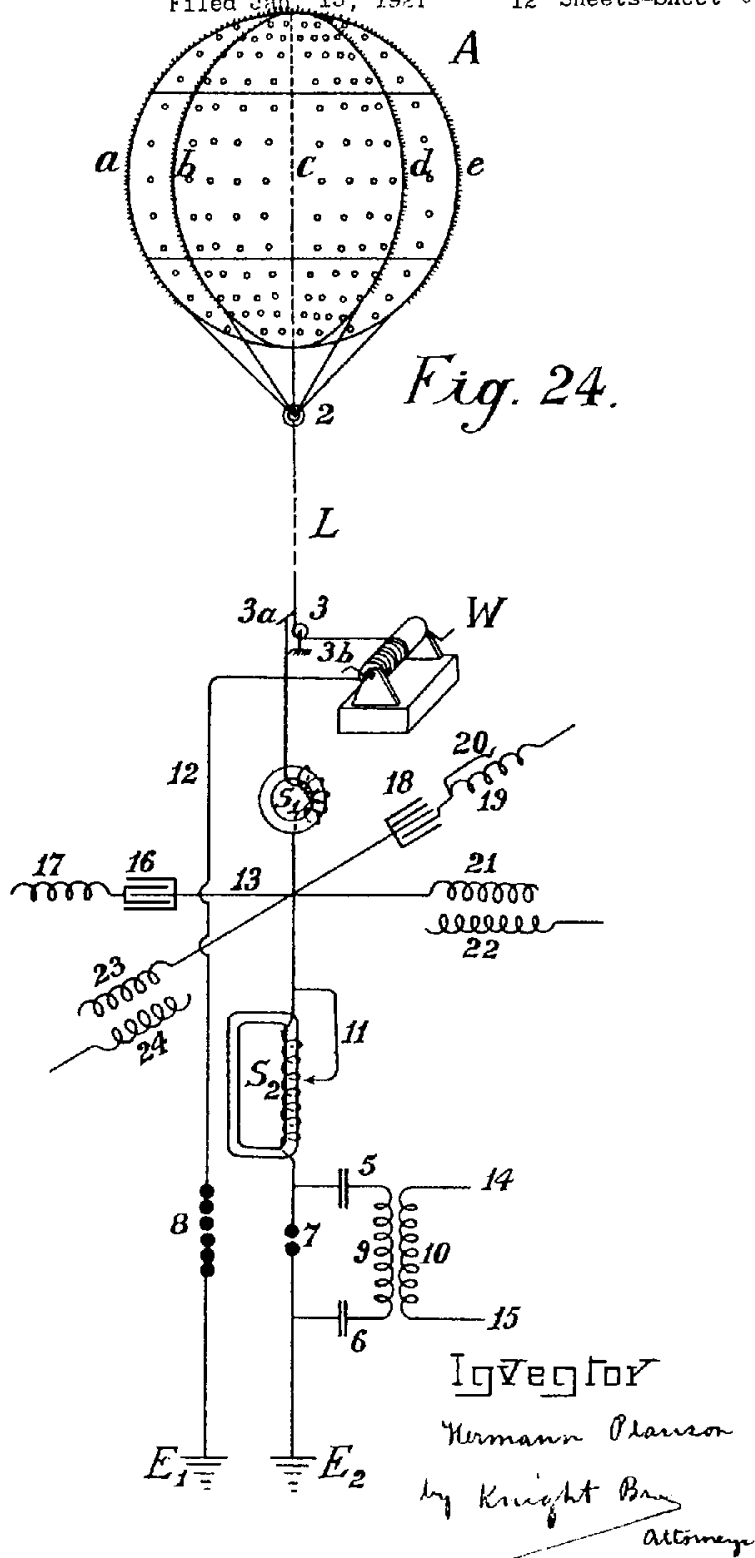
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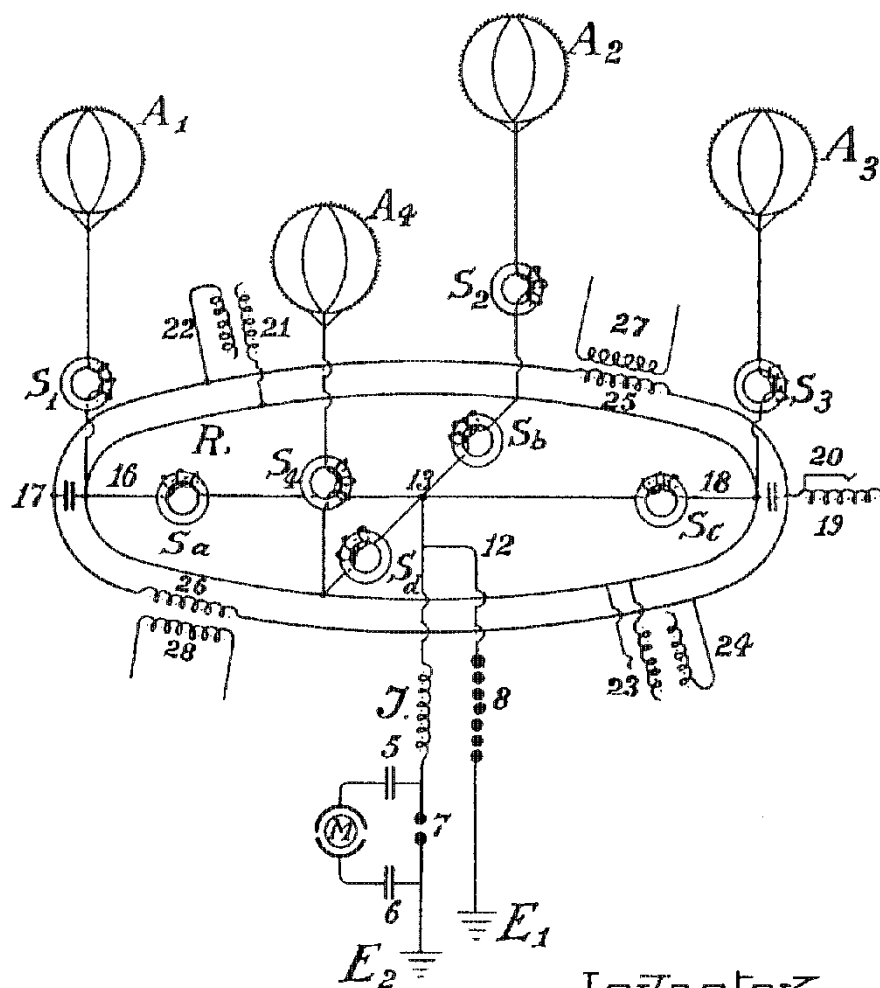
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Fig. 25.



IgVegtor

Hermann Plauson

by
Knight Bros
attorneys

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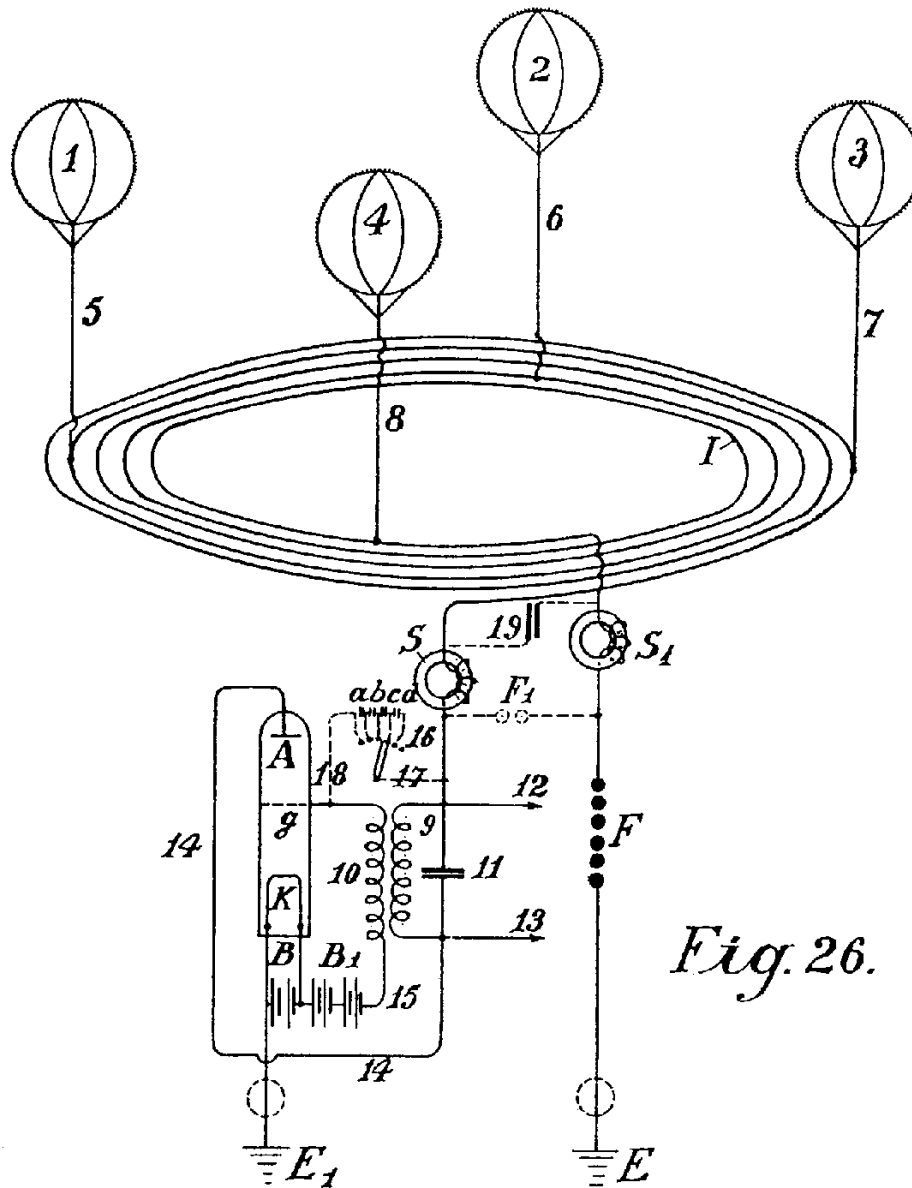


Fig. 26.

Inventor

Hermann Plauson

by Knight Bros
Attorneys

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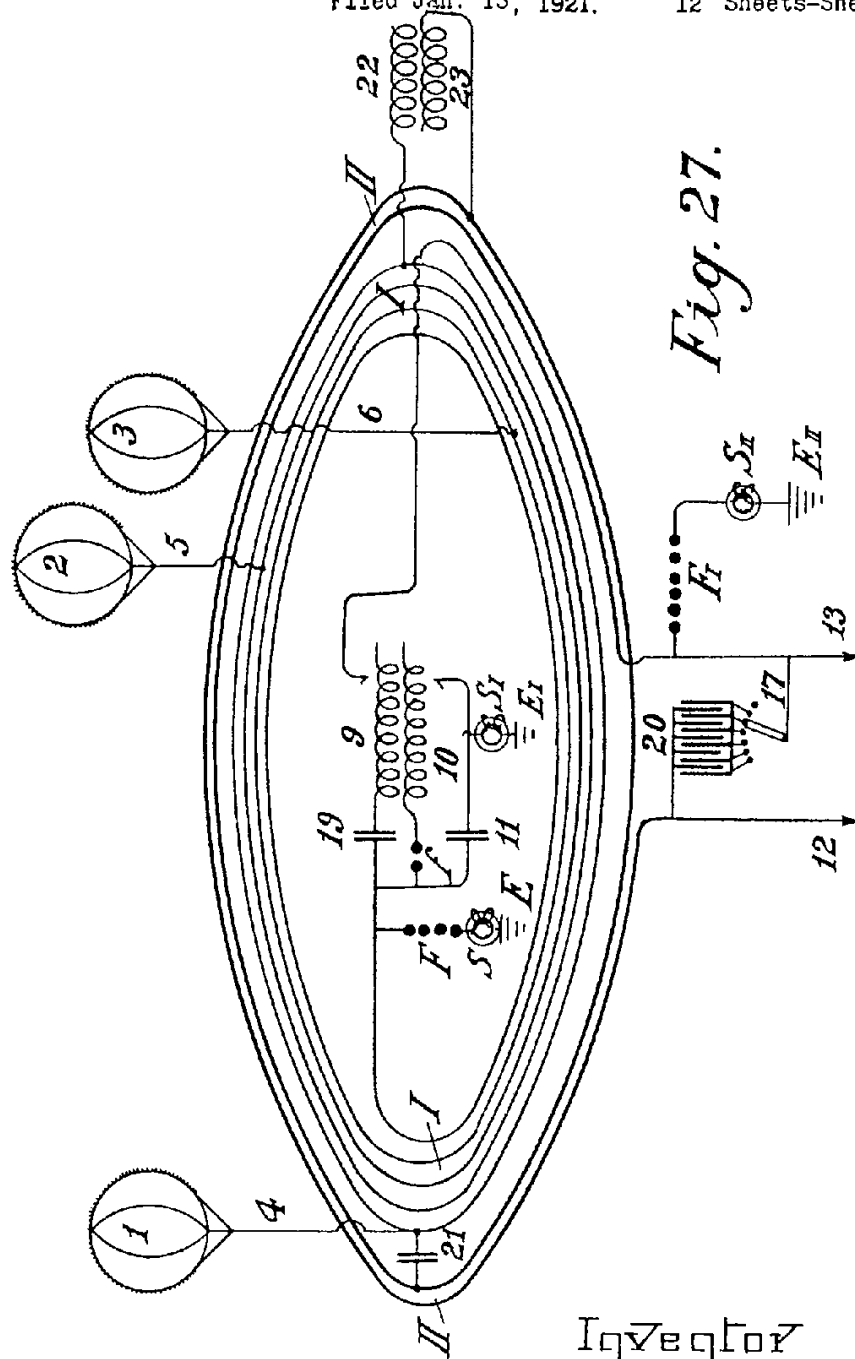


Fig. 27.

Ignegrof

Kernann Plauson

by Knight Bros
attorneys

June 9, 1925.

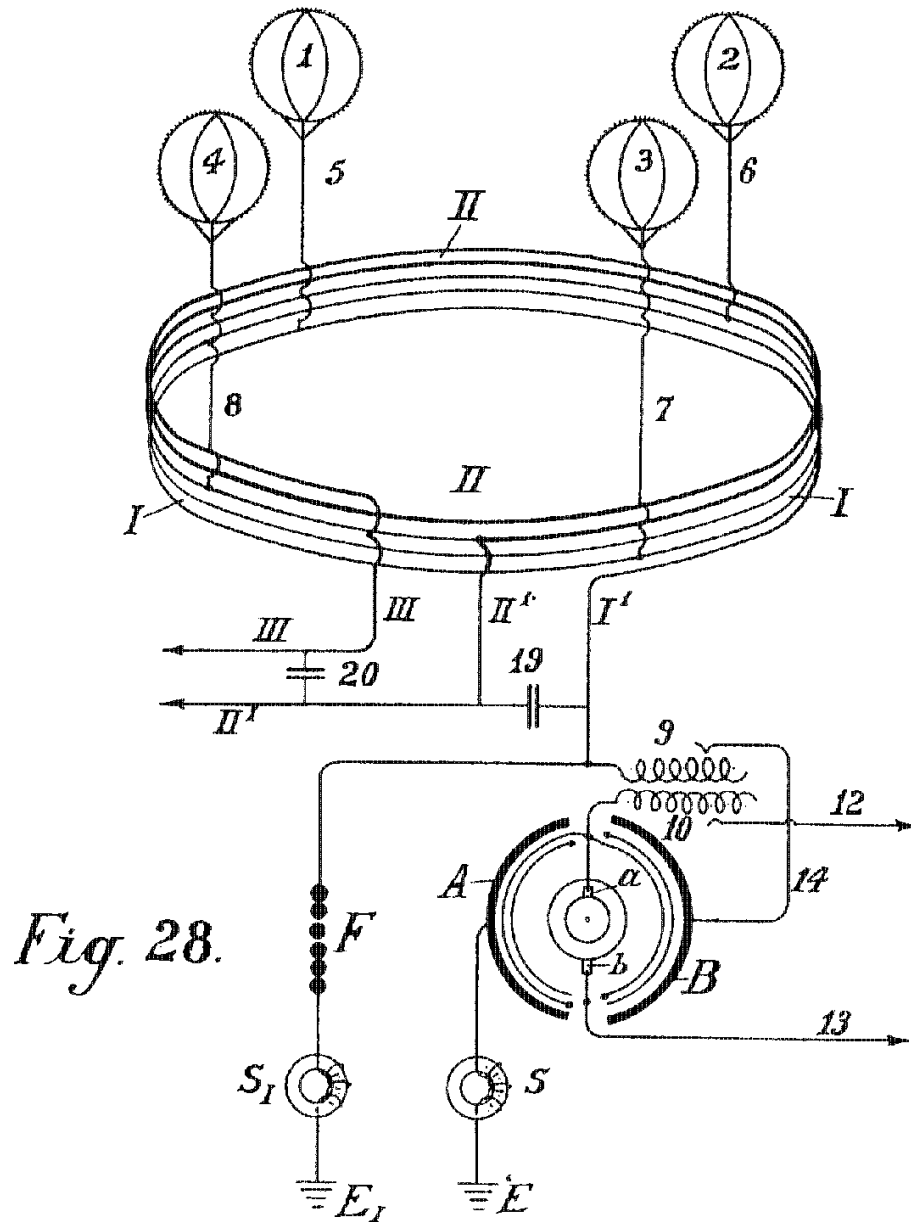
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H. PLAUSON

CONVERSION OF ATMOSPHERIC ELECTRIC ENERGY

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Inventor

Hermann Plauson

by Knight & Bess
attorneys

June 9, 1925.

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H. PLAUSON

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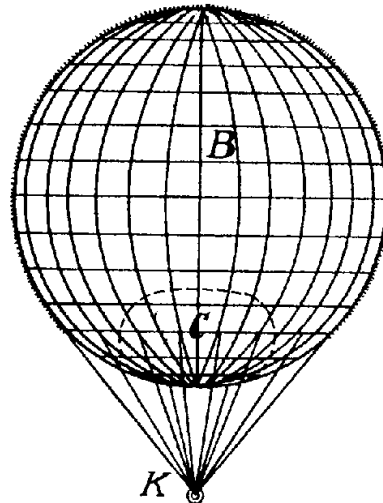


Fig. 29.

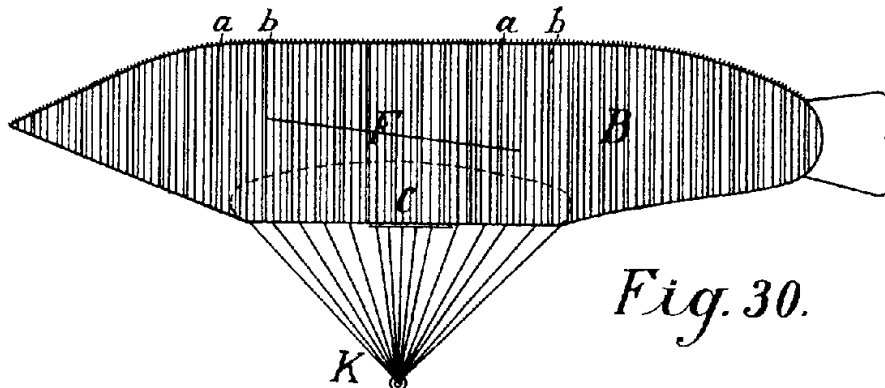
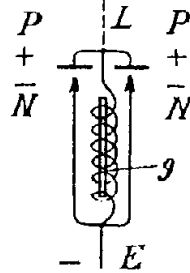
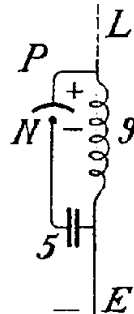


Fig. 30.



Ignator

Hermann Plauson

by

Knight Bros
Attorneys

June 9, 1925.

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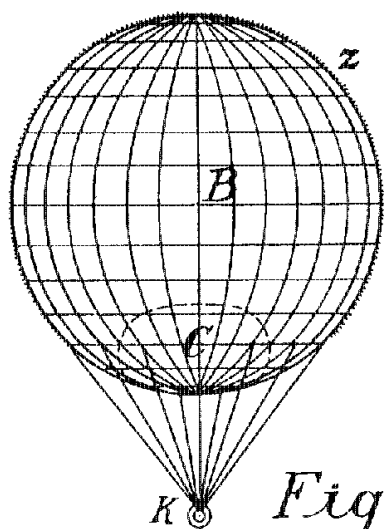


Fig. 31.

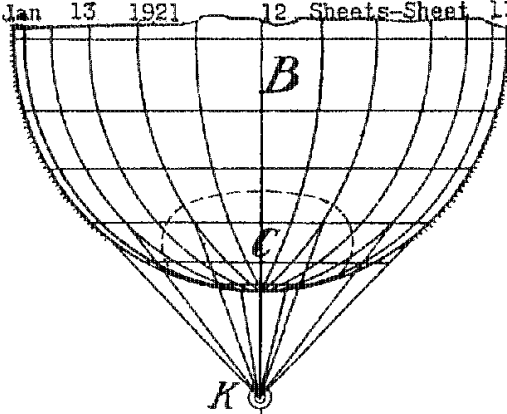
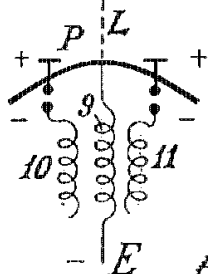


Fig. 32.

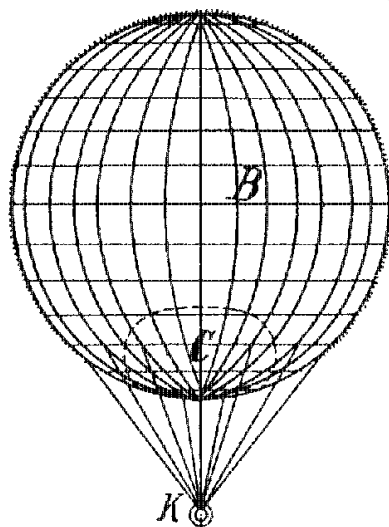
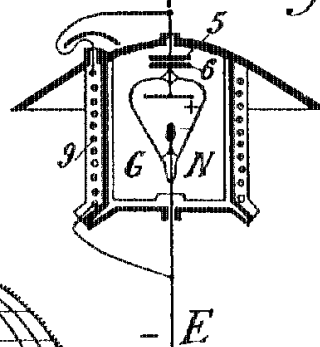
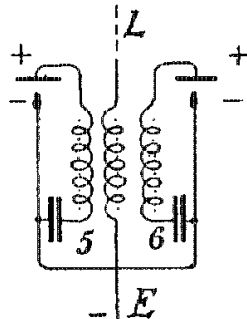


Fig. 33.



Inventor
Hermann Plauson
by Knight Bros.
Attorneys

June 9, 1925.

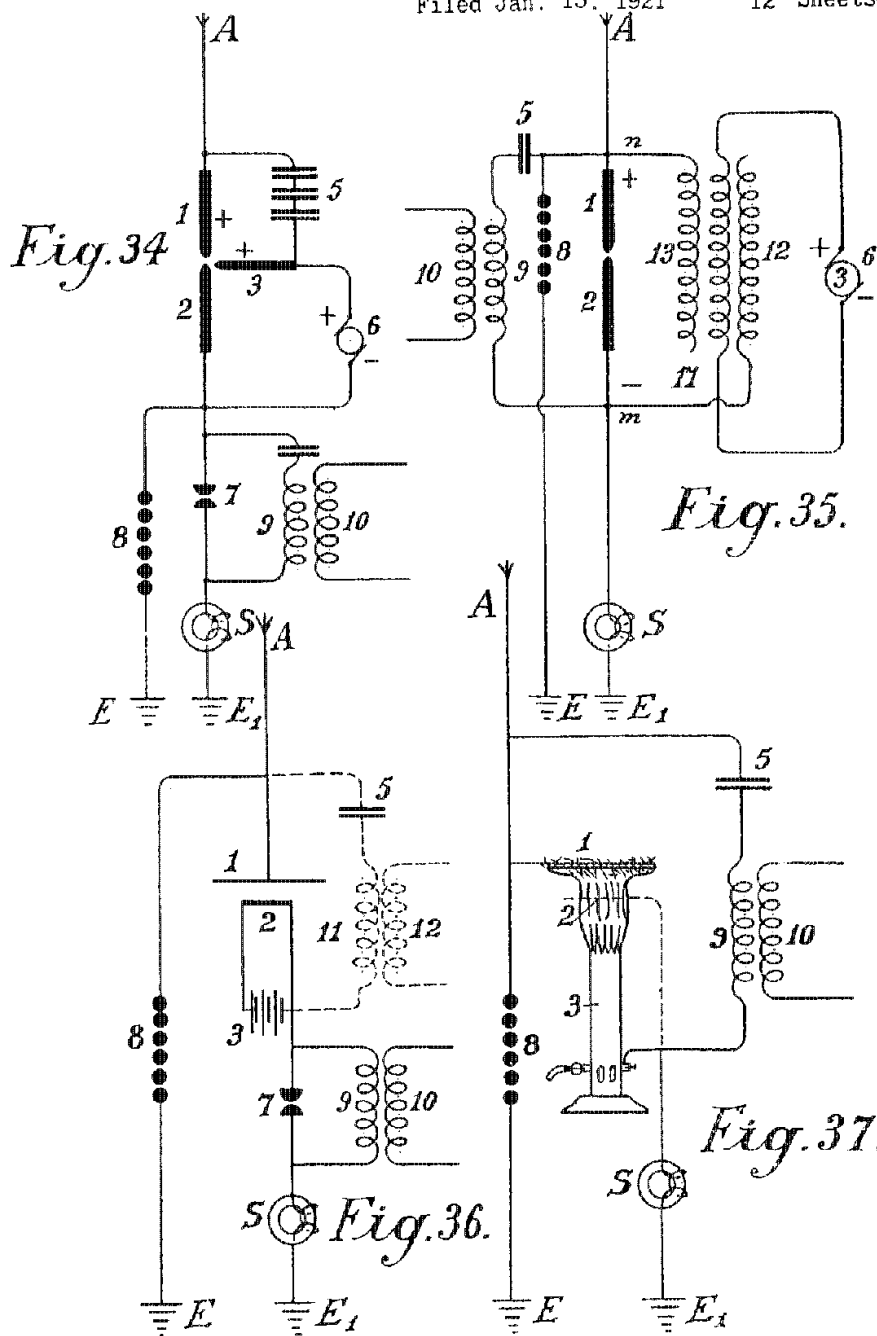
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CONVERSION OF ATMOSPHERIC ELECTRIC ENERGY

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In Witness

Norman Plauson

by Knight B. Attorney

UNITED STATES PATENT OFFICE.

HERMANN PLAUSON, OF HAMBURG, GERMANY.

CONVERSION OF ATMOSPHERIC ELECTRIC ENERGY.

Application filed January 13, 1921. Serial No. 437,107.

To all whom it may concern:

Be it known that I, HERMANN PLAUSON, Estonian subject, residing in Hamburg, Germany, have invented certain new and useful Improvements in the Conversion of Atmospheric Electric Energy, of which the following is a specification.

Methods of obtaining atmospheric electricity by means of metallic nettings set with spikes which are held by means of ordinary or anchored kite balloons made of fabrics and filled with hydrogen, are in theory already known. Atmospheric electricity obtained in this way has been suggested to be used in the form of direct current for the charging of accumulators. This knowledge however is at present only theoretical as the conversion in practice has hitherto been a failure. No means are known of protecting the apparatus from destruction by lightning. The balloons used for collecting the charge must also be made of very large size in order to be able to support the weight of the metallic netting and the heavy cable connections.

Instead of using heavy metallic netting as collectors attached to single air balloons of non-conducting materials which are liable to be torn and are permeable to the gas, it is proposed to use metallic balloon collectors which have the following important advantages—

(a) The metallic cases are impenetrable to helium and hydrogen; they also represent large metallic weather-proof collecting surfaces.

(b) Radio active means and the like may be easily applied internally or externally; whereby the ionization is considerably increased and therewith also the quantity of atmospheric electricity capable of being collected.

(c) Such balloon collectors of light metal do not require to be of large size as they have to carry only their own moderate weight, and that of the conducting cable or wire.

(d) The entire system therefore offers little surface for the action of storm and wind and is resistant and stable.

(e) Each balloon can be easily raised and lowered by means of a winch so that all repairs, recharging and the like can be carried out without danger during the operation.

It is further proposed to use a collecting aerial network of several separate collectors spread out in the air above the earth, which collectors are interconnected by electrical conductors.

According to this invention charges of atmospheric electricity are not directly converted into mechanical energy, and this forms the main difference from previous inventions, but the static electricity which runs to earth through aerial conductors in the form of direct current of very high voltage and low current strength is converted into electro-dynamic energy in the form of high frequency vibrations. Many advantages are thereby obtained and all disadvantages avoided.

The very high voltage of static electricity of a low current strength can be converted by this invention to voltages more suitable for technical purposes and of greater current strength. By the use of closed oscillatory circuits it is possible to obtain electromagnetic waves of various amplitude and thereby to increase the degree of resonance of such current. Such resonance allows various values of inductance to be chosen whereby again the governing of the starting and stopping of machines driven thereby by simply tuning the resonance between coils of the machine and the transformer circuit forming the resonance can easily be obtained. Further, such currents have the property of being directly available for various uses, even without employing them for driving motors, of which there may be particularly mentioned, lighting, production of heat and use in electro-chemistry.

Further, with such currents a series of apparatus may be fed without direct current supply through conductors and also the electro-magnetic high frequency currents may be converted by means of special motors adapted for electro-magnetic oscillations into mechanical energy, or finally converted by special machines into alternating current of low frequency or even into direct current of high potential.

The invention is more particularly described with reference to the accompanying diagrams in which:—

Figure 1 is an explanatory figure.

Figure 2 is a diagrammatic view of the simplest form.

Figure 3 shows a method of converting atmospheric electrical energy for use with motors.

Figure 4 is a diagram showing the use of protective means.

Figure 5 is a diagram of an arrangement for converting large current strengths.

Figure 6 is a diagram of an arrangement including controlling means.

Figure 7 shows means whereby the spark gap length can be adjusted.

Figure 8 shows a unipolar connection for the motor.

Figure 9 shows a weak coupled system suitable for use with small power motors.

Figures 10, 11 and 12 show modified arrangements.

Figure 13 shows a form of inductive coupling for the motor circuit.

Figure 14 is a modified form of Figure 13 with inductive coupling.

Figure 15 is an arrangement with non-inductive motor.

Figure 16 is an arrangement with coupling by condenser.

Figures 17, 18 and 19 are diagrams of further modifications.

Figure 20 shows a simple form in which the aerial network is combined with special collectors.

Figure 21 shows diagrammatically an arrangement suitable for collecting large quantities of energy.

Figure 22 is a modified arrangement having two rings of collectors.

Figure 23 shows the connections for three rings of collectors.

Figure 24 shows a collecting balloon and diagram of its connection of condenser batteries.

Figures 25 and 26 show modified collector balloon arrangements.

Figure 27 shows a second method of connecting conductor for the balloon aeriels.

Figure 28 shows an auto-transformer method of connection.

Figure 29 shows the simplest form of construction with incandescent cathode.

Figure 30 shows a form with cigar shaped balloon.

Figure 31 is a modified arrangement.

Figure 32 shows a form with cathode and electrode enclosed in a vacuum chamber.

Figure 33 is a modified form of Figure 32.

Figure 34 shows an arc light collector.

Figure 35 shows such an arrangement for alternating current.

Figure 36 shows an incandescent collector with Nernst lamp.

Figure 37 shows a form with a gas flame.

Figure 1 illustrates a simple diagram for converting static electricity into dynamic energy of a high number of oscillations. For the sake of clearness in the drawings an influence machine is assumed to be employed

and not an aerial antenna. 13 and 14 are combs for collecting the static electricity of the influence machine. 7 and 8 are spark discharging electrodes, 6 and 5 condensers, 9 an inductive primary coil, 10 secondary coil, 11 and 12 ends of conductors of the secondary coil 10. When the disc of the static influence machine is rotated by mechanical means, the combs collect the electric charges one the positive and the other the negative, and charge the condensers 5 and 6 until such a high potential is formed across the spark gap 7—8, that the spark gap is jumped. As the spark gap 7—8 forms a closed circuit with condensers 6 and 5, and inductive resistance 9, as is well known, waves of high frequency electromagnetic oscillations will pass in this circuit.

The high frequency of the oscillations produced in the primary circuit induces waves of the same periodicity in the secondary circuit. Thus in the primary circuit electromagnetic oscillations are formed by the passage of the spark over the spark gap and these waves are maintained by fresh charges of static electricity.

By suitably selecting the ratio between the number of the coils in the primary and secondary circuits with regard to a correct application of the co-efficients of resonance (capacity, inductance, and resistance) the high voltage of the primary circuit may be suitably converted into low voltage and high current strength.

When the oscillatory discharges in the primary circuit becomes weaker or entirely cease, the condensers are charged again by the static electricity until the accumulated charge again breaks down the spark gap. All this is repeated as long as electricity is produced by the static machine by employing mechanical energy.

An elementary form of the invention is shown in Figure 2 in which two spark gaps in parallel are used one of which may be termed the working gap 7 in Figure 2, whilst the second serves as a safety device for excess voltage and consists of a larger number of spark gaps than the working section, which gaps are arranged in series and are bridged by very small capacities as is illustrated in a_1, b_1, c_1 , Figure 2 which allow of uniform sparking in the safety section.

In Figure 2 A is the aerial antenna for collecting charges of atmospheric electricity. 13 is the earth connection of the second part of the spark gap, 5 and 6 are condensers, 9 a primary coil. Now when through the aerial A the positive atmospheric electricity seeks to combine with the negative charge to earth, this is prevented by (the air gap between) the spark gaps. The resistance of the spark gap 7 is, as shown in the drawings, lower than that of the other safety section which consists of three spark gaps connected in

series, and consequently a three times greater air resistance is offered by the latter.

So long therefore, as the resistance of the spark gap 7 is not overloaded, so that the other spark gaps have an equal resistance with it the discharges take place only over spark gap 7. Should however the voltage be increased by any influences so that it might be dangerous for charging the condensers 5 and 6 or for the coil insulation 9 and 10 in consequence of break down, by a correct regulation of this spark gap the second spark gap can discharge free from inductive effects direct to earth without endangering the machine.

Without this second spark gap, arranged in parallel having a higher resistance than the working spark gap it is impossible to collect and render available large quantities of electrical energy.

The action of this closed oscillation circuit consisting of spark gap 7, two condensers 5 and 6, primary coil 9, and also secondary coil 10 is exactly the same as the one described in Figure 1 with the arrangement of the static induction machine with the only difference that here the second spark gap is provided. The electromagnetic high frequency alternating current obtained can be tapped off from the conductors 11 and 12 for lighting and heating purposes. Special kinds of motors adapted for working with these peculiar electrical charges may be connected at 14 and 15 which can work with static electricity charges or with high frequency oscillations.

In addition to the use of spark gaps in parallel a second measure of security is also necessary for taking off the current. This precaution consists according to this invention, in the introduction of and method of connecting certain protective electromagnets or choking coils in the aerial circuit as shown by S in Figure 3.

A single electromagnet only having a core of the thinnest possible separate laminations is connected with the aerial.

In the case of high voltages in the aerial network or at places where there are frequent thunder storms, several such magnets may however be connected in series.

In the case of large units or plants several electromagnets can be employed in parallel or in series parallel.

The windings of these electromagnets may be simply connected in series with the aeriels. In this case the winding preferably consists of several thin parallel wires, which make up together, the necessary section.

The winding may be made of primary and secondary windings in the form of a transformer. The primary winding will be then connected in series with the aerial network, and the secondary winding more or less short-circuited over a regulating resist-

ance or an induction coil. In the latter case it is possible to regulate to a certain extent the effect of the choking coils. In the further description of the connecting and constructional diagrams the aerial electromagnet choke coil is indicated by a simple ring S.

Figure 3 shows the simplest way of converting atmospheric electricity into electromagnetic wave energy by the use of special motors adapted for high oscillatory currents or static charges of electrical energy. Recent improvements in motors for working with static charges and motors working by resonance, that is to say, having groups of tuned electromagnetic cooperating circuits render this possible but such do not form part of the present invention.

A motor adapted to operate with static charges will for the sake of simplicity be diagrammatically indicated by two semi-circles 1 and 2 and the rotor of the motor by a ring M. (Figure 3.) A is a vertical aerial or aerial network. S the safety choke or electromagnet with coil O as may be seen is connected with the aerial A. Adjacent the electromagnet S the aerial conductor is divided into three circuits, the circuit 8 giving the safety spark gap, the circuit 7 with the working spark gap, and then a circuit including the stator terminal 1, the rotor and stator terminal 2 at which a connection is made to the earth wire. The two spark gaps are also connected metallically with the earth wire. The method of working these diagrams is as follows:

The positive atmospheric electric charge collected tends to combine with the negative electricity (or earth electricity) connected with the earth wire. It travels along the aerial A through the electromagnet S without being checked as it flows in the same direction as the direct current. Further, its progress is arrested by two sparks gaps placed in the way and the stator condenser surfaces. The stator condenser surfaces are charged until the charge is greater than the resistance of the spark gap 7, whereupon a spark springs over the spark gap 7 and an oscillatory charge is obtained as by means of the motor M, stator surfaces 1 and 2, and spark gap 7, a closed oscillation circuit is obtained for producing the electromagnetic oscillations. The motor here forms the capacity and the necessary inductance and resistance, which, as is well known, are necessary for converting static electricity into electromagnetic wave energy.

The discharges formed are converted into mechanical energy in special motors and can not reach the aerial network by reason of the electromagnet or choke. If, however, when a spark springs over the spark gap 7 a greater quantity of atmospheric electricity tends to flow to earth, a counter voltage is

induced in the electromagnet, which is greater the more rapidly and strongly the flow of current direct to the earth is. By the formation of this opposing voltage a sufficiently high resistance is offered to the flow of atmospheric electricity direct to earth to prevent a short circuit with the earth.

The circuit containing spark gap 8 having a different wave length which is not in resonance with the natural frequency of the motor, does not endanger the motor and serves as security against excess voltage, which, as practical experiments have shown, may still arise in certain cases, but can be conducted direct to earth through this spark gap.

In the diagram illustrated in Figure 4 the spark gap 7 is shunted across condensers 5 and 6 from the motor M. This construction affords mainly a better insulation of the motor against excess voltage and a uniform excitation through the spark gap 7.

In Figure 5 a diagram is illustrated for transforming large current strengths which may be employed direct without motors, for example, for lighting or heating purposes. The main difference is that here the spark gap consists of a star shaped disc 7 which can rotate on its own axis and is rotated by a motor opposite similarly fitted electrodes 7^a. When separate points of stars face one another, discharges take place, thus forming an oscillation circuit over condensers 5 and 6 and inductance 9 for oscillatory discharges. It is evident that a motor may also be directly connected to the ends of the spiral 9.

The construction of the diagram shown in Figure 6 permits of the oscillation circuit of the motor being connected with an induction coil. Here a regulating inductive resistance is introduced for counter-acting excess voltages in the motor. By cutting the separate coils 9 (coupled inductively to the aerial) in or out the inductive action on the motor may be more or less increased or variable aerial action may be exerted on the oscillation circuit.

In Figure 7 the oscillation circuit is closed through the earth (E and E₁). The spark gap 7 may be prolonged or shortened by more or fewer spark gaps being successively connected by means of a contact arm 7^b.

Diagram 8 shows a unipolar connection of the motor with the aerial network. Here two oscillation circuits are closed through the same motor. The first oscillation circuit passes from aerial A through electromagnet S, point x , inductance 9^a to the earth condenser 6 and further, over spark gap 7 to the aerial condenser 5 and back to x . The second oscillation circuit starts from the aerial condenser 5 at the point x^1 over the inductance 9 to the earth condenser 6 at the point x^2 and through the condenser 6 over

the spark gap 7 back to x^1 . The motor itself is inserted between the two points of the spark gap 7. From this arrangement slightly damped oscillation wave currents are produced.

In the diagram illustrated in Figure 9 a loosely coupled system of connections is illustrated which is assumed to be for small motors for measuring purposes. A indicates the aerial conductor, S the electromagnet in the aerial conductor, 9 the inductance, 7 the spark gap, 5 and 6 condensers, E the earth, M the motor, and 1 and 2 stator connections of the motor. The motor is directly metallically connected with the oscillation circuit.

In Figure 10 a purely inductive coupling is employed for the motor circuit. The motor is connected with the secondary wire 10 as may be seen in Figure 11 in a somewhat modified diagram connection. The same applies to the diagram of Figure 12.

The diagrams hitherto described preferably allow of motors of small and medium strength to be operated. For large aggregates, however, they are too inconvenient as the construction of two or more oscillation circuits for large amounts of energy is difficult; the governing is still more difficult and the danger in switching on or off is greater.

A means of overcoming such difficulties is shown in Figure 13. The oscillation circuit here runs starting from the point x over condenser 5, variable inductance 9, spark gap 7 and the two segments (3^a and 4^a) forming arms of a Wheatstone bridge, back to x . If the motor is connected by brushes 3 and 4 transversely to the two arms of the bridge as shown in the drawings, electromagnetic oscillations of equal sign are induced in the stator surfaces 1 and 2 and the motor does not revolve. If however, the brushes 3 and 4 are moved in common with the conducting wires 1 and 2 which connect the brushes with the stator poles a certain alteration or displacement of the polarity is obtained and the motor commences to revolve.

The maximum action will result if one brush 3 comes on the central sparking contact 7 and the other brush 4 on the part x . They are however, usually in practice not brought on to the central contact 7 but only held in the path of the bridge segments 4^a and 3^a in order not to connect the spark gaps with the motor oscillation circuit.

As however, the entire oscillation energy can thereby not act on the motor it is better to carry out the same system according to the diagram 14. The diagram 14 differs from the foregoing only by the motor not being directly metallically connected with the segments of the commutator, but only a primary coil 9 which induces in a secondary coil 10, current which feeds the motor M and takes the place of the rotor. By this

arrangement a good transforming action is obtained, a loose coupling and also an oscillation circuit without a spark gap.

In Figure 15 the motor is not purely inductively as in 14, but directly metallically branched off from the primary coil (at x and x') after the principle of the auto-transformer.

In Figure 16 instead of an inductance a condenser 6 is in similar manner, and for the same object inserted between the segments 3^a and 4^a. This has the advantage that the segments 3^a and 4^a need not be made of solid metal but may consist of spiral coils whereby a more exact regulation is possible and further motors of high inductance may be employed.

The arrangements of Figures 17, 18 and 19 may be employed for use with resonance and particularly with induction condenser motors; between the large stator induction condenser surfaces, small reversing pole condensers are connected, which, as may be seen from Figures 17, 18 and 19 are led together to earth. Such reversing poles have the advantage that with large quantities of electrical energy the spark formation between the separate oscillation circuits ceases.

Figure 19 shows a further method which prevents electromagnetic oscillations of high number of alternations formed in the oscillation circuit striking back to the aerial conductor. It is based on the well known principle that a mercury lamp, one electrode of which is formed of mercury, the other of solid metal such as steel allows an electric charge to pass in only one direction from the mercury to the steel and not vice versa. The mercury electrode of the vacuum tube N is therefore connected with the aerial conductor and the steel electrode with the oscillation circuit. From this it results that charges can pass only from the aerial through the vacuum tube to the oscillation circuit, but not vice versa. Oscillations which are formed on being transformed in the oscillation circuit cannot pass to the aerial conductor.

In practice these vacuum tubes must be connected behind an electromagnet as the latter alone affords no protection against the danger of lightning.

As regards the use of spark gaps, all arrangements as used for wireless telegraphy may be used. Of course the spark gaps in large machines must have a sufficiently large surface. In very large stations they are cooled in liquid carbonic acid or better still in liquid nitrogen or hydrogen; in most cases the cooling may also take place by means of liquefied low homologues of the metal series or by means of hydrocarbons the freezing point of which lies at between -90° C. and -40° C. The spark gap casing must also be insulated and be of

sufficient strength to be able to resist any pressure which may arise. Any undesirable excess super-pressure which may be formed must be automatically let off. I have employed with very good results mercury electrodes which were frozen in liquid carbonic acid, the cooling being maintained during the operation from the outside through the walls.

Figure 20 is one of the simplest forms of construction of an aerial network in combination with collectors, transformers and the like illustrated diagrammatically. E is here the earth wire, 8 the safety spark gap, 7 the working spark gap, 1 and 2 the stator surfaces of the motor, 5 a condenser battery, S the protective magnet which is connected with the coil in the aerial conductor, A¹ to A¹⁰ aerial antennae with collecting balloons, N horizontal collecting or connecting wires from which, to the centre a number of connections run.

The actual collectors consist of metal sheaths preferably made of an aluminium magnesium alloy, and are filled with hydrogen or helium and are attached to copper plated steel wires. The size of the balloon is selected so that the actual weight of the balloon and the weight of the conducting wire is supported thereby. On the top of the balloon aluminium spikes, made and gilded in a special manner hereinafter described, are arranged in order to produce a conductor action. Small quantities of radium preparations, more particularly polonium-ionium or mesothorium preparations considerably increase the ionization, and therewith the action of these collectors.

In addition to metal balloons, fabric balloons which are superficially metal coated according to Schoop's metal spraying process, may however also be employed. A metallic surface may also be produced by lacquering with metallic bronzes, preferably according to Schoop's spraying process or lacquering with metallic bronze powders in two electrical series of widely different metals, because thereby the collecting effect is considerably increased.

Instead of the ordinary round balloons, elongated cigar shaped ones may be employed. In order also to utilize the frictional energy of the wind, patches or strips of non-conducting substances which produce electricity by friction, may be attached to the metallized balloon surfaces. The wind will impart a portion of its energy in the form of frictional electricity, to the balloon casing, and thereby the collecting effect is substantially increased.

In practice however, very high towers (up to 300 metres is fully admissible) may be employed as antennae. In these towers copper tubes rise freely further above the top of the tower. A gas lamp secured

against the wind is then lit at the point of the copper tube and a netting is secured to the copper tube over the flame of this lamp to form a collector. The gas is conveyed through the interior of the tube up to the summit. The copper tube must be absolutely protected from moisture at the place at which it enters the tower and also rain must be prevented running down the walls of the tower which might lead to a bad catastrophe. This is done by bell shaped enlargements which expand downwards, being arranged in the tower in the form of high voltage insulators of Siamese pagodas.

Special attention must be devoted to the foundations of such towers. They must be well insulated from the ground, which may be obtained by first embedding a layer of concrete in a box form to a sufficient depth in the ground and inserting in this an asphalt lining and then glass bricks cast about 1 or 2 metres in thickness. Over this in turn there is a ferro-concrete layer in which alone the metal foot of the tube is secured. This concrete block must be at least 2 metres from the ground and be fully protected at the sides by a wooden covering, from moisture. In the lower part of the tower a wood or glass house for the large condenser batteries or for the motors may be constructed. In order to lead the earth connection to the ground water, a well insulated pit constructed of vitreous bricks, must be provided. Several such towers are erected at equal distances apart and connected with a horizontal conductor. The horizontal connecting wires may either run directly from tower to tower or be carried on bell shaped insulators similar to those in use for high voltage conductors. The width of the network may be of any suitable size and the connection of the motors can take place at any suitable places.

In order to collect large quantities of electricity with few aerials it is well to provide the aerial conductor with batteries of condensers as shown in two methods of construction in Figures 21 and 22. In Figure 21 the batteries of condensers 5 are connected on the one hand with the aerial electricity collectors Z by the aerial conductor A, and on the other hand interconnected in series with an annular conductor from which horizontal conductors run to the connecting points C to which the earth wire is connected.

Figure 22 shows a similar arrangement. Should two such series of antennæ rings be shown by a voltmeter to have a large difference of potential (for example, one in the mountains and one in the plain) or even of different polarity these differences may be compensated for by connecting sufficiently large condenser batteries (5, 5^a, 5^b) by means of Maji star conductors D and D¹. In Fig-

ure 23 a connection of three such rings of collectors to form a triangle with a central condenser battery is illustrated.

The condenser batteries of such large installations must be embedded in liquefied gases or in liquids freezing at very low temperatures. In such cases a portion of the atmospheric energy must be employed for liquefying these gases. It is also preferable to employ pressure. By this means the condenser surfaces may be diminished, and still allow for large quantities of energy to be stored, secure against breakdown. For smaller installations the immersing of the condensers in well insulated oil or the like, suffices. Solid substances on the other hand cannot be employed as insulators.

The arrangement in the diagrams hitherto described was always such that the condenser batteries were connected with both poles directly to the aerial conductors. An improved diagram of the connections for obtaining atmospheric electricity for the condenser batteries has however, been found to be very advantageous, this arrangement consists in that they are connected by only one pole (unipolar) to the collecting network. Such a method of arrangement is very important, as by means of it a constant current and an increase of the normal working pressure or voltage is obtained. If for example a collecting balloon aerial which is allowed to rise to a height of 300 metres, shows 40,000 volts above earth voltage, in practice it has been found that the working voltage (with a withdrawal of the power according to the method hereinbefore described by means of oscillating spark gaps and the like) is only about 400 volts. If however, the capacity of the condenser surfaces be increased, which capacity in the above mentioned case was equal to that of the collecting surface of the balloon aërials, to double the amount, by connecting the condenser batteries with only one pole, the voltage rises under an equal withdrawal of current up to and beyond 500 volts. This can only be ascribed to the favourable action of the connecting method.

In addition to this substantial improvement it has also been found preferable to insert double inductances with electromagnets and to place the capacities preferably between two such electromagnets. It has also been found that the useful action of such condensers can be further increased if an induction coil be connected as inductive resistance to the unconnected pole of the condenser, or still better if the condenser itself be made as an induction condenser. Such a condenser may be compared with a spring which when compressed carries in itself accumulated force, which it again gives off when released. In charging, a charge with reversed sign is formed at the

other free condenser pole, and if through the spark gap a short circuit results, the accumulated energy is again given back since now new quantities of energy are induced at the condenser pole connected with the conductor network, which in fact charges with opposite signs to that at the free condenser pole. The new induced charges have of course the same sign as the collector network. The whole voltage energy in the aerial is thereby however increased. In the same space of time larger quantities of energy are accumulated than is the case without such inserted condenser batteries.

In Figures 24 and 25 two different diagrams of connections are more exactly illustrated, Figure 24 shows a collecting balloon and the diagram of the connections to earth. Figure 25 four collecting balloons and the parallel connection of the condenser batteries belonging thereto.

A is the collecting balloon made of an aluminium magnesium alloy (electron metal, magnalium) of a specific gravity of 1.8 and a thickness of plate 0.1 to 0.2 mm. Inside there are eight strong vertical ribs of T shaped section about 10 to 20 mm. in height and about 3 mm. in thickness with the projecting part directed inwards (indicated by a, b, c, d and so forth); they are riveted together to form a firm skeleton and are stiffened in a horizontal direction by two cross ribs. The ribs are further connected with one another internally and transversely by means of thin steel wires, whereby the balloon obtains great power of resistance and elasticity. Rolled plates of 0.1 to 0.2 mm. in thickness made of magnalium alloy are then either soldered or riveted on this skeleton so that a fully metallic casing with smooth external surface is obtained. Well silvered or coppered aluminium plated steel wires run from each rib to the fastening ring 2. Further, the coppered steel hawser L preferably twisted out of separate thin wires (shown in dotted lines in Figure 24) and which must be long enough to allow the balloon to rise in the desired height, leads to a metal roller or pulley 3 and from thence to a winch W, well insulated from the earth. By means of this winch, the balloon, which is filled with hydrogen, or helium, can be allowed to rise to a suitable height (300 to 5,000 metres) and brought to the ground for recharging or repairs.

The actual current is taken directly through a friction contact from the metal roller 3 or from the wire, or even from the winch or simultaneously from all three by means of brushes (3, 3^a and 3^b). Beyond the brushes the conductor is divided, the paths being:—firstly over 12 to the safety spark gap 8, from thence to the earth conductor E¹, and secondly over electromagnet S¹, point 13, to a second loose electromagnet

having an adjustable coil S², then to the spark gap 7 and to the second earth conductor E². The actual working circuit is formed through the spark gap 7, condensers 5 and 6, and through the primary coil 9; here the static electricity formed by oscillatory discharges is accumulated and converted into high frequency electromagnetic oscillations. Between the electromagnets S¹ and S² at the crossing point 13, four condenser batteries are introduced which are only indicated diagrammatically in the drawings each by one condenser. Two of these batteries (16 and 18) are made as plate condensers and prolonged by regulating induction coils or spirals 17 and 19 while the two others (21 and 23) are induction condensers. As may be seen from the drawings each of the four condenser batteries 16, 18, 21, 23 is connected only by one pole to the aerial or to the collector conductor. The second poles 17, 19, 22, 24 are open. In the case of plate condensers having no inductive resistance an induction coil is inserted. The object of such a spiral or coil is the displacement of phase of the induction current by $\frac{1}{4}$ periods, whilst the charging current of the condenser poles which lie free in the air, works back to the collector aerial. The consequence of this is that in discharges in the collector aerial the back inductive action of the free poles allows a higher voltage to be maintained in the aerial collecting conductor than would otherwise be the case. It has also been found that such a back action has an extremely favourable effect on the wear of the contacts. Of course the inductive effect may be regulated at will within the limits of the size of the induction coil, the length of the coil in action being adjustable by means of wire connection without induction (see Fig. 24, No. 20).

S¹ and S² may also be provided with such regulating devices in the case of S² (illustrated by 11). If excess voltage be formed it is conducted to earth through the wire 12 and spark gap 8 or through any other suitable apparatus, since this formation would be dangerous for the other apparatus.

The action of these condenser batteries has already been hereinbefore described.

The small circles on the collector balloon indicate places at which zinc amalgam or gold amalgam or other photoelectric acting metals in the form of small patches in extremely thin layers (.01 to .05 mm. in thickness) are applied to the balloon casing of light metal. Such metallic patches may also be applied to the entire balloon as well as in greater thickness to the conducting network. The capacity of the collector is thereby considerably strengthened at the surface. The greatest possible effect in collecting may be obtained by polonium amalgams and the like. On the surface of the

collector balloon metal points or spikes are also fixed along the ribs, which spikes serve particularly for collecting the collector charge. Since it is well known that the resistance of the spikes is less the sharper the spike is, for this purpose it is therefore extremely important to employ as sharp spikes as possible. Experiments made as regards these have shown that the formation of the body of the spike or point also plays a large part. For example, spikes made of bars or rollers with smooth surfaces, have a many times greater point resistance as collector accumulator spikes than those with rough surfaces. Various kinds of spike bodies have been experimented with for the collector balloons hereinbefore mentioned. The best results were given by spikes which were made in the following way. Fine points made of steel, copper, nickel, or copper and nickel alloys, were fastened together in bundles and then placed as anode with the points in a suitable electrolyte (preferably in hydrochloric acid or muriate of iron solutions) and so treated with weak current at 2 to 3 volts pressure. After 2 to 3 hours according to the thickness of the spikes or pins the points become extremely sharp and the bodies of the spikes have a rough surface. The bundle can then be removed and the acid washed off with water. The spikes are then placed as cathode in a bath consisting of solution of gold, platinum, iridium, paladium or wolfram salts or their compounds and coated at the cathode galvanically with a thin layer of precious metal, which must however be sufficiently firm to protect them from atmospheric oxidation.

Such spikes act at a 20 fold lower voltage almost as well as the best and finest points made by mechanical means. Still better results are obtained if polonium or radium salts are added to the galvanic bath when forming the protective layer or coating. Such pins have a low resistance at their points and even at one volt and still lower pressures have an excellent collector action.

In Figure 24 the three unconnected poles are not connected with one another in parallel. That is quite possible in practice without altering the principle of the free pole. It is also preferable to interconnect in parallel to a common collector network, a series of collecting aeri-
als.

Figure 25 shows a diagram for such an installation. A^1, A^2, A^3, A^4 are four metal collector balloons with gold or platinum coated spikes which are electrolytically made in the presence of polonium emanations or radium salts, which spikes or needles are connected over four electro-magnets S^1, S^2, S^3, S^4 , through an annular conductor R. From this annular conductor four wires run over four further electromagnets $S^5,$

S^6, S^7, S^8 , to the connecting point 13. There the conductor is divided, one branch passing over 12 and the safety spark gap 8 to the earth at E^1 , the other over inductive resistance J and working spark gap 7 to the earth at E^2 . The working circuit, consisting of the condenser 5 and 6 and a resonance motor or a condenser motor M, such as hereinbefore described, is connected in proximity round the sparking gap section 7.

Instead of directly connecting the condenser motor of course the primary circuit for high frequency oscillatory current may also be inserted.

The condenser batteries are connected by one pole to the annular conductor R and can be either inductionless (16 and 18) or made as induction condensers as shown by 21 and 23. The free poles of the inductionless condensers are indicated by 17 and 19, those of the induction condensers by 22 and 24. As may be seen from the drawings all these poles 17, 22, 19, 24 may be interconnected in parallel through a second annular conductor without any fear that thereby the principle of the free pole connection will be injured. In addition to the advantages already set forth the parallel connection also allows of an equalization of the working pressure in the entire collector network. Suitably constructed and calculated induction coils 25 and 26 may also be inserted in the annular conductor of the free poles, by means of which a circuit may be formed in the secondary coils 27 and 28 which allows current produced in this annular conductor by fluctuations of the charges or the like appearances to be measured or otherwise utilized.

According to what has been hereinbefore stated separate collector balloons may be connected at equidistant stations distributed over the entire country, either connected directly with one another metallically or by means of intermediate suitably connected condenser batteries through high voltage conductors insulated from earth. The static electricity is converted through a spark gap into dynamic energy of a high number of oscillations and may in such form be coupled as a source of energy by means of a suitable method of connecting, various precautions being observed, and with special regulations. The wires leading from the collector balloons have hitherto been connected through an annular conductor without this endless connection, which can be regarded as an endless induction coil, being able to exert any action on the whole conductor system.

It has now been found that if the network conductor connecting the aerial collector balloons with one another is not made as a simple annular conductor, but preferably short circuited in the form of coils over a

condenser battery or spark gap or through thermionic tubes or valves or audions, then the total collecting network exhibits quite new properties. The collection of atmospheric electricity is thereby not only increased but an alternating field may be easily produced in the collector network. Further, the atmospheric electrical forces showing themselves in the higher regions may also be directly obtained by induction. In Figures 26 and 28 a form of construction is shown on the basis of which the further foundations of the method will be more particularly explained.

In Figure 26 1, 2, 3, 4 are metal collector balloons, 5, 6, 7, 8 their metallic aerial conductors and I the actual collector network. This consists of five coils and is mounted on high voltage insulators in the air, on high voltage masts (or with a suitable construction of cable embedded in the earth). One coil has a diameter of 1 to 100 km. or more. S and S' are two protective electromagnets, F the second safety section against excess voltage, E its earth conductor and E' the earth conductor of the working section. When an absorption of static atmospheric electricity is effected through the four balloon collectors, the current in order to reach the earth connection E' must flow spirally through the collector network over the electromagnet S, primary induction coil 9, conductor 14, anode A of the audion tube, incandescent cathode K, as the way over the electromagnet and safety spark gap F offers considerably greater resistance. Owing to the fact that the accumulated current flows in one direction, an electromagnetic alternating field is produced in the interior of the collector network coil, whereby the whole free electrons are directed more or less into the interior of the coil. An increased ionization of the atmosphere is therefore produced. In consequence of this the points mounted on the collector balloon show a considerably reduced resistance and therefore increased static charges between the points on the balloon and the surrounding atmosphere are produced. The result of this is a considerably increased collector effect.

A second effect which could not be obtained otherwise is obtained by the electromagnetic alternating field which running parallel to the earth surface, acts more or less with a diminishing or increasing effect on the earth magnetic field, whereby in the case of fluctuations in the current a return induction current of reversed sign is always produced in the collector coil by earth magnetism. Now if, however, a constantly pulsating continuous alternating field is produced as stated in the above collector network I, an alternating current of the same periodicity is produced also in the collecting

network coil. As the same alternating field is further transmitted to the aerial balloon, the resistance of its points is thereby considerably reduced, whilst the collector action is considerably increased. A further advantage is that positive electrons which collect on the metal surfaces during the conversion into dynamic current produce a so-called drop of potential of the collector area. As an alternating field is present, the negative ions surrounding the collector surfaces, when discharge of the collector surfaces takes place produce by the law of induction, an induction of reversed sign on the collector surface and so forth (that is to say again a positive charge). In addition to the advantages hereinbefore set forth, the construction of connecting conductors in coil form when of sufficiently large diameter, allows of a utilization of energy arising in higher regions also in the simplest way. As is well known electric discharges frequently take place at very great elevations which may be observed, such as St. Elmo's fires or northern lights. These energy quantities have not been able to be utilized up to now. By this invention all these kinds of energy, as they are of an electromagnetic nature and the direction of the axis of the collector coils stands at right angles to the earth's surface, can be more or less absorbed in the same way as a receiver in wireless telegraphy absorbs waves coming from a far distance. With a large diameter of the spiral it is possible to connect large surfaces and thereby to take up also large quantities of energy.

It is well known that large wireless stations in the summer months, and also in the tropics are very frequently unable to receive the signals in consequence of interruptions which are caused by atmospheric electricity, and this takes place with vertical coils of only 40 to 100 m. diameter. If on the contrary horizontal coils of 1 to 100 km. diameter be employed very strong currents may be obtained through discharges which are constantly taking place in the atmosphere. Particularly in the tropics or still better in the polar regions where the northern lights are constantly present, large quantities of energy may probably be obtained in this way. A coil with several windings should act the best. In similar manner any alteration of the earth magnetism should act inductively on such a coil.

It is not at all unlikely that earthquakes and spots on the sun will also produce an induction in such collector coils of sufficient size. In similar manner this collector conductor will react on earth currents more particularly when they are near the surface of the earth or even embedded in the earth. By combining the previous kind of current collectors so far as they are adapted for

the improved system with the improved possibilities of obtaining current the quantities of free natural energy which are to be obtained in the form of electricity are considerably increased.

In order to produce in the improved collector coil uniform current oscillations of an undamped nature so-called audion high vacuum or thermionic tubes of suitable connection are employed instead of the previously known spark gaps (Fig. 26, Nos. 9-18). The main aerial current flows through electromagnet S (which in the case of a high number of alternations is not connected here but in the earth conductor E¹) and may be conveyed over the primary coils in the induction winding through wire 14 to the anode A of the high vacuum grid tube. Parallel with the induction resistance 9 a regulating capacity of suitable size, such as condenser 11 is inserted. In the lower part of the vacuum grid tube is arranged the incandescent filament or the cathode K which is fed through a battery B. From the battery B two branches run, one to the earth conductor E¹ and the other through battery B¹ and secondary coil 10 to the grid anode *g* in the vacuum tube. By the method of connections shown in dotted lines, a desired voltage at the grid electrode *g* may also be produced through the wire 17 which is branched off from the main current conductor through switches 16 and some small condensers (*a, b, c, d*) connected in series, and conductor 18, without the battery B¹ being required.

The action of the entire system is somewhat as follows:—

On the connecting conductor of the aerial collector network being short circuited to earth, the condenser pole 11 is charged and slightly damped oscillations are formed in the short circuited existing oscillation circuit formed of the condenser 11 and self inductance 9. In consequence of the coupling through coil 10, fluctuations of voltage take place in the grid circuit 15 with the same frequency, which, fluctuations in turn influence the strength of the electrode current passing through the high vacuum amplifying tube and thus produce current fluctuations of the same frequency in the anode circuit. A permanent supply of energy to the oscillation circuits 9 and 10 consequently takes place, until a condition of balance is set up, in which the consumed oscillation energy is equal to that absorbed. Thereby constant undamped oscillations are now produced in the oscillation circuits 9-11.

For regular working of such oscillation producers high vacuum strengthening tubes are necessary and it is also necessary that the grid and anode voltages shall have a phase difference of 180° so that if the grid is negatively charged, then the anode is

positively charged and vice versa. This necessary difference of phase may be obtained by most varied connections, for example, by placing the oscillation circuit in the grid circuit or by separating the oscillation circuit and inductive coupling from the anodes and the grid circuit and so forth.

A second important factor in this way of converting static atmospheric electricity into undamped oscillations is that care must be taken that the grid and anode voltages have a certain relation to one another; the latter may be obtained by altering the coupling and a suitable selection of the self induction in the grid circuit, or as shown by dotted lines 18, 17, 16 by means of a larger or smaller number of condensers of suitable size connected in series; in this case the battery B¹ may be omitted. With a suitable selection of the grid potential a glow discharge takes place between the grid *g* and the anode A, and accordingly at the grid there is a cathode drop and a dark space is formed. The size of this cathode drop is influenced by the ions which are emitted in the lower space in consequence of shock ionization of the incandescent cathodes K and pass through the grid in the upper space. On the other hand the number of the ions passing through the grid is dependent on the voltage between the grid and the cathode. Thus if the grid voltage undergoes periodic fluctuations (as in the present case) the amount of the cathode drop at the grid fluctuates and consequently the internal resistance of the tube correspondingly fluctuates, so that when a back coupling of the feed circuit with the grid circuit takes place, the necessary means are afforded for producing undamped oscillations and of taking current, according to requirements from the collecting conductor.

The frequency of the undamped oscillations produced is with a suitably loose coupling equal to the self frequency of the oscillation circuits 9 and 10. By a suitable selection of the self induction of the coil 9 and capacity 11 it is possible to extend from frequencies which produce electromagnetic oscillations of only a few metres wave length down to the lowest practical alternating current frequency. For large installations a suitable number of frequency producing tubes in the form of the well known high vacuum transmission tubes of .5 to 2 kw. in size may be connected in parallel so that in this respect no difficulty exists.

The use of such tubes for producing undamped oscillations, and also the construction and method of inserting such transmission tubes in an accumulator or dynamo circuit is known and also that such oscillation producing tubes only work well at voltages of 1,000 up to 4,000 volts, so that on the contrary their use at lower voltages is

considerably more difficult. By the use of high voltage static electricity this method of producing undamped oscillations as compared with that through spark gaps must be regarded as an ideal solution particularly for small installations of outputs of from 1 to 100 kw.

By the application of safety spark gaps, with interpolation of electro-magnets, not only is short circuiting avoided but also the taking up of current is regulated. Oscillation producers inserted in the above way form a constantly acting electromagnetic alternating field in the collector coil, whereby as already stated, a considerable accumulating effect takes place. The withdrawal wire or working wire is connected at 12 and 13, but current may be taken by means of a secondary coil which is firmly or movably mounted in any suitable way inside the large collector coil, i. e. in its electromagnetic alternating field, so long as the direction of its axis runs parallel with that of the main current collecting coil.

In producing undamped oscillations of a high frequency (50,000 per second and more) in the oscillation circuits 9 and 11, electromagnets S and S¹ must be inserted if the high frequency oscillations are not to penetrate the collector coil, between the oscillation producers and the collector coil. In all other cases they are connected shortly before the earthing (as in Figs. 27 and 28).

In Figure 27 a second method of construction of the connecting conductor of the balloon aeriels is illustrated in the form of a coil. The main difference consists in that in addition to the connecting conductor I another annular conductor II is inserted parallel to the former on the high voltage masts in the air (or embedded as a cable in the earth) but both in the form of a coil. The connecting wire of the balloon aeriels is indicated as a primary conductor and also as a current producing network; the other is the consumption network and is not in unipolar connection with the current producing network.

In Figure 27 the current producing network I is shown with three balloon collectors 1, 2, 3 and aerial conductors 4, 5, 6; it is short circuited through condenser 19 and inductance 9. The oscillation forming circuit consists in this diagram of spark gap f, inductance 10, and condenser 11; the earth wire E, is connected to earth over electromagnet S¹. F is the safety spark gap which is also connected to earth through a second electromagnet S at E. On connecting up the condenser circuit 11 this is charged over the spark gap f whereby an oscillatory discharge is formed. This discharging current acts through inductance 10 on the inductively coupled secondary 9, whereby in the producing network a modi-

fication of the potential of the condenser 19 is produced. The consequence of this is that oscillations arise in the coil shaped producer network. These oscillations induce a current in the secondary circuit II, which has a smaller number of windings and a less resistance, the voltage of which, according to the proportion of the number of windings and of the ohmic resistance, is considerably lower whilst the current strength is greater.

In order to convert the current thus obtained into current of an undamped character, and to tune its wave lengths, a sufficiently large regulatable capacity 20 is inserted between the ends 12 and 13 of the secondary conductor II. Here also current may be taken without an earth conductor, but it is advisable to insert a safety spark gap E² and to connect this with the earth over an electromagnet S².

The producer network may be connected with the working network II over an inductionless condenser 21 or over an induction condenser 22, 23. In this case the secondary conductor is unipolarly connected with the energy conductor.

In Figure 28 the connecting conductor between the separate accumulator balloons is carried out according to the autotransformer principle. The collecting coil connects four aerial balloons 1, 2, 3, 4, the windings of which are not made side by side but one above the other. In Figure 28 the collector coil I is shown with a thin line, the metallicly connected prolongation coils II with a thick line. Between the ends I¹ and II¹ of the energy network I a regulating capacity 19 is inserted. The wire I² is connected with the output wire and with the spark gap F.

As transformer of the atmospheric electricity an arrangement is employed which consists in using rotary pairs of condensers in which the one stator surface B is connected with the main current, whilst the other A is connected with the earth pole. Between these pairs of short circuited condensers are caused to rotate from which the converted current can be taken by means of two collector rings and brushes, in the form of an alternating current, the frequency of which is dependent on the number of balloons and the revolutions of the rotor. As the alternating current formed in the rotor can act, in this improved method of connection described in this invention, through coils 10 on the inductance 9, an increase or diminution of the feed current in I can be obtained according to the direction of the current by back induction. Current oscillations of uniform rhythm thereby result in the coil shaped windings of the producer network.

As the ends of this conductor are short cir-

cuted through the regulatable condenser 19 these rhythms produce short circuited undamped oscillations in the energy conductor, the periodicity and wave lengths of which oscillations can be adjusted according to desire by altering the capacity 19 to a given wave length and therewith also to a given frequency. These currents may also be employed in this form directly as working current through the conductors II¹ and III. By inserting the condenser 20 a connection between these conductors may also be made, whereby harmonic oscillations of desired wave length are formed. By this means quite new effects as regards current distribution are obtained. The withdrawal of current can even take place without direct wire connection if, at a suitable point in the interior of the producing network (quite immaterially whether this has a diameter of 1 or 100 km.) a coil tuned to these wave lengths and of the desired capacity is firmly or movably mounted in the aerial conductor in such a way that its axial direction is in parallel with that of the collector coil. In this case a current is induced in the producing network, the size of which is dependent on the total capacity and resistance and also on the periodicity employed. A possibility is thereby afforded in future, of taking energy from the producer network by wireless means. As thereby in addition to atmospheric electricity also magnetic earth currents and the energy from the higher atmosphere (at least partially) may be simultaneously obtained, this last system for collecting the atmospheric energy is of particular importance for the future.

Of course everywhere instead of spark gaps suitable grid vacuum tubes may be employed as producers for undamped oscillations. The separate coils of the producer network with large diameters may be connected with one another through separate conductors all in parallel or all in series or in groups in series. By regulating the number of oscillations and also the extent of the voltage more or less large collector coils of this kind may be employed. The coils may also be divided spirally over the entire section. The coils may be carried out in annular form or also in triangular, quadrangular, hexagonal or octagonal form.

Of course wires may be carried from a suitable place to the centre or also laterally which serve the current waves as guides. This is necessary when the currents have to be conducted over mountains and valleys and so forth. In all these cases the current must be converted into a current of suitable periodicity.

As already hereinbefore mentioned separate collecting balloons may be directly metallically interconnected at equidistant sta-

tions distributed over the entire country or may be connected by interpolation of suitable condenser batteries by means of high voltage conductors. The static electricity is converted through a spark gap into dynamic energy of a high number of oscillations, and could then in such form, with a suitable arrangement of the connections, observing various measures of precaution, be employed as source of energy after separate or special regulation.

According to this invention in order to increase the collecting effect of the balloon in the aerial collector conductor or in the earth wire, radiating collectors are employed. These consist either of incandescent metal or oxide electrodes in the form of vacuum grid tubes, or electric arcs (mercury and the like electrodes) Nernst lamps, or finally flames of various kinds may be simply connected with the respective conductor.

It is well known that energy can be drawn off from a cathode consisting of an incandescent body opposite an anode charged with positive electricity (vacuum grid tube). Hitherto however, a cathode was always first directly placed opposite an anode, and secondly the system always consisted of a closed circuit.

Now if we dispense with the ordinary ideas in forming light or flame arcs in which a cathode must always stand directly opposite an anode, and if we place an incandescent cathode opposite an anode charged to a high potential or another body freely floating in the air, or regard the incandescent cathode only as a source of unipolar discharge (which represent group and point discharges in electro-static machines similar to unipolar discharges), it may be ascertained that incandescent cathodes and less perfectly all incandescent radiators, flames and the like admit of relatively large current densities and allow large quantities of electric energy to radiate into the open space in the form of electron streams as transmitters.

The object of this invention is as described below, if such incandescent oxide electrodes or other incandescent radiators or flames are not freely suspended in space but connected metallically with the earth so that they can be charged with negative terrestrial electricity, these radiators possess the property of absorbing the free positive electrical charges contained in the air space surrounding them (that is to say of collecting them and conducting them to earth). They can therefore, serve as collectors and have, in comparison to the action of the spikes, or points, a very large radius of action R; the effective capacity of these collector is much greater than the geometrical capacity (R_0) calculated in an electro-static sense.

Now as our earth is surrounded as is well

known, with an electro-static field and the difference of potential

$$\frac{\delta V}{\delta h}$$

of the earth field according to the latest investigations, is in summer about 60 to 100 volts and in winter 300 to 500 volts per metre of difference in height (δh), a simple calculation gives the result that when such a radiation collector or flame collector is arranged for example on the ground, and a second one is mounted vertically over it at a distance of 2,000 metres and both are connected by a conducting cable, there is a difference of potential in summer of about 2,000,000 volts and in winter even of 6,000,000 volts and more.

According to Stefan Boltzmann's law of radiation, the quantity of energy which an incandescent surface (temperature T) of 1 sq. cm. radiates in a unit of time into the open air (temperature T_0) is expressed by the following formula:

$$S = 6 (T^4 - T_0^4) \text{ watt/sq. cm.}$$

and the universal radiation constant 6 is according to the latest researches of Ferry (Annales de Chimie et de physique 17 page 267 (1909)) equal to 6.30×10^{-12} watt/sq. cm.

Now if an incandescent surface of 1 sq. cm. shows, as compared with the surrounding space a periodic fall of potential δV it radiates (independent of the current direction, that is to say of the sign) in accordance with the above formula, for example at a temperature of 3725°C. an energy of 1.6 kw. per sq. cm. per second. As for the radiation the same value can be calculated for the collection of energy, but reversed. Now as carbon electrodes at the temperature of the electric arc support on the current basis a current density up to from 60 to 65 amperes per sq. cm. no difficulties will result in this direction in employing radiating collectors as accumulators.

If the earth be regarded as a cosmically insulated condenser in the sense of geometrical electro-statics $\propto$ there results from the geometric (compare Ewald Rasch, "das elektrische Bogenlicht" (The electric arc light) page 169) capacity of the earth according to Chwolson:

For negative charging 1.3×10^9 Coulomb
For negative potential $V = 10 \times 10^8$ volts.
From this there results however, $EJT \approx 24.7 \times 10^{24}$ watt/Sec. Now if it is desired to make a theoretic short circuit through an earthed flame collector this would represent an electric total work of about 79,500 10^{10} kilowatt years. As the earth must be regarded as a rotating mechanism which is thermo-dynamically, electromagnetically, and also kinematically coupled with the sun and stars system by cosmic radiations and

gravitation a diminution of the electric energy of the earth field is not to be feared. The energies which the incandescent collectors would withdraw from the earth field can only cause by the withdrawal of motor work a lowering of the earth temperature (temperature $T_E = 300$) and reduce this to that of the world space ($T = 0$) by using the entire energy. This is however not the case as the earth does not represent a cosmically entirely insulated system. On the contrary there is conveyed to the same according to the recent value corrected by Ferry for the solar constants through the radiation from the sun an energy of $18,500 \times 10^{10}$ kw. Accordingly any lowering of the earth temperature (T_E) without a simultaneous lowering of the sun's temperature (T_S) would contradict Stefan Boltzmann's law of radiation.

$$S = 6 (T_S^4 - T_E^4).$$

From this it must be concluded that if the earth temperature (T_E) sinks, the total radiation S absorbed by the earth increases, and further also that the secular speed of cooling of the earth is directly dependent on that of the sun and the other radiators cosmically coupled with the sun and is connected most closely with these.

The incandescent radiation collectors may, according to this invention, be employed for collecting atmospheric electricity if they (1) are charged with the negative earth electricity (that is to say when they are directly connected by means of a metallic conductor with the earth) and (2) if large capacities (metal surfaces) charged with electricity are mounted opposite them as positive poles in the air. This is regarded as the main feature of the present invention as without these inventive ideas it would not be possible to collect with an incandescent collector, sufficiently large quantities of the electrical charges contained in the atmosphere as technology requires; the radius of action of the flame collectors would also be too small, especially if it be considered that the very small surface density (energy density) (δ about $= 2 \times 7 \cdot 10^9$ St. E. per sq. cm.) does not allow of large quantities of charge being absorbed from the atmosphere.

$\propto$) Calculated according to Poisson's calculation;

$\Delta V = -4\pi\delta$; as here the alteration of the potential or potential gradients only takes place in the direction of the normal, this calculation assumes the simple form

$$\delta = \frac{1}{4\pi} \times \frac{\delta^2 V}{\delta r^2}$$

It has indeed already been proposed to employ flame collectors for collecting atmospheric electricity and it is known that

their collecting effect is substantially greater opposite the points. It is however, not known that the quantities of current which could hitherto be obtained are too small for technical purposes. According to my experiments the reason for this is to be found in the too small capacities of the collector conductor poles. If such flame or radiating collectors have no or only small positive surfaces, their radius of action for large technical purposes is too small. If the incandescent collectors be constantly kept in movement in the air they may collect more according to the speed of the movement, but this is again not capable of being carried out in practice.

By this invention the collector effect is considerably increased by a body charged with a positive potential and of the best possible capacity being also held floating (without direct earth connection) opposite such an incandescent collector which is held floating in the air at a desired height. If for example, a collecting balloon of sheet metal or of metalized balloon fabric be caused to mount to 300 up to 3,000 metres in the air and as positive pole it is brought opposite such a radiating collector connected by a conductor to earth, quite different results are obtained.

The metallic balloon shell (with a large surface) is charged to a high potential by the atmospheric electricity. This potential is greater the higher the collecting balloon is above the incandescent collector. The positive electricity acts concentratedly on the anode floating in the air as it is attracted through the radiation shock ionization, proceeding from the incandescent cathode. The consequence of this is that the radius of action of the incandescent cathode collector is considerably increased and thereby also the collecting effect of the collecting balloon surface. Further the large capacity of the anode floating in the air plays therefore an important part because it allows of the taking of large charges, and thereby a more uniform current is obtained even when there is a large consumption; this cannot be the case with small surfaces.

In the present case the metallic collecting balloon is a positive anode floating in the air and the end of the earth conductor of this balloon serves as positive pole surface opposite the surface of the radiating incandescent cathode, which in turn is charged with negative earth electricity being conductively connected to earth.

The process may be carried out by two such contacts (negative incandescent cathode and anode end of a capacity floating in the air) a condenser and an inductive resistance being switched on in parallel, whereby simultaneously undamped oscillations may be formed.

In very large installations it is advisable to connect two such radiating collectors in series. Thus an arc light incandescent cathode may be placed below on the open ground and an incandescent cathode which is heated by special electro-magnetic currents be located high in the air. Of course for this the special vacuum Liebig tubes with or without grids may also be employed. An ordinary arc lamp with oxide electrodes may be introduced on the ground and the positive pole is not directly connected with the collecting balloon, but through the upper incandescent cathode or over a condenser. The method of connecting the incandescent cathode floating in the air may be seen in Figs. 29-33.

B is the air balloon, K a Cardan ring (connection with the hawser) C the balloon, L a good conducting cable, P a positive pole, N negative incandescent cathode, and E earth conductor.

Fig. 29 represents the simplest form of construction. If electric oscillations are produced below on the ground by means of a carbon arc lamp or in other suitable way a considerably greater electric resistance is opposed to that in the direct way by inserting an electrical inductive resistance 9. Consequently between P and N a voltage is formed, and as, over N and P only an inductionless ohmic resistance is present, a spark will spring over so long as the separate induction co-efficients and the like are correctly calculated. The consequence of this is that the oxide electrode (carbon or the like) is rendered incandescent and then shows as incandescent cathode an increased collecting effect. The positive poles must be substantially larger than the negative in order that they may not also become incandescent. As they are further connected with the large balloon area which has a large capacity and is charged at high voltage, an incandescent body which is held floating in the air and a positive pole which can collect large capacities is thereby obtained in the simplest way. The incandescent cathode is first caused to become incandescent by means of separate energy produced on the earth, and then maintained by the energy collected from the atmosphere.

Fig. 30 only shows the difference that instead of a round balloon a cigar shaped one (of metal or metalized fabric) may be employed and also a condenser 5 is inserted between the incandescent cathode and the earth conductor so that a short circuited oscillation circuit over P, N 5 and 9 is obtained. This has the advantage that quite small quantities of electricity cause the cathode to become incandescent and much larger cathode bodies may be rendered incandescent.

In this form of construction both the in-

candescant cathode and also the positive electrode may be enclosed in a vacuum chamber as may be seen in Fig. 32. A cable L is carried well insulated through the cover of a vessel and ends in a condenser disc 5. The cover is arched in order to keep off the rain. The vessel is entirely or partially made of magnetic metal and well insulated inside and outside. Opposite the disc 5 another disc 6 and on this again a metallic positive pole of the vacuum tube *g* with the incandescent cathode (oxide electrode) N is arranged. The negative electrode is on the one hand connected with the earth conductor E, and on the other hand with the inductive resistance 9 which is also connected with the cable L with the positive pole and wound round the vessel in coils. The action is exactly the same as that in Fig. 29 only instead of an open incandescent cathode one enclosed in vacuum is employed. As in such collectors only small bodies can be brought to incandescence in large installations a plurality of such vacuum tubes must be inserted in proximity to one another. According to the previous constructions Figs. 31 and 33 are quite self evident without further explanations.

Figs. 34-37 represent further diagrams of connections over radiating and flame collectors, and in fact, how they are to be arranged on the ground.

Fig. 34 shows an arc light collector with oxide electrodes for direct current and its connection; Fig. 35 a similar one for alternating current, Fig. 36 an incandescent collector with a Nernst lamp and Fig. 37 a similar one with a gas flame.

The positive pole 1 of the radiating collectors is always directly connected to the aerial collecting conductor A. In Fig. 34 this is further connected over the condenser battery 5 with a second positive electrode 3. The direct current dynamo *b* produces current which flows over between the electrodes 3 and 2 as an arc light. On the formation of an arc the negative incandescent electrode 2 absorbs electricity from the positive poles standing opposite it and highly charged with atmospheric electricity and conveys the same to the working circuit. The spark gap 7, inductive resistance 9 and induction coil 10 are like the ones previously described. The protective electromagnet S guards the installation against earth circuiting, the safety spark gap 8 from excess voltage or overcharging.

In Fig. 35 the connection is so far altered that the alternating current dynamo feeds the exciting coil 11 of the induction condenser. 12 is its negative and 13 its positive pole; if the coil 3 on the magnet core of the dynamo is correctly calculated and the periodicity of the alternating current is sufficiently high an arc light can be formed

between the two poles 1 and 2. As the cathode 2 is connected with the negatively charged earth, and therefore always acts as a negative pole, a form of rectification of the alternating current produced by the dynamo 3 is obtained, the second half of the period is always suppressed. The working circuit may be carried out in the same way as in Fig. 34; the working spark gap 7 may however be dispensed with, and instead thereof between the points *n* and *m* a condenser 5 and an induction resistance 9 may be inserted from which the current is taken inductively.

Fig. 36 represents a form of construction similar to Fig. 34 only that here instead of an arc lamp a Nernst incandescent body is employed. The Nernst lamp is fed through the battery 3. The working section is connected with the negative pole, the safety spark gap with the + poles. The working spark gap 7 may also be dispensed with and the current for it taken at 12 over the oscillation circuit 5, 11 (shown in dotted lines).

Flame collectors (Fig. 37) may also be employed according to this invention. The wire network 1 is connected with the aerial collector conductor A and the burner with the earth. At the upper end of the latter, long points are provided which project into the flame. The positive electrode is connected with the negative over a condenser 5 and the induction coil 9 with the earth.

The novelty in this invention is firstly, the use of incandescent cathodes opposite positive poles which are connected with large metallic capacities as automatic collecting surfaces, (2) the connection of the incandescent cathodes with the earth whereby, in addition to the electricity conveyed to them from the battery or machine which causes the incandescing, also the negative charge of the earth potential is conveyed, and (3) the connection of the positive and negative poles of the radiating collectors over a condenser circuit alone or with the introduction of a suitable inductive resistance, whereby simultaneously an oscillatory oscillation circuit may be obtained. The collecting effect is by these methods quite considerably increased.

I declare that what I claim is:—

1. An electrical energy generating system, comprising a conducting surface for static charges, means to support same at a distance above the earth, a conductor leading to the earth level, a spark gap associated with said conductor to convert electrostatic charges into electromagnetic high frequency oscillations means to supply said electromagnetic energy to a net work, and a spark gap of greatly increased relative resistance in parallel therewith.

2. An electrical energy generating system

comprising a conductor, means to support same above the earth level, an inductance therein, a spark gap associated with said conductor, a second spark gap of much higher relative resistance in parallel therewith and an energy receiving circuit coupled with the spark gap of lesser resistance. 35

3. An electrical energy generating system comprising a collecting surface, means to support same above the earth level, a conductor connecting said collecting surface with the earth level, a choke in said conductor, an electromagnetic resistance converting electrostatic energy to electromagnetic energy, a safety higher resistance in parallel therewith and a net work coupled with the conversion resistance of lesser value. 40

4. An electrical energy generating system comprising electric conductors spaced above the earth to form electromagnetic oscillating circuits, conductors connecting to earth level, electrostatic to electromagnetic energy conversion means therein, a safety high electrostatic resistance in parallel therewith and means to alter the electromagnetic characteristic of the circuits. 45

5. An electrical energy generating system comprising in combination a static collecting surface arranged above the earth, conductors connecting to earth level, a pair of

spark gaps in parallel of different electrostatic resistance, a utilization net work shunted across the spark gap of lesser resistance and an electromagnetic choke in said conductors. 50

6. An electrical energy generating system comprising an open circuit energy collecting aerial, a pair of sparking gaps in parallel of widely different resistance, connected thereto and a closed electric oscillation circuit in shunt across the gap of lesser resistance. 55

7. An electrical energy generating system comprising an open circuit energy collecting aerial, a pair of sparking gaps in parallel of widely different resistance connected thereto, a closed electric oscillation circuit in shunt across the gap of lesser resistance, a plurality of electrostatic collecting surfaces, means to connect said collecting surfaces in parallel in groups and means to connect said groups symmetrically with said aerial. 60

In witness whereof, I have hereunto signed my name this 30 day of Dec., 1920, in the presence of two subscribing witnesses. 65

HERMANN PLAUSON.

Witnesses:

H. F. ARMSTRONG,
W. H. BEESTON.

SonoMagnetics Research Trust
Post Office Box 22, Rumney, N.H. 03266-6409 USA
1-(603) 204-5273