W. W. STRONG.

METHOD AND MECHANISM FOR REDUCING RESISTANCE OF AIR GAPS.

APPLICATION FILED JAN. 14, 1913.

1,261,178. Patented Apr. 2, 1918.

Fig. 1.

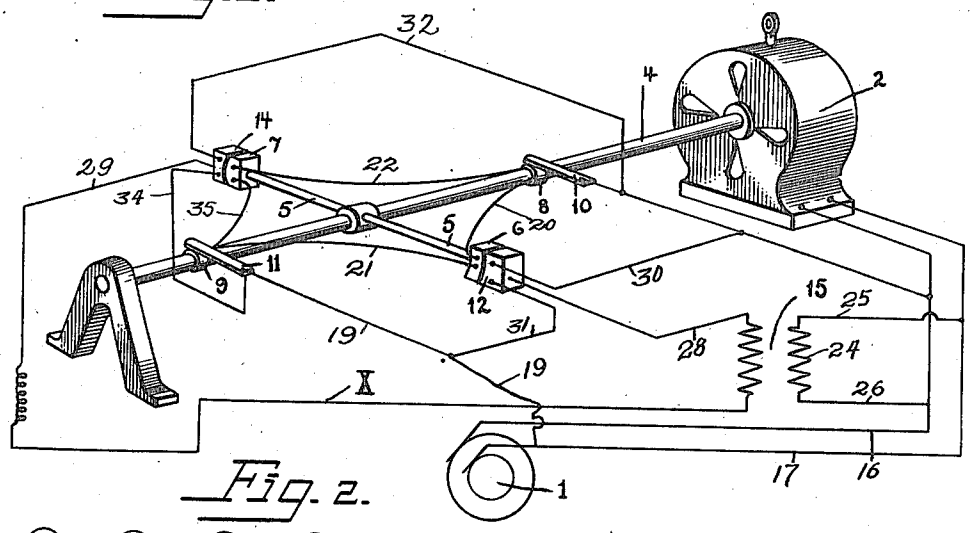


Fig. 2.

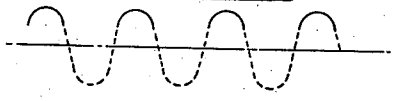


Fig. 3.

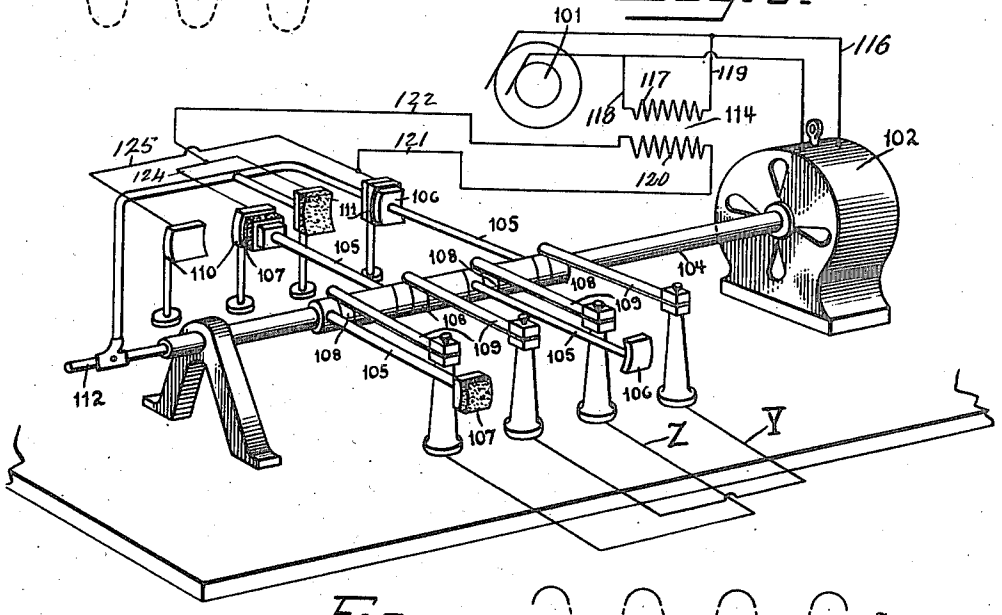


Fig. 5.

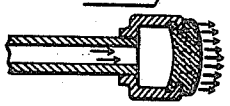
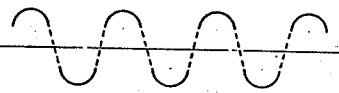


Fig. 4.



Witnesses

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METHOD AND MECHANISM FOR REDUCING RESISTANCE OF AIR-GAPS.

1,261,178. Specification of Letters Patent. Patented Apr. 2, 1918.

Application filed January 14, 1913. Serial No. 741,967.

To all whom it may concern:

Be it known that I, WILLIAM W. STRONG, a citizen of the United States and a resident of Mechanicsburg, in the county of Cumberland, State of Pennsylvania, have invented certain new and useful Improvements in Methods and Mechanism for Reducing Resistance of Air-Gaps, of which the following is a specification.

This invention relates to electrical appliances and more particularly to a method of decreasing resistance between spaced apart electrodes.

The principal object of this invention is the method of reducing resistance between spaced apart electrodes by introducing a highly ionized gas between the electrodes.

Another object of this invention is the method of deriving a uni-directional current, or currents, from an alternating current by introducing a surface giving off ions of a definite single sign in the alternating current circuit.

A further object of this invention is the method of destroying, or preventing, an oscillatory discharge between spaced apart electrodes when the current between the electrodes is started or stopped.

Other and further objects of this invention will in part be obvious and will in part be pointed out in the specification hereinafter following by reference to the accompanying drawings in which like characters represent like parts throughout the several figures thereof.

Figure 1 is a diagrammatical view illustrating one form of apparatus for carrying out my invention.

Fig. 2 is a diagrammatical view illustrating a portion of an alternating electrical wave that is transformed into an intermittent uni-directional current by the use of the apparatus and method diagrammatically shown in Fig. 1.

Fig. 3 is a diagrammatical view showing another form of apparatus for utilizing my method to transform an alternating circuit into two intermittent uni-directional currents.

Fig. 4 is a diagrammatical view illustrating portions of an alternating current which are transformed as uni-directional currents by means of my method and apparatus illustrated in Fig. 3.

Fig. 5 illustrates one form of electrode which may be used in carrying out my method.

It is well recognized in the art that the presence of ions in a gas between spaced metallic electrodes serves to carry the current between the electrodes. If these ions are free to move and are sufficiently numerous they will cause the difference of potential between electrodes in circuit to be decreased. In other words, the presence of these ions makes the gas a conductor, and the conducting property of the gas will depend upon the density and number of ions; the value of their electrical charge; and the ease or mobility with which the ions move. Since electrons are at present generally recognized as the smallest ions, they are therefore better able to satisfy the above specified conditions, and consequently are better carriers of the electric current than any other known kind of ion.

My method of decreasing resistance between spaced apart electrodes consists in producing a large number of ions, possessing as high a mobility as possible, between the electrodes at times when the electric current is flowing between the electrodes. On account of their mobility, it is obvious that the production of electrons is preferable to the other kinds of ions. Many kinds of ionizing agents may be used for this purpose; for example, the ions may be produced by radiations from radio active substances; from electrical discharges, such as the well known X-ray, and other rays of this character; or from incandescent bodies.

For many purposes the use of incandescent bodies is preferable for carrying out my method, for the reason incandescent surfaces are easily produced or obtained and the ionization is localized near the surface of such a body. The ionization of a gas near the surface of an incandescent solid depends upon the temperature of the solid; the nature of the solid; the condition of its surface; and the value of the electric and magnetic fields in the region where the ionization is being produced. There are two types or kinds of ions, that is, positive and negative ions. It is well established that the positive ions are of molecular magnitude or larger, while the negative ions are much smaller and often electrons. By suitably selecting the temperature, the condition of the incandescent surface, the values of the

electric or magnetic fields, the relative and absolute number of positive and negative ions may be controlled or modified. By suitably arranging conditions to produce ions of substantially one sign only, it is possible to obtain an almost entirely uni-directional current from an alternating current acting between electrodes, for the reason that if an electrode is giving off ions of a single sign it will assist, or at least not resist, the current flowing in one direction, but will greatly resist the flow of the current in the opposite direction.

There are several means by which a solid may be raised to incandescence, for example, a beam of radiation such as heat may be focused upon the solid; the solid may be heated by an electrical current, or it may be placed in or near the region where a chemical reaction of great heat producing power is taking place. A concrete case of the latter type is the raising of surfaces to incandescence by means of surface combustion. Surface combustion consists in the burning of a homogenous mixture of two gases such as air and illuminating gas (in proper proportions for complete combustion) without flame, in contact with a granular incandescent solid whereby a large part of the energy of combustion goes to heating the incandescent solid. For example, the mixed gases may be admitted to the rear of a porous granular diaphragm of heat resisting material and the mixture fired as it comes through the pores of the diaphragm. As soon as the diaphragm becomes hot the combustion takes place entirely within the granular diaphragm without flame and the outer surface of the diaphragm becomes very hot, while the inner surface may be kept comparatively cool dependent on the speed of the incoming gas. By this method very high temperatures may be obtained.

Referring now to Fig. 1 of the drawings in which all of the parts or elements are diagrammatically represented, the alternating current generator 1, which is a source of supply, is directly connected to a synchronous motor 2 by means of the conductors 16 and 17 in such manner that the motor will run in synchronism with the generator. A drive shaft 4 is properly mounted in suitable bearings, and carries a metallic conducting arm 5. On the outer ends of this arm are mounted electrodes 6 and 7. Each of these electrodes is provided with an outer surface capable of being heated to incandescence by means of a small electrical furnace contained within the electrode. The current to the electrical furnace being furnished through collector rings 8 and 9, by means of brushes 10 and 11. The brush 10 is connected by the conductor 18 with the main feed wire 16 and the brush 11 is in like manner connected by means of the conductor 19 with the main feed wire 17. The conductors 20 and 21 connect the heating element in the electrode 6 with the collector rings 8 and 9 respectively thus completing the circuit to supply the current to heat the electrode 6, and the conductors 22 and 23 similarly connect the collector rings 8 and 9 with the heating element in the electrode 7. Stationary electrodes 12 and 14 are provided with inner surfaces which may be also heated to incandescence by means of electrical furnaces, the currents to which may be supplied in any suitable and proper manner for example, the heating element in the electrode 12 may be supplied with electricity through the conductor 30 connected with the lead 18 and the conductor 31 connected with the lead 19, while the heating element in the electrode 14 may be supplied with electricity through the conductors 32 and 34 connected to the leads 18 and 19 respectively. A transformer 15 is arranged with its primary 24 connected with the generator by means of the conductors 25 and 26 and its secondary 27 connected by means of the conductors 28 and 29 with the stationary electrodes 12 and 14 respectively, thus forming a circuit X, the intermittent uni-directional current of which may be utilized for any desirable purpose. In the carrying out of my method by means of this apparatus, the transmitting surfaces of the moving and stationary electrodes are raised to incandescence; the synchronous motor 2 is run in step with the generator so that the moving electrodes are passing the stationary electrodes when the alternating wave has reached its crest on the positive side. Since the electrodes are very highly heated, any gas near their surfaces is in a high state of ionization, and therefore when the moving electrodes pass near or over the stationary electrodes, the incandescent surfaces of the stationary electrodes and the moving electrodes are brought very near together and the spaces between these electrodes are filled with a highly ionized gas. Consequently resistance to the passage of the electricity between these points is very greatly diminished.

Experiment has shown that surface combustion produces an ionization in which negative electrons are very greatly in excess, and these electrons are given off or thrown out from the incandescent surface. If a surface of this kind be introduced in a spark gap it assists the passage of an electric current in one direction, but resists the passage of the electric current in the other direction. I therefore make use of this principle in my method to prevent the oscillation or oscillatory discharge at the time the spark gap is broken, and I also make use of this discovery to rectify or partially rectify an alternating current.

In Fig. 3 I have diagrammatically illustrated mechanism wherein certain of the electrodes comprise surfaces of combustion. In this figure the diagrammatic representation of an alternating current generator 101, which is the source of electricity, is directly connected to a synchronous motor 102 by means of the conductors 115 and 116 respectively, which rotates a drive shaft 104. The drive shaft 104 is properly mounted in bearings and carries a plurality of metallic arms 105, upon the outer ends of which are mounted metallic electrodes 106 and surface combustion electrodes 107. The drive shaft 104 is hollow up to the arm carrying the second electrode provided with a surface combustion plate. The arms for the surface combustion electrodes 107 are also hollow tubes and serve as conductors to lead a proper combustion mixture to the electrode surface combustion faces. Each of the moving electrodes is electrically connected with its respective collector ring 108, which are all insulated one from another, and each collector ring is provided with a brush 109. There are stationary electrodes provided for each movable electrode, and metallic stationary electrodes 110 are provided to cooperate with the movable surface combustion electrodes 107, and stationary surface combustion electrodes 111 are provided to coöperate with the movable metallic electrodes 106. A proper combustible gaseous mixture is fed to the surface combustion electrodes by any convenient means, such as for example, the supply pipe 112. A transformer 114 is arranged with its primary 117 connected by conductors 118 and 119 to the generator and its secondary 120 is arranged with each end respectively attached to a metallic stationary electrode and also to a surface combustion stationary electrode, by means of the conductors 121 and 122 which connect with the conductors 124 and 125 that are each respectively connected to a stationary metallic electrode and to a stationary surface of combustion electrode. The brushes 109 are connected in circuits Y and Z in such manner that as the synchronous motor 102 runs in synchronism with the generator one circuit will be completed when the alternating wave has reached its positive crest and the other circuit will be completed when the alternating wave has reached the negative crest, thus the result will be two independent uni-directional currents, one over the circuit Y and the other over the circuit Z. It will be noted that the surfaces of combustion are all so arranged that the current each time leaves the surface in the same direction. For example, Fig. 3 is shown with the circuit Y as being excited. The current enters the stationary surface combustion electrode 111, passes into the movable metallic electrode, completes the circuit through the brushes and outer circuit, leaves the movable surface combustion electrode 107 and enters the stationary metallic electrode 110. In each case it will be noted that the current passes from a surface of combustion into a metallic electrode. The electrodes in the circuit Y are arranged in exactly the same manner, that is, the current in this circuit will also pass from a surface of combustion into a metallic electrode, both in going into and coming out of the movable member. This arrangement of surface combustion and metallic electrodes will greatly assist in the rectification of the current and prevent oscillatory discharges.

Having thus described my invention what I desire to claim is:—

1. As an apparatus for preventing oscillating discharges in a high potential electrical circuit, a spark gap, and means for maintaining surface combustion in one of the electrodes sufficient to maintain the surface of said electrode at incandescence.

2. The method of preventing oscillating discharges in a high potential circuit, which method comprises providing an electrical circuit having a spark gap, and then by means of surface combustion maintaining one of the electrodes of said spark gap at incandescence.

3. As an apparatus for preventing oscillating discharges in a high potential electrical circuit, said apparatus comprising an electrode the effective surface thereof being adapted to be maintained in a state of incandescence by surface combustion, and means to lead a combustible gas to the said electrode, said means comprising a housing to support the said electrode and a suitable conduit to lead the combustible gas to the housing.

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Witnesses:

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