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ELECTRICAL PRECIPITATING SYSTEM.

APPLICATION FILED DEC. 14, 1918.

1,433,699. Patented Oct. 31, 1922.

Fig. 1

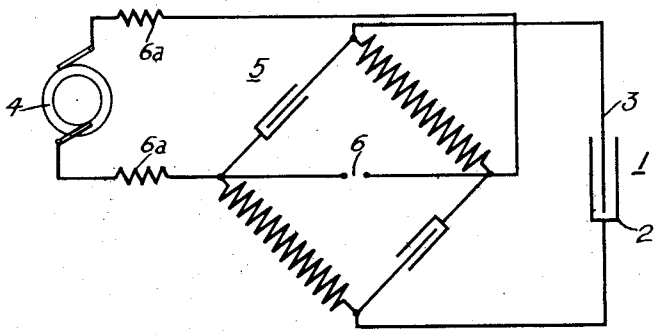


Fig. 2

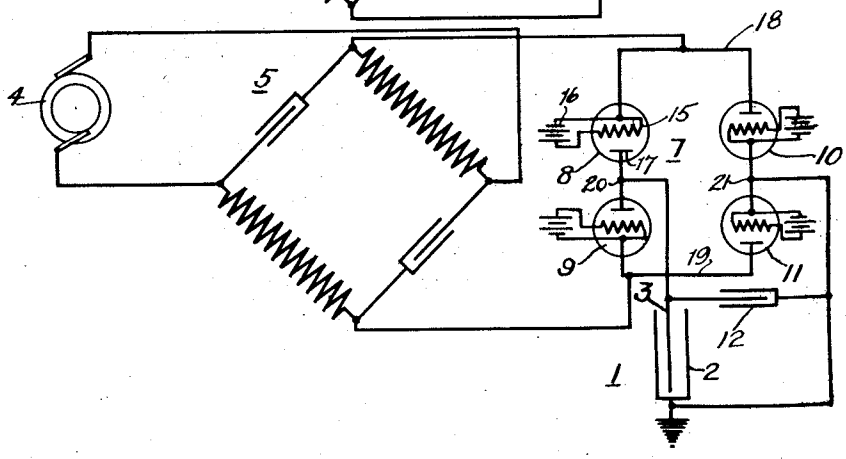
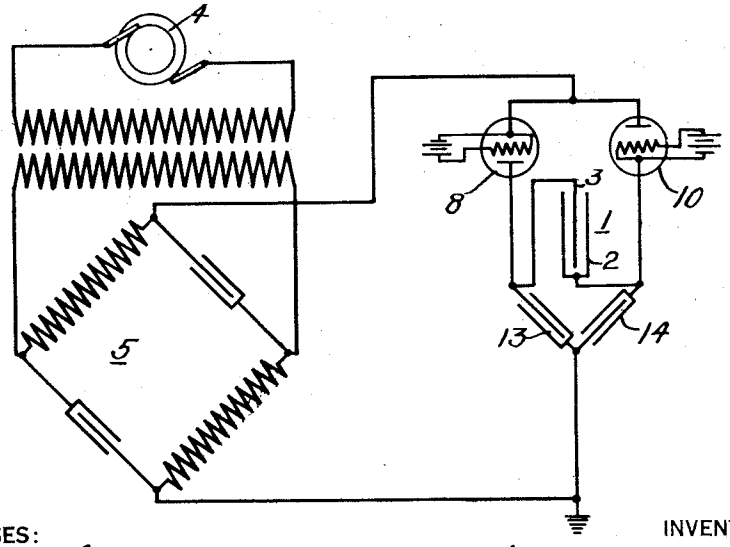


Fig. 3



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UNITED STATES PATENT OFFICE.

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ELECTRICAL PRECIPITATING SYSTEM.

Application filed December 14, 1918. Serial No. 266,744.

To all whom it may concern:

Be it known that I, LEWIS WARRINGTON CHUBB, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electrical Precipitating Systems, of which the following is a specification.

My invention relates to precipitating systems and particularly to systems for the precipitation of smoke or other solid particles from fluid streams, and it has for its object to provide a system of the character designated in which the precipitating operation is effected by the application of a constant current to the precipitating apparatus, irrespective of the internal resistance thereof.

Gases or vapors from which it is desired to precipitate suspended particles vary greatly in density, temperature, and other respects while passing through the chamber in which the precipitation is to take place. It is a matter of more or less difficulty, therefore, to so apply extremely high voltage to such precipitating chambers that the danger of a short-circuit between the electrodes which are positioned therein is entirely and constantly eliminated.

I have discovered that, if a constant current, derived from an extremely high-voltage source, is used to energize the precipitating apparatus, it is of little moment to what degree the temperature, density, and other characteristics of the fluid being treated vary. The use of direct current in systems of the character designated is especially beneficial where a very close control of the precipitating operation is desired, such as must be maintained, for instance, where the particles being collected from fluids are of considerable value, as is the case in smelting projects of various types. In systems of the character described, it is desirable that there be no cessation of the precipitating operation during the time the particle-laden fluid is passing through the treating chamber. Such cessation, under normal conditions, will of course, take place when a short-circuit occurs and when the high voltage which is so necessary for the production of corona emission, is dissipated during the interval between the time when such a short-circuit takes place and the time when the voltage is restored to its desirable high value. During this interval, a great deal of the fluid which it is desired to treat may pass from the stack and the suspended particles therein be wholly lost.

A primary object of my invention is, therefore, to provide means between the source of power supply and the point of application of such power, namely, the precipitating apparatus, that will admit of a very high voltage being impressed thereupon and which will be instrumental in causing a constant current to be supplied to the precipitating apparatus, irrespective of fluctuations in the characteristics of the treated fluid.

In the accompanying drawing, Fig. 1 illustrates an embodiment of my invention wherein means are shown upon which a constant voltage is impressed and from which a constant current is derived; Fig. 2 illustrates a modification of the system shown in Fig. 1 in which rectifying apparatus is utilized to supply the precipitating chamber with direct current; and Fig. 3 illustrates a further modification of the system shown in Figs. 1 and 2, in which a novel manner of supplying direct-current voltage of a high value to the precipitating apparatus is shown.

Referring to Fig. 1, a precipitating apparatus 1, comprising a collecting electrode member 2 and a corona-emitting electrode 3, is shown as supplied with power from any suitable source, here shown, for convenience, as an alternator 4.

A transforming device 5 of the "monocylic-bridge" type is interposed between the source 4 and the precipitating apparatus 1, as will hereinafter be more fully described. An inherent characteristic of such transforming device admits of the impression thereupon of constant voltage and the derivation therefrom of a constant current. Transforming devices of this character are, moreover, usually composed of two inductive elements and two condensive elements alternating in position with each other to vectorially form the four sides of a rhombus and, as will be observed in connection with Fig. 1, the constant voltage is impressed across one diagonal of the "bridge" and the constant current is derived from the other diagonal thereof. It must be understood, however, that any other reactive aggregate could be used in this connection and, by proper manipulation and adjustment of the

various elements, could be designed to obtain a like result. A spark gap 6, or other relief means, may be positioned across the diagonal of the bridge upon which the constant voltage is impressed, in order to prevent high-voltage transients reaching the source 4 when the treating chamber 1 becomes short-circuited and releases the stored energy of the reactive elements of the bridge.

In order to prevent a discharge back through the source, it may be desirable to place choke-coils, or other current-limiting devices, in the leads to the source 1, as shown at 6^a—6^a.

In Fig. 2, the system shown in Fig. 1 is modified in that a rectifying aggregate 7, comprising, in this instance, four hot-cathode rectifiers 8, 9, 10 and 11, is interposed between the constant-current or independent diagonal of the monocyclic bridge 5 and the precipitating apparatus 1. Each rectifier may comprise the usual cathode 15, to which is connected a battery 16, and a suitable anode 17. The rectifiers are arranged in the four sides of a loop circuit, the constant current terminals of the monocyclic bridge being connected to oppositely located conductors 18 and 19 between the rectifiers 7 and 10 and the rectifiers 9 and 11, respectively. The terminals of the precipitation circuit are connected to intermediate points 20 and 21 in the loop circuit, that is, between the rectifiers 7 and 9 and the rectifiers 10 and 11, respectively. An energy-storing and restoring element, here shown as a condenser 12, is connected between the two sides of the precipitator circuit.

In Fig. 3, the precipitator 1 is associated with a rectifier-aggregate arrangement containing the two rectifier elements 8 and 10, in two adjacent arms thereof and condensive elements 13 and 14 in two other adjacent arms, the precipitating apparatus or load circuit being connected in such manner that the rectifier elements are positioned on one side thereof and the condensive elements on the other side.

The manner in which the rectifying system is employed and claims specifically directed thereto are fully set forth in my co-pending application, Serial Number 167,089, filed May 7th, 1917, and assigned to the Westinghouse Electric & Manufacturing Company. This application has matured into Patent 1,357,223, granted Nov. 2, 1920.

In the conversion or rectification of alternating current to direct current it is common practice to employ a two-anode rectifying aggregate, connecting one anode to each terminal of the alternating-current source and connecting the cathode to substantially the mid-point of the alternating-current source. By this means, both half waves are caused to flow to the direct-current load but the two halves of the alternating-current source are alternately active, resulting in the uneconomical use of the supply transformer. Furthermore, the theoretical maximum value of the rectified voltage is but one-half the maximum value of the alternating-current supply.

In accordance with the system set forth in the above-mentioned patent, I provide a rectifying system in which the entire transformer supply voltage is employed during each half cycle and wherein the maximum voltage which may be applied to the load is substantially twice the maximum voltage of the alternating-current supply.

Briefly summarizing the description of the above-mentioned patent, this result is attained by employing auxiliary condensers, charging them to the voltage of the supply during one-half cycle and discharging them through the load, which, in this case, is the precipitator treating chamber, in series with the supply during the succeeding half cycle, and, in this manner, substantially twice the voltage of the supply is imposed upon the treating chamber during each half cycle, a result which is highly beneficial, since the voltage required to cause corona emission in a precipitating apparatus attains very high values.

Having described a number of systems in which my invention is embodied, the operation thereof is as follows:

A constant voltage is impressed upon one diagonal of the monocyclic-bridge arrangement 5, and the precipitating apparatus 1 is connected to, and derives energy from, the independent or other diagonal of the same device. A constant current will, therefore, be supplied to the apparatus 1 and any tendency for such current to rise, because of the existence of unequal temperatures, different densities, or other reasons existing within the apparatus 1, will be nullified by the action of the constant-voltage constant-current characteristics maintained by the bridge arrangement 5.

The usual form in which my invention is embodied, and probably the one preferred at the present time for precipitation, is shown in Fig. 2, since the alternating-current method of precipitation is not at present applicable to all classes of work. In this figure, I show direct constant current fed to the apparatus 1 through the instrumentality of the bridge apparatus 5 and the rectifying aggregate 7. Since the hot-cathode rectifier, in itself forms no part of my present invention, and as the operation thereof is well-known to those skilled in the art, no detailed description of the rectification process is deemed necessary here. It is sufficient to note that the alternating current from the monocyclic bridge is rectified in passing through the pairs of illus-

trated hot-cathode devices, whereby a pulsating direct current is continuously applied to the terminals 20 and 21 of the precipitator circuit. As a further assurance of constant operation I provide the energy-storing and restoring condenser 12 which, in this instance, acts as an electrical reservoir.

The particular rectifier arrangement illustrated as associated with the precipitating apparatus 1 in Fig. 3 is peculiarly adapted to rectifier application since, by the use of such apparatus, it is possible to obtain substantially twice the value of the voltage which may be obtained under normal conditions. Moreover, by the particular manner in which the arrangement is used in my system this higher voltage is applied to the precipitator and constant current is fed thereto by the employment of two rectifier elements only and, since the precipitator itself functions as a condenser of considerable capacity, the system described in my patent, above referred to, is of special benefit in the connection shown.

While I have shown a number of embodiments of my invention, it is obvious that many modifications therein may occur to those skilled in the art and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or specifically set forth in the appended claims.

I claim as my invention:

1. In a system of precipitation, the combination with a treating chamber, of a constant-potential source of power therefor, and means interposed therebetween whereby said treating chamber is supplied with a constant current, irrespective of the resistance therein.

2. The combination with a precipitating chamber, and a source of constant-potential power supply therefor, of a reactive aggregate comprising reactance elements arranged in a bridge, said source being connected to one diagonal of said bridge and said precipitating chamber being connected across the other or independent diagonal of said bridge, whereby constant current is supplied to said precipitating chamber, irrespective of the resistance therein.

3. In a system of precipitation, the combination with a treating chamber, of a source of alternating-current constant-potential power therefor, means comprising a bridge composed of reactance elements interposed between said chamber and said power source, said source being connected across one diagonal of said bridge and said treating chamber being connected across the other or independent diagonal thereof, and rectifying means in said last-named circuit, whereby a constant direct current is fed to said treating chamber.

4. In a system of precipitation, the combination with a treating chamber, of a source of alternating-current constant-potential power therefor, means comprising a bridge composed of reactance elements interposed between said chamber and said power source, said source being connected across one diagonal of said bridge and said treating chamber being connected across the other or independent diagonal thereof, rectifying means in said last-named circuit, whereby a constant direct current is fed to said treating chamber, and energy-storing and restoring means connected in parallel relationship with said treating chamber.

5. In a system of precipitation, the combination with a treating chamber, of a source of alternating-current constant-potential supply therefor, means therebetween whereby said treating chamber is fed with a constant current, and a rectifier aggregate arranged in a bridge, said treating chamber being connected across one diagonal of said bridge, whereby a potential greater than the potential of said source is impressed upon said treating chamber.

6. In a system of precipitation, the combination with a treating chamber, of a source of alternating-current constant-potential supply therefor, means therebetween whereby said treating chamber is fed with a constant current, and a rectifier aggregate arranged in a bridge, energy-storing and restoring means in two adjacent arms of said bridge, and rectifying means in the other arms of said bridge, said treating chamber being connected across one diagonal of said bridge, whereby a potential equal to twice the potential of said source is impressed upon said treating chamber.

7. In a system of precipitation, the combination with a treating chamber, of a source of alternating-current constant-potential supply therefor, means therebetween whereby said treating chamber is fed with a constant current, and a rectifier aggregate arranged in a bridge, energy-storing and restoring means in two adjacent arms of said bridge, and rectifying means in the other arms of said bridge, said treating chamber being connected across one diagonal of said bridge, whereby a potential higher than the potential of said source is impressed upon said treating chamber, with but one-half of the rectifying elements normally used in said system.

8. In a system of electrical precipitation, the combination with a fluid-treating chamber, of a source of electrical power therefor, and self-regulating means for inherently applying a voltage to said chamber substantially proportional to the impedance of the discharge path through the fluid being treated.

9. In a system of precipitation, the com-

bination with a treating chamber, of a constant-current source of power therefor, whereby said treating chamber is supplied with constant current, irrespective of the internal impedance thereof.

10. The method of energizing a precipitation apparatus which consists in applying a constant current thereto, irrespective of the impedance therein.

11. The method of energizing a precipitation apparatus in conjunction with a constant-potential power source and a bridge device therebetween, which consists in impressing a constant potential upon said device and deriving a constant current therefrom, whereby the precipitation apparatus is supplied with a constant current, irrespective of the resistance therein.

12. The method of electrically precipitating suspended particles from fluids, which consists in inherently adjusting the value of the voltage impressed on said fluids substantially in accordance with the impedance of the discharge path through said fluid.

13. The method of electrically precipitating suspended particles from fluids, which consists in automatically adjusting the value of the voltage impressed on said fluids substantially in accordance with the impedance of the discharge path through said fluids.

14. The method of electrically precipitating suspended particles from fluids, which consists in inherently adjusting the value of the voltage impressed upon said fluids so that it remains just below the break-down value thereof.

15. In a system of precipitation, the combination with a treating chamber, of a source of alternating-current, a monocyclic bridge having one set of terminals connected to said source, a rectifier aggregate arranged in a bridge, means for connecting the remaining terminals of said monocyclic bridge to one set of terminals of the rectifier bridge and means for connecting the remaining terminals of said rectifier bridge to said treating chamber.

16. A system of precipitation comprising a treating chamber, a source of alternat- current of substantially constant potential, a monocyclic bridge having one set of terminals connected to said source, a rectifier aggregate arranged in a bridge, energy-storing and restoring means being connected in two adjacent arms of the rectifier bridge and rectifying means in the other arms of that bridge, means for connecting the remaining terminals of the monocyclic bridge to the terminals of said rectifier bridge located between like devices and means for connecting said treating chamber to the remaining terminals of the rectifier bridge.

In testimony whereof, I have hereunto subscribed my name this 29th day of Nov. 1918.

LEWIS WARRINGTON CHUBB.