

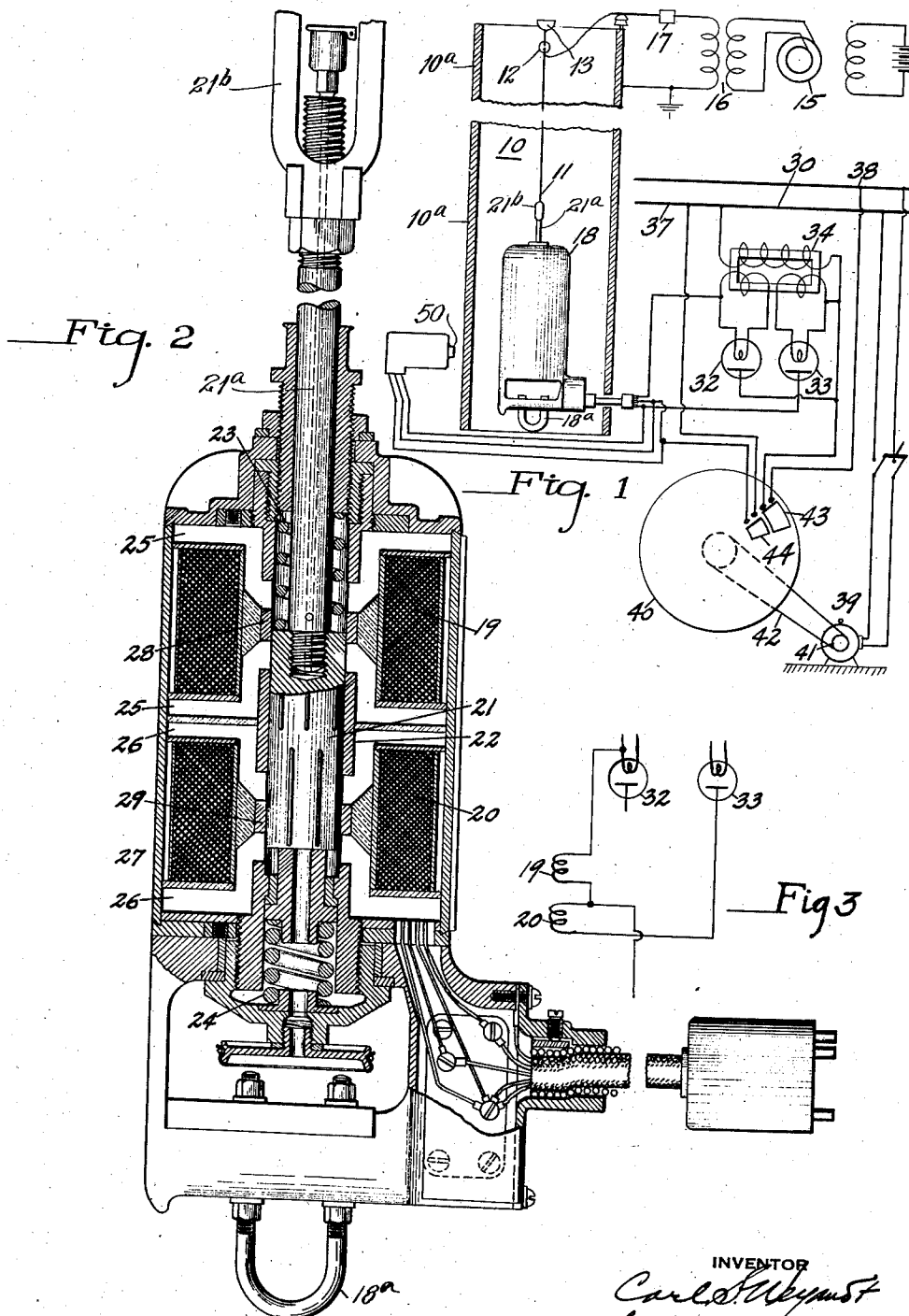
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C. S. WEYANDT

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SYSTEM OF ELECTRICAL PRECIPITATION

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INVENTOR

INVENTOR
Carl S. Weymst
 by *E. Foster*
 his attorney

UNITED STATES PATENT OFFICE

CARL S. WEYANDT, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO SYNTRON COMPANY, A CORPORATION OF DELAWARE

SYSTEM OF ELECTRICAL PRECIPITATION

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My invention relates to systems of electrical precipitation and particularly to systems in which an electrically charged electrode is periodically vibrated or agitated.

One object of my invention is to provide an automatic system for periodically vibrating or agitating a charged conductor or electrode that is suspended or otherwise disposed in the path of a current of air or gas whereby any particles that may be deposited on the conductor or electrode shall be dislocated to prevent the continuous deposits and formation of a film by the particles removed from the air or gas.

Another object of my invention is to provide a system of the above indicated character containing rectifying control devices and means for rendering them effective to control a vibrating member only during an operating interval.

Other objects of my invention are to provide a simple and inexpensive system of control whereby the vibrating or agitating member shall be periodically rendered effective to vibrate the electrode for a predetermined interval of time, after which the vibrating member shall be rendered ineffective in order to permit the electrode to remain in a state of rest.

In systems of electrical precipitation, in which a charged conductor or electrode is disposed in the path of a current of air or gas, the conductor or electrode may be constructed in different forms or provided with extending portions that tend to collect and retain the particles that have been removed from suspension in the air or gas.

The collection of such particles on the electrode tends to reduce the efficiency of the system and introduces a liability of short-circuit conditions between the electrode and the walls of the precipitation chamber which constitute an electrode of opposite polarity, relative to that of the charged conductor or electrode.

In order to eliminate such tendency and the possible occurrence of short-circuit conditions, the charged conductor or electrode should be vibrated or agitated to dislodge the collected particles. A vibration for a period of the order of thirty seconds at intervals of about thirty minutes appears to be satisfactory. Such intervals of operation will depend, of course, upon the particular construction employed in the electrode.

In practicing my invention, I utilize a vibrator of any suitable character, such for example as a reciprocating electric motor which may be of the type described and claimed in my co-pending application Serial No. 541,519, filed July 26, 1922, which comprises a movable core member controlled by two solenoids and rectifying devices for alternately energizing the solenoids; or of the single coil type disclosed in my prior application, Serial No. 697,053, filed March 5, 1924. The rectifying devices are of the two element bulb type comprising a filament and a plate.

In order to obviate useless expenditure of energy in the bulbs while they are not needed to transmit energy to the solenoids, I provide a motor-operated switch to time the intervals of energization of the bulb filaments to correspond to the intervals of operation of the vibrating member.

Just prior to the time when the operation of the vibrating member is desired the filaments are heated to render the bulbs effective to transmit current to the respective operating coils which they control. The filaments are de-energized at the end of each operating interval and until the next operating interval.

In the accompanying drawings, Figure 1 is a diagrammatic view illustrating schematically the disposition of a vibrator element relative to a charged electrode and the circuit connections for controlling the vibrator;

Fig. 2 is a vertical sectional view of the

vibrator element, illustrating the disposition of the different parts thereof.

Fig. 3 is a fragmentary diagrammatic illustration of the asymmetric conductors or valves in their relation to the vibrator windings.

As illustrated in Fig. 1 of the accompanying drawings, the air or gas to be acted upon, to have the suspended particles therein removed, is passed through a precipitation chamber 10 within which an electrode 11 is shown suspended from an insulator 12 supported by a bracket 13. The wall 10^a of the precipitation chamber 10 and the suspended electrode 11 constitute the two electrodes or terminals of a circuit between which a static electric field is established.

Although the electrode 11 and the wall 10^a of the chamber 10 may be constructed in different forms, as illustrated in Patents 895,729, dated Aug. 11, 1908, and 1,067,974 dated July 22, 1913, I have herein illustrated them for the sake of simplicity, as having smooth surfaces.

The energizing circuit for the electrodes 10^a and 11 is schematically illustrated as comprising a generator 15, a transformer 16 and a suitable rectifying device 17. The energizing circuit may take any of the forms known to those skilled in the art.

The static charges impressed upon the electrodes 10^a and 11 so influence the particles suspended in the air or gas traversing the precipitation chamber as to cause them to be deposited upon one or the other of the electrodes. Since the particles that are deposited on the electrodes tend to impair the efficiency of the operation of the system of precipitation, a vibrating or agitating device 18 is provided to vibrate the electrode 11 and dislodge the particles deposited thereon.

Although I discuss herein only the vibration of the suspended electrode 11, it is to be understood that the wall 10^a of the precipitation chamber may be simultaneously vibrated, if desired. The same method of control and the mechanism herein described may be employed.

The vibrating device 18 comprises, for example, two operating coils or solenoids 19 and 20, a movable core member 21 controllable thereby, a guide 22 for the core and two helically wound resilient springs 23 and 24 to absorb the shock of relative movements between the coils and the core.

The magnetic circuits of the operating coils 19 and 20 include laminated members 25 and 26 and a casing 27, all of magnetizable metal. As either coil is energized, the core member 21 is attracted thereby toward the tips 28 or 29 of the laminated members 25 and 26 to decrease the reluctance of the magnetic circuit of the energized coil.

The core member 21 is suitably secured to and suspended on the electrode 11 through a

member 21^a on which is secured a member 21^b of insulating material, the latter attached to electrode 11. A supporting bracket 18^a is provided upon which a suitable weight may be disposed to obtain the desired initial tension in the suspended electrode.

Since the position of the core member in its suspended state is relatively stationary, the coil structure will move up and down, as a unitary structure, on the core member 21 as a guide.

Energy is supplied to the coils from a suitable source, such as a commercial alternating current circuit 30, through rectifying devices such as the two-element bulbs 32 and 33. The filaments of the bulbs are heated by current derived from the circuit 30 through a transformer 34.

The filament of bulb 32 is connected, as shown in Fig. 3, to one terminal of coil 19 and the plate of bulb 33 is connected to one terminal of coil 20. The other terminals of both coils are joined and a common conductor connects them to one of the contact fingers adapted to be engaged by the segments 44. The other contact finger associated with segment 44 is connected to conductor 37 of the circuit 30.

The other segment 43 controls a circuit which connects one terminal of the primary winding of the transformer 34, the filament of the tube 33 and the plate or anode of the tube 32 to the conductor 38 of the circuit.

In order to control periodically the energization of the filaments and of the operating coils of the vibrating member, I provide a motor 39, a drum or disc member 40 and suitable driving means therebetween, such as a pulley 41 and belt 42. Two segments 43 and 44 are disposed on the insulating disc 40 and are arranged to engage two sets of corresponding contact fingers, respectively.

The ratio between the respective diameters of the pulley 41 and the disc 40 may be varied, according to the speed of the motor 39, to cause the segments on the disc to engage their corresponding contact fingers at predetermined intervals such as, for example, every thirty minutes.

The duration of the operating period may be adjusted by varying the lengths of the segments 43 and 44.

Since the filaments of the bulbs must be heated before the bulbs will transmit energy to the operating coils of the vibrating member 18, the segment 43 that controls the energization of the filament circuits is disposed a few degrees in advance of the segment 44 that controls the coil circuits. The filaments will therefore be heated during a short interval, and the bulbs will be ready to transmit energy to the operating coils of the vibrating member.

Since the bulbs will transmit energy only when the polarity of the filament is negative

relative to that of the plate, the bulbs will selectively and alternately transmit the different wave portions of the circuit current to the operating coils.

5 For example, when the conductor 37 is positive relative to the conductor 38, the filament of bulb 32 will be positive relative to its plate and no current will traverse the bulb 32.

10 However, at the same time, the conductor 38 being of negative polarity, the filament of bulb 33 will be negative relative to its plate and current will traverse the bulb 33. The current traversing bulb 33 energizes coil 20 to attract the core member 21 toward the coil 20. Since the core member 21 is relatively stationary, the coil structure rises as a unit on the core 21 during the energization of coil 20.

20 It will be seen, upon reference to the diagram of the coil circuits in Fig. 1, that the current traversing the bulb 33 energizes coil 20 only, since coil 19 is connected in circuit with the bulb 33 and must receive current through that bulb.

25 As the current in the circuit alternates and the conductor 38 becomes positive relative to conductor 37, the filament of bulb 32 becomes negative relative to its plate and transmits current which energizes coil 19. At this time the filament of bulb 33 is positive, being connected to conductor 38 and bulb 33 transmits no current to coil 20.

30 The coil 19 being now energized, the coil structure is moved downward by the combined force of coil 19 and of gravity.

35 The vibrating member 18 thus vibrates the electrode 11 at a frequency corresponding to the frequency of alternation of the current in the circuit 30 for an interval of time depending upon the lengths of the segments 43 and 44 and the speed of the motor 39.

40 By reason of the advanced position of the filament segments 43 relative to the coil segment 44 the bulbs are rendered effective to transmit current before the coil circuits become closed.

45 After the predetermined interval of operation, the circuits of the filaments are opened and the bulbs are rendered ineffective to transmit current, thus precluding further energization of the operating coils until the next operating period.

50 The vibrating device is illustrated as suspended from one electrode. In the cement industry, a plurality of precipitation chambers, such as I have herein illustrated, are disposed to constitute a single precipitation unit. By properly joining the lower ends of the several suspended electrodes in the several chambers, to a common movable member, a single vibrating device may be applied to control all of the electrodes of one precipitation unit.

55 I have herein illustrated and described the application of the control mechanism to vibrating the suspended electrode to dislodge

the collected particles, but it may be similarly applied to control the periodic energization of a reciprocating motor arranged to vibrate the electrode 10^a constituting the wall of the precipitation chamber by causing the core 21 to strike the chamber wall through a rod 50 controlled by the core and suitably disposed adjacent the wall of the chamber. 70

75 Although I have shown a device and system of one type for accomplishing the result desired, various changes may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim as my invention:— 80

1. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising an electromagnetic reciprocating device, electroionic control means therefor, and means for periodically energizing said control means. 85

2. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device, means for controlling the operation thereof, and a timing device for controlling the controlling means. 90

3. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device, and automatic timing means for controlling the operation of said device. 95

4. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device, an electric valve for controlling its operation, and means for energizing the valve. 100

5. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a device for periodically varying the tension in said conductor, electroionic control means therefor, and timing means for first rendering the control means operative and then subjecting the tension-varying element to the influence of the control means. 105

6. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a device for impressing a periodic force upon the conductor, control means for said equipment, and means for first establishing an operative condition in the control means and then subjecting the element to its control. 110

7. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device for the conductor, a valve for controlling the oper- 115

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ation of the vibrating element, and a timing device for first energizing the valve and then subjecting the vibrating element to its control.

8. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device for the conductor, a valve device comprising a filament for controlling the vibrating element, and a timing device for controlling the energization of the filament.

9. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device embodying an operating coil for vibrating the conductor, an electroionic valve disposed to control the circuit of the coil, said valve embodying a filament, and a timing device for controlling the circuit containing the valve and the operating coil of the vibrating device and the circuit containing the filament.

10. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device embodying an operating coil for vibrating the conductor, an electroionic valve disposed to control the circuit of the coil, said valve embodying a filament, a switch in circuit with the filament, a switch in circuit with the operating coil, and means for periodically closing said switches.

11. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device embodying an operating coil for vibrating the conductor, an electroionic valve disposed to control the circuit of the coil, said valve embodying a filament, a switch in circuit with the filament, a switch in circuit with the operating coil, and means for periodically closing said switches for predetermined intervals of time.

12. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device embodying an operating coil for vibrating the conductor, an electroionic valve disposed to control the circuit of the coil, said valve embodying a filament, a switch in circuit with the filament, a switch in circuit with the operating coil, and timing means for controlling said switches.

13. In an electric precipitator, the combination with a vertically suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device embodying an operating coil for vibrating the conductor, an electroionic valve disposed to control the circuit of the coil, said valve embodying a filament, a switch in circuit with

the filament, a switch in circuit with the operating coil, and timing means for controlling said switches comprising a movable drum, segments thereon, contact fingers for engaging said segments and a motor for imparting movement to said drum.

14. In an electric precipitator, the combination with a suspended electrode secured at one end, of means for vibrating the electrode comprising means for alternately increasing and decreasing the tension of the electrode by a force applied at the other end, along the line of suspension.

15. In an electric precipitator, the combination with a suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device, means for controlling the operation thereof, and a timing device for controlling the controlling means.

16. In an electric precipitator, the combination with a suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device and automatic timing means for controlling the operation thereof.

17. In an electric precipitator, the combination with a suspended conductor, of means for periodically vibrating the conductor comprising a vibrating device, an electric valve for controlling its operation, and means for energizing the valve.

18. The combination with a suspended electrode of an electric precipitator, of means for vibrating said electrode comprising a vibrator having relatively movable members, one of which is a winding and one of which is a magnetizable member influenced thereby, and means suspending one of said members upon said electrode.

19. An electric precipitator comprising a tubular electrode, a cooperating electrode, electro-magnetic means for vibrating said tubular electrode, and electro-magnetic means contained within said tubular electrode for vibrating said cooperating electrode.

20. In an electric precipitator, positive and negative electrodes, one of said electrodes comprising a suspended conductor, and a vibrating element of electro-magnetic means adapted to vibrate and impart movement to said conductor.

21. An electric precipitator comprising an electrode, a cooperating tubular electrode fixed with respect thereto, electro-magnetic means for effecting vibratory movement of said electrode.

22. In an electrical precipitator, a suspended electrode, a magnetizable element mounted thereon, and electro-magnetic means having appreciable mass supported by said electrode adapted for reciprocal relative movement with respect to said magnetizable element whereby the inertia of said electro-magnetic means effects vibration of said electrode.

23. In an electrical precipitator, a suspended electrode, and electro-magnetic means including a part connected to said electrode and a second part having appreciable mass movable with respect to said first part and operable to impart vibratory movement to the latter.

In testimony whereof, I have hereunto subscribed my name this 17th day of November, 1923.

CARL S. WEYANDT.