

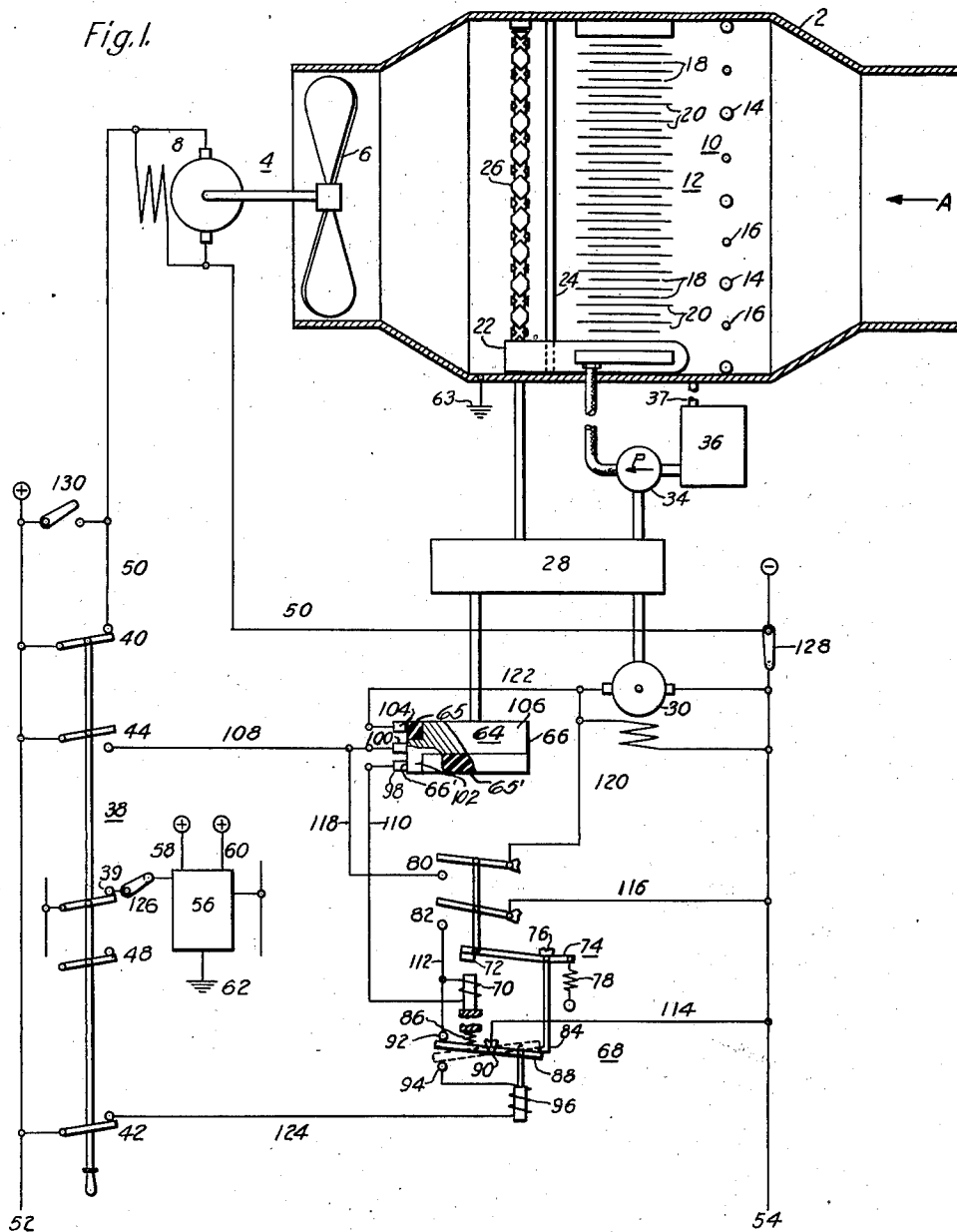
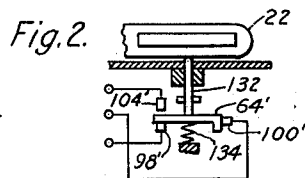
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PRECIPITATION SYSTEM

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PRECIPITATION SYSTEM

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Our invention relates to electrical dust-precipitators having intermittently operated means for removing precipitated dirt from its electrodes, the dust-precipitators being preferably, but not necessarily, of a type which first charges gas-borne dust-particles in an ionizing zone and subsequently precipitates the charged particles from the gas-stream.

Electrostatic precipitation has been successfully tried for cleaning air in traveling railway-cars. The small space available for carrying such equipment has made it necessary to use a compactly arranged dust-precipitator having less space allotted for dirt layers inside the assembly of its dust-collecting electrodes or members, than is the case with more liberally designed units; and it is desirable to provide a small built-in travelling electrode-cleaning mechanism which forcibly removes dirt layers precipitated on the electrodes by successively discharging a clean fluid into successive portions of the dust-collecting assembly.

It is among the objects of our invention to provide an electrostatic dust-precipitating system having a control such that a single operation will start a cleaning mechanism which thereafter will progressively clean the dust-precipitator without further attention; the mechanism stopping after it has completed its cleaning cycle or function.

For the application of our invention, an electrostatic dust-precipitator is provided with an electrode-cleaning mechanism having a nozzle, and operating and control means for moving the nozzle from a starting or rest position, across the dust-collecting portion of the electrostatic dust-precipitator, and then back to its starting position, this cycle occurring once or as many times as desired. Liquid is supplied to the moving nozzle which discharges it toward the dust-collecting portion so that the dust-collecting portion is slowly, progressively cleaned. A system of this kind is disclosed in the copending patent application of G. W. Penney and G. W. Hewitt, Serial No. 603,503, filed concurrently herewith.

An important object of our invention is to provide an electrostatic dust-precipitator having such an electrode-cleaning mechanism which is normally at rest, but startable by an impulse for automatically causing its nozzle to travel over a definite extent of the dust-collecting members of the dust-precipitator. When the nozzle reaches its stopping position, the mechanism assumes a condition requiring a preparatory im-

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pulse before another starting impulse can cause it to repeat its cleaning cycle.

Other objects, features, innovations, combinations, methods and details of our invention will be discernible from the following description of a preferred form thereof, which is to be taken in conjunction with the accompanying schematic drawing, in which:

Figure 1 is a view representing an electrostatic dust-precipitating system provided with an electrode-cleaning mechanism; and

Fig. 2 is a view showing another embodiment of a part which can be substituted for a part in the system of Fig. 1.

Referring to the drawing, a gas-duct 2 is shown which may be part of an air-conditioning system of a railway-car. A fan 4, comprising a propeller 6 and an electric motor 8, forces a gas-flow through the gas-duct in the direction of the arrow "A."

A gas-cleaning means is provided in the gas-duct 2, which comprises an ionizing means 10 and a precipitating means 12. The ionizing means comprises a plurality of elongated spaced relatively large tubular ground electrodes 14 and intermediate ionizing wires 16 between them. The electrodes and wires are relatively insulated, with the wires preferably maintained at a positive high potential with respect to the electrodes 14 which are grounded or electrically conductively connected to the gas-duct 2. Ionizing means of this kind is now relatively well-known. The precipitating means 12 comprises an assembly of a plurality of spaced relatively alternately insulated and uninsulated plate-electrodes 18 and 20. The insulated plate-electrodes 18 are smaller than the grounded plate-electrodes 20. An electrostatic field is provided between the plate-electrodes by maintaining the plate-electrodes 18 at a high positive potential with respect to the plate-electrodes 20.

In the operation of the apparatus thus far described, dust-carrying gas passes through the ionizing means 10, where the gas-borne dust-particles are charged. The gas then passes through the precipitating means 12, where the charged dust-particles are precipitated onto the plate-electrodes which function as dust-collecting members. The precipitated dust accumulates on these plate-electrodes and it is desirable to clean them occasionally in order to maintain the operating efficiency of the gas-cleaning equipment, and for other reasons.

To this end, a nozzle 22 is supported somewhat above the top edges of the plate-electrodes,

in a manner for permitting the nozzle to be moved across the top side of the precipitating means 12 from one end to the other and back. Any suitable guide rails, indicated at 24, may guide and support the nozzle. The nozzle is moved through a reversing screw 26 into the grooves of which a bar which is secured to the nozzle extends. The reversing screw 26 is of the well-known type which causes a member meshed with its screw-grooves to travel for the length of the screw and automatically reverse its direction of travel at each end of the screw.

The screw 26 is driven, through a reducing gearing 28, when an electrical motor 30 is energized. The motor 30 when energized, also drives an oil-pump 34 which pumps oil from a reservoir or container 36 to the nozzle 22 which directs the oil, under pressure, across the top of the portion of the precipitating means with which it is aligned. The oil removes dirt on the dust-collecting members 18 and 20 and the dirtied oil flows into a drain 37 which returns the oil to the container 36, where it can be cleaned.

The operating means, comprising the nozzle 22, the pump 34 and the motor 30, is operated under the control of an electrical control means which, in the preferred form of our invention, also shuts down the gas-flow while the operating means functions.

The control means includes an operable switch 38 movable to a plurality of different positions in which it closes different circuits for controlling different operations of the system. In the drawing, the switch 38 is shown as a manually-operable switch having an upper position in which its contacts 39, 40 and 42 are closed and its contacts 44 are open, and a lower position in which the contacts 39, 40 and 42 are open and the contacts 44 are closed. Additional switch contacts 48 are shown as illustrative of other circuits which may be controlled by the switch. The switch contacts 40 control an energizing circuit 50, connected between power lines 52 and 54, for the fan motor 8. In closed position of the contacts 40, the motor 8 is energized, establishing a gas-stream in the gas-duct 2. The switch contacts 39 control an independent circuit which includes a power-pack 56 for providing when the contacts 39 are closed relatively high voltages for the ionizing wires 16 and for the insulated high-voltage plate-electrodes 18 through conductors 58 and 60. The high-voltage circuits have one end grounded, as indicated at 62 at the power-pack and at 63 at the gas-duct 2. When the operating switch 38 is moved to its down position, the motor 8 and the power-pack 56 are deenergized, and operation of the electrode-cleaning mechanism is initiated.

The control means also includes a plurality of circuits controlled by a rotatory circuit-controlling drum driven by the gearing 28 in fixed relation with the movement of the nozzle. The drum includes a conducting drum-contact 64 and insulating segments 65 and 65'. Such drums are well known, and in Fig. 1, the drum-contact 64 has been shown as a development, it being understood that its edges 66 and 66' are contiguous to each other. The control means also includes a trip relay 68 having an operating coil 70 which, when energized, attracts an armature 72 secured to a bell-crank 74 which pivots about a pivot 76 against the action of a restoring spring 78. When the coil 70 is deenergized, the spring 78 pulls the armature away from the coil. In attracted position of the armature, relay contacts

80 and 82 are closed, these contacts being opened when the operated coil 70 is deenergized. When the bell-crank 74 moves in response to attraction of the armature 72 toward the coil 70, its lower leg 84, which is in the form of a latch, is moved so as to permit a compression spring 86 to push a contact-lever 88 counterclockwise about a pivot 90. This causes the contact lever to break contact with a front contact 92 and make contact with a back contact 94, the contact-lever finally assuming a position shown by the dotted lines. When the coil 70 is deenergized, the contact-lever 88 remains in its operated position shown by the dotted lines but can be restored to its full-line position by energization of a resetting coil 96 which pulls an end down so that it can be latched by the latching leg 84 of the bell-crank 74. This resets the relay.

In the normal rest position of the drum, stationary brushes 98 and 100 are in engagement with a start-portion 102 of the conducting drum-contact 64 which completes a conducting path between the brushes. In this position, a stationary brush 104 engages the insulating segment 65 so that the circuit-path between it and the brush 100 is open. Upon energization of the motor 30, it drives, through gearing 28, both the nozzle-device and the drum. The latter rotates away from its rest position, thereby interrupting the circuit-path between the brushes 98 and 100, because the insulating segment 65' moves under brush 98. At the same time brushes 100 and 104 are bridged by a running portion 106 of the drum-contact 64, thereby completing a circuit-path between the brushes 100 and 104. This condition persists until the drum-contact 64 is rotated to a position where the insulating segment 65 again passes under the stationary brush 104 and the start-portion 102 bridges the stationary brushes 98 and 100.

During gas-cleaning, the control means, including the operating switch 38, is in the condition shown, with contacts 39, 40 and 42 closed, the nozzle 22 in its normal rest or start position, and the drum-contact 64 in a normal rest position. The resettable relay 68 has its contacts 80 and 82 open, and its contact-lever 88 latched in the full line position.

When the switch 38 is moved to down position, contacts 39 and 40 open, and contacts 44 close completing an initial circuit from the power-line 52 through the closed contacts 44, a conductor 108 connected to the brush 100, the start-portion 102 of the drum-contact 64, the brush 98, a conductor 110, the operating coil 70 of the resettable trip relay 68, a conductor 112, the front contact 92, contact lever 88 and a conductor 114 connected to the other power-line 54. Energization of the operating coil 70 trips the contact-lever 88 which disengages from the front contact 92, but at the same time contacts 80 and 82 close, the latter completing an alternate or holding circuit for maintaining the operating coil 70 energized, this alternate circuit extending from the conductor 112 through the closed contacts 82 and a conductor 116. When the contact-lever 88 is released, it engages back contact 94, but nothing happens because the circuit including this contact is open at switch contacts 42 when the switch 38 is in down position.

Closing of the contacts 80 completes an energizing circuit which starts the motor 30, this circuit including conductor 108, conductor 118, contacts 80 and conductor 120. The energized

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motor 30 simultaneously, through gearing 28, moves the nozzle 22 slowly toward the other end of the gas-duct 2, operates the oil-pump 34 for delivering oil to the nozzle, and rotates the drum having the drum-contact 64.

Rotation of the drum-contact causes the start-portion 102 to leave the brush 98, thereby interrupting the circuit for the operating coil 70 which thereby becomes deenergized. At the same time, the brush 104 is engaged by the running portion 106 of the drum-contact 64, thereby completing a running circuit to the motor 30. This running circuit is substituted for the motor starting circuit, previously described, which included the contacts 80. The running circuit comprises the conductor 108, brush 100, running portion 106, brush 104, and conductor 122. The motor 30, therefore, continues to move the nozzle slowly across the top of the precipitating means 12, progressively cleaning it. When the nozzle reaches the other end or side of the gas-duct, the screw 26 automatically reverses its movement so that it moves back toward its original starting position. With the apparatus adjusted for a single back and forth traverse of the precipitator by the nozzle, the latter reaches this position at the same time that the drum-contact 64 reaches its normal position, shown in Fig. 1, where the brush 104 is engaged by segment 65, opening the motor circuit, and the brush 98 is engaged by the start-portion 102. However, the operating coil 70 is not reenergized because the contact-lever 88 is in its disturbed position, out of engagement with the front contact 92 which is in the initial operating circuit for the coil 70, and the alternate operating circuit for the coil 70 is open at the contacts 82. This means that the contacts 80 are also open so that the starting circuit for the motor 30, which includes these contacts, cannot be energized until after the contacts 30 are again closed.

Accordingly, a single movement of operating switch 38, by opening the contacts 40 stops the gas-flow through the gas-duct, by opening the contacts 39 cuts off the energy supply to the electrodes of the electrostatic gas-cleaning dust-precipitating means, and by closing the contacts 44 starts an electrode-cleaning operation which automatically stops after the nozzle 22 makes a single back and forth traverse of the precipitating means 12.

When it is desired to again provide a clean gas-stream, the operating switch 38 is moved to its upper position in which its contacts 39 and 40 reenergize the power-pack 56 and the fan-motor 3, and its contacts 42, now closed, complete a circuit for energizing the resetting coil 96 through a circuit comprising a conductor 124, the resetting coil 96, back contact 94, contact-lever 88 in association with the back contact, and conductor 114. Energization of the resetting coil 96 jerks the contact-lever 88 clockwise about its pivot 90 so that it resets under the latching leg 84 of the bell-crank 74. The movement of the contact-lever 88 interrupts the circuit to the resetting coil 96 and prepares the initial circuit to the operating coil 70, which passes through the front contact 92. However, this last circuit is not completed because the switch contacts 44 are now open. Accordingly, operating the switch 38 for starting of the gas-flow through the gas-duct 2 automatically resets the relay 68, and the electrode-cleaning mechanism is prepared to operate for cleaning the dust-precipitator when the op-

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erating switch 38 is subsequently moved to its down position for stopping the gas flow.

Apparatus of the type herein described has a distinct advantage in railway application where it is desirable to provide automatic cleaning of the dust-precipitator at the end of a train run or when a car is taken out of service. The switch 38 can be moved to its down, or a first, position where it automatically stops the car-ventilating system and automatically starts a cycle of electrode-cleaning operations that automatically stop only after a predetermined cycle of cleaning operations is completed, so that an operator is not required to wait. The car-ventilating system can be again started by simply moving the switch to its up, or a second, position. Accordingly, an electrostatic dust-precipitator is incorporated in the operation-controlling apparatus of the conventional car ventilating system, which does not require additional manipulations on the part of an operator.

If it is desired to use the ventilating system without gas-cleaning, normally closed switches 126 and 128 may be opened and normally opened switch 130 may be closed. It is evident that the apparatus can be made such that the nozzle travels any desired distance. For example, by cutting the speed of the drum contact 64 in half, the nozzle will make two complete back and forth movements over the precipitator.

In Fig. 1, the drum-contact 64 is driven so that its displacement is proportional to the movement of the nozzle 22 from its starting position. However, it may be observed that, when the nozzle is in the starting position, a circuit is completed across the brushes 98 and 100 by the start-portion 100, while the circuit across the brushes 100 and 102 is interrupted. After the nozzle leaves its starting position, the former circuit is interrupted and the latter closed. Accordingly, it is possible to substitute a movable contact operated directly by the nozzle 22, and such a modification is shown in Fig. 2, in which a slidable pin 132 is provided that bears against a contact 64', which is forced toward the pin by a spring 134. In the normal resting position of the nozzle-device 22, it forces the pin 132 against the contact 64' which is pressed, against the action of the spring 134, to a position in which it completes a circuit across the brushes 98' and 100'. When the nozzle 22 moves away from its starting position, the spring 134 moves the contact 64' so as to interrupt the circuit between the brushes 98' and 100' and complete the circuit between the brushes 100' and 104'. The brushes 98', 100' and 104' are connected in the control means in the same manner as the brushes 98, 100, and 104.

While we have described our invention in a preferred form, it is evident that the apparatus has been shown schematically so that it can be readily understood without too much detailed description. Obviously, many modifications and different embodiments, utilizing the teachings of our invention, are possible, and it is desired that the claims be so construed.

We claim as our invention:

1. An electrostatic dust-precipitating system of a type described, comprising electrical gas-cleaning means including a plurality of dust-collecting electrodes operable for cleaning a gas-stream, a settable means operable, after first being set from an unset condition, for cleaning said dust-collecting electrodes, comprising control means placeable either in a first position

rendering said electrical gas-cleaning means operable or in a second position in which it operates said settable means, if set, through a predetermined electrode-cleaning cycle after which the settable means becomes unset, and means operated when said control means is changed from said second position to said first position for automatically setting said settable means for subsequent operation as aforesaid, said settable means being inoperable for electrode cleaning while unset.

2. An electrostatic dust-precipitating system of a type described, comprising gas-duct means, an electric fan operable for creating a gas-flow in said gas-duct means, electrical gas-cleaning means comprising a plurality of dust-collecting electrodes in said gas-duct means, an electrode-cleaning device comprising a nozzle directed toward said dust-collecting electrodes, means for supporting said nozzle for movement along a side of said dust-collecting electrodes, an electric motor operable, when energized, for moving said nozzle, energizing means including switch means for selectively energizing said fan and said motor, a resettable relay-means operable from reset position for providing a starting circuit for said motor, a distinct circuit for maintaining said motor energized, after being started, for moving said nozzle a predetermined distance and then deenergizing the motor, said relay-means becoming unset after each operation, said switch means being operable, after operation for energizing said fan, to reset said relay means.

3. An electrostatic dust-precipitating system of a type described, comprising gas-duct means, an electric fan for providing a gas-flow in said gas-duct means, electrical gas-cleaning means comprising a plurality of dust-collecting electrodes in said gas-duct means, high-voltage-providing means for said electrical gas-cleaning means, an electrode-cleaning device comprising a nozzle directed toward said dust-collecting electrodes, means for supporting said nozzle for movement along a side of said dust-collecting electrodes, an electric motor means operable, when energized, for moving said nozzle and for supplying cleaning liquid to said nozzle, and energizing means including selectively operable switch means for energizing either said electric fan and high-voltage-providing means or said electric motor means, a resettable relay-means operable from reset position for providing a starting circuit for said motor means, a distinct circuit for maintaining energization of said motor means while the nozzle is moving, said relay means becoming unset after each operation, and separate means operable when said switch means can energize said fan and high-voltage-providing means, for resetting said control relay-means so as to be prepared for subsequent operation.

4. An electro-static dust-precipitating system of a type described, comprising gas-duct means, electrical gas-cleaning means comprising a plurality of dust-collecting electrodes in said gas-duct means, an electrode-cleaning device comprising a nozzle directed toward said dust-collecting electrodes, means for supporting said

nozzle for movement along a side of said dust-collecting electrodes, means for supplying said nozzle with a liquid during its movement, an electric motor for moving said nozzle, a settable means, a switch means having a first position and a second position, means operable when said switch means is in said first position for providing gas-cleaning by said electrical gas-cleaning means, and for resetting said settable means, and means associated with said second position of said switch means for energizing said electric motor, if said settable means is set, said relay means becoming unset upon energization of said electric motor, and remaining unset thereafter until reset by said switch means.

5. An electrostatic dust-precipitating system of a type described, comprising gas-duct means, electrical gas-cleaning means comprising a plurality of dust-collecting electrodes spaced across said gas-duct, means for supporting said nozzle for movement across the top of said dust-collecting electrodes from end to end, a motor for moving said nozzle, and control means for including a first circuit for energizing said motor for automatically causing said nozzle to make a complete traverse of its path, starting at one end and returning to said one end, and then stopping, said control means including means operable by said nozzle for interrupting said first circuit when said nozzle is at said one end, and biased to complete said first circuit when said nozzle is away from said one end, and a second circuit and switch means for completing said first circuit when said nozzle is at said one end, said switch means including a resettable device which prevents said second circuit from completing said first circuit a second time unless reset, and separate means for so resetting said device.

6. An electrostatic dust-precipitating system of a type described, comprising, in combination, an electrostatic gas-cleaning means including a plurality of dust-collecting electrodes; operable gas-moving means; an electrode-cleaning device comprising a nozzle directed toward said dust-collecting electrodes, means for supporting said nozzle for movement along a side of said dust-collecting electrodes, and an electric motor for moving said nozzle; control means comprising an unsetting and resettable trippable device and a motor-control means for moving said nozzle a predetermined distance along said side of said dust-collecting electrodes, and then unsetting said trippable device; said trippable device, when unset, preventing subsequent energization of said electric motor, and, when reset, permitting energization of said electric motor; said control means comprising an interlock selectively operable to a first condition for initiating and maintaining operation of said gas-moving means, or to a second condition rendering said gas-moving means inoperable and initiating energization of said electric motor by said motor-control means in the manner aforesaid; said control means resetting said trippable device when said interlock is operated to said first condition.

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