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V. J. LINGER
ELECTROPRECIPITATOR

2,857,978

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2 Sheets-Sheet 1

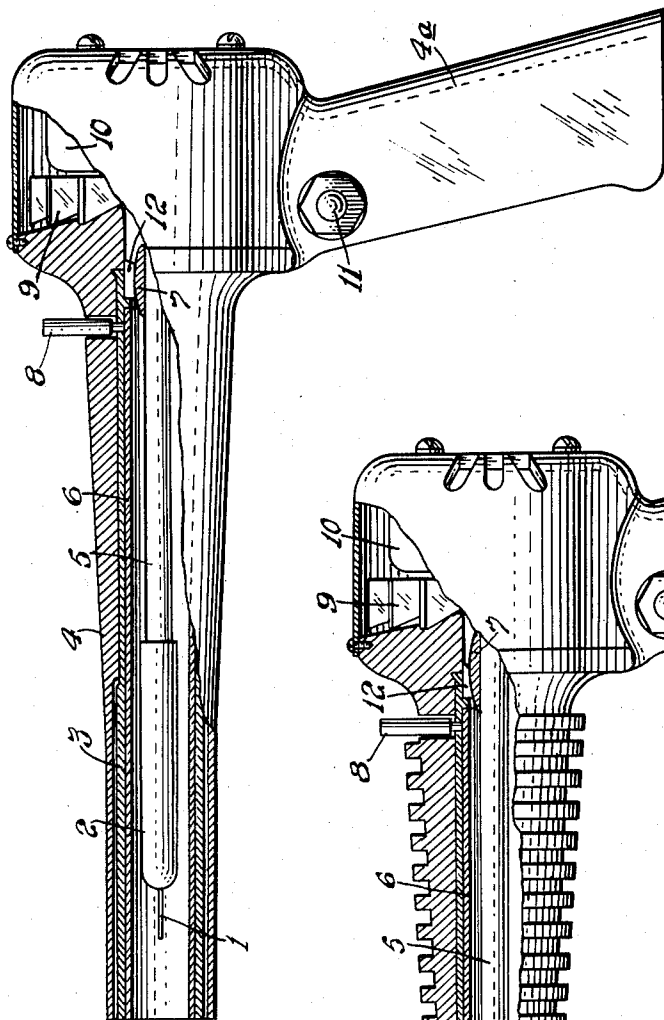


Fig. 1

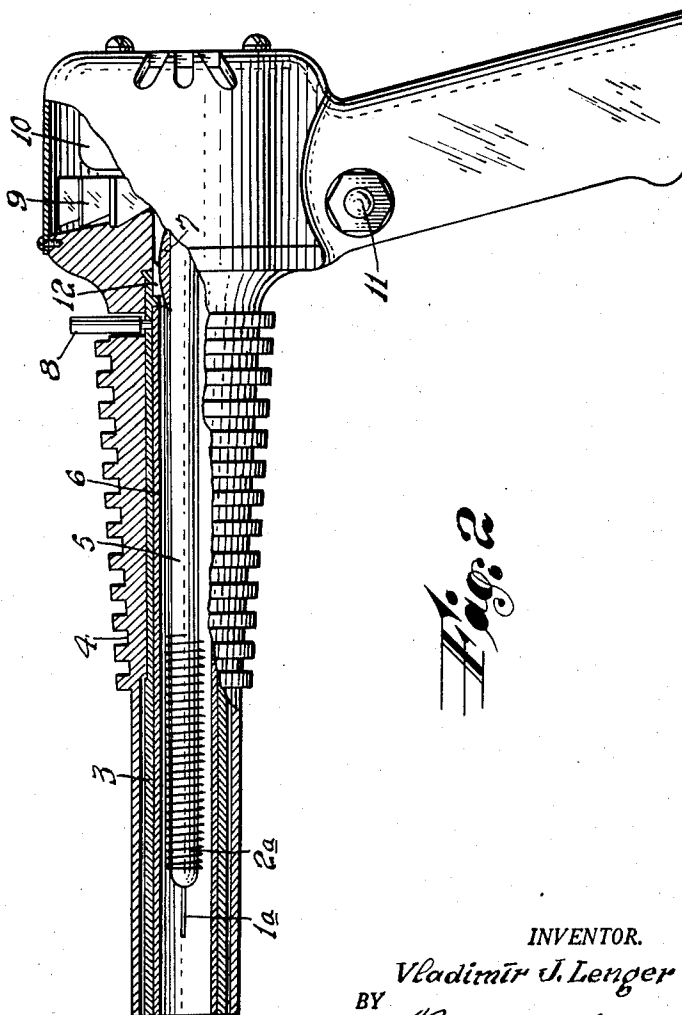


Fig. 2

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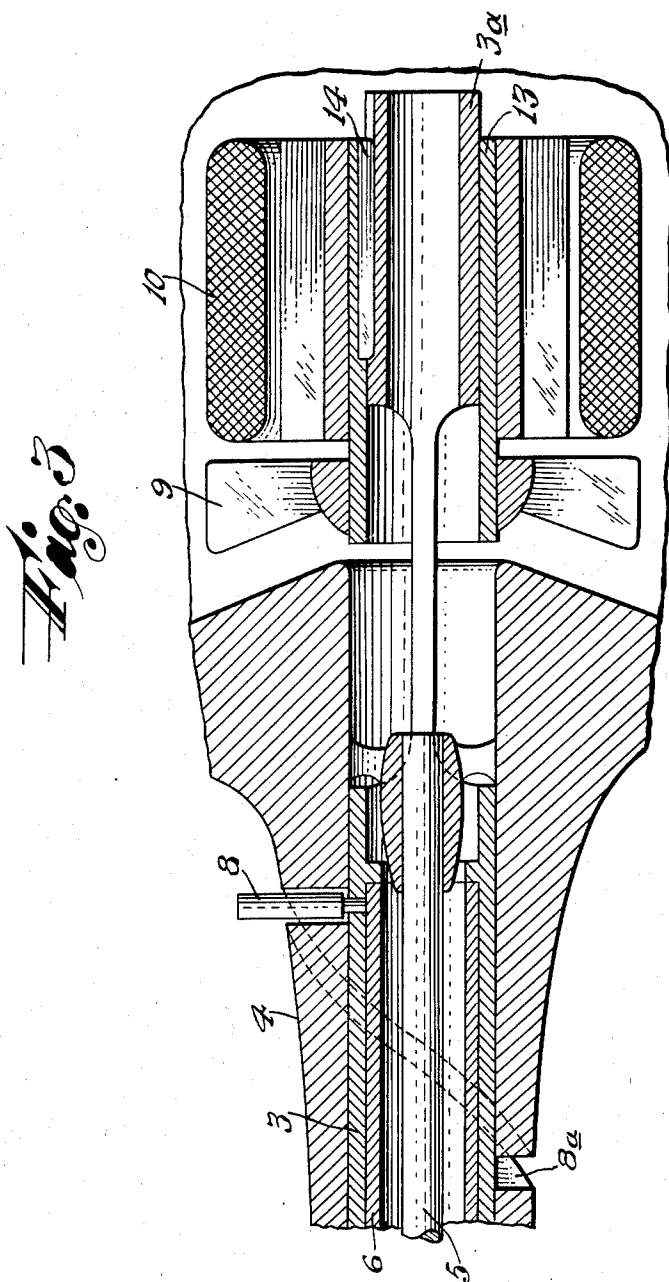
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ELECTROPRECIPITATOR

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6 Claims. (Cl. 183—7)

This invention relates to the testing of air contaminated with aerosols, that is, with suspended fine solid or liquid particles, such as, dust, smoke or fumes, and is particularly directed to a suitable device for such testing.

Among all kinds of devices available for determining the content of solid or liquid particles suspended in air, electroprecipitators show maximal efficiency. The known electroprecipitators include fixed tubular coaxial electrodes and means for passing a measured amount of the tested air passing between them so that the charged particles are precipitated on the anode surface. The known electroprecipitators are useful only for aerosol concentrations 8.10^3 or lower; their efficiency being rapidly decreased by the deposit precipitated on the anode surface. The low conductivity of the deposit increasingly interferes with the transfer of the charges and the efficiency declines soon to 50–30 percent of the optimal value. This decrease in efficiency is caused by the fact that part of the particles, particularly the heavier particles, pass the space between the electrodes with the air stream without being sufficiently charged and captured on the anode. Thus, the results obtained in strongly contaminated air are unreliable. Air must be passed through the electroprecipitator for a sufficient period of time in order to secure the testing of an average sample, and precise determination of the degree of contamination requires the maintenance of optimal conditions for precipitation throughout the test period.

An object of the present invention is to secure the more reliable testing of the air particularly in industrial work rooms, mines and the like, which may be contaminated with dust of various chemicals, with smoke, mineral acid fumes, fine silica or radioactive dust. Another object of this invention is to provide an improved, more reliable and readily employed instrument for testing air contaminated with aerosols of various kinds.

In accordance with this invention an electroprecipitator is provided with two electrodes having different lengths, at least one of which is periodically or continually shifted with respect to the other in parallel direction, in order to always expose to the passed air an anode surface which is not coated with a heavy layer of precipitated particles and thus has a constantly high precipitating activity which is not reduced by a comparatively thick layer of the precipitated particles. In an advantageous embodiment of the invention the anode is in the form of an outer tubular electrode which is movable along the inner cathode in a direction parallel to the axis of the latter.

In a further advantageous embodiment of the invention, the cathode is electrically heated in order to increase the thermal gradient between the electrodes. The fine particles of the aerosol are thereby subjected to a more rapid motion and the average time required for their passage between the electrodes is shortened. The force acting on the particles is directly proportional to the thermal gradient and inversely proportional to the absolute temperature.

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In the preferred embodiment of the invention the usual ionization cathode is combined with a thermoelectric cathode, and both cathodes have the same voltage impressed thereon, the thermoelectric cathode forming a thermal barrier for the particles of the aerosol.

The device according to this invention is suitable for testing air of both low and high aerosol particle concentrations including radioactive smoke and fumes. The sample of the precipitated particles on the inner surface of the interchangeable tubular anode may be subjected to gravimetric, konimetric or radiophysical analysis.

The invention will be further described with reference to the accompanying drawings, wherein:

Fig. 1 is an elevational view, partly broken away and in longitudinal section of an electroprecipitator embodying this invention;

Fig. 2 is a view similar to that of Fig. 1, but showing another embodiment of the invention; and

Fig. 3 is an enlarged sectional detail view showing a suitable mechanical means for effecting relative movement of the electrodes of the devices in Figs. 1 and 2.

Referring in detail to Fig. 1 of the drawings, it will be seen that the electroprecipitator there illustrated includes a housing or casing in the form of a rigid barrel 4 having a pistol grip 4a at one end. A tubular sleeve 3 is slidable within the barrel 4, and an interchangeable tubular anode 6, which may be made of sheet aluminum having a thickness of 0.6 to 1.0 mm., is removably received within the sleeve 3 and normally moves with the latter.

A radial pin 8 projects from the sleeve 3 through a helical groove or slot 8a in the supporting barrel or body 4 so that the sleeve 3 and the anode 6 mounted therein can be displaced along the barrel 4 either by manually advancing the pin 8 along groove 8a or by a mechanical connection between the sleeve 3 and a motor 10 mounted within the handle end of barrel 4.

Fig. 3 shows, merely by way of example, a suitable mechanical connection for effecting displacement of the sleeve 3 along barrel 4 in response to operation of motor 10, and which includes an axial extension 3a on the sleeve 3 and a hollow motor shaft 13 telescopically receiving the extension 3a and connected to the latter, for example, by a key and slot connection 14, so that the extension 3a and sleeve 3 are rotated when motor 10 is operated. Since the pin 8 is received in the helical groove 8a of barrel 4, the rotation of sleeve 3 causes the pin to move along the helical groove or slot and thereby effects axial displacement of the sleeve 3 carrying anode 6 with respect to barrel 4.

The electroprecipitator of Fig. 1 further includes a cathode 1, 2 having a length which is substantially less than that of the cathode 6 and a smaller diameter than the internal diameter of the anode so that, when the cathode is mounted coaxially within the anode, as shown, an annular space is created therebetween through which the air to be tested is made to flow by an axial fan 9 mounted on the shaft of motor 10 and adapted to produce a constant rate of air flow. The cathode 1, 2 is mounted at the end of an insulating support member 5 which extends from a socket 7 carried within the barrel 4 at the end of the latter adjacent motor 10.

When operated manually, the anode 6 is shifted parallel to the direction of the axis of the cathode 1, 2 at certain periods of time during the testing of the air by rotating the pin 8 so that the latter moves along the groove 8a, and the position of the anode relative to the cathode can be observed by suitable markings applied to the barrel 4 and cooperating with the pin 8. A semiconductor anemometer 12 may be placed within barrel 4 adjacent fan 9 for checking the amount of the air passed through the precipitator. The instrument is put in operation by means

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of a switch 11 which is interposed in a conventional electrical circuit for the motor 10.

Since the cathode 1, 2 has an axial length substantially less than that of the anode 6, the aerosol particles are precipitated onto only that portion of the anode which is axially coextensive with the cathode at any instant. Thus, as the anode 6 is axially displaced, either manually or mechanically in response to operation of fan 9 by motor 10, as described above, successive portions of the anode are disposed axially coextensive with the cathode to receive the precipitated aerosol particles. Accordingly, as a layer of aerosol particles is deposited on a portion of the anode, the latter moves axially relative to the cathode to dispose an uncoated portion of the anode along the axial length of the cathode so that the precipitating efficiency of the device is not impaired by the build-up of the layer of precipitated particles and may be maintained at a uniformly high value throughout the test period, thereby ensuring that the amount of aerosol particles on the anode at the end of the test period is an accurate measure of the contamination of the tested air.

Referring now to Fig. 2, it will be seen that the electroprecipitator there illustrated is generally similar to that described above with reference to Fig. 1, and that the parts thereof are identified by the same reference numerals employed in connection with the corresponding parts of Fig. 1. The electroprecipitator of Fig. 2 differs from that of Fig. 1 only in that the cathode of the device of Fig. 2 includes the usual ionization cathode 1a and, in addition thereto, a hot thermoelectric cathode 2a for increasing the thermal gradient between the anode 6 and the cathode 1a, 2a, and for correspondingly increasing the force acting on the particles in the tested air, which force is directly proportional to the thermal gradient.

The drawings represent only two specific examples of the invention which is not limited thereto. It is clear that the same effect may be obtained if the anode is fixed and the cathode is movable axially with respect thereto, or if both the anode and cathode are moved to obtain the necessary relative axial displacement.

I claim:

1. An electroprecipitator for testing air contaminated with aerosol particles, comprising an outer tubular electrode having a rectilinear axis, an inner tubular electrode extending coaxially within said outer tubular electrode and spaced radially inward from the latter to define an annular passage between said inner and outer electrodes, one of said electrodes being substantially longer than the other of said electrodes, means for causing a flow of the air to be tested through said annular passage while an electrostatic field and an ionization field are created between said electrodes so that aerosol particles contained in the air are charged and deposited on that portion of said one electrode which is then coextensive with the length of said other electrode, said electrodes being axially movable with respect to each other, and means for effecting axial, relative movement of said electrodes during the flow of air to be tested through said annular passage so that successive portions of said one electrode are disposed coextensive with the length of said other electrode to successively receive particles precipitated from the tested air and thereby maintain a relatively high precipitating efficiency.

2. An electroprecipitator for testing air contaminated

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with aerosol particles, comprising an inner, fixed tubular cathode having a rectilinear axis, an outer interchangeable tubular anode coaxially receiving said cathode and having an internal diameter greater than the external diameter of said cathode to define an annular passage therebetween, said anode being substantially longer than said cathode and axially movable with respect to the latter, an electric motor, fan means driven by said motor and operative to cause a flow of air to be tested through said annular passage while an ionization field and an electrostatic field are created between said cathode and anode so that aerosol particles contained in the airflow are charged and deposited on that portion of said anode which is then axially coextensive with said cathode, and means for axially displacing said anode relative to said cathode during the flow of air through said annular passage so that successive portions of said anode are disposed axially coextensive with said cathode to successively receive particles precipitated from the tested air and thereby maintain a relatively high precipitating efficiency.

3. An electroprecipitator as in claim 2; wherein said cathode includes an electrically heated tubular thermoelectric cathode and an ionization cathode.

4. An electroprecipitator as in claim 2; wherein said means for axially displacing the anode relative to the cathode includes a hollow support surrounding said tubular anode and having a helical slot therein, and a radial pin extending from said anode through said slot for manual movement along the latter so that the anode is axially displaced in response to turning thereof by said pin.

5. An electroprecipitator as in claim 1; wherein said means for causing a flow of air through said annular passage includes a fan and an electric motor for driving said fan; and said means for effecting axial relative movement of said electrodes includes a mechanical connection between said motor and an electrode operative to cause axial displacement of the latter in response to operation of said fan.

6. An electroprecipitator as in claim 1; wherein said means for causing a flow of air through said annular passage includes a fan and an electric motor for driving said fan; and said means for effecting axial relative movement of said electrodes includes a hollow support surrounding said outer tubular electrode and having a helical slot therein, a radial pin extending from said outer electrode through said slot for movement along the latter, and a mechanical connection between said motor and said outer electrode to turn the latter so that said pin and slot cooperate to axially displace said outer electrode in response to turning of the latter upon operation of said fan.

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