

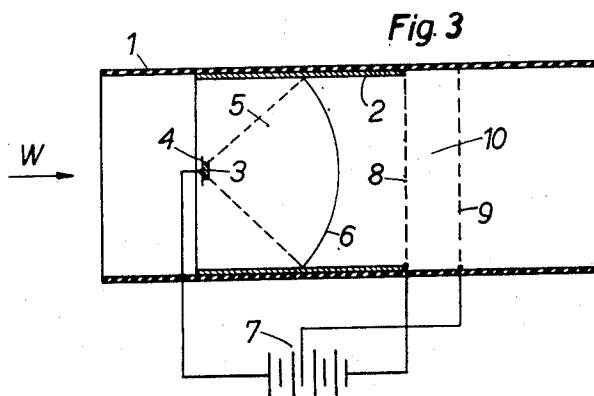
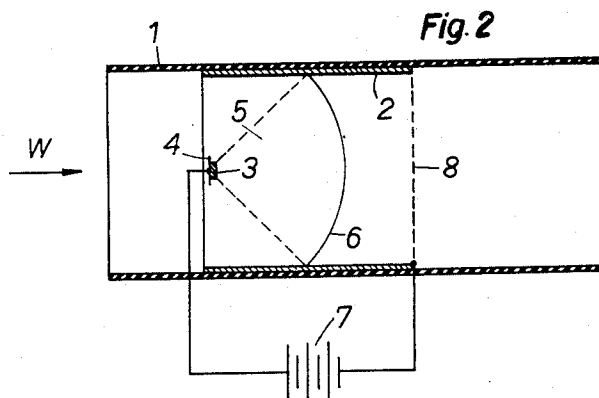
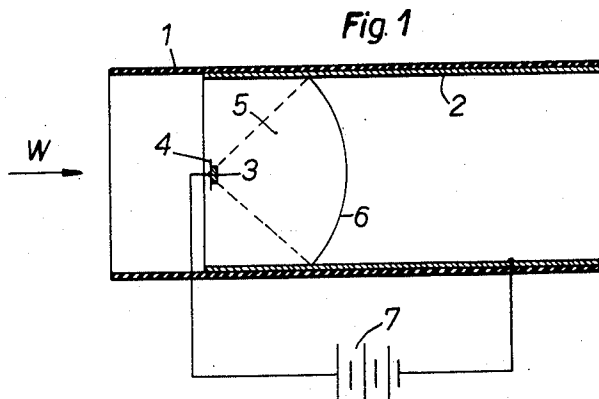
April 26, 1960

R. LEUPI ET AL
APPARATUS FOR THE ELECTRIC CHARGING BY MEANS OF
RADIOACTIVE PREPARATIONS OF MATTER
SUSPENDED IN A GAS STREAM

2,934,648

Filed April 25, 1955

3 Sheets-Sheet 1



INVENTORS
ROBERT LEUPI & JOHANN
SCHEDLING
BY: *Richards & Geier*
ATTORNEYS

April 26, 1960

R. LEUPI ET AL
APPARATUS FOR THE ELECTRIC CHARGING BY MEANS OF
RADIOACTIVE PREPARATIONS OF MATTER
SUSPENDED IN A GAS STREAM

2,934,648

Filed April 25, 1955

3 Sheets-Sheet 2

Fig. 4

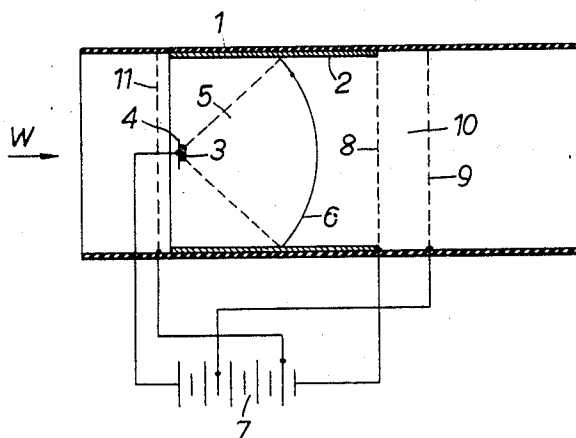


Fig. 5

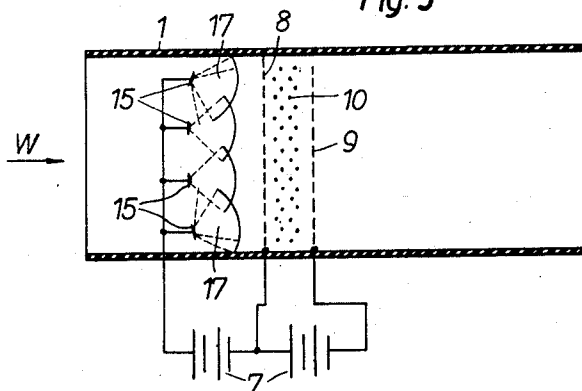
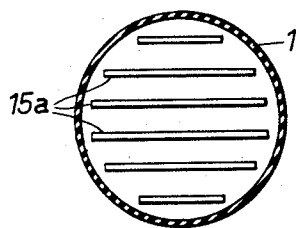


Fig. 5a



INVENTOR:

ROBERT LEUPI & J. SCHEDLING

By: *Richards & Geier*
ATTORNEYS

April 26, 1960

R. LEUPI ET AL
APPARATUS FOR THE ELECTRIC CHARGING BY MEANS OF
RADIOACTIVE PREPARATIONS OF MATTER
SUSPENDED IN A GAS STREAM

2,934,648

Filed April 25, 1955

3 Sheets-Sheet 3

Fig. 6

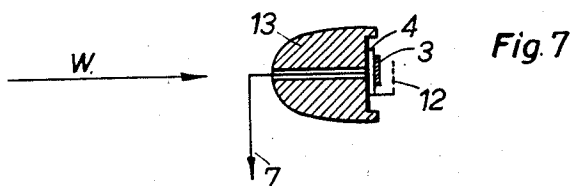
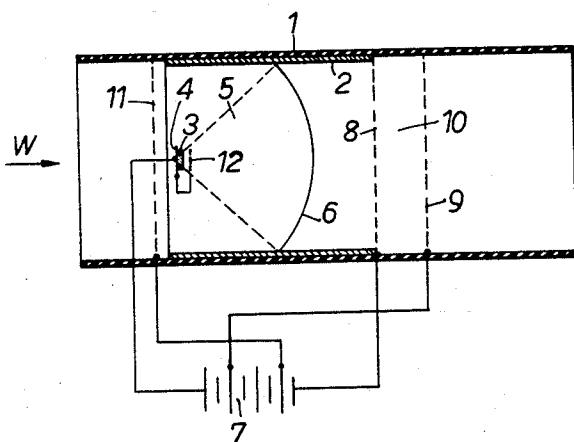
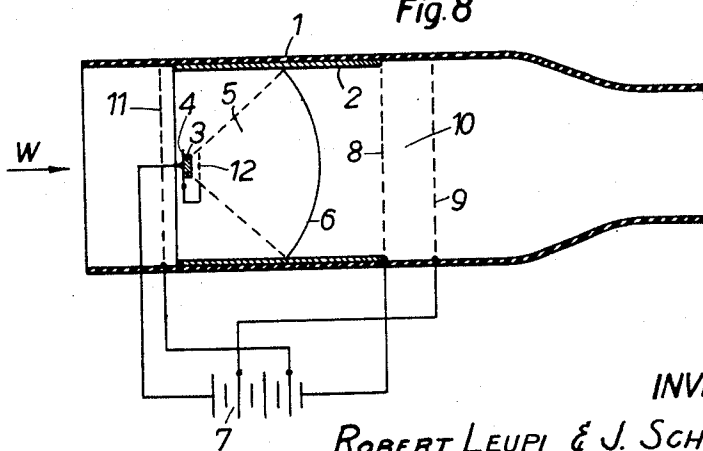


Fig. 8



INVENTOR:

ROBERT LEUPI & J. SCHEDLING

BY: *Richards & Geier*

ATTORNEYS

1

2,934,648

APPARATUS FOR THE ELECTRIC CHARGING BY MEANS OF RADIOACTIVE PREPARATIONS OF MATTER SUSPENDED IN A GAS STREAM

Robert Leupi, Sarnen, Switzerland, and Johann Schedling, Vienna, Austria, assignors to G. A. Messen-Jaschin, Sarnen, Switzerland

Application April 25, 1955, Serial No. 503,566

Claims priority, application Switzerland April 1, 1955

4 Claims. (Cl. 250—44)

The present invention relates to the electric charging of matter suspended in a gas stream, with ions of one polarity by means of one or several radioactive preparations for producing ions and an electrical field for producing optimum charging conditions.

Apparatus trying to attain this object with the above-mentioned means are already known. They all work imperfectly as they do not or at least not sufficiently take into consideration the characteristic particulars of the ionisation process and of the subsequent charging process. With respect to the ionisation process it should for example be considered that the specific ionisation of the alpha rays shortly before their complete braking at the end of their range passes through a very distinct maximum (Bragg's curve). An alpha source of small dimensions compared with its range is thus surrounded by a hollow spherical zone of maximum specific ionisation i.e. by a Bragg's zone. A layer emitting alpha radiation, suitably arranged in the surface of a metallic support and being of small dimension when compared with its range, emits a radiation cone limited at its base by a spherical calotte of maximum specific ionisation. In the apparatus according to the present invention these facts are specifically taken into consideration in that all further means for attaining an optimum charging, such as electrodes for producing electric fields and limiting surfaces for guiding the gas stream to be electrically charged, are arranged at the outside of the space limited by the range and the Bragg's zone.

The use of an electric field has also already been proposed for charging suspended matter, i.e. for preventing discharging of the latter by removal of the more easily movable charge carriers without too extensive energy losses in the subsequent separator. In the first case these means were destined to separate in the alpha channels closely arranged ions of both signs to prevent their recombination and to prepare them for deposit on the suspended matter.

In gas streams it has also been proposed to provide metal sieves for producing an electrical longitudinal field in the space traversed by the alpha rays in order to attain in this space under simultaneous action of the gas velocity and of the electric field, an excess of ions of one polarity and to accelerate the removal of the ions of the other sign. However, this cannot lead to a plain success as long as new ions of both signs are continuously formed in the field along the alpha tracks, whereby these ions which should be removed have the possibility to deposit on the suspended matter and thus to reduce the charging of the latter.

If, in contra-distinction thereto, as in the apparatus according to the present invention the electrodes destined to produce the field in the charging space are arranged at the outside of the radiation zone, i.e. with an alpha source arranged at the outside of the space limited by the radiation cone and the Bragg's zone, the electric field will partly be produced in spaces in which at least by beta and alpha rays no new ions will be formed. The field will

2

for this reason be especially strong in the last mentioned spaces and the ions of the not desired polarity may be quickly removed in these spaces so that zones are produced which practically exclusively contain ions of the desired polarity for charging the suspended matter. Preferably this aim may be attained by using in addition thereto the different mobility of the newly formed positive and negative ions.

Other features and advantages of the present invention will become apparent from the description now to follow of several embodiments thereof, given by way of example only, and in which reference will be made to the accompanying diagrammatic drawings, in which the use of the already mentioned alpha rays emitting layers at the surface of metallic carriers is set forth. In these drawings:

Fig. 1 is a first embodiment,

Fig. 2 is a second embodiment,

Fig. 3 is a third embodiment,

Fig. 4 is a fourth embodiment,

Fig. 5 is a variant to the embodiment of Fig. 3.

Fig. 5a is a cross-section showing a variant to the embodiment of Fig. 5,

Fig. 6 illustrates a variant to the embodiment of Fig. 4,

Fig. 7 shows a variant of a detail of the embodiments according to Figs. 1-6, and

Fig. 8 is a fifth embodiment.

In the drawings similar elements are provided with the same reference numerals throughout the figures.

The apparatus of Fig. 1 for the electric charging by means of alpha sources of matter suspended in gas stream, comprises a tubular housing 1 of insulating material being, in operation, traversed in direction of the arrow "w" by a gas stream. A cylindrical metal electrode 2 is arranged within the housing 1 and in the axis of said electrode 2 an alpha source 3 is provided on an electrically conducting support 4. The inner radius of the metal electrode 2 is substantially equal to the radius of the section of the radiation cone 5 of source 3, lying vertically to the plane of the drawing, with the Bragg's zone 6.

Thereby the alpha source 3 radiates in the direction w of the gas stream and is brought to a voltage with respect to the cylinder electrode 2 by means of a battery 7. The geometrical configuration of the employed electrodes and of the thereby produced electric field results, as experience has shown, in an excess of ions of the same sign as the electrode 4, more particularly in those spaces which will be of the greatest importance for the subsequent charging of the suspended matter.

The embodiment according to Fig. 2, which otherwise corresponds to the apparatus shown in Fig. 1, is provided at its down-stream end of the electrode 2 and outside of the Bragg's zone 6 with a metal sieve 8 connected with the electrode 2 and serving as additional counter-electrode. By means of this sieve electrode 8 a homogenisation is obtained in the Bragg's zone 6, of the field between the electrodes 2, 8 and the radiation carrier 4.

Instead of the alpha source the apparatus according to Figs. 1 and 2 and also the apparatus illustrated in Figs. 3-8 could be provided with a beta source the ionisation range of which could be limited by a zone of maximum range of the beta rays instead of by a Bragg's zone. Radioactive substances (e.g. tritium) which emit rather soft, very strongly ionising beta rays are more particularly suitable.

As the ions moving in direction of the sieve-electrode 8 are not only subjected to the electrode field forces but also to the stream forces of the gas stream, ions may, through the electrode 8, enter the space on the lee-side of the latter. It may be desirable to brake down the ions having passed the electrode 8 and to constitute behind the latter a zone of higher ion concentration in order

to obtain an optimum charging of the suspended matter. As shown in the embodiment according to Fig. 3 this may be attained by means of a further sieve electrode 9 brought to a potential between the one of the electrode 8 and the one of the electrode 4. The desired braking and increase of concentration of the ions takes place in the space 10 if the potential difference between the electrode 8 and 9 is suitably chosen.

If on the luff-side of the alpha source a further sieve electrode 11 is arranged as shown in the embodiment of Fig. 4 this electrode too will have a favourable action onto the single-polar and optimum charging of the matter suspended in the gas stream, if it is brought to a potential corresponding to or only slightly different from the potential of the electrodes 2 and 8. The action of the electrode 11 is based on the influence of the electric field produced together with the other electrodes onto the total distribution of the ions employed for the charging in the sectional area traversed by the gas stream.

In all cases in which the sectional area of the gas stream containing the suspended matter is larger than the sectional area of the section of the radiation cone with the zone of maximum range i.e., with the Bragg's zone, it is preferred to arrange several radioactive preparations 15 in a plane vertical with respect to the gas stream as shown in Fig. 5. Their distribution in this surface and the directing of their radiation cones thereby is thus that the whole sectional area of the gas stream is covered by the radiation zones of the different radioactive preparations, i.e. of the Bragg's zones 16 and that the radiation cones 17 of the different preparations 15 lie as far as possible completely within the gas stream. In the variant shown in cross section in Fig. 5a tritium is employed as radioactive substance. The different preparations 15a are constituted by strips parallelly arranged with respect to each other in a radial plane of the cylindrical housing 1.

As is easily seen the electric field produced by the electrodes 4, 2, 8 and 11 has a certain separating effect onto the already charged matter of the gas stream, leading to the formation of deposits on the electrodes. If such a deposit takes place on electrode 4 it may result, by absorption, to a decreasing of the alpha emission of electrode 3 and thus to a substantial decrease of the total number of produced ions. Such a deposit is favoured by the high field strengths of the highly inhomogenic field near the electrode 4. If, however, as in the embodiment according to Fig. 6, a net-shaped electrode 12 of small dimension is placed a few millimeters in front of the ray-emitting surface 3 and if this electrode 12 is brought to the potential of electrode 4 the formation of deposit on surface 3 is practically avoided. The ionising rays are only to a very small extent weakened by this net-electrode of suitable execution and the electric field of the whole arrangement is also changed to a very small extent only.

A further possibility of formation of absorbent deposits on the radioactive layer 3 resides in the formation of the known whirls at the lee-side of the ray source metallic surface 4. By these whirls the suspended matter is carried away and deposits on the surface of 3. A device in form of a stream line body 13 according to the embodiment of Fig. 7 for partly enclosing the metallic surface 4 and the emitting surface 3 prevents even at high stream velocities the production of whirls and thus of a deposit on the active surface.

In all cases in which the gas to be electrically charged must enter a sectional area which is smaller than the section of the radiation cone 5 with the zone of maximum range i.e. with the Bragg's zone 6, the ionising effect of the ray source 3 would not be fully utilized if the air would be restricted to this sectional area in the charging space already. Preferably in such cases the gas stream is first led for electric charging as above described through a cylindrical tube 2 the radius of which substantially cor-

responds to the radius of the mentioned section of the radiation cone and afterwards only through a tapering insulating tube to the small cross sectional area. Such a variant is shown in Fig. 8 and this proceeding not only has the advantage of a better utilization of the ionising effect of the ray source but it has also the advantage that due to the smaller gas velocity in the actual charging space the suspended matter remains a longer time in this space containing ions of exclusively the same polarity.

We claim:

1. An apparatus for electric charging of matter suspended in a gas stream comprising a plate-like conductive support having one surface turned away from said gas stream, one radioactive preparation arranged on said surface provided with a ray-emitting surface turned away from said gas stream and producing a ray cone, a counter-electrode arranged at the outside of the range of ionizing rays and of the effective ray cone, and a direct current source for producing a potential difference between said conductive support and said counter-electrode.

2. An apparatus for the electric charging of matter suspended in a gas stream comprising, a conductive support, at least a radioactive preparation arranged on said conductive support with its ray-emitting surface turned away from the gas stream and producing a ray cone at least a counter-electrode arranged at the outside of the range of ionising rays and of the effective ray cone, and a direct current source for producing a potential difference between said conductive support for the radioactive preparation and said counter-electrode and at least a perforated counter-electrode arranged in the direction of the gas stream behind the zone of maximum range of the rays and filling the whole sectional area of flow.

3. An apparatus for the electric charging of matter suspended in a gas stream comprising, a conductive support, at least a radioactive preparation arranged on said conductive support with its ray-emitting surface turned away from the gas stream and producing a ray cone, at least a counter-electrode arranged at the outside of the range of ionising rays and of the effective ray cone, and a direct current source for producing a potential difference between said conductive support for the radioactive preparation and said counter-electrode and two perforated counter-electrodes of different potential arranged in the direction of the gas stream behind the zone of maximum range of the rays and filling the whole sectional area of flow.

4. An apparatus for the electric charging of matter suspended in a gas stream comprising, a conductive support, at least a radioactive preparation arranged on said conductive support with its ray-emitting surface turned away from the gas stream and producing a ray cone, at least a counter-electrode arranged at the outside of the range of ionising rays and of the effective ray cone, and a direct current source for producing a potential difference between said conductive support for the radioactive preparation and said counter-electrode and a perforated counter-electrode filling the whole sectional area of flow and arranged in the direction of flow before the radioactive preparation.

References Cited in the file of this patent

UNITED STATES PATENTS

2,381,455	Jacob	Aug. 7, 1945
2,594,777	Hicks	Apr. 29, 1952
2,723,349	Rylsky	Nov. 8, 1955

OTHER REFERENCES

"Production of Unipolar Air with Radium Isotopes," by T. L. Martin, a reprint from *Electrical Engineering*, January 1954, 6 pages.