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APPARATUS FOR PRODUCING ELECTRIFIED POWDERS BY FRICTION

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Fig. 1

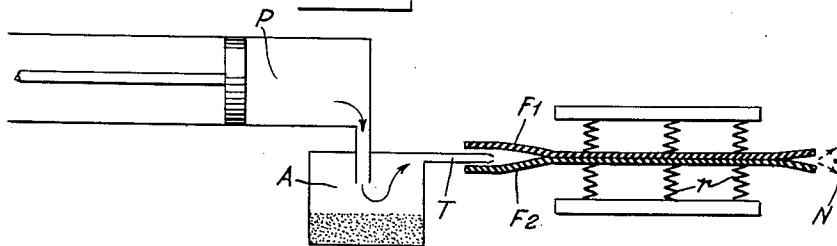


Fig. 2

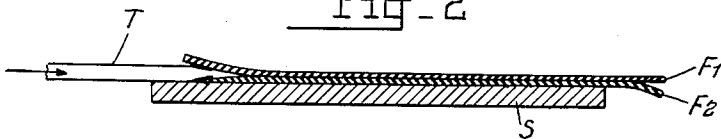


Fig. 3

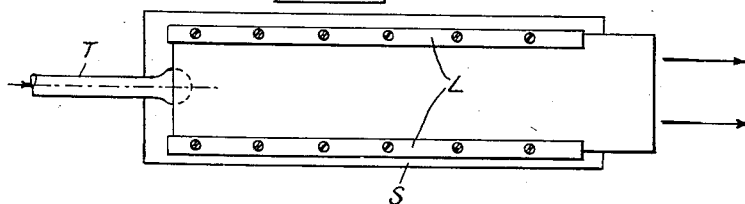


Fig. 4

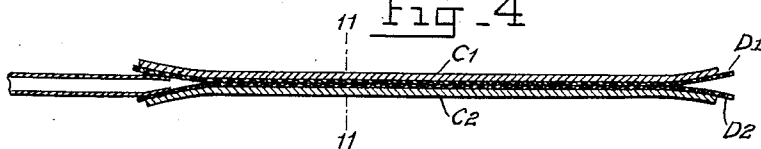


Fig. 5



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APPARATUS FOR PRODUCING ELECTRIFIED
POWDERS BY FRICTION

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Original application July 23, 1947, Serial No. 763,132. Divided and this application July 22, 1949, Serial No. 106,176. In France October 21, 1946

12 Claims. (Cl. 175—265)

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This invention relates to apparatus for imparting an electrical charge to particles of a pulverulent material and is more particularly concerned with apparatus of the character indicated adapted for providing electrified particles for agricultural and industrial powder spraying, for example, the spray dusting of plants.

In my copending application, Serial No. 763,133, now abandoned, I have described a process for spraying electrified powder particles and have disclosed the possibility of electrifying powder particles by friction. I have found that in order to electrify the powder particles to a high degree of effectiveness, it is necessary to cause all of the particles to come into contact with the friction surface and preferably to make several successive contacts. The provision of simple partitions arranged as baffles is not sufficient to obtain the desired result since the current of gas carrying the particles to be electrified is deflected by the baffles which impart a rotary motion to the current and this motion is also imparted to the particles so that effective frictional contact is not obtained.

In accordance with the present invention, I provide means for insuring multiple frictional contact between the particles and the frictional surface, the means which I provide comprising two flat surfaces disposed in face to face relationship and between which the current of gas carrying the powder particles is caused to pass. The flat surfaces may be vibrated.

I have also found that at the instant a powder particle comes into contact with the friction surface, the particles must not be subjected to an opposed magnetic field, which may be caused either by the charge on adjacent powder particles or by the charge on the friction surface. In accordance with the invention, the friction members are arranged in such manner that the charges which are deposited thereon are symmetrical with respect to the charges on the powder particles.

Furthermore, the electrified powder particles must not be allowed to adhere to the friction surface by electrostatic attraction, since this would prevent fresh particles from coming in contact with the surface and might cause blocking of the apparatus. In addition, electrified particles must never be permitted to agglomerate, since this would tend to permit the charges to escape. The apparatus of the invention prevents adherence and agglomeration of the particles since the friction surfaces are so arranged that the current of gas readily sweeps the particles along.

The nature of the particles and of the friction

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surfaces determines the polarity of the charges, and to a certain extent the magnitude of the charges. It has been determined which type of friction substance, herein referred to as triboelectric material, is most suitable for each type of powder. In the apparatus of the invention the opposed friction surfaces should be formed from a resilient friction substance which resists wear, since rapid wearing away of the material of the friction surface interferes with the separation of the charges of opposite polarity. Care should also be taken to avoid dampness since dampness adversely affects frictional electrification. Among the substances which are particularly suitable for constructing the opposed friction surfaces are rubber, horse-hair, threads, and sheets of plastic material.

When a powder is to be used which is difficult to electrify, the powder may advantageously be mixed with another powder that holds an electric charge well, such as sulphur, casein, anthraquinone and lime. The powders are generally mixed before they are passed between the friction surfaces but in some cases it is desirable to mix the powders only after one of them has passed through the electrifying device, in order to facilitate operation.

The powder particles which have been electrified by being passed through my device as hereinabove described may, without further treatment, be directed on to the surface to be powdered. I also contemplate setting up an electrical field around the surfaces to be powdered in order to accelerate precipitation. As mentioned, I provide apparatus for electrifying particles in accordance with the principles set forth above comprising two leaves having opposed friction surfaces which are resilient or are resiliently held in contact. A current of gas carrying the powder to be electrified is blown between the leaves, the resiliency of the leaves permitting the air pressure to separate them and thus permit the gas-suspended powder particles to pass therebetween. The device provides a large area of contact and the friction surfaces of the leaves are close in contact so that the space between the surfaces is small. In my device a particle of powder passing between the two leaves carrying equal charges of the same polarity is not subjected to the electric field produced by such charges.

The speed of the air current between the leaves, the vibrations caused by said air current, and the choice of the substances used (rubber for example) prevent the powder from heaping up between the leaves.

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Since the leaves are very close together, particles of powder might become locked between them, which would clog the apparatus. This difficulty can be avoided by arranging the leaves in such a manner that the pressure of the air produced by the blower is capable, in case of obstruction, of separating the adjacent leaves and of thereby unclogging the apparatus. Owing to this arrangement, it is even sometimes unnecessary to provide a permanent spacing between the two leaves; the air pressure moves them apart just enough to allow the powder to pass. It is moreover possible to make the leaves more or less readily separable, and even to make such separation adjustable, either by using flexible leaves, or by holding them in contact with one another by pressure of a spring.

The nature of the surfaces of the leaves plays an essential part in the electrification, since it is these surfaces which come into contact with the powder. Said surfaces may be smooth, or provided with various asperities, or provided with a covering of suitable composition.

Each leaf may be composed of two constituents or laminae, viz. an internal constituent or lamina, chosen to provide maximum electrification, and an external constituent or lamina, the function of which is both to provide the requisite resilience and, by means of its conductivity, to permit the electric charges developed on the friction surfaces to flow away.

Finally, particular devices may be added for carrying away the charges, such as: metal blades, spikes, wires, etc. interposed between the leaves, imbedded in the leaves, or disposed on the outer surface of the leaves. Said devices may be effective either by decreasing the distance which the charges have to travel in a poor conducting substance, or by causing the friction surfaces to discharge, by ionizing the adjacent gaseous medium.

The aforesaid leaves may be provided with numerous asperities or holes, whereby a construction is provided which is similar to a structure characterised by the presence of numerous small obstacles.

The leaves may also be provided with longitudinal striae i. e. striae disposed in the direction of flow of the particle carrying gas, which in effect provides a plurality of parallel capillary tubes. A single stria may, however, be used.

In order to make the invention more clearly understood several embodiments have been illustrated in the accompanying diagrammatic drawings which are given by way of non-limitative examples.

Fig. 1 is a general longitudinal sectional view of an apparatus for producing electrified powder.

Fig. 2 is a similar section of a modification.

Fig. 3 is a plan view corresponding to Fig. 2.

Fig. 4 shows a section of another modification.

Fig. 5 is a section through the line II—II of Fig. 4.

Referring to Fig. 1, it will be seen that the apparatus comprises a pump P, by means of which air can be supplied to a receptacle A containing the powder. Said pump is provided with a tube T opening between two walls or leaves F₁ and F₂ which are pressed against one another by light springs r. The mixture of air and powder blown between the leaves moves them apart and is electrified as it comes into contact with them. A cloud of electrified powder is obtained at N.

Figs. 2 and 3 show an electrifying device comprising two rubber leaves F₁ and F₂ which are

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fixed to a base S by means of laterally arranged clamping strips L. The resilience of the rubber is sufficient to enable the air charged with powder blown through the tube T to pass through the apparatus in lengthwise direction. This device is suitable in particular for electrifying powders mainly comprising lime, silica, metallic oxides, etc.

The device of Figs. 4 and 5 is similar to the previous one, but the rubber leaves are replaced by thin flexible sheets C₁, C₂, on which a silk fabric has been cemented at D₁, D₂. The whole arrangement is held for example by means of rivets located on the sides. The powder passing between the two sheets is in direct contact with the silk. This device is suitable in particular for electrifying crushed sulphur.

Suitable provision is made in each instance to permit the electric charges developed on the friction surfaces to flow away.

The springs r in Fig. 1, the clamping strips L in Figs. 2 and 3 and the rivets in Figs. 4 and 5 serve the further function of carrying away the accumulated charge from the leaves.

The foregoing examples are not intended for any other purpose than to illustrate the principle of the apparatus. In particular, the nature of the leaves and the composition of the powders are essentially variable. The same applies to the dimensions, the output, the shape and the number of the leaves. It is understood, in particular, that the leaves may be rectangular, triangular, circular, segment-shaped, etc. They may be flat, wound in the shape of concentric cylinders or of spiral, or folded on themselves.

This application is a division of my copending application, Serial No. 763,132 filed July 23, 1947.

I claim:

1. Apparatus for dusting plants and the like with electrically charged particles which comprises, in combination, means for supplying a stream of gas carrying particles to be charged, a passageway having closely spaced parallel walls, means for directing the stream of gas between said walls, said walls normally being substantially in engagement with one another and being sufficiently yieldable to be separable by said stream to permit free passage of said stream without clogging, the opposed faces of said walls being provided with a longitudinal striae and means for conducting a charge away from said walls.

2. Apparatus for dusting plants and the like with electrically charged particles which comprises, in combination, means for supplying a stream of gas carrying particles to be charged, closely spaced parallel leaves, means for directing the stream of gas between said leaves, said leaves normally being substantially in engagement with one another and being sufficiently yieldable to be separable by said stream to permit free passage of said stream without clogging, the opposed faces of said leaves being provided with apertures and means for conducting a charge away from said leaves.

3. Apparatus for dusting plants and the like with electrically charged particles which comprises, in combination, means for supplying a stream of gas carrying particles to be charged, a channel having closely spaced parallel walls, means for directing the stream of gas between said walls, said walls normally being substantially in engagement with one another and being sufficiently yieldable to be separable by said stream to permit free passage of said stream without

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clogging, the said walls being of a two-ply construction comprising an inner non-conductive lamina and an outer conductive lamina and means for conducting a charge away from said walls.

4. Apparatus for dusting plants and the like with electrically charged particles which comprises, in combination, means for supplying a stream of gas carrying particles to be charged, closely spaced parallel leaves, means for directing the stream of gas between said leaves, a base supporting said leaves, means for securing the longitudinal edges of said leaves to said base said leaves normally being substantially in engagement with one another and being sufficiently yieldable to be separable by said stream to permit free passage of said stream without clogging, and means for conducting a charge away from said leaves.

5. Apparatus for dusting plants and the like with electrically charged particles, comprising means for supplying a stream of gas carrying particles to be charged, means for charging said particles solely by friction comprising a passageway having closely spaced yieldable walls of triboelectric material providing opposed charging surfaces, means for directing the stream of gas carrying said particles between said surfaces whereby said particles are charged by repeated contact with said surfaces, said walls normally being substantially in engagement with one another but being sufficiently yieldable to be separated by said stream, means for thereafter directing the stream of gas carrying said charged particles toward the object to be dusted and means for conducting a charge away from said charging surfaces.

6. Apparatus for dusting plants and the like with electrically charged particles, comprising a tubular passageway having resilient walls, means for pressing opposite walls of said passageway yieldably together, means for forcing a stream of gas carrying particles to be charged through said passageway, said walls normally being substantially in engagement with one another but being sufficiently yieldable to be separated by said stream, whereby said opposite walls are forced apart enough to permit passage of said stream and said particles are charged by repeated contact with said walls, means for directing the stream of gas issuing from said passageway toward the object to be dusted with said charged particles and means for conducting a charge away from said charging surfaces.

7. Apparatus for dusting plants and the like with electrically charged particles, comprising a tubular passageway having opposed closely adjacent resilient walls, means for forcing a stream of gas carrying particles to be charged through said passageway whereby said opposite resilient walls are forced apart sufficiently to permit passage of said stream and said particles are electrically charged by repeated contact with said walls, means for directing the stream of gas issuing from said passageway toward the object to be dusted with said particles and means for conducting a charge away from said charging surfaces.

8. Apparatus for dusting plants and the like with electrically charged particles, comprising a tubular passageway having opposed flexible side walls, means for resiliently pressing said opposed walls together at spaced intervals, means for forcing a stream of gas carrying particles to be charged through said passageway whereby said

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opposed walls are forced apart only sufficiently to permit passage of said stream and said particles are electrically charged by repeated frictional contact with said walls, means for directing the stream of gas issuing from said passageway toward the object to be dusted and means for conducting a charge away from said charging surfaces.

9. Apparatus for dusting plants and the like with electrically charged particles, comprising means for supplying a stream of gas carrying particles to be charged, means for charging said particles solely by friction comprising a passageway connected with said supplying means and comprising closely spaced charging surfaces having a large surface area in relation to the cross-sectional area of said passageway, said surfaces normally being substantially in contact with one another but being separable by the force of said stream to prevent clogging of the passageway while maintaining said surfaces close together so that said particles are charged by repeated frictional engagement with said walls as the particles are carried through said passageway by the gas stream, means for directing the gas stream carrying the charged particles from the outlet of said passageway toward an object to be dusted and means for conducting a charge away from said charging surfaces.

10. Apparatus for dusting plants and the like with electrically charged particles which comprises, in combination, means for supplying a stream of gas carrying particles to be charged, a passageway having closely spaced parallel walls, means for directing the stream of gas and particles between said walls, said walls being normally in engagement but being sufficiently yieldable to be separated by said stream of gas and particles to permit substantially laminar flow of said gas through the passageway and provide repeated frictional engagement between said walls and particles to impart an electrostatic charge to said particles and means for conducting a charge away from said walls.

11. Apparatus for dusting plants and the like with electrically charged particles, which comprises means for supplying a stream of gas carrying particles to be charged, superposed parallel leaves of flexible material, means for directing the stream of gas and particles between the leaves, resilient means yieldably pressing said leaves substantially into engagement with one another, said leaves being separated by said stream of gas and particles to permit laminar flow of said gas between the leaves and repeated frictional engagement between said particles and the leaves to impart an electrostatic charge to said particles and means for conducting away from said leaves an opposite charge imparted to the leaves by said frictional engagement.

12. Apparatus for dusting plants and other objects with electrically charged particles, comprising a tubular passageway having yieldable walls, means for pressing opposite walls of the passageway yieldably together, means for forcing a stream of gas through said passageway, means for introducing the particles to be charged into said stream in advance of said passageway, the opposite walls of said passageway being separated by said stream to permit substantially laminar flow of gas between said walls with repeated frictional engagement between said particles carried by the gas and said walls to impart an electrostatic charge to said particles and an opposite

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charge to said walls and means for removing said
opposite charge from said walls.

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