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2,555,339

DISPOSABLE ELECTRODE ASSEMBLY

Filed Aug. 27, 1946

2 Sheets-Sheet 1

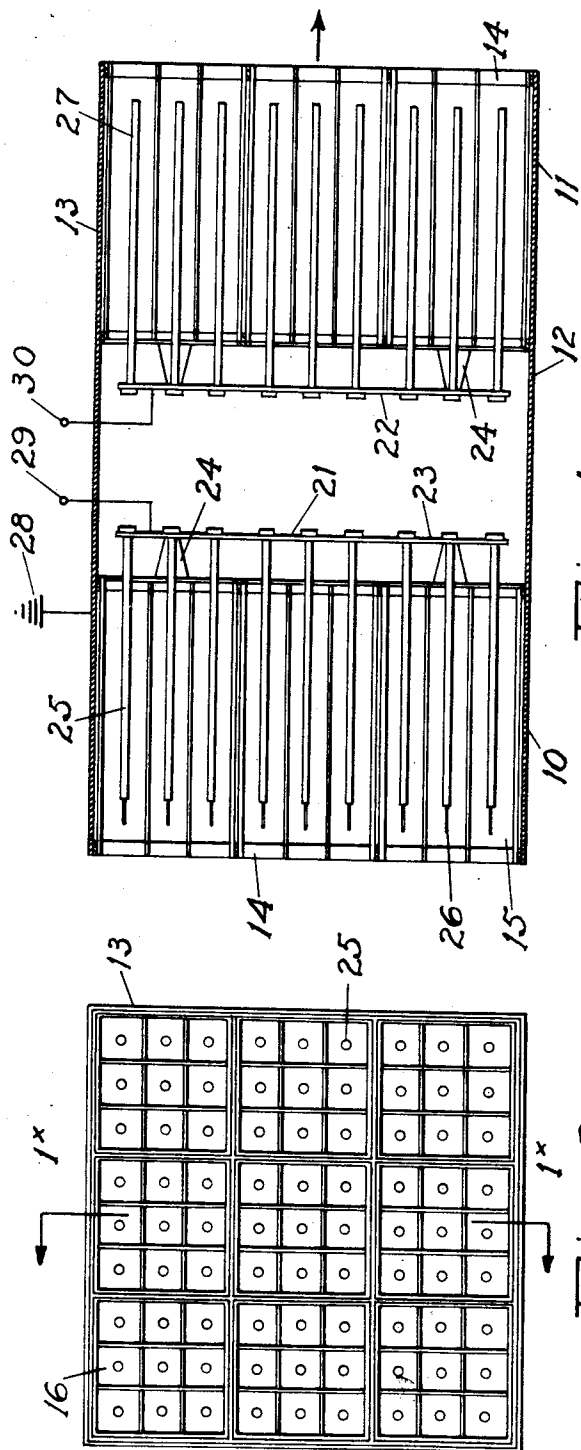


Fig. 1.

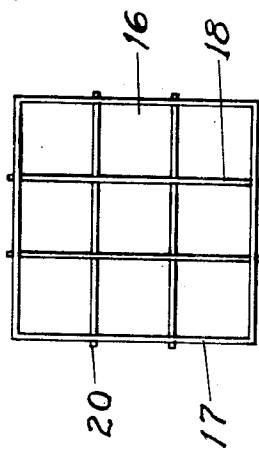


Fig. 4.

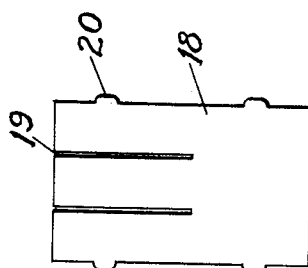


Fig. 5.

Fig. 2.

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2 Sheets-Sheet 2

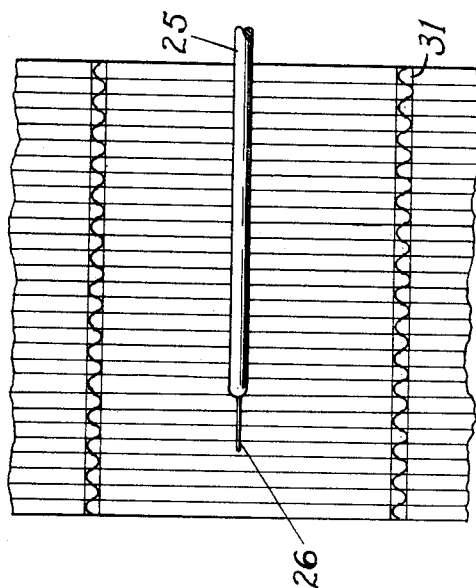


Fig. 6.

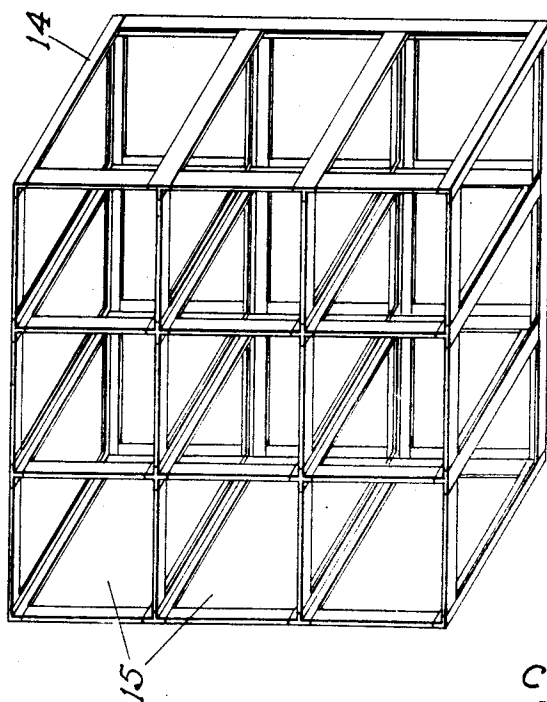


Fig. 3.

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UNITED STATES PATENT OFFICE

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DISPOSABLE ELECTRODE ASSEMBLY

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10 Claims. (Cl. 183—7)

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This invention relates to electrical precipitators and more particularly to electrical precipitators having disposable extended surface electrodes.

Objects of the invention are to provide in an electrical precipitator disposable extended surface electrodes which may be readily removed and discarded after they have become coated with precipitated matter and which may be replaced by fresh electrodes; to provide relatively inexpensive electrode structures which are economical to discard when they have become damaged or dirty; to provide disposable electrodes made from water-laid or other fibrous material such as cardboard or a more bibulous paper, papier mache, textile fabric impregnated with a stiffening agent; and the like. Other objects are to provide an electrical precipitator having disposable extended surface electrodes of the character described, the electrodes having either smooth or roughened particle-collecting surfaces and which may be made additionally conducting for precipitation purposes by impregnating the electrode structures with suitable wetting liquids, or incorporating conductive substances in the material from which the electrodes are formed, or by coating one or more surfaces of the electrodes with a conducting film or network.

Typically, the invention may be embodied in an electrical precipitator comprising extended surface electrode support means, insulating means supporting high tension electrodes in complementary relation to the extended surface electrode support means, and extended surface electrode structures carried by the first-mentioned support means in spaced relation to the high tension electrodes, the extended surface electrode structures being removable independently of the high tension electrodes. The removable electrode structures may be formed from a variety of materials, principally fibrous materials, as will be explained in greater detail hereinafter, and these structures may have roughened collecting surfaces and/or may be made additionally conductive in ways to be more fully developed.

The invention will be described with greater particularity, and other of its aims and advantages will be in part apparent and in part pointed out in the following detailed description, reference being had to the accompanying drawing, in which:

Fig. 1 is a vertical sectional view of an electrical precipitator embodying the invention, taken along a plane parallel to the direction of gas flow through the precipitator;

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Fig. 2 is an end view of the precipitator shown in Fig. 1;

Fig. 3 is a perspective view of an extended surface electrode support forming a part of the precipitator illustrated in Figs. 1 and 2;

Fig. 4 is an end view of a disposable cellular extended surface electrode;

Fig. 5 is a plan view of a partition element of the electrode shown in Fig. 4 and

Fig. 6 is a fragmentary sectional view of a modified form of a cellular extended surface electrode.

Referring to the drawings, particularly to Figs. 1 and 2 thereof, the electrical precipitator shown is of the two-stage type and includes a charging stage or section 10, a collection stage or section 11 and an intermediate high tension compartment 12. The precipitator is provided with a casing 13 open at the ends to permit a stream of gas bearing suspended particulate matter to be passed through the casing from left to right, as indicated by the arrow in Fig. 1.

In the charging and collection zones there are positioned identical supports 14, one of which is shown in perspective in Fig. 3. A support 14 may take the form of an open framework, preferably constructed from steel channel stock and flat stock welded together. It provides a plurality of contiguous compartments 15 for the reception of disposable extended surface electrode structures 16, the latter being shown in detail in Fig. 4.

Referring to Fig. 4, the extended surface electrode structure 16 has a hollow rectangular outer shell 17 and a plurality of interlocking partition elements 18 dividing the interior of the shell into a plurality of longitudinal cells. Both the shell and partitions may be formed from cardboard or other similar stock.

One of the partition elements is shown in plan view in Fig. 5; it is provided with a pair of parallel cuts or slots 19 extending longitudinally for one-half the length of the partition and dividing the partition laterally into three sections of approximately equal size and shape. The partition also has tabs or ears 20 projecting from its longitudinal sides. Four such partitions are interlocked in the manner of an egg crate separator and are inserted in the outer shell 17, the ears 20 projecting through corresponding short slots formed in the sides of the outer shell, as shown in Fig. 4. The assembled extended surface electrode structure may then be inserted as a unit in one of the compartments 15 of the electrode support.

It will be apparent that the electrode structure

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16 is convenient to ship and easy to assemble. The assembled unit may be collapsed for shipment by merely pressing two of its diagonally opposite longitudinal edges towards each other, or it may be shipped erect in the form shown in Fig. 4. Alternatively, if desired, the assembly may be shipped knocked-down, the outer shell being collapsed to occupy a minimum of space.

In addition to providing support for the extended surface electrode structures, the support 14 also carries a high tension electrode assembly. The high tension electrode assembly 21 for the charging stage differs functionally and in minor but important structural respects from the high tension electrode assembly 22 for the collection stage, but the two assemblies are mounted upon their respective supports 14 in substantially the same way.

The high tension electrode assembly for the charging stage includes a lattice 23, preferably of welded metallic construction, the crossed members of the lattice being spaced on centers corresponding to the centers of the individual extended surface electrode cells. The lattice is mounted on insulators 24 carried by the support 14.

The charging electrodes 25 are supported by the lattice 23 in cantilever fashion. The butts of the electrodes are received in holes formed at the junctures of the lattice elements and are secured therein as by welding. One charging electrode 25 is provided for each cell of the extended surface electrode structure. The main body of the electrode 25 may be in the form of a metallic rod having a substantial radius of curvature not adapted to provide corona discharge, while the tip 26 of the electrode is formed of a short length of fine wire welded to the rod to provide a section having a very small radius of curvature adapted to provide corona or brush discharge.

The precipitating electrode assembly 22 for the collection stage, as stated, is generally similar in construction to the electrode assembly 21, and is similarly mounted. The electrode elements 27 differ from the corresponding elements 25 primarily in that they do not have a fine-wire tip and hence provide only a high tension electric field without corona discharge.

A diagrammatic showing of the power supply appears in Fig. 1. The casing 13 may be grounded as at 28 and high voltage current conductors 29 and 30 may be connected to a source or sources of current (not shown) for supplying current to the high tension electrode assemblies 21 and 22, respectively.

The extended surface electrode structure shown in detail in Fig. 4 is constructed from plane-surfaced cardboard. A modified form, a fragment of which is shown in Fig. 6, is made of corrugated paperboard, the corrugations 31 of which extend transversely of the cell in a direction at right angles to the direction of flow of the gas stream therethrough. These corrugations provide a series of pockets in the extended surface electrode in which precipitated material will adhere with greater tenacity than to a plane surface. There is thus less likelihood of the precipitated material being stripped from the surface of the electrode and becoming re-entrained in the gas stream. Of course, the surface of the extended surface electrodes may be roughened in other patterns, if desired.

As will be understood by persons skilled in the art, the current flow in the space between the complementary electrodes of electrical precipi-

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tators is relatively small, although the potential drop across the space is quite high. Hence, the specific conductivity of the extended surface electrodes does not have to be very great, in view of their large area, to provide the requisite current flow and to maintain the desired potential. Some papers, particularly if slightly humidified, have the necessary conductivity. The conductivity of the paper or other material constituting the disposable electrode may be increased by wetting the material with a conductive liquid. Such liquid preferably is also somewhat viscous or adhesive, which property increases the stickiness of the surface of the disposable electrode whereby more effectively to hold precipitated matter. I have found that liquids such as aqueous solutions of calcium chloride, lithium chloride, zinc chloride, and other hygroscopic salts are well suited for this purpose. Triethylene glycol, with or without a wetting agent, can be used to advantage.

The conductivity of the material of the disposable electrodes can also be increased by incorporating conductive material such as metallic fibers or carbon powder, including graphite, in the fibrous sheet structure. Alternatively, the sheets may be coated with a conductive layer or film of carbon, graphite, or metal powder. Also, the sheet material forming the extended surface electrodes may be paper or cardboard having an adherent surface layer consisting of thin metallic foil.

The operation of the electrical precipitator herein shown and described is believed to be obvious from the foregoing description. In brief, however, a high tension electric field accompanied by brush discharge is created between the complementary electrodes of the charging stage 10 by impressing on the electrodes, through conductors 28 and 29, a high electrical potential. A similar field, but without brush discharge, is created between the complementary electrodes of the collection stage 11. A stream of gas bearing suspended particles is passed through the precipitator in the direction of the arrow of Fig. 1. In the charging stage, the suspended particles are given an electric charge as will be understood by those skilled in the art to which this invention pertains. Some of the charged particles are attracted to the surfaces of the extended surface electrodes in the charging stage and are deposited thereon. In the collection stage, most of the residual charged suspended matter is precipitated upon the walls of the disposable electrode structures.

It will be understood that electrical connection is established between the disposable electrode structures and their supporting frames 14 by direct contact between these elements, but such connection may be made, if desired, by metallic conductors which may be soldered to the supports 14 and clipped or otherwise attached to the electrode structure.

When the disposable electrodes have become so coated with precipitated material that efficiency of precipitation is impaired and danger of disruptive discharge is imminent, the precipitator may be shut down, the disposable electrode structures removed by simply pulling them out of their compartments in the support frames, new electrode structures inserted, and the precipitator once more put into operation, all in a very short time and with a minimum of inconvenience and expense.

It will be obvious that the extended surface

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collecting electrode structures may take the form not only of a plurality of interlocking sheets of fibrous material defining a plurality of parallel conduits, but also may take the form of a plurality of sheets of fibrous material, however arranged, cooperating to define a plurality of parallel conduits.

From the foregoing description, it will be seen that the present invention provides disposable electrode structures for electrical precipitators which greatly facilitate the construction, arrangement and operation of such precipitators. It will also be apparent that the invention permits of a variety of modifications not specifically shown and described without departing from the spirit and scope of the invention as defined in the claims.

I claim:

1. In an electrical precipitator, extended surface electrode support means defining a longitudinally extending precipitation zone having an opening into each end thereof, an extended surface electrode structure carried by said support means comprising a plurality of water-laid fibrous sheet members constructed and arranged to define a plurality of longitudinally extending conduits in said precipitation zone, said extended surface structure being positionable into and removable from said support means through the opening at one end thereof, high tension electrode mounting means adjacent the other end of said support means, and substantially rigid high tension electrodes mounted in said mounting means to project into said conduits through the opening in said other end of the support means.

2. In an electrical precipitator, extended surface electrode support means defining a longitudinally extending precipitation zone having an opening into each end thereof, an extended surface electrode structure carried by said support means comprising a plurality of interlocking water-laid fibrous sheet members constructed and arranged to define a plurality of longitudinally extending conduits in said precipitation zone, said extended surface structure being positionable into and removable from said support means through the opening at one end thereof, high tension electrode mounting means adjacent the other end of said support means, and substantially rigid high tension electrodes mounted in said mounting means to project into said conduits through the opening in said other end of the support means.

3. In an electrical precipitator, extended surface electrode support means defining a longitudinally extending precipitation zone having an opening into each end thereof, an extended surface electrode structure carried by said support means comprising a plurality of water-laid fibrous sheet members including a conduction increasing substance constructed and arranged to define a plurality of longitudinally extending conduits in said precipitation zone, said extended surface structure being positionable into and removable from said support means through the opening at one end thereof, high tension electrode mounting means adjacent the other end of said support means, and substantially rigid high tension electrodes mounted in said mounting means to project into said conduits through the opening in said other end of the support means.

4. In an electrical precipitator, extended surface electrode support means defining a longitudinally extending precipitation zone having an

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opening into each end thereof, an extended surface electrode structure carried by said support means comprising a plurality of water-laid fibrous sheet members including a conductive liquid constructed and arranged to define a plurality of longitudinally extending conduits in said precipitation zone, said extended surface structure being positionable into and removable from said support means through the opening at one end thereof, high tension electrode mounting means adjacent the other end of said support means, and substantially rigid high tension electrodes mounted in said mounting means to project into said conduits through the opening in said other end of the support means.

5. In an electrical precipitator, extended surface electrode support means defining a longitudinally extending precipitation zone having an opening into each end thereof, an extended surface electrode structure carried by said support means comprising a plurality of water-laid fibrous sheet members including a comminuted solid conducting substance constructed and arranged to define a plurality of longitudinally extending conduits in said precipitation zone, said extended surface structure being positionable into and removable from said support means through the opening at one end thereof, high tension electrode mounting means adjacent the other end of said support means, and substantially rigid high tension electrodes mounted in said mounting means to project into said conduits through the opening in said other end of the support means.

6. In an electrical precipitator, extended surface electrode support means defining a longitudinally extending precipitation zone having an opening into each end thereof, an extended surface electrode structure carried by said support means comprising a plurality of corrugated paper board sheet members constructed and arranged to define a plurality of longitudinally extending conduits in said precipitation zone, said extended surface structure being positionable into and removable from said support means through the opening at one end thereof, high tension electrode mounting means adjacent the other end of said support means, and substantially rigid high tension electrodes mounted in said mounting means to project into said conduits through the opening in said other end of the support means.

7. An extended surface electrode structure for electrical precipitators comprising an elongate tubular member, a plurality of substantially parallel partition members in said tubular member extending longitudinally of and spaced laterally of said tubular member, said partition members extending between and being supported by opposed walls of said tubular member, additional substantially parallel partition members in said tubular member extending longitudinally of and spaced laterally of said tubular member and intersecting at least some of said first mentioned partition members, said additional partition members extending between and being supported by opposed walls of said tubular member, said partition members having cooperating interlocking slots along their lines of intersection.

8. An extended surface electrode structure as defined in claim 7 wherein said tubular member and said partition members comprise water-laid fibrous material.

9. An extended surface electrode structure as defined in claim 7 wherein said tubular member and said partition members comprise corrugated paper board.

10. An extended surface electrode structure as defined in claim 7 wherein said tubular member and said partition members comprise water-laid fibrous material including a conduction increasing substance.

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