Jan. 19, 1954 W. F. HULL 2,666,495

ELECTRODE ASSEMBLY FOR ELECTRICAL PRECIPITATORS

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Fig. 1.

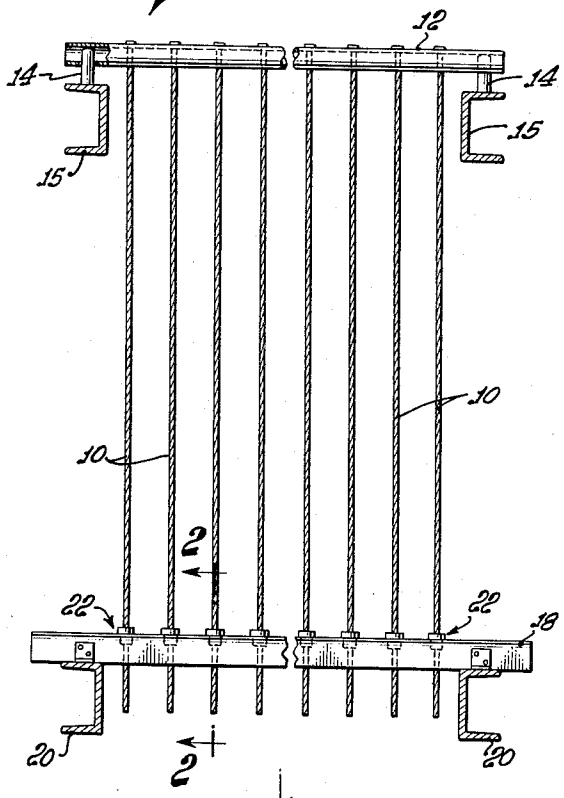


Fig. 2.

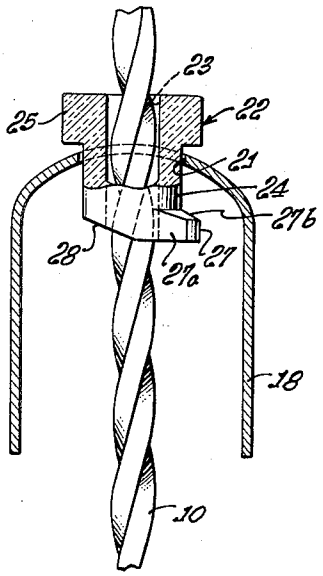


Fig. 3.

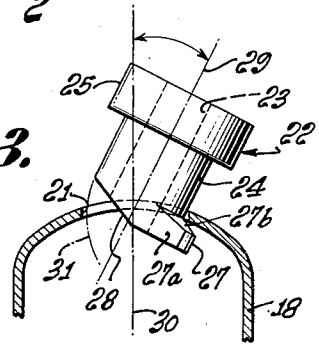


Fig. 4.

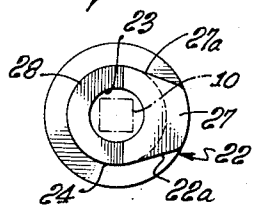
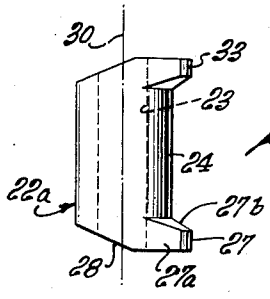


Fig. 5.



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ELECTRODE ASSEMBLY FOR ELECTRICAL PRECIPITATORS

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4 Claims. (Cl. 183—7)

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The present invention is generally concerned with an electrical precipitator for removing suspended particles from a gas stream, and more particularly with means for mounting the high tension electrodes in the precipitator.

In electrical precipitators, high tension electrodes are provided, the character of these electrodes being such as to facilitate corona discharge therefrom when the electrodes are maintained at a sufficiently elevated potential with respect to the opposing electrodes. For this purpose, high tension electrodes are typically a wire of small diameter or an elongated rod having sharp corners, as either of these forms provides surfaces of a relatively small radius which facilitate the formation of corona discharge.

In some forms of precipitators, it is customary to provide one or more rows of spaced rods, the rows extending in the direction of gas flow. Each electrode is suspended at its upper end and is guided at or near its lower end so that the electrode can move longitudinally or vertically but is closely confined against any lateral or horizontal movement. The guide engaging the electrode for this purpose is typically a ceramic bushing which insulates the electrode from the adjacent metal members which hold the bushing.

Heretofore it has been customary to hold each bushing in place on a metal support member by means of a metallic keeper. These keepers could be bolted to the support bars, but were frequently welded since the vibration produced by rapping the electrodes for cleaning purposes tends to loosen bolts. With the bolts loosened, the keepers may eventually fall off from the continued vibration, allowing the bushings to become displaced. This difficulty is overcome by welding the keeper; but welding is a relatively expensive step in the construction of an electrode structure and also has the further disadvantage that the replacement of a bushing is relatively difficult and time-consuming since the whole keeper must be cut off and a new one welded on.

It thus becomes a general object of my invention to design a bushing of the character described which is simple and easy to install or to replace yet is firmly held in place so that it will not be jarred out of its proper position by vibration or other movement encountered during normal operation of the precipitator.

It is also an object of my invention to provide a ceramic bushing for an elongated electrode member which eliminates the need for a separate keeper and which can be installed or removed without the need of any special tools or equipment.

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These and other objects of my invention have been attained by providing an improved form of ceramic bushing which can be mounted upon a spacer bar to slidably receive the high tension electrode. The bushing includes a central body portion, which is preferably cylindrical in shape. At one end of the body is provided an integrally formed collar which is of greater radial dimension than the central portion and therefore adapted to support the bushing from the spacer bar. At the other or lower end of the body portion is an eccentric lip which is spaced axially from the collar in order to receive between the lip and the collar a part of the spacer bar. The lip extends radially beyond the central body portion of the bushing at one side, preferably for less than one-half the circumference of the central portion. Insertion of the bushing in an opening in the spacer bar is facilitated by beveling the corner of the bushing opposite the eccentric lip. A bushing of this character can be inserted in an opening in the spacer bar which is but slightly larger than the outer diameter of the body portion by tilting the bushing at an angle to the axis of the opening in the spacer bar and first inserting the lip. Then the bushing can be rocked to bring its axis coincident with the axis of the opening and next slid downwardly within the opening until the collar rests upon the spacer bar. After this the electrode is inserted through the central opening in the bushing. The electrode holds the bushing against such rocking movement as is necessary to remove the bushing from the spacer bar and yet allows the bushing to move a limited amount longitudinally of the electrode. This movement is limited in either direction by the collar and the eccentric lip.

How the above and other objects and advantages of my invention are attained will be more readily understood by reference to the following description and the annexed drawings, in which:

Fig. 1 is a fragmentary elevation of a portion of a typical high tension structure for an electrical precipitator showing the application thereto of my novel form of bushing;

Fig. 2 is an enlarged vertical cross-section on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view similar to Fig. 2 showing the tilted position of the bushing relative to the spacer bar when being inserted in or removed from the opening in the spacer bar;

Fig. 4 is a bottom view of a bushing alone; and

Fig. 5 is a side elevation of a modified form of my invention.

Fig. 1 shows in side elevation a typical high

tension electrode structure for an electrical precipitator. A plurality of elongated electrode members 10 are arranged in a row. Typically, but without limitation thereto, each electrode is a square twisted bar as shown in Fig. 2. These electrodes extend vertically or preferably substantially so, and are supported at their upper ends from a suitable suspension bar, such as pipe 12. Any suitable type of connection between the electrode and pipe 12 may be employed. Pipe 12 is mounted at its ends on pins 14 which pass through a hole in one wall of the pipe and engage the inner face of the opposite wall, the weight of the pipe resting on pins 14. Pins 14 are attached to channels 15 which are a part of the structural framework of the precipitator, the remainder of the framework of the precipitator not being illustrated herein since it is well known in the art and may be of any suitable type.

At the lower ends of the electrodes, there is provided spacer bar 18 which rests upon and is supported by channels 20, likewise a part of the structural framework of the precipitator. Spacer bar 18 may be of any suitable design or cross-sectional shape, but is here shown in Fig. 2 as being a channel-shaped member, with the back of the channel outwardly convex rather than flat. A member of this type has considerable rigidity both horizontally and vertically without being excessively heavy or having any part of thick cross-section. It is preferred that the bar have a relatively thin section at the location of engagement with the insulator bushings, since this enables the bushings to be made smaller. Along the top of channel 18, a series of openings 21 with upwardly extending, parallel axes is provided, the spacing between them corresponding to the desired spacing between electrodes 10. In each opening 21 is mounted a bushing 22 which has a central opening 23 through which an electrode 10 passes. The electrode passes through the bushing with a sliding fit so that longitudinal movement of the electrode relative to the bushing may take place to accommodate expansion and contraction accompanying thermal changes. At the same time the electrode is confined within close limits against horizontal movement in any direction and insulated from the spacer bar which is also at an elevated potential.

Bushing 22 may be made of any ceramic material having suitable strength and electrical properties and it is molded in one piece. It includes a central body portion 24 which is preferably cylindrical, although the invention is not necessarily limited to any particular shape, and is slightly smaller than the diameter of opening 21 to leave a slight clearance between the bushing body and the channel 18. At the upper end of body portion 24 is a circular collar 25 which has radial dimensions greater, at least in part, than the radial dimension of body portion 24 in order that the collar provides a shoulder that may rest upon channel 18 and support the bushing, as shown in Fig. 2. Collar 25 is larger than opening 21, which is only slightly larger than the external dimensions of body portion 24 in order that the bushing may be held against lateral movement of any substantial extent. Collar 25 is here shown as circular in cross-section, although other shapes may be used if desired.

At the lower end of body 24, the bushing is formed with an integral lip 27 which projects radially beyond body portion 24 at one side thereof. Side faces 27*a* of this lip are tapered outwardly toward each other as shown in Fig. 4 in order to facilitate placement of the bushing. With this construction, the lip occupies slightly less than one-half the circumference of the central portion, about 150° as shown in the drawings.

What may be termed the forward face 27*b* of the eccentric lip is preferably inclined as shown in Fig. 2 in order to reduce the thickness (axial dimension) of the lip towards its outer end, making it easier to insert a bushing for a given thickness at the base of lip 27, which should be as thick as possible to give the desired strength. Likewise, the rear corner of the bushing opposite lip 27 is beveled as at 28, in Fig. 2. The relative shape and position of faces 27*b* and 28 is such that the spacing between the faces does not exceed the diameter of opening 21. The angle of the face at 28 is made such that the two faces 28 and 27*b* are generally parallel or slightly inclined outwardly toward each other so that the lip of the bushing can pass through an opening 21 in the space bar when the bushing is tilted.

In operation, the bushing is positioned as shown in Fig. 2, with its axis, which is the axis of the central opening 23, extending upwardly or substantially vertically. In order to insert the bushing in an opening 21, it is first tilted as shown in Fig. 3 until its axis 29 is inclined to the vertical or inclined to the upwardly extending axis 30 of opening 21. The parts are preferably designed so that axis 29 is at a substantial angle, say about 30° or more, with respect to the axis 30 at this time, as the locking action is more certain, even after wear on the parts, than if the bushing need be tilted only a smaller amount. In this tilted or inclined position, eccentric lip is inserted downwardly into opening 21 until the lower part of body 24 is at or within this opening. The bushing may then be rocked about a point at the junction between body 24 and lip 27 until the bushing axis 29 extends upwardly in coincidence with axis 30 of opening 21. The bushing is then dropped down until collar 25 rests on spacer bar 18 to support the bushing in place. This rocking motion is possible since by beveling the lower rear corner of the bushing, no part of it extends beyond arc 31 struck about the center about which the bushing is rocked with a radius equal to the diameter of body 24. These movements are reversed in order to remove a bushing from the spacer bar.

After the bushing is in place, electrode 10 is lowered through the central opening of the bushing, as shown in Fig. 2. The presence of the electrode in the bushing holds it with its axis in a fixed position and prevents it from being tilted to the position of Fig. 3 in which it can be removed from opening 21. Electrode 10 and bushing 22 are capable of relative movement in a direction longitudinal of the electrode. Downward movement of the bushing relative to the spacer bar is stopped by engagement of collar 25 with the upper face of channel 18. In a similar manner upward movement of the bushing is limited by engagement of eccentric lip 27 with the underside of channel 18. As a consequence the bushing cannot be disengaged from spacer bar 18 as long as the electrode passes through the bushing since the presence of the electrode confines the movement of the bushing to movement along the electrode and along the axis of opening 21, preventing any tilting movement of the bushing of the character required to remove it from the spacer bar.

Collar 25 is circular in transverse cross section and extends outwardly beyond body portion 24 for the full circumference of the latter. How-

ever, my invention is not necessarily limited to this construction and under some circumstances it may be satisfactory to reduce the size of collar 25. There is shown in Fig. 5 a modified form of bushing 22a in which the collar 25 has been replaced with an eccentric lip 33, similar to eccentric lip 27 at the lower end of the bushing. In this construction, either end of the bushing may be inserted into an opening 21 in the spacer bar, and likewise the bushing may be inserted or withdrawn in either direction axially of the spacer bar opening. The two eccentric lips extend radially beyond the central body portion 24 for a portion only of the circumference of the latter and thus provide at each end of the bushing shoulder means which engages the spacer bar when the bushing is moved in either direction axially of the spacer bar opening. This form of bushing is held in place by the electrode in the same manner as previously described.

Electrodes 10 are normally relatively thin elongated members with their longitudinal axes extending vertically, or nearly so. For that reason the axes of the electrode, the bushing, and the opening in the spacer bar are referred to herein as being vertical or upwardly extending. It will be understood that these terms are descriptive and not limitative upon the invention since my novel form of bushing may be used with electrodes which are inclined or horizontal and in such case descriptive directional terms would be modified accordingly.

It will be appreciated that changes in the relative sizes and dimensions of the various parts of the insulator may be made without departing from the spirit of the invention. The thickness of channel 18, the axial length of body 24, the clearance between the body of the bushing and the wall of opening 21, as well as other factors all have an influence upon the exact dimensions chosen; and a change in one or more of these dimensions may make desirable or possible other changes in sizes and shapes of parts.

Having described a preferred form of my invention and a modification thereof, it will be understood that various other modifications may be made therein by persons skilled in the art without departing from the spirit and scope of my invention. Consequently, it is desired that the foregoing description be considered as illustrative of, rather than limitative upon, the appended claims.

I claim:

1. In a high tension electrode assembly for an electrical precipitator, the combination comprising: a metal bar having an opening therethrough; a one-piece hollow insulator bushing in and substantially filling said opening with the axis of the bushing normally substantially coincident with the axis of said opening, said bushing having at one end shoulder means projecting beyond the periphery of said opening to engage the metal bar and support the bushing and having at its other end an eccentric lip at one side only of the bushing body, said lip extending beyond the periphery of said opening to engage the metal bar and prevent withdrawal of the bushing through the opening by axial movement when in said normal position but short enough to permit the bushing to be removed in a direction axial of the opening when its axis is tilted with respect to the axis of the opening; and a comparatively stiff electrode slidably passing centrally through the insulator bushing with slight clearance and holding the bushing against such tilting movement.

2. In a high tension electrode assembly for an electrical precipitator, the combination comprising: a horizontally extending spacer bar having a plurality of spaced circular openings with their axes vertical; a hollow one-piece bushing in each opening and fitting the associated opening with slight clearance to permit movement of the bushing relative to the bar, each bushing having a generally cylindrical body with an annular collar at its upper end of a diameter larger than the associated opening in the spacer bar and having at its lower end an eccentric lip extending beyond the bushing body at one side only and beyond the periphery of the opening in the spacer bar to engage the spacer bar and prevent withdrawal of the bushing through the spacer bar opening while the axis of the bushing is vertical, but disengageable from the spacer bar by tilting the bushing to incline its axis to the vertical, the bushing body being otherwise of substantially uniform diameter; and a plurality of comparatively stiff vertically extending electrodes, one passing vertically through each bushing with slight clearance and holding the axis of the associated bushing against tilting movement away from the vertical.

3. A one-piece insulator bushing for a high tension electrode comprising: a hollow cylindrical body portion having at one end an integral lip extending radially beyond the body portion at one side of the bushing only, the end of the body portion being beveled at the side opposite the lip, said body portion otherwise having a smooth continuous exterior surface of substantially uniform diameter; and an integrally formed annular shoulder at the other end of said body portion spaced from the lip and of a diameter larger than said body portion.

4. An insulator bushing as in claim 3 in which the maximum overall dimension of the body portion in a radial plane passing through the lip and beveled portion is not greater than the uniform diameter of the body portion.

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