J. G. DAVIDSON.

APPARATUS FOR ELECTRICAL TREATMENT OF GASES.

APPLICATION FILED FEB. 3, 1917.

1,334,231. Patented Mar. 16, 1920.

Fig. 1.

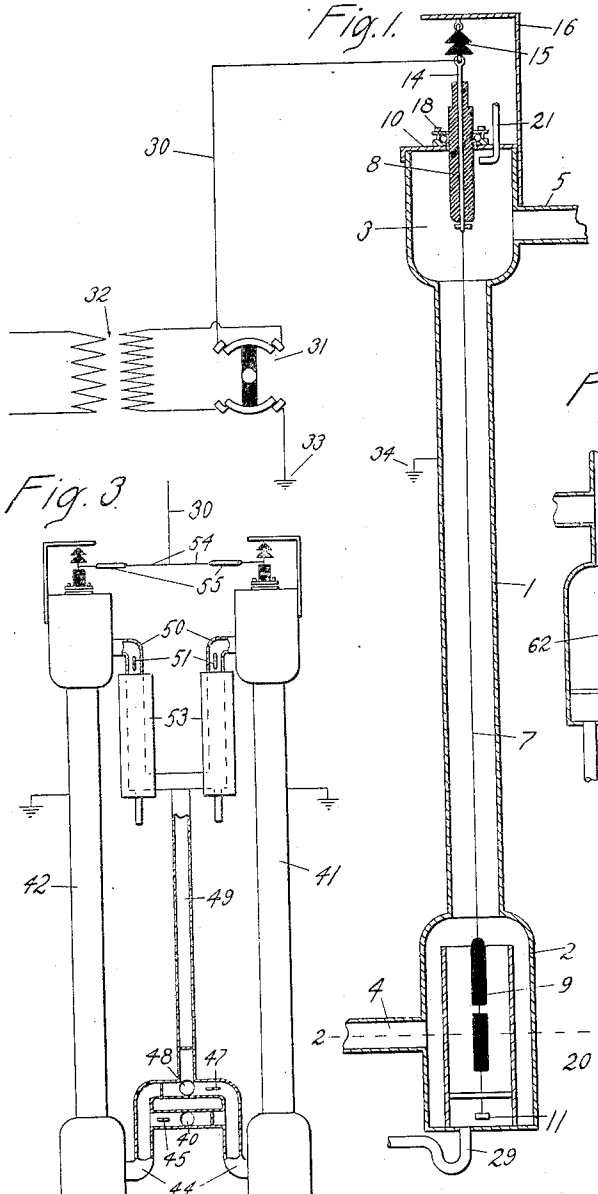

Fig. 6.

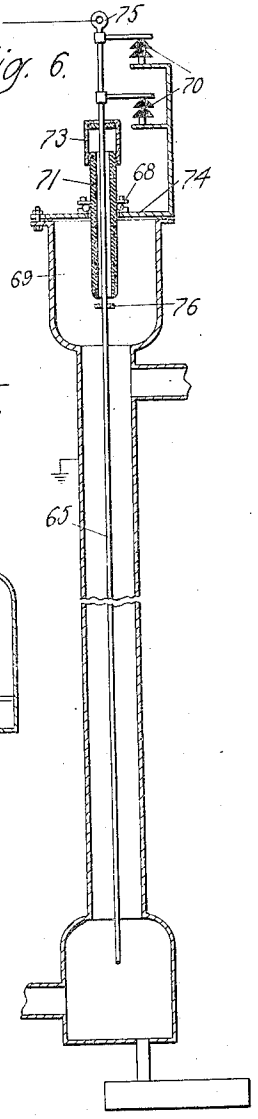

Fig. 5.

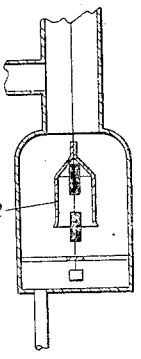

Fig. 3

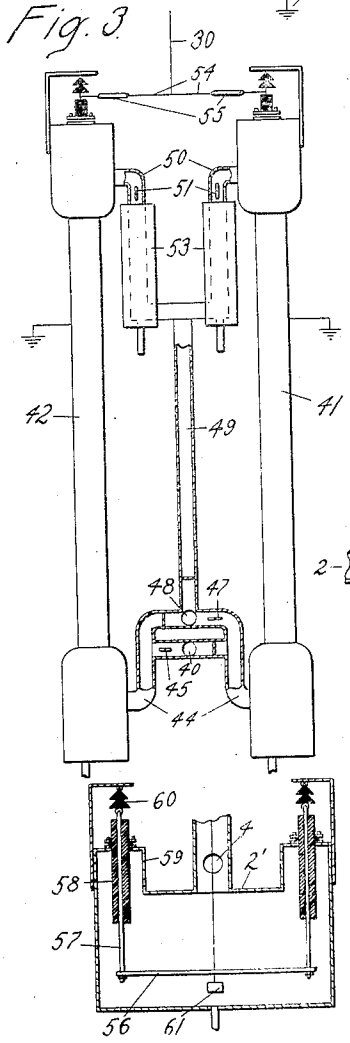

Fig. 2.

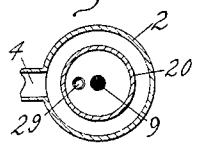

Fig. 4.

Inventor:
James Grant Davidson
by Arthur P. Knight
his Attorney

UNITED STATES PATENT OFFICE.

JAMES GRANT DAVIDSON, OF VANCOUVER, BRITISH COLUMBIA, CANADA, ASSIGNOR TO INTERNATIONAL PRECIPITATION COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

APPARATUS FOR ELECTRICAL TREATMENT OF GASES.

1,334,231. Specification of Letters Patent. Patented Mar. 16, 1920.

Application filed February 3, 1917. Serial No. 146,484.

To all whom it may concern:

Be it known that I, JAMES GRANT DAVIDSON, a subject of the King of Great Britain and Ireland, resident of Vancouver, in the county of Vancouver, Province of British Columbia, Dominion of Canada, have invented a new and useful Apparatus for Electrical Treatment of Gases, of which the following is a specification.

This invention relates to an apparatus for subjecting gases to the action of an electrical field—for example,—for the purpose of precipitating suspended material from such gases.

The main object of the present invention is to provide an apparatus for this purpose which will be capable of successful and effective operation on gases which contain tarry matter or similar material, the presence of which interferes seriously with the operation of ordinary types of electrical gas treating apparatus, by reason of the tendency of such material to deposit on the insulators and other parts, causing deterioration or failure of the insulators by surface leakage and otherwise.

Insulating materials now in ordinary use in apparatus of this character, are open to the following objections, when used in electrical precipitation of suspended material from gases and vapors containing tarry material, more particularly when such gases and vapors are at comparatively high temperature. Some materials, such as glass or earthenware, crack with such changes of temperature as are liable to occur in the precipitating operation; other insulating materials, such as resinous compositions, may partially dissolve or disintegrate in the presence of certain oils or tars, especially at high temperatures, or may lose their mechanical or insulating or dielectric strength under the high temperature encountered in the apparatus; in the case of some materials, such as unglazed earthenware, brush discharge from a high tension electrode over the adjacent surface of an insulator supporting same, may cause tar to carbonize and fuse or combine with the insulating material, thereby forming a relatively good conductor, the brush discharge then creeping farther and so on until the insulation is destroyed. Regardless of the material used for the insulator, the brush discharge over the tar covered surface adjacent to the high potential electrode, will lengthen continually as the coating of tar becomes thicker and may eventually allow the discharge to flash or arc over to the grounded end of the insulator. This carbonizes the tar along the line of such discharge, thus forming a permanent conductor which is difficult to remove.

An important object of the present invention is to provide apparatus of this kind with insulating means capable of maintaining its effectiveness, under the conditions of working above referred to, for a sufficiently prolonged time, to avoid undue or excessive expense and loss of time due to repairs and shut-downs, and to thereby provide an installation which is capable of commercially successful operation.

A further object of the invention is to provide for protecting the insulation against deposition of tarry material thereon.

Another object of the invention is to provide means for cleaning the insulator.

The accompanying drawings illustrate embodiments of my invention and referring thereto:

Figure 1 is a vertical section of one form of the apparatus.

Fig. 2 is a horizontal section on line 2—2, Fig. 1.

Fig. 3 is a partly sectional elevation of another form of the apparatus.

Figs. 4, 5 and 6 are detail sections of further modifications.

The form of my improved gas treating apparatus shown in Fig. 1 consists of a single tubular element. It will be understood that any number of these elements may be connected in multiple or in series as may be desired. 1 designates a vertical tube or pipe constituting a collecting electrode for the apparatus and connected at its lower and upper ends respectively to enlarged chambers 2 and 3, constituting, for example, inlet and outlet chambers, chamber 2 being connected to a supply pipe 4 and chamber 3 being connected to the outlet pipe 5.

The discharge electrode 7, which may consist, for example, of a fine wire, is suspended axially in the vertical tube 1, preferably by being stretched between an insulator 8 mounted in the upper chamber 3 and an insulator 9, mounted in the lower chamber

2. Said upper insulator 8 preferably consists of an elongated tube of insulating material mounted by suitable supporting means in the top plate 10 of the upper chamber 3. I prefer to make the tube 8 of quartz or fused silica, this tube being of sufficient length and being so mounted in its support that the portion of the tube above the top plate 10 is sufficient to provide for maintaining the insulation under all working conditions and the portion of the tube below the top plate 10 is of sufficient length to maintain the insulation necessary for operation for sufficient time to enable commercial operation of the apparatus even when the said portion of the insulator becomes covered with tarry material. In this connection, the use of quartz or silica for this insulator is of especial advantage, for the reason that this material retains its high insulating quality under the high temperature existing under such conditions and for the further reason that such material, by reason of its low coefficient of expansion, does not tend to disrupt or crack by local heating thereof in any such operation. Moreover, the tarry material does not fuse into the surface of quartz in the way it does with unglazed porcelain. Further, after a conducting line of carbonized tar has been formed on quartz by an arcing discharge over its surface as mentioned above, it may be removed by burning without detriment to the material.

On account of the comparative fragility and brittleness of quartz, it is desirable to mount the electrode 7 in such manner that the quartz insulator 8 does not have to withstand any considerable mechanical bending stress or jar. For this purpose, the conductor 14 from which the electrode 7 is suspended may be supported by an insulator 15 mounted outside of the precipitator on suitable support 16, said conductor 14 extending through the quartz tube 8 and the latter extending through the top of the upper chamber 3, a stuffing box 18 being preferably provided for closing the joint between insulator tube 8 and the top of said chamber, and providing a cushion support for said insulator.

The lower insulator 9 is also preferably made of one or more elongated tubes or rods of quartz secured at the upper ends thereof to the discharge electrode 7 and at the lower ends thereof to the bottom of chamber 2, or to a tensioning weight 11.

In order to minimize deposition of tarry material on the lower insulator 9, I may provide a shield formed as a tube 20, surrounding said insulator and extending within the lower chamber 2 so as to deflect the gases entering through pipe 4 and prevent them from coming in immediate contact with said insulator 9. Said shield or tube 20 being grounded, a strong electric field exists between the discharge electrode and said tube, causing precipitation, on the wall of said shield or tube, of any suspended matter that may find its way into the space therewithin, thereby insuring as far as possible, the retention of the surface of said insulator in clean condition. The lower chamber 2 may be provided with a drain pipe or trap 29, for carrying off precipitated materials.

In some cases, it may be desirable to provide for cleaning the surface of one or both of the insulators, and for this purpose, I may provide means such as a pipe indicated at 21 in the upper chamber 3 for discharging oil or other cleaning liquid onto or against the surface of the upper insulator, the upper and lower insulators being in line with the vertical discharge electrode.

Suitable means are provided for applying high tension current, either direct or alternating, to the discharge electrode 7. For this purpose, the conductor 14 may be connected with wire 30 leading to a high tension rectifier 31 which is adapted to rectify high tension current supplied from the step-up transformer 32, said rectifier having ground connection 33 and the collecting electrode 1 being grounded as indicated at 34 to complete the circuit. Or, if desired, the conductor 14 may be connected directly to a high tension alternating current supply circuit for supplying alternating current to the apparatus.

The operation of the apparatus above described is as follows:—

Gas to be cleaned or treated is supplied through pipe 4 to the lower chamber 2 and passes upwardly through the tubular collecting electrode 1 to the upper chamber 3, and flows out through the pipe 5. In passing upwardly through the collecting electrode 1, the gas is subjected to the action of the electrical field with the result that any suspended material contained in the gas will be precipitated on the electrodes, especially on the collecting electrode 1, and, in the case of a tarry or other liquid or semi-liquid precipitate, will run down into the lower chamber 2 and may be drawn off through the trap or outlet pipe 29. In this operation, the tubular shield 20 prevents the incoming gas from striking the lower insulators 9 so that the deposition of tarry matter thereon from the gas directly is prevented or reduced to a minimum. More or less tarry matter is, however, liable to run down onto the lower insulator from the discharge electrode and the upper insulator. The gases, by the time they reach the upper chamber 3, will in general be substantially free from any tarry material or other suspended matter, so that there is little liability of deposition of such material on the upper insulator. Such material as may collect on either the upper or lower insulators may be

washed therefrom either continually or from time to time by passing a current of suitable liquid, such as oil from the pipe 21, on to the upper insulator from which it runs down on the discharge electrode and over the lower insulator to clean the same.

My invention may advantageously be applied as shown in Fig. 3 in a form comprising two treater units each, for example, of substantially the construction shown in Fig. 1 and connected so that the gas may be caused to traverse said treater units in series or parallel and to be reversed from time to time. In this form of the invention the two treater units indicated at 41 and 42 are of substantially the same construction as shown in Fig. 1.

The inlet pipes 44 for the respective treater units are connected through valves 45 to an inlet conduit 40 through which the gas to be treated is supplied to the apparatus and are also connected through valves 47 to an outlet pipe 48 through which the gas is conducted to storage means, to a stack or to any required point of delivery. Said outlet pipe 48 is also connected by pipe 49 to pipes 50 leading to the upper chambers 3 for the respective treaters, valves 51 being provided in these pipes. If desired, these pipe connections may be suitably heat insulated, or, as shown in the drawing, cooling means or jackets indicated at 53 may be provided therefor to cool the gas on its way from one treater to the other. The discharge electrodes of the two treaters are connected to the energizing circuit wire 30 by branch connections 54 including switches 55, so that either treater may be cut out of operation for cleaning or repairs. Under these conditions, the several valves above referred to will be so operated that the gas will flow from the inlet pipe 40 to the treater tube which is in operation, upwardly through said tube and then downwardly through the pipe 49 to the outlet 48. In normal operation, however, the two treaters are preferably connected in series relation, the valves being, for example, operated as shown in the drawings so that the gas entering at pipe 40 will pass through pipe 44 to the lower part of treater 42, and thence upwardly in said treater and out through pipe 50. The action of the electrical field in the treater 42 causes the tarry matter and other suspended material to be precipitated in said treater and the remaining gas and vapor passing through the cooling tubes 50 may be cooled sufficiently to condense more or less of the vapor therein to a liquid consisting, for example, of a light oil, this being the product condensed under certain conditions when gases produced by the distillation of carbonaceous materials are being treated. Such oils passing along with the gases into the treater 41 are precipitated therein and collect on the electrodes and insulators of said treater 41 in such manner as to continually wash the same, thereby keeping the insulators and the electrodes clean. If, at any time, the insulators in the treater 42 become excessively coated with tarry material or other precipitated matter, the direction of the gas current may be reversed by suitably manipulating the several valves so that the condensed oil may be caused to run down on the insulators and electrodes in said treater 42, so as to clean the same.

In Fig. 4, I have shown a modified construction for mounting the lower end of the discharge electrode, which is stretched by a weight 61 and held in place at its lower end by a spacing bar 56 supported on rods 57 which are mounted in insulators 58 extending vertically in upwardly extending pockets 59 at each side of the lower chamber 2', said rods 57 being hung from insulators 60 outside of the lower chamber aforesaid, so that the insulators 58 serve only for insulation purposes and do not have to stand the strain of support of said rods, the whole lower insulating system described, furnishing a means for keeping the lower end of the discharge electrode from swinging, and at the same time keeping the insulators in comparatively clean gas, so as to minimize deposition of tarry material thereon, and also to provide for the lower insulators the structural advantages above described with reference to the mounting of the upper insulators in Fig. 1.

As an alternative for the above described means for maintaining the lower insulator in effective condition, I may, as shown in Fig. 5, provide a protecting hood indicated at 62, which may be of metal or any other suitable material and is mounted on the discharge electrode above the lower insulator so as to extend over and around the same in such manner as to prevent any tarry matter running down the discharge electrode from reaching said insulator. I may, in some cases, as shown in Fig. 4, connect the inlet pipe 4 to the vertical tubular electrode at a point above the lower effective limit of the discharge and collecting electrodes so that the gas in the lower portion of said collecting electrode is kept clean by the action of the electrical field, and the suspended material in the incoming gases does not strike or collect directly on the lower insulator: Similarly, the outlet pipe may, if desired, enter below the top of the tubular collecting electrode so as to keep a body of clean gas between the upper insulator and the current of gas through the treater.

In some cases, particularly where gases are being treated which are comparatively good conductors, or where other conditions make it desirable, the discharge electrode may be made of comparatively large diame-

ter and without portions presenting sharp edges. Moreover, in some cases, where the edge or point effect for facilitating discharge may be desirable, the discharge electrode may be of such construction that the fine wires or other surfaces presenting sharp contour may be mounted in comparatively rigid frame means. In all such cases, the rigid discharge electrode means may be of sufficient rigidity to enable its support at one end only, and particularly to enable the support of the discharge means from its upper end, such an arrangement having the advantage in cases where the gas or vapor is introduced at the lower end of the treater, that all the troubles due to collection of tar on the lower insulator, where one is used, is obviated.

For this purpose, the construction shown in Fig. 6 may be used, the discharge electrode 65 being in this case shown as a rigid tube or rod, having, if necessary, suitable means such as flanges formed thereon for facilitating discharge, said tube or rod extending through the upper insulator 71 which is mounted by stuffing box 68 in the top of the upper chamber 69 of the treater and said tube or rod being supported by insulators 70 outside of the treater, the support being sufficiently rigid to prevent vibration or displacement of the electrode under conditions of practice to an extent sufficient to interfere with the operation. Insulator 71 is preferably of quartz for the reasons above stated, and in order to protect the comparatively fragile quartz from injury by unavoidable vibration of the electrode 65, I may, as shown in this figure, form said insulator as a tube of sufficient internal diameter to clear or be out of contact with the electrode rod or tube 65, suitable means, such as a flexible tube 73 being provided to close the joint between this insulator tube 71 and the rod or tube 65 while permitting slight lateral movements of the electrode rod or tube. The top plate 74 of the upper chamber 69 of the treater may in this case be removably mounted on said upper chamber so that if desired the said top plate may be released from connection with the said upper chamber and the discharge electrode rod may be raised by suitable lifting means connected to an eye-bolt 75 on said electrode rod or tube, the insulator 71 and the adjacent parts being removed along with said rod, or if desired, the stuffing box 68 may be loosened and the insulator and discharge electrode drawn through, the electrode rod or tube 65 being provided with projecting means such as indicated at 76 for insuring withdrawal of the insulator tube 71 along with the electrode.

What I claim is:—

1. In combination with a gas receiving chamber, of an electrical treater and a discharge electrode within the said chamber, of a bushing of fragile insulating material extending through a wall of the chamber and connected thereto by a yielding medium, a conductor extending through the bushing and connected to the discharge electrode, and a support for the conductor outside the chamber.

2. In combination with a gas receiving chamber, of an electrical treater and a discharge electrode within the said chamber, of a bushing of fragile insulating material extending through a wall of the chamber, a yielding medium for closing the joint between the bushing and the said wall, a conductor extending through the bushing and connected to the discharge electrode, and a support for the conductor outside the chamber.

3. In combination with a gas receiving chamber, of an electrical treater, an insulator mounted above said chamber, a conductor supported upon said insulator and extending through the top of said chamber and means for closing the joint between said conductor and the top of the chamber, comprising an insulating bushing extending through the top of the chamber and a yielding connection between the bushing and the top of the chamber whereby the bushing is protected from jar, and a discharge electrode mounted on said conductor inside of said chamber so as to be supported by said insulator independently of said bushing.

4. In an apparatus for electrical treatment of gases, the combination with a treating chamber of a discharge electrode therein, a conductor for supporting said discharge electrode, said conductor passing vertically through the top of said chamber, an insulator above the top of said chamber and supporting said conductor and an insulating bushing of fused silica extending through the top of said chamber and surrounding said electrode, and a cushioning joint means for mounting the said bushing in the top of said chamber.

5. A construction, as set forth in claim 4, and comprising a yielding connection between the said conductor and said bushing to close the joint between said parts while protecting the bushing from jar.

6. In an apparatus for the electrical treatment of gases, a gas receiving chamber, a discharge electrode therein, an insulator for mounting said discharge electrode, gas inlet means for said gas receiving chamber and deflecting means surrounding said insulator and located in the path of the gas from said inlet means in such manner as to protect said insulator from the deposition of suspended material carried by such gas.

7. In an apparatus for the electrical treatment of gases, a gas receiving chamber, a discharge electrode therein, an insulator for

mounting said discharge electrode and means for supplying cleaning liquid to said insulator to remove deposited liquid therefrom.

8. In an apparatus for the electrical treatment of gases, a gas receiving chamber, a discharge electrode extending vertically therein, upper and lower insulators mounted in said chamber in line with said discharge electrode for holding said electrode in place and means for supplying cleaning liquid to said upper insulator so as to cause such liquid to clean both upper and lower insulators and the discharge electrode.

9. In an apparatus for electrical treatment of gases, a gas receiving chamber including a tubular collecting electrode, a discharge electrode extending longitudinally therein, and means for passing gas through a portion only of said tubular collecting electrode, so that a remaining portion of said tubular electrode is out of the path of the gas and is kept clear of suspended matter by the action of the electrical field between said electrodes, and insulating means for said discharge electrode mounted in said gas receiving chamber in such manner that the said remaining portion of said tubular collecting electrode is between said insulator and a current of gas.

10. An apparatus for electrical treatment for gases containing condensable suspended matter comprising two electrical precipitating means and connections for conducting the gas to be treated in series through said precipitating means, said connections including means for cooling the gases in passage thereof between the precipitating means to condense liquid for cleaning the final precipitating means and valve means in said connections for reversing the flow of gas in the precipitating means.

In testimony whereof I have hereunto set my hand, at Los Angeles, California, this 19th day of January, 1917.

JAMES GRANT DAVIDSON.