

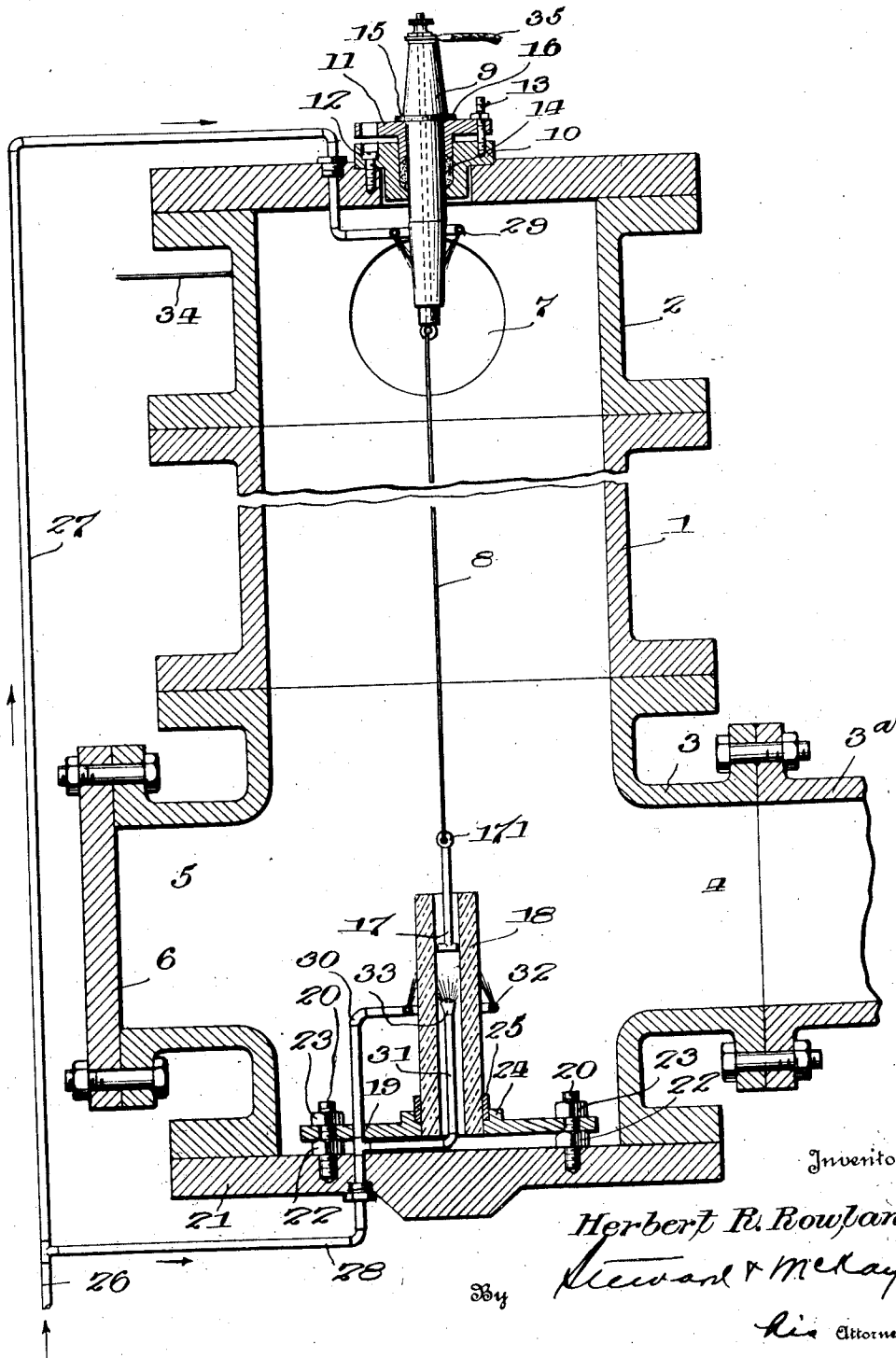
Oct. 5, 1926.

1,601,771

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APPARATUS FOR ELECTRICAL TREATMENT OF GASES AND VAPORS

Filed Nov. 15, 1923



Patented Oct. 5, 1926.

1,601,771

UNITED STATES PATENT OFFICE.

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APPARATUS FOR ELECTRICAL TREATMENT OF GASES AND VAPORS.

Application filed November 15, 1923. Serial No. 675,010.

This invention relates to apparatus for electrical treatment of gases and vapors; and it relates more particularly to improved means for the maintenance of effective insulation between the electrodes of opposite polarity employed in such apparatus.

The type of apparatus to which the invention relates is that in which the gas or vapor to be treated is passed through a suitable treating chamber in which it is subjected to the action of a high tension electric field maintained between opposed electrodes, the electric field generally being characterized by a continuous or intermittent silent or corona electric discharge between the electrodes. While various forms of apparatus of this type may differ in certain details of structure according to the particular uses to which they are put, they all in common employ opposed electrodes that differ in configuration and extent of surface area, one being of such small surface area and sharp contour as to produce a concentrated field adjacent thereto and the other of a comparatively extended surface and a contour to produce a field of less intensity adjacent thereto. A characteristic structure of such apparatus comprises a treating chamber, circular in cross section, the interior walls of which constitute the electrode of the more extended surface, in combination with a fine wire extending axially of the chamber and constituting the opposed electrode of small surface area and sharp contour. In certain uses to which such apparatus is put, such, for example, as the treatment of gases for the precipitation therefrom of suspended particles, the discharge is generally unidirectional, proceeding from the fine-wire electrode to the walls of the treatment chamber, the greater field intensity adjacent the fine wire electrode facilitating the electrical discharge and movement of the suspended particles toward the chamber walls and the lesser field intensity adjacent the chamber walls facilitating the deposit thereon of the suspended particles. In certain other uses to which such apparatus are put, such, for example, as the electrical treatment of gases or vapors or mixtures thereof to produce desired products by chemical reactions set up therein, as for instance the production of lower-boiling point hydrocarbons from the vapors of higher boiling point hydrocarbons, the elec-

trical discharge may be unidirectional as before or may take place in alternating directions between the electrodes. In any event, in all such uses of the apparatus the more intense electrical field about the electrode of sharper contour performs an important function in electrically charging or otherwise acting upon the gases or vapors treated, for the acceleration of reactions therein or for precipitation of particles therefrom, and that electrode has come generally to be termed the discharge electrode, the other being generally termed the receiving or collecting electrode.

In order to provide for maximum efficiency of operation in an apparatus of the type referred to, it is essential to maintain as high a potential difference between the electrodes as possible without causing disruptive discharge or arcing between them. Aside from other conditions of operation, this presents the matter of proper insulation as a difficult problem, particularly the insulation about the discharge electrode to avoid current leakage therefrom. The difficulty of maintaining proper insulation is furthermore greatly increased by the conditions incident to the treatment of gases or vapors initially containing conductive particles of matter, or in which such particles may be formed by the treatment, the conditions of operation in most instances causing deposition to a greater or less extent of such particles upon the insulators supporting the discharge electrode in the treating chamber, an electrically conducting deposit being thus gradually formed which in time short-circuits the insulation.

It is desirable, in apparatus of the type referred to, that the wire electrode be supported under moderate tension in the treating chamber and be maintained from swinging or oscillatory movements, so that it will remain evenly spaced throughout its length from the surface of the opposed electrode and yet be free to expand and contract in length under the varying degrees of heat encountered in operation. This has generally been accomplished in the prior art structures by suspending the wire electrode from an insulator disposed in the upper part of the treating chamber and attaching a weight to the lower end of the wire to tension it and by providing some form of perforated bar or bracket affixed to side

walls of the chamber through which the wire extends and by which the wire is maintained from lateral movement. While the perforated bar or bracket was either formed of non-conducting material or was insulated from the side walls of the apparatus, its surface presentation was necessarily such as to readily receive and retain deposits from the gases or vapors undergoing treatment, so that with this form of mounting for the discharge electrode, the breakdown of the insulation from the deposited particles was very apt to occur.

Attempts have been made in the prior art to maintain the effectiveness of the insulation about the discharge electrode by means of a stream of a washing or cleansing liquid directed against the surface of the upper insulator from which that electrode depends, reliance being placed on the downflow of the liquid to remove deposits from the wire electrode itself and from the lower insulating bar or bracket employed to restrain the wire electrode from lateral movement. Such means, however, have not ensured the maintenance of effective insulation, due in part to the fact that the surface presentation of the lower insulating bar or bracket referred to was such as to retain deposits to a degree resisting their complete removal by the washing means employed.

A general object of the present invention is to provide an apparatus of the type hereinbefore mentioned with improved insulating means which will remain effective under all conditions of use to which such an apparatus may be put.

A more specific object of the invention is to provide means for tensioning the wire electrode within the treating chamber and means associated therewith for insulating the electrode and for restraining it from lateral movement, all of which means shall present surfaces not readily retaining conductive deposits from the gases or vapors undergoing treatment.

Another particular object of the invention is to provide means for directing streams of a washing or cleansing liquid directly against the surfaces of all insulators exposed within the treating chamber in such a manner as to be effectual in maintaining those surfaces substantially free from conductive deposits thereon.

The foregoing and other objects of the invention and its principles will more clearly appear from a concrete embodiment thereof hereinafter described and illustrated in the accompanying drawings forming a part hereof. It is to be understood, however, that the concrete embodiment referred to is merely illustrative of my invention and that various other specific embodiments may be made within the broad scope of the invention as defined in the appended claims.

The single figure of the drawings is a vertical longitudinal sectional view of one type of apparatus for the electrical treatment of gases or vapors in which my invention may be and is shown as embodied.

In the illustrative apparatus, which is of a type especially adapted for treatment of hydrocarbon vapors to convert the same into lighter products such as gasoline, the treating chamber for the gases or vapors is constituted by a central tubular section 1 (much shortened as here shown to bring it within the allowable limits of the drawing), circular in cross section and of conducting material; together with upper and lower header sections 2 and 3. The interior walls of this chamber, and more particularly the interior walls of the central section, form the electrode of larger area employed in the apparatus.

The gases or vapors or mixtures thereof are passed upwardly or downwardly through the treating chamber as desired. The lower header 3, which in this instance is a 4-way union, is shown with two opposite side arms providing openings 4 and 5, the latter of which is provided with a removable closure 6 and affords access to the inside of the treating tube or chamber for purposes of inspection or repair. The opening 4 serves in the present example to admit gases or vapors to be treated. The treating tube or chamber may be coupled in series with one or more additional tubes of similar character through which the gases or vapors flow successively, an arm of the lower 4-way union of one such other tube being indicated at 3^a. The upper header 2 is shown as provided with an exit port or passage 7.

A discharge electrode of the well-known filamentary or fine-wire type is indicated at 8, very small gage nichrome wire being suitable for the purpose.

The parts of the apparatus thus far described are of well known construction and arrangement and my invention relates more particularly to novel insulating supports and mountings for the discharge electrode in association with novel liquid supply and distributing means all maintaining the discharge electrode properly positioned within the treating chamber and effectively insulated at all times from the opposed electrode and other parts of the apparatus.

My invention in one of its broad aspects contemplates the employment of upper and lower insulator members for the discharge electrode spaced along its length and serving to maintain that electrode bodily supported axially of the surrounding tube walls and restrained from lateral movement, and means for directing separate streams of a washing or cleansing liquid directly against the exposed surfaces of those insulator members to maintain them free from con-

ductive deposits. My invention further contemplates a novel lower insulator member presenting a surface not readily retaining deposits from the gases or vapors undergoing treatment and easily cleaned by the liquid streams referred to from any deposits which do occur.

The insulator members may be of any suitable non-conducting material although I preferably employ fused silica or quartz, the use of such material being of special advantage for the reason that it retains its insulating qualities under the high temperatures encountered in certain uses of the apparatus and for the further reason that deposits of tarry matters or the like do not fuse into the surface of the quartz.

The upper insulator, preferably of fused quartz or silica, as stated, is indicated at 9. A stuffing-box mounting in the cover of the treating chamber is provided for this upper insulator, the mounting comprising a bushing 10 through which the insulator is extended, and a packing gland 11. The bushing 10 is screw-bolted to the cover of the treating chamber as indicated at 12 while the packing gland is adjustable within the bushing by means of the screw bolts 13. A packing of cushioning material about the insulator is indicated at 14. The upper portion of the insulator is provided with an annular shoulder 15 between which and the upper surface of the gland 11 a washer 16 of suitable cushioning material is placed.

As hereinbefore stated, in apparatus of the type to which my invention relates, a weight or plummet is secured to the lower end of the fine wire electrode to moderately tension the same; and, in accordance with the present invention, said plummet constitutes a movable member of guiding and restraining means, a cooperating stationary member of which is mounted in the lower part of the treating chamber. The stationary and movable members of said guiding means are advantageously arranged to cooperate telescopically, one being slidably disposed within the other, in such manner that the fine-wire electrode is not only suitably tensioned but is also restrained from undesirable lateral movement, being thereby maintained properly centered axially within the treating chamber.

In the embodiment of the invention here illustrated, the plummet takes the form of an inverted T-shaped member 17, formed of insulating material such as glass or fused silica, quartz, or the like, having a flattened upper end portion 171 which is apertured to permit suspension from the end of the fine-wire electrode 8. The lower end or head of the T-shaped member 17 fits slidably within the bore of a stationary upright insulator tube 18, also of fused silica, quartz or the like, said tube being mounted on the

bottom of the treating chamber, advantageously in a manner to be more particularly described hereinafter. The stem of the insulator plummet 17 is spaced from the inner walls of the cooperating tubular insulator 18, as shown, only the ends of the T-head bearing against said walls. This evidently increases the efficiency of the insulating effect. This arrangement accurately centers the plummet and hence restrains the discharge electrode from lateral movement in the treating chamber and yet permits rise and fall of the plummet to accommodate variations in the length of the wire under expansion and contraction due to temperature conditions in the treating chamber. This arrangement, it is also to be noted, provides a relatively extended body of insulating material between the lower portion of the discharge electrode and the walls of the apparatus but having surfaces exposed to the gases and vapors undergoing treatment which are of relatively sharp curvature and vertically disposed so that deposits are not readily retained thereon.

The tubular insulator 18 may be rigidly mounted in the lower portion of the treating chamber by various forms of mountings. I preferably employ, however, a mounting comprising a plate supported in position spaced from the floor of the treating chamber and having a central aperture for the reception of the lower end of the tubular insulator, this form of mounting having certain advantages in connection with the means for washing the insulator surfaces, as will more fully appear as the description of the preferred embodiment of the invention proceeds. The plate, indicated at 19, is in the form of a disk having apertures circumferentially spaced about its peripheral portion for the insertion therethrough of screw-bolts 20. The bottom closure 21 of the treating chamber is tapped to receive the screw bolts and two nuts 22 and 23 are provided for each bolt, one set of nuts 22 to support the plate in position spaced from the bottom of the treating chamber and the other set 23 to secure the mounting of the plate.

The plate 19 is also formed with an upwardly extending centrally disposed boss 24 to provide a thickened central portion of the plate, and this portion is vertically bored and countersunk to provide a supporting socket. The quartz tube electrode is solidly cemented into a steel ring 25 which fits tightly into the annular countersink and is frictionally held by the walls thereof, while the lower end of the quartz tube extends within the central bore.

In the illustrative embodiment of my invention the means for supplying and distributing the washing or cleansing liquid to the insulator surfaces comprises a main

supply pipe 26 and branch pipes 27 and 28, one to supply the upper insulator and the other the lower insulator. The branch 27 is extended upwardly and horizontally above the treating chamber and thence inwardly through the upper closure of that chamber, terminating in a stream-directing member comprising an annular nozzle 29 surrounding the body of the upper insulator within the treating chamber, the annular nozzle having jet apertures directing streams of the liquid obliquely downward against the surface of the insulator.

The branch pipe 28 for supplying the lower insulator extends upwardly through the bottom closure of the treating chamber and is divided into two branches 30 and 31. The pipe 30 extends upwardly to one side of the lower insulator 18 and then horizontally toward the insulator to a termination in the annular nozzle 32 surrounding the insulator. The pipe 31 extends first horizontally in the space between the mounting plate 19 and the bottom closure 21 of the treating chamber, and then upwardly within the bore of the tubular insulator 18 to termination in a nozzle 33. The exterior nozzle 32 and the interior nozzle 33 are disposed in substantially the same horizontal plane, slightly below the weight 17, and the discharge apertures in these nozzles are disposed to direct the liquid streams obliquely upward against the outer and inner walls of the tubular insulator, the upward direction of the streams serving to wash the insulator surfaces about the weight 17 and the downflow of the liquid serving to continue the washing action along the length of the insulator to its lower end. The member 18, being an open-ended tube, and spaced at its lower end from the bottom closure of the treating chamber, there is no possibility of the washing liquid accumulating therein, and the walls of this member being vertically disposed are easily kept free of deposits to the extent necessary to prevent short-circuiting.

It is apparent from the foregoing that the member 18 functions not only as an insulator but also as the guide and holder for the fine-wire electrode and its plummet, providing for the elongation and contraction of the wire while maintaining it centrally within the tubular walls of the treating chamber; further, that this insulator, guide and holder presents surfaces upon which solid particles do not readily deposit and which are easily kept clean.

The liquid supplied to the insulator surfaces may be of any suitable nature to remove deposits from the insulator surfaces, either a liquid performing its function by a simple washing action on the insulator surfaces or one having solvent properties enabling it to dissolve the matters deposited from the gases and vapors undergoing treat-

ment. I have found that a hydrocarbon oil such as kerosene affords an effective washing or cleansing liquid for the purpose here intended and generally use it. The oil employed as the washing or cleansing liquid runs down the insulator surfaces and ultimately spreads upon the plate 19. When using the apparatus in the electrical treatment of vapors from a high-boiling point hydrocarbon such as kerosene to produce gasoline or the like, the high temperature occurring in the treating chamber causes vaporization of the oil upon the plate 19, such oil thus utilized to provide a part of the vapor mixture to be treated.

The difference in potential between the electrodes 1 and 8 to produce the desired electric field in the treating chamber, may be maintained by any suitable current supplying and transforming means producing the required high potential current, as is well known in the art. Leads from such current producing means to the electrodes 1 and 8 are indicated at 34 and 35.

What is claimed is:—

1. In an apparatus for electrical treatment of gases and vapors, in combination, a treating chamber, a straight filamentary electrode extending centrally of said treating chamber, means for insulating said electrode from the walls of said treating chamber comprising insulator members spaced apart along the length of said electrode, and liquid supply and distributing means for directing streams of a washing or cleansing liquid directly and separately against each insulator member on opposite sides thereof.

2. In an apparatus for electrical treatment of gases and vapors, in combination, a treating chamber, a straight filamentary electrode extending axially of said chamber, spaced insulators about said electrode to insulate the same from opposite walls of said chamber, and liquid supply and distributing means for directing streams of a washing or cleansing liquid directly and separately against the surface of each insulator, said liquid supply and distributing means including an annular nozzle about each insulator.

3. In an apparatus for electrical treatment of gases and vapors, in combination, an electrode member formed as a vertical tube, a wire electrode suspended in said tube to extend vertically and centrally thereof, a tubular insulator member rigidly mounted centrally of said tube and surrounding a portion of said wire electrode, and means supplying streams of a washing or cleansing liquid to the inner and outer surfaces of said tubular insulator member.

4. In apparatus for electrical treatment of vapors and gases, the combination, with an upright closed reaction chamber the walls

of which constitute an electrode, of a co-operating fine-wire electrode, insulator means by which said electrode is suspended centrally within said chamber from the upper part thereof, and tubular insulator means in the lower part of said chamber, and further insulator means attached to said fine wire electrode and movably disposed within said tubular insulator means.

5. In apparatus for electrical treatment of vapors and gases, the combination, with an upright closed reaction chamber the walls of which constitute an electrode, of a co-operating fine-wire electrode, insulator means by which said electrode is suspended centrally within said chamber from the upper part thereof, a guide plummet attached to the lower end of said electrode, and a suitably mounted insulator tube within which said plummet is free to move up and down.

6. In apparatus for electrical treatment of gases and vapors, in combination, a tubular electrode, a fine-wire electrode suspended within said tubular electrode, and insulator means maintaining said wire electrode in proper spaced relation to the surrounding walls of said tubular electrode, said means comprising cooperating parts, one attached to said wire electrode and the other mounted stationary therebelow, said parts telescoping one within the other.

7. In an apparatus for electrical treatment of gases and vapors, in combination, a treating chamber, a straight filamentary discharge electrode suspended in said chamber and means for tensioning said electrode and restraining it from lateral swinging movement, said means comprising a weight upon the depending end of said electrode and a tubular insulating element surrounding said weight and rigidly mounted in said treating chamber.

8. In an apparatus for electrical treatment of gases and vapors, in combination, a vertical treating chamber, a wire electrode suspended in said chamber to extend vertically and centrally thereof, a tubular member of insulating material rigidly mounted in said treating chamber centrally thereof and below said wire electrode and a tensioning weight of insulating material upon the lower end of said wire electrodes slidably engaging the interior walls of said tubular member.

9. In an apparatus for electrical treatment of gases and vapors, in combination, a vertically extending treating chamber having walls forming one electrode, a fine-wire electrode suspended in the upper por-

tion of said treating chamber to depend 60 vertically and centrally of said chamber, a tensioning weight upon the lower end of said fine-wire electrode, an open ended tubular insulating and holding member surrounding the lower end portion of said 65 fine-wire electrode and said weight, means for rigidly mounting said tubular member in said treating chamber with the lower open end of said tubular member spaced from the bottom of said chamber, and 70 means for supplying a washing or cleansing liquid to the interior walls of said tubular member.

10. In an apparatus for electrical treatment of gases and vapors, in combination, a 75 vertically extending treating chamber, a fine-wire electrode suspended in said treating chamber, a tensioning weight on said fine-wire electrode, a tubular insulator extending vertically and centrally of said treating chamber in the lower portion thereof 80 and surrounding said weight, a mounting plate for said tubular insulator spaced from the bottom of said treating chamber and a liquid supply pipe extending through the 85 space between said mounting plate and the bottom of said treating chamber and upwardly within said tubular insulator to distribute streams of a washing or cleansing liquid against the interior walls of said in- 90 sulator.

11. In an apparatus for electrical treatment of gases and vapors, in combination, a vertically extending treating chamber having a top and bottom, an upper insulator 95 mounted in the top of said chamber and centrally thereof, a lower tubular insulator extending vertically and centrally thereof, a fine-wire electrode suspended from said upper insulator, a tensioning weight 100 on the lower end of said fine-wire electrode, said fine-wire electrode depending to dispose said weight within said lower tubular insulator, a mounting plate for said lower tubular insulator, means for supporting 105 said plate rigidly in position spaced from the bottom of said treating chamber, said plate being centrally bored for the insertion there-through of the lower end of said tubular insulator and being countersunk about said 110 bore, and a holding ring surrounding said tubular insulator adjacent its lower end and frictionally engaging the side walls of the countersunk portion of said plate.

In testimony whereof I hereunto affix my 115 signature.

HERBERT R. ROWLAND.