Dec. 25, 1956 A. B. STEEVES 2,775,640

METHOD AND MEANS FOR INSULATING HIGH VOLTAGE ELECTRODES

Filed Oct. 1, 1952 2 Sheets-Sheet 1

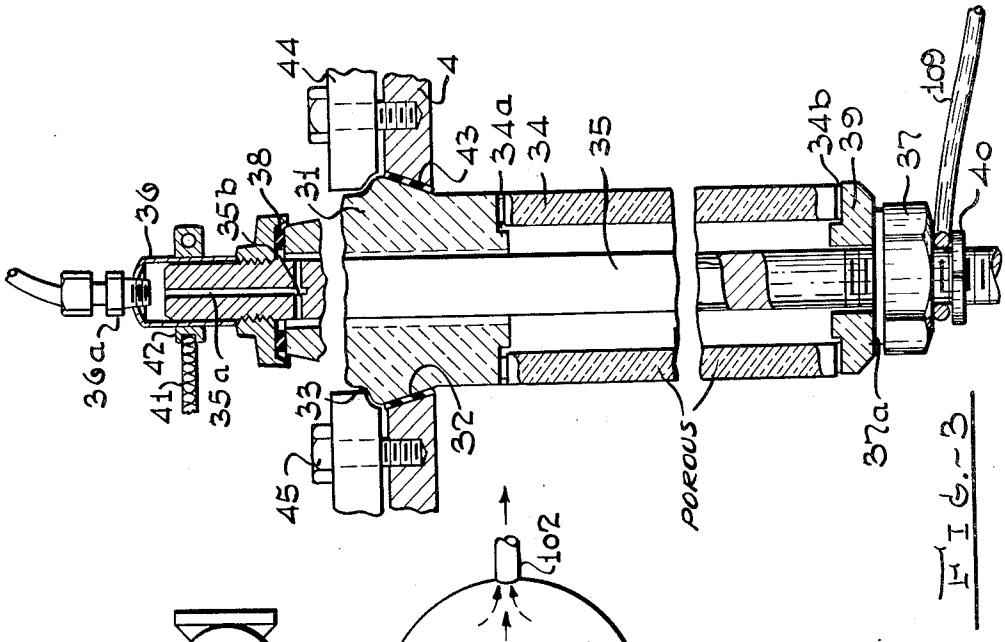


FIG. 3

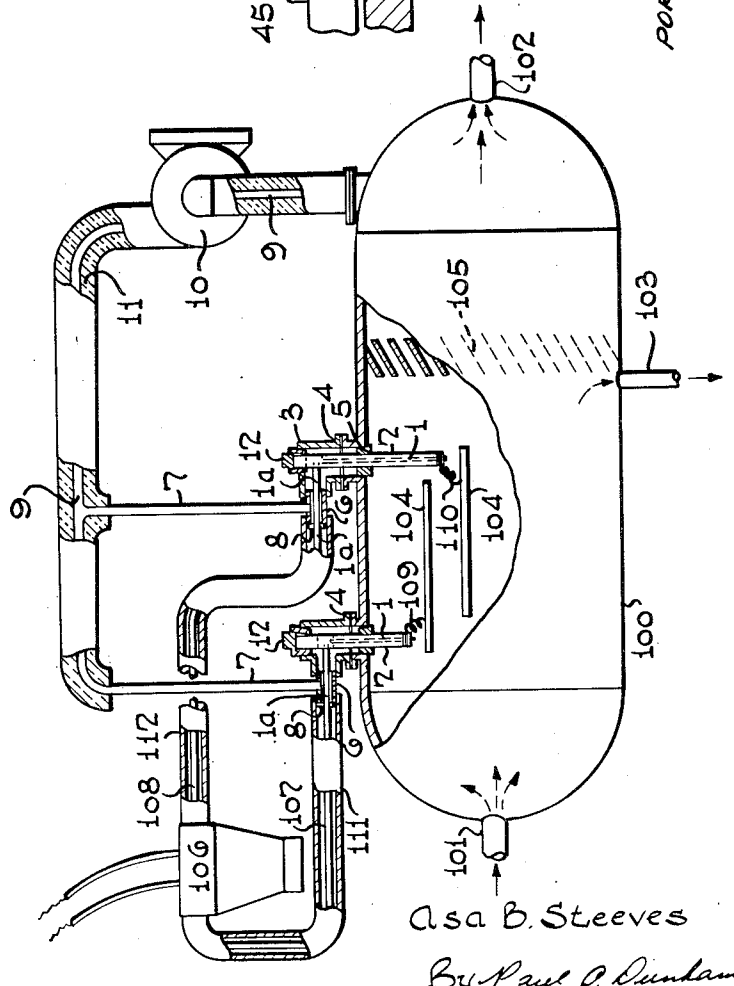


FIG. 1

Asa B. Steeves Inventor

By Paul A. Dunham Attorney

Dec. 25, 1956 A. B. STEEVES 2,775,640

METHOD AND MEANS FOR INSULATING HIGH VOLTAGE ELECTRODES

Filed Oct. 1, 1952 2 Sheets-Sheet 2

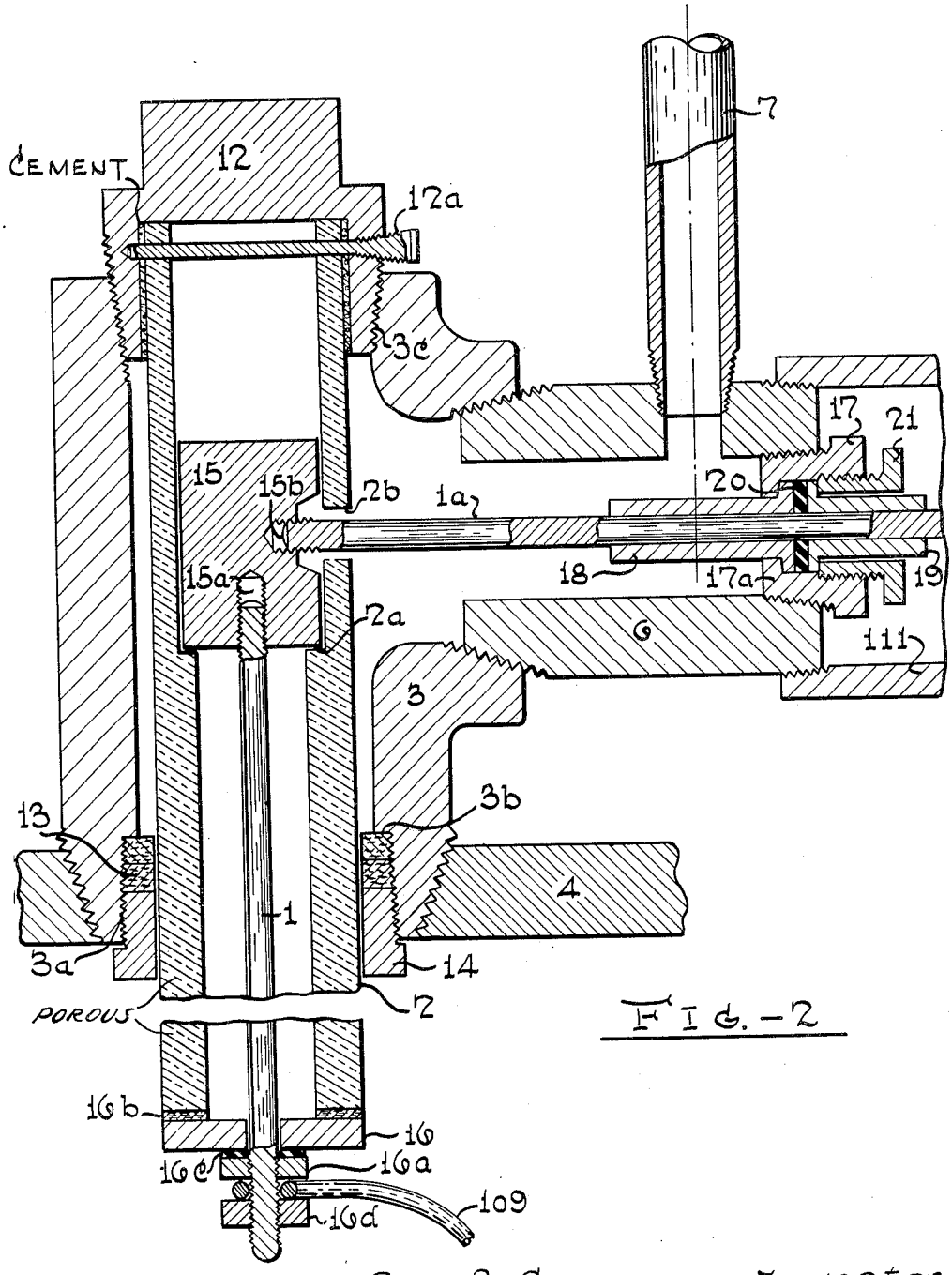


Fig. -2

Asa B. Steeves Inventor

By Paul O Dunham Attorneys

United States Patent Office 2,775,640 Patented Dec. 25, 1956

2,775,640

METHOD AND MEANS FOR INSULATING HIGH VOLTAGE ELECTRODES

Asa B. Steeves, Metuchen, N. J., assignor to Esso Research and Engineering Company, a corporation of Delaware

Application October 1, 1952, Serial No. 312,458

5 Claims. (Cl. 174—15)

The present invention relates to electrical insulators and particularly to a means and a method for insulating high voltage electrodes. The invention is especially concerned with such method and means as provided for the purpose of preventing flash-over due to the deposition of conductive materials on an insulator means for an electrode element. The method and means is particularly adapted for use in conjunction with electrodes such as are employed for introducing or removing high voltage into or from the interior of a metal enclosure or container. An example of such use would be in equipment employed for the precipitation of dust from gaseous materials, or such as that employed for facilitating separation of oil and water emulsions. The invention is more especially described herein in conjunction with its employment in an oil desalting system, in which water is added to an oily material containing organic salts to form an emulsion with the oil, after which the emulsion is separated and the water removed with the organic salts substantially in solution therein.

In systems of the character contemplated, it has been found that short circuiting of the electrodes may frequently be produced as a result of the formation of conductive deposits on the exterior surfaces of the insulator means employed. For example, in precipitators for removing dust and foreign matter carried by a gas, the particles of dust may adhere to the surface of the insulator, building up a conductive film thereon sufficient to cause flash-over of the current passing through the electrode. Likewise, in desalting operations such as mentioned above, where the electrode and insulator may be submerged in a contaminated liquid, such as an oil and water emulsion, globules of water may collect on the insulator surface, and dissolved salts may be deposited thereon to such extent as to provide a film or conductive track on the surface of the insulator sufficient to destroy the insulating value thereof.

It is an object of the present invention to provide a method and means whereby the deposition of such conductive materials on the surface of an insulator is substantially prevented, or where such materials have been deposited, the deposited film or conductive track may be interrupted or broken to an extent sufficient to prevent short circuiting of the electrode.

It is also an object of the invention to provide an improved insulator of the character contemplated, having substantially porous walls, by means of which the formation of conductive films or tracks is substantially prevented by passing a non-conductive fluid material outwardly through the walls of the porous insulator under a sufficient differential pressure to produce the desired flow.

The invention and its objects may be more fully understood from the following description when read in conjunction with the attached drawings, of which:

Fig. 1 is a schematic illustration of a typical system for electrically aiding precipitation of water and dissolved organic salts from an oil and water emulsion such as is employed in conjunction with a system for desalting hydrocarbon oils;

Fig. 2 is an enlarged showing of one form of the apparatus partly in vertical section and illustrating the use of an electrical insulator of a porous material, and;

Fig. 3 is an enlarged view of another form of electrical insulator contemplated and also showing the manner in which conventional equipment may be modified according to the invention.

Referring more particularly to the drawings in Fig. 1, the numeral **100** designates a separator vessel for separation of an emulsion of oil and water, in which organic salts may be dissolved in the contained water. In such a vessel, the oil is usually the continuous phase of the emulsion. As shown, the vessel **100** is provided with an inlet **101** for introduction of the emulsion. An outlet **102** is provided for the removal of separated salt-free oil, and an outlet **103** for removal of separated water containing dissolved salts. The vessel is provided interiorly with a plurality of electrically charged plates **104** and settling baffles **105**. The plates **104** are electrically charged as by means of an electrical current supplied through a transformer **106** by way of high tension conductors **107** and **108** connected to electrodes **1** which are in turn connected by means of conductors **109** and **110** to the plates **104**. As shown, the conductors **107** and **108** are preferably enclosed in conduits **111** and **112**. The electrodes **1** are likewise enclosed by a non-conductive insulator bushing **2** mounted as by means of a service **T 3** communicating with the vessel at one end through a cover plate **4** for a suitable flanged opening **5** in the wall of the vessel. The service **T 3** is also connected to conduits **111** and **112** with the conductors **107** and **108** suitably connected to the electrode as by means of an electrode extension **1***a*. Preferably the service **T** is separated from the conduit as by means of a union or coupling element **6** provided with a threaded passageway through a sidewall thereof adapted to receive the threaded end of a conduit **7**. The **T 3** and coupling element **6** are sealed from direct communication with the conduits **111** and **112**, as by means of plug sealing means **8** through which the electrode extension may pass in sealed relationship thereto into connection with the conductors **107** and **108**. In the apparatus as shown, the conduit elements **7** are in turn connected to a common header conduit **9** communicating with the vessel **100** adjacent the outlet for separated oil therefrom. If desired, a pump **10** may be inserted in the line **9**. The numeral **11** designates thermal insulation material for the conduit **9**.

Referring now to Fig. 2 of the drawings, the insulator structure indicated in Fig. 1 and the structural elements related thereto are shown in enlarged detail. In this form of the apparatus, the insulator element is an elongated tubular bushing **2** of a porous material such as porous aluminum oxide, or another similar material. The service **T 3** has an inner end opening **3***a* interiorly threaded and provided with a shouldered portion **3***b*, and an outer end opening or passageway **3***c* interiorly threaded to receive an exteriorly threaded hollow closure plug **12**. The insulator bushing **2** is adapted to fit into the hollow plug **12** in the manner shown, the outer end of the bushing being sealed with reference to the inner wall of the plug, as by coating with sodium silicate, and a mechanical connection established between the bushing **2** and the plug as by means of a threaded pin **12***a* extending through one wall of the plug and through suitable openings in the end of the busing in the fashion shown. The bushing **2** is long enough to extend through the lower end **3***a* of the service **T**, and therebeyond to any distance required. Normally, the bushing will be of such length as to extend through the lower end of the service **T** and beyond the

plate member 4, or the vessel wall, to a distance from about 5 to about 10 times the outer diameter of the bushing. The bushing is sealed in the T at the lower end by means of a packing material 13 and a packing gland member 14, the packing material 13 being seated against the shoulder 3b by means of the gland member 14, threaded into the passageway 3a, and thus providing a fluid tight seal between the T and the bushing.

The bushing itself is provided with an internally shouldered portion 2a adapted to receive an electrode connector plug element 15. The plug 15 is provided with an inwardly opening threaded recess 15a, and a laterally opening threaded recess 15b. The recess 15a is adapted to receive the electrode element 1, while the recess 15b is adapted to receive an electrode extension element 1a extended through a passageway 2b in the sidewall of the bushing 2. The electrode 1 extends longitudinally through the bushing 2, in radially spaced relation thereto, outwardly beyond the end of the bushing, terminating in a threaded end adapted to receive an annular washer 16 and a washer retainer nut 16a. A fluid tight seal for the exposed end of the bushing 2 is provided by means of annular gaskets 16b and 16c. As shown, the high tension conductor connection 109 is held in contact with the electrode and the nut 16a by means of a nut 16d.

As shown in Fig. 2, the plug sealing means 8 consists of a tubular plug member 17 exteriorly threaded to engage the union 6, and having an inwardly extending annular flange portion 17a providing a seating surface for a flanged bushing element 18 seated on the flange 17a and extending therethrough into the union 6. A second flanged bushing element 19 extends outwardly from within the plug 17 into the conduit 111, both bushings frictionally engaging the electrode extension element 1a. A compressible gasket seal 20 is provided between the flanged ends of the respective bushings and a packing gland nut 21 is adapted to be threaded into the plug 17 to maintain a sealing relationship with the electrode extension element 1a.

In operation of the apparatus as shown in Figs. 1 and 2, warm oil from the outlet end of the separator vessel 100 is circulated by thermal syphonic effect, and/or pump 10, through the conduits 9 and 7 into the union 6 and service T 3 exteriorly of the bushing 2. The oil passes through the pores of the bushing 2 into the interior thereof. Some of this material may also enter the bushing by way of the passageway 2b. From the interior of the bushing the oil then passes outwardly through the end of the bushing exposed beyond the packing gland member 14 extending through the pores of the bushing material. In this way a replaceable film of a non-conductive fluid may be established on the surface of the insulator bushing 2, such as to prevent the formation of conductive deposits on the surface of the bushing, thereby to avoid tracking and flashover which might normally occur between the end of the electrode exposed beyond the bushing and adjacent metallic surfaces of the vessel 100 and coverplate 4. The discharge or extrusion of a non-conductive fluid through the pores of the bushitng 2 will not only minimize the deposition of undesired materials thereon, but should such deposition occur, will tend to break up and carry away the material which otherwise might form a conductive track. Although operation of the system is described with reference to its employment in conjunction with a liquid material, such as oil from vessel 100, it should be obvious that it may also be employed in conjunction with fluids of any suitable type from any suitable source. For example, it is also contemplated that the fluid material passed through the pores of the bushing 2 may be supplied from an extraneous source, and this fluid may be either gaseous or a liquid such as any conventional type of non-conductive transformer oil. The fluid may also be petroleum or silicone greases of light consistency. The only limiting factor, other than as stated above, would be the requirement that such materials as may be employed be capable of being extruded or otherwise discharged through the pores of the material used for the bushing 2, at the operating temperature of the system. Also, as indicated with reference to the apparatus as shown in Fig. 1, the fluids supplied through the lines 7 may be pressurized in any suitable fashion, as for instance, by means of a pump 10. Where a thermo-syphonic circulation is depended upon for circulation, at least a portion of the conduit line, including lines 9 and 7, should be insulated, while a remaining portion thereof should be exposed to cooling, either atmospheric or artificial.

In selecting a material for employment in the manner described, the higher the viscosity of the material employed, the smaller will be the quantity required. The following table shows the flow rates of several oils of various viscosities, all of which were supplied to the bushing at a differential pressure therethrough of approximately 10 inches of water.

Oil Used	No. 1	No. 2	No. 3	No. 4
Differential Pressure at bushing (Inches of H_2O)	10	10	10	10
Temperature (°F.)	75	74	72	72
Viscosity at temperature indicated (Centipoises)	250	141	50	52
Flow rate (gals./hr.)	0.48	0.70	1.21	3.15

It is, of course, desirable that the fluid or other fluidizable material employed for the purposes described should be a non-conductive material which is clean and dry. In order to assure cleanliness of this material, any suitable filter means also may be employed in the supply lines. Preferably such filter means should be capable of removing all foreign matter having a particle size of 5 microns or larger, so as to avoid clogging of the pores of the bushing material.

The form of the insulator means illustrated by Fig. 3 is comparable in many respects to that of the form of insulator illustrated by Fig. 2, and may be employed in a similar fashion. The insulator as shown in Fig. 3 is formed in two parts. The outer part or portion 31 is conventionally of a non-porous insulating material such as porcelain, being formed with an inverted frusto-conical enlargement 32 providing an outwardly facing shoulder 33. The inner part or portion 34 is a tubular bushing of a porous material adapted to be seated at its outer end against the inner end of the portion 31. Both the bushing element 34 and the portion 31 are provided with an interior passageway or bore through which is passed an electrode element 35. The passageway through the portions 31 and 34 is of somewhat greater diameter than the diameter of the electrode whereby the electrode is spaced radially from the walls of the passageway. The electrode 35 has a length greater than the total length of the two portions 31 and 34 respectively, extending outwardly through the outer end of the portion 31 and inwardly through the inner end of the portion 34. The outer end of the electrode is threaded to receive a hood nut 36, and the inner end is threaded to receive a retainer nut 37. A gasket seal 38 is provided between the hood nut 36 and the outer end of the portion 31, while a non-conductive annular plug 39 is provided for the inner end of the bushing portion 34. The bushing 34 is sealed at its outer end to the inner end of the portion 31 and to the plug 39 as by means of a sodium silicate coating at 34a and 34b. A washer 37a is provided between the assembly nut 37 and the plug 39. As in the structural form illustrated by Fig. 2, a plate connection is provided by means of the conductor 109 held in contact with the electrode 35 by means of the nut 40 threaded on the end of the electrode. Also, as mentioned with respect to Fig. 2, the insulator extends into the container vessel to a distance of from about 5 to about 10 times the diameter of the bushing element 34. An electrical connection between the electrode 35 and a power source is provided

by a conductor such as conductor **41** secured to the hood nut **36** by clamp **42**.

As shown in Fig. 3, the opening provided in the plate **4** for insertion of the electrode and insulator is shaped to receive the frusto-conical enlargement **32** on the insulator portion **31**, and a gasket seal **43**. The insulator is mounted in fluid tight relation in the opening by means of a split ring retainer element **44** which engages the insulator shoulder **33**. The element **44** may be secured to the plate **4** by means of stud bolts **45**, or otherwise.

In the structure illustrated by Fig. 3, the outer end of the electrode **35** is drilled to provide a conduit passageway **35***a* extending into the electrode end beyond the engagement thereof with hood unit **36**, and lateral passageways **35***b* opening therefrom through the electrode into the insulator bore. Also, as shown, the hood unit **36** is provided with conduit connection and fitting **36***a* which provides for introduction of a pressurized fluid into the hood nut, thence through the electrode passageways **35***a* and **35***b* into the interior of the insulator portions **31** and **34** enclosing the electrode **35**, to be discharged outwardly through the pores of the material of the portion **34**.

The insulator assembly as illustrated by Fig. 3 may be accomplished by the employment of elements originally manufactured for such purpose, but under certain circumstances existing equipment may be modified to accomplish the same structure. For example, a standard electrode may be drilled to provide the passageways **35***a* and **35***b*, and standard hood nuts provided with a suitable conduit connection **36***a*. Likewise, the insulator portion **31** may be obtained by removing the inner end of a standard porcelain insulator element just beyond the shouldered enlargement and seating surface thereof and substituting a porous bushing element, such as the element **34**, therefor. In this way, existing equipment may be adapted readily to accomplish the invention and its objects substantially as set forth and claimed herein.

What is claimed is:

1. In an apparatus for subjecting fluid materials to the effect of high potential electric currents, including a container vessel for said fluid materials, a service entrance means for passing an electrical conductor element through a wall of said vessel, comprising an entrance port in said vessel wall, a substantially tubular, rigid conduit means of an impermeable material mounted in said port in fluid-tight relation to said vessel wall and extending outwardly beyond said vessel wall, a hollow tubular bushing of a rigid, porous dielectric material secured in fluid-tight coaxial relation to said conduit means, and dependent therefrom to extend into said vessel, beyond said wall, an electrode element disposed substantially coaxially within said conduit means and said bushing forming a substantially annular conduit passageway around said electrode element within said conduit means and bushing, means for sealing said electrode element with reference to said conduit means at one end of said electrode element and means for sealing said electrode with reference to said bushing at the other end of said electrode element, said electrode element extending outwardly through said sealing means at each of the outer and inner ends thereof, means for introducing a fluid dielectric material into said conduit means, and said annular conduit passageway within said conduit means and bushing, under a differential pressure to discharge said fluid material outwardly from said passageway into the vessel through the pores of said bushing material.

2. An apparatus according to claim 1, in which said conduit means is a hollow, substantially tubular, insulator element of a dielectric material, having an inner end extended into said vessel, in which said bushing is secured in fluid-tight relation to and depends from the inner end of said conduit means into said vessel, in which said means for introducing a fluid dielectric material into said conduit means comprises a conduit bore in said electrode element, opening through the outer end of said electrode element outwardly beyond said means for sealing said electrode element with reference to said conduit means, and opening inwardly through said electrode element into said annular passageway formed around said electrode element within said conduit means and bushing, and a conduit connection for introducing said fluid material into said bore.

3. An apparatus according to claim 2, in which said conduit connection is a hood nut enclosing the outer end of said electrode element in fluid-tight relation thereto, said bore opening outwardly into said hood nut, and conduit means for said fluid material also opening into said hood nut.

4. An apparatus according to claim 1 in which said container vessel has an inlet end and an outlet end, and in which said entrance port is disposed at the inlet end of said vessel, and in which said means for introducing a fluid dielectric material into said conduit means is a conduit connection opening at one end into said conduit means and at the other end into said vessel at the outlet end thereof.

5. An apparatus according to claim 1, in which said conduit means is a T-branch conduit member, having aligned, opposed inner and outer open end branch portions, and an open end, intermediate, lateral branch portion, said conduit member being secured by its inner branch portion in said port, opening into said vessel therethrough, and having a plug closure for the open end of said outer branch portion, in which said bushing is an elongated member having an outer end secured in fluid-tight relation to said plug, said bushing being dependent from said plug to extend in telescopic coaxial relation through said aligned branch portions of said conduit member beyond the inner end portion thereof into said vessel, and sealed with relation to the inner end of said conduit member, in which said electrode element comprises a first electrode portion disposed in coaxial radially-spaced relation to said bushing having an outer end portion terminating within said bushing, and an inner end portion extending into said vessel beyond the inner end of said bushing, and a second electrode portion disposed in substantially coaxial radial-spaced relation to said intermediate, lateral conduit branch portion, said second electrode portion having an inner end and an outer end, said inner end extended radially into said bushing and into connection with the outer end of said first electrode portion, and said outer end extending through and beyond the open end of said lateral branch portion of said T-branch conduit, and in which said means for introducing a fluid dielectric material into said conduit means is a pipe opening into said lateral T-branch portion, whereby said fluid material is passed inwardly through the pores of said bushing material into said annular conduit passageway at the outer end of said bushing and outwardly therefrom into said vessel through the pores of said bushing material at the inner end of said bushing.

References Cited in the file of this patent

UNITED STATES PATENTS

1,493,262	Hammond	May 6, 1924
1,786,729	Austin	Dec. 30, 1930
2,160,660	Hobart	May 30, 1939
2,491,370	Forster	Dec. 13, 1949

OTHER REFERENCES

Oliver, F. J. Electrical Mfg., May 1950, p. 101. (Copy in Div. 42.)