June 30, 1959 L. C. WATERMAN ET AL 2,892,768

ELECTRIC TREATER FOR EMULSIONS

Filed July 28, 1955

FIG. 1

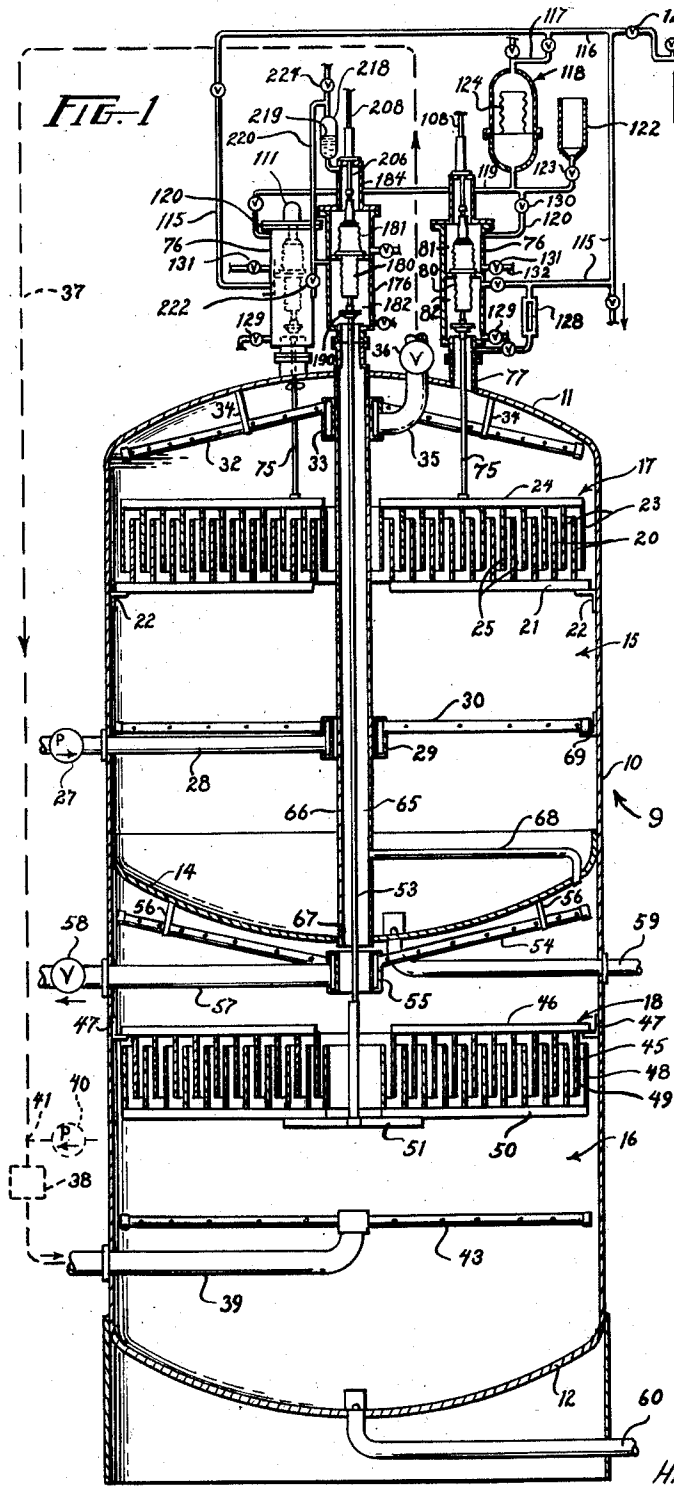


FIG. 2

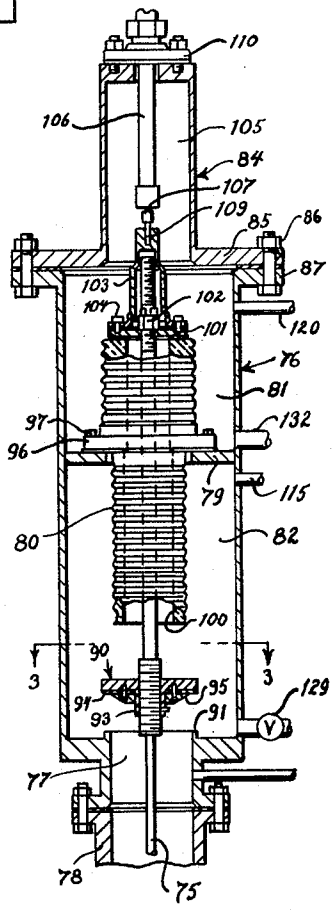
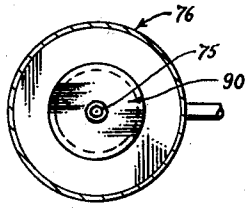


FIG. 3



INVENTORS
LOGAN C. WATERMAN
WILLIAM L. SHIRLEY
BY THEIR ATTORNEYS
HARRIS, KIECH, FOSTER & HARRIS

United States Patent Office 2,892,768
Patented June 30, 1959

2,892,768

ELECTRIC TREATER FOR EMULSIONS

Logan C. Waterman and William L. Shirley, Houston, Tex., assignors to Petrolite Corporation, Wilmington, Del., a corporation of Delaware

Application July 28, 1955, Serial No. 524,914

21 Claims. (Cl. 204—304)

This invention relates to electric resolution of emulsions and more particularly to the resolution of oil-continuous emulsions by the use of one or more high voltage electric fields.

In the electric treatment of emulsions, particularly in the treatment of petroleum distillates containing an electrically-separable dispersed phase, it is often necessary to connect the equipment directly on stream with other equipment. This means that failures must be eliminated or minimized if the complete process is to continue. Heretofore, one source of trouble has been through failure of electrical insulators supporting or energizing the electrodes. If repairs, replacement or inspection thereof were necessary, it was previously required to shut down the treater, drain and steam out the vessel, and then inspect, repair or replace the insulator. This procedure usually involved many valuable hours of operating time.

It is an object of the present invention to provide a structure which facilitates insulator inspection, repair or replacement and which, in fact, permits the replacement of an insulator without draining and, if desired, without unpressuring the container, thereby saving much shut-down time and avoiding the necessity of steaming out the vessel.

It is a further object of the invention to provide a simplified insulation system for high-voltage treaters by which movement of an electrode-energizing member can be made to seal off an insulator pocket.

In the interest of superior performance and savings in space, cost, heat, etc., it is often desirable to employ multiple treatment using separate electrode sets in the same vessel, usually with connections whereby the oil to be treated can flow sequentially through the electrode sets. It has previously been proposed to mount these sets in separate superimposed chambers, but this has heretofore required that at least some of the insulation for the lower electrode set must be in an inaccessible position near the upper end of the lower treating chamber. It is an object of the present invention to provide a structure by which all of the insulators of a multistage treater can be positioned in close proximity and in accessible positions.

Another object of the invention is to provide a multistage treater in which the electrode set or electrode means in the lower treating chamber is energized by a member supported by an insulator near the uppermost end of the treater; also to provide an arrangement whereby such energizing member is disposed in a relatively long entrapment space traversing the upper treating chamber but separated therefrom. A further object is to provide such an entrapment space within a pipe opening on the lower treating chamber and extending between a partition and a head member bounding the upper treating chamber.

Quite unexpected problems have arisen from insulator failures, particularly when treating certain distillates or petroleum fractions containing internal phase material

which is highly corrosive or which tends to form short-circuiting deposits on insulator surfaces. In some instances, the oil purified by the electric treatment can be permitted to come into contact with the insulator surfaces. In other instances, however, it has been found necessary to use a separate dielectric medium contacting the insulators and to provide physical separation between the dielectric medium and the treated oil.

It is an object of the present invention to provide novel insulator-protective arrangements by which the oil being treated can be physically separated from any dielectric fluid used to protect the insulators. A further object is to mount an insulator with end portions respectively exposed to upper and lower chambers containing dielectric media, and to transfer pressure between these media. A further object is to transfer such pressure through a movable member, such as a bladder, which physically separates the dielectric media.

In some instances it has been found practical to separate a dielectric fluid from the treater contents by the use of a body of gas. It is an object of the invention to provide such a system. In other instances, however, it has been found that contaminants sometimes pass through interfaces and even through such an intervening body of gas. In such instances, it is an object of the present invention to separate such fluids by a movable member such as a bladder.

Other objects and advantages of the invention will be apparent to those skilled in the art from the herein-illustrated embodiment of the invention as applied to a multiple-stage treater particularly adapted to the treatment of like petroleum emulsions containing small amounts of dispersed phase material which must be separated therefrom.

Referring particularly to the drawing:

Fig. 1 is a vertical sectional view through a multistage treater of the invention;

Fig. 2 is an enlarged view of the right-hand insulator housing of Fig. 1; and

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2.

The electric treater is shown as including a container structure **9** including an upright cylindrical container **10** closed at its upper and lower ends by heads **11** and **12** to form a pressure vessel. The interior thereof is divided by a partition **14** into upper and lower treating zones or chambers **15** and **16** respectively containing upper and lower electrode means or electrode sets **17** and **18**.

The upper electrode set **17** includes a lower electrode formed of a plurality of concentric cylindrical electrodes **20**, usually made of sheet metal, secured to a framework **21** mounted on brackets **22** and thereby electrically connected to the container **10**. The upper electrode of the set **17** is composed of similar concentric cylindrical metallic electrodes **23** supported by a framework **24** which is in turn suspended from the insulation system of the invention, to be described. The electrodes **20** and **23** are intermeshed to provide a plurality of open-ended treating spaces **25** in which are established high volatge unidirectional electric fields of substantially uniform voltage gradient.

The emulsion or petroleum product to be treated is pumped by a pump **27** into the upper treating chamber **15** through an influent means shown as including a pipe **28** communicating with an annular manifold **29** from which radiates a plurality of sidewardly-perforated pipes **30**. The perforations are preferably closer together toward the container **10** to distribute the incoming liquid in such manner that a column thereof flows upwardly in the upper treating chamber **15** with substantially equal velocity at all radial positions. This rising stream is

pierced by the lower edges of the electrodes 20 and 23, being thereby divided into small streams flowing through the treating spaces 25 at substantially uniform velocity, the individual streams combining above the electrodes and rising to an appropriate effluent means. This effluent means is shown as including a plurality of perforated pipes 32 radiating from an annular manifold 33 and supported by brackets 34, the perforations again being closer together toward the container 10 to facilitate the desired columnar flow of liquid in the upper treating chamber 15. The treated oil collected in the manifold 33 discharges through a pipe 35 having a back-pressure valve 36.

It is often desirable to process the treated oil additionally by flowing it, with or without repressuring, from the pipe 35 through piping, indicated by the dotted line 37, to a mixer 38 connected to a pipe 39 of an influent means for the lower treating chamber 16. It is often desirable to mix another liquid with the treated oil ahead of the mixer 38. A pump 40 is shown in this connection and pumps a stream of water or other liquid to a junction 41 preparatory to further mixing in the mixer 38.

The resulting mixture is further electrically treated in the lower treating chamber 16 by the electrode set 18. The electrodes of this set may take numerous forms but are shown constructed similarly to the electrodes of the upper set 17, in which event it is desirable that the incoming mixture be conveyed from the pipe 39 through a radial-pipe distributor including perforated pipes 43 similar to the pipes 30 previously described.

The electrodes set is shown as including an upper electrode composed of concentric cylindrical electrodes 45 secured to a framework 46 supported by brackets 47 and thereby grounded to the container 10. The lower or "live" electrode of this set includes a plurality of concentric cylindrical electrodes 48 cooperating with the electrodes 45 and defining open-ended treating spaces 49. The electrodes 48 are connected to a framework 50 resting on a support 51 which is energized and supported by an electrode-energizing member or conducting member 53 extended to the top of the container 10, being thereby supported by an insulating means of the invention, as will be described.

The treated oil rising from the lower electrode set 18 enters an effluent means composed of perforated pipes 54 which conduct the oil to an annular manifold 55 which surrounds and is spaced from the member 53. Such a collection system for the treated oil is suspended by brackets 56 from the partition 14. The treated oil leaves the container 10 through a pipe 57 equipped with a back-pressure valve 58 which controls the pressure in the lower treating chamber 16.

The electric fields established by the electrode sets 17 and 18 coalesce the dispersed phase material into droplets of sufficient size to gravitate from the oily material being treated. The coalesced masses settle to the bottom of the respective chambers 15 and 16 and are respectively withdrawn through effluent pipes 59 and 50, equipped with back-pressure valves or with suitable control valves, not shown, known in the art.

It is very desirable that the electrode-energizing conducting member 53 for the lower electrode set 18 should extend upwardly through the upper treating chamber 15 while being isolated from the upper electrode set and the liquid in this chamber. To accomplish this, the conducting member 53 extends upward in an entrapment space provided by a relatively large tube or pipe 66 open at its lower end to the upper interior of the lower treating chamber 16. The lower end of the pipe 66 is secured within an opening 67 of the partition 14, the upper end of this pipe extending through a similar opening in the upper head 11. These pipe ends are preferably welded respectively to the partition and to the upper head, forming an annular treating chamber which is completely sealed from the lower treating chamber 16 except through the external piping previously described. On the other hand, the upper end of the pipe 66 is completely closed during operation of the treater, as will be described. The treated oil from the lower chamber 16 is in open communication with the entrapment space 65 and will rise therein to fill at least the lower portion thereof. A small vent pipe 68 may communicate between the upper interior of the lower chamber 16 and the entrapment space 65 to prevent formation of any pocket of gas in the former.

The pipe 66 not only rigidifies the structure but also can be used to center or support the influent and effluent means of the upper treating chamber 15. In this latter connection, the manifolds 29 and 33 provide central openings, through which the pipe 66 extends. It is usually desirable, however, to support the pipes 30 and 32 by brackets, as shown.

The framework 24 of the upper electrode structure of the electrode set 17 is supported at a plurality of peripheral positions by three conducting members 75, two of which are shown in Fig. 1. The container structure 9 includes a corresponding plurality of tubular housings 76. With exception to be noted, each of these housings is constructed identically with parts arranged as best shown in Fig. 2. Each housing is in open communication with the upper interior of the upper treating chamber 15 through an opening 77. As shown, each housing is individually supported by and detachably connected to a flanged neck member 78.

As some intermediate portion, each housing 76 provides an internal flange 79 supporting an intermediate portion of an insulator 80. The interior of the housing 76 provides an insulator zone composed of upper and lower zones 81 and 82, the insulator 80 providing upper and lower portions respectively extending into these zones. Each insulator 80 supports one of the members 75. The upper end of each tubular housing 76 includes a removable cover member 84 providing a flange 85 connected by bolts 86 to a flange 87 of the tubular housing 76.

Each of the members 75 is preferably a rod connected to the upper electrode of the set 17 to move therewith or to control the position thereof. Means is provided for moving this rod between two positions, such a position-adjusting means preferably engaging both the insulator 80 and the rod.

Each rod or member 75 carries a valve member 90 which closes the opening 77 when the member 75 is in its lower position and which is raised from this opening when such member is in its upper position. In this connection, the lower portion of each tubular housing preferably provides an annular valve seat 91 against which the valve member 90 may seat in fluid-tight relationship to seal the lower zone 82 from the interior of the upper treating chamber 15. The valve member 90 is preferably adjustably positioned on the member 75, as by being equipped with a neck 93 threaded thereto. An annular sealing member 94 is held against a lower radial face of the valve member 90 by a tapered retaining member 95 which tends to center the member 75 as it is lowered, thus serving as a guide means to insure that the exposed peripheral portion of the sealing member 94 will properly engage the seat 91.

If desired, each member 75 can be secured to its supporting insulator 80 to be vertically adjusted by movement of such insulator. It is preferable, however, to provide for relative movement therebetween and to anchor the intermediate portion of the insulator to the internal flange 79 by a flange 96 secured to the insulator and detachably connected by screws 97 to the internal flange. In such instance, the insulator 80 provides a central passage 100 through which the member 75 adjustably extends. The upper end of the insulator carries a supporting member or plate 101 through which slidably extends a threaded upper portion of the member 75. A nut 102 surrounds this threaded portion and imposes the

weight of the electrode on the plate **101**. The nut **102** and the upper treated end of the member **75** are preferably surrounded by a hood **103** detachably connected to the plate **101** by bolts **104**. This connection should provide for electrical contact between the hood **103** and the plate **101**.

Means is provided for supplying a high electrical potential to the member **75** to energize the upper electrode of the set **17**. Such energization is preferably from a high voltage source and it will be found that particularly beneficial results will be obtainable with the electrodes shown if the high voltage source is unidirectional. To connect such source to the upper electrode of the set **17**, one of the cover members **84** is vertically elongated to provide a bushing chamber **105** forming a part of the upper zone **81**. A high voltage bushing **106** extends into the chamber **105**. It provides a conductor **107** the upper end of which is within or connected to a high voltage cable **108** (Fig. 1) extending to the high voltage source, the lower end **109** of the conductor forming a slip fit with the hood **103**. The bushing **106** provides a flange **110** detachably connected to the top of the cover member **84**. Only one of the housings **76** thus far described need be equipped with a bushing **106**. The remaining housings provide domed cover members **111** (Fig. 1) which merely close the upper zone **81** but which are removably connected to the housing by the bolts **86** previously described.

It will be observed that each of the lower zones **82** is normally in open communication with the upper treating chamber **15**. In some instances, the immediately-adjacent treated oil can be permitted to rise in contact with the lower portion of the insulator **80**. In other instances, however, the treated oil contains contaminants which will form conductive paths along the surface of the insulator if permitted to come in contact therewith, such paths often causing electrical flashover. In some instances, it is desirable that the lower zone **82** be filled with a dielectric fluid other than the treated oil, preferably a gas such as air, nitrogen, helium, carbon dioxide, etc. It is also desirable that the pressures in the upper and lower zones **81** and **82** be maintained substantially equal.

To accomplish these results, the upper end of each lower zone **82** provides a pipe **115** connected to a manifold **116**. The later is connected by a pipe **117** to a pressure-transfer means **118** which in turn is connected to a manifold **119** from which pipes **120** lead to the respective upper ends of the upper zones **81** thus far described. The elements **115**—**120** comprise an inverted generally U-shaped piping connected between the lower and upper zones and having an enlarged section, provided by the pressure transfer means **118**, having upper and lower ends communicating respectively with such upper and lower zones. Such enlarged section preferably includes pressurally-contacting bodies of the fluids contained in the upper and lower zones **81** and **82**, although one of the liquid bodies may in some instances be a third fluid in pressure-transferring relationship to one of the fluids in these zones. As illustrated, the upper zones **81** are filled with a dielectric liquid, typically a transformer oil, by use of a funnel **122** connected by a valve **123** to the manifold **119**.

The pressure transfer means **118** is shown as including a flexible pressure-transfer member **124** in the form of a bladder or bellows preferably formed of a material such as neoprene. This member may have its edges clamped between flanges of the closed housing forming the pressure transfer means **118**. The space below the member **124** may be completely filled with the dielectric liquid in the manifold **119** or there may be a compressed body of air or other gas separating such dielectric liquid from the member **124** or some portion thereof. In the embodiment under consideration, the space immediately above the member **124** is filled with the same gas as fills the lower zone **82**. In this connection, nitrogen or other compressed gas may be supplied from a pressure container **126** to the manifold **116** through a normally-closed valve **127**. This gas fills the pipe **115** and displaces any liquid in the lower zone **82** to a level below the insulator **80**, this level being indicated by a level gauge **128** connected as shown. Such gas thus maintains the treated oil at a level below the insulator **80**. At the lower end of each housing **76** is a drain pipe closed by a valve **129** by which the pressure in the lower zone **82** can be relieved or its contents drained.

The member **124** substantially equalizes the pressures in the manifolds **116** and **119**, thereby substantially equalizing the pressures in the upper and lower zones **81** and **82**. Correspondingly, there is no large pressure difference therebetween to cause displacement of the dielectric oil into the lower zone **82** or gas into the upper zone **81**. Further, and importantly in many installations, the member **124** forms a positive barrier preventing transfer of contaminants from one dielectric fluid to another. It has been found that certain contaminants may be diffused through interfaces or through columns of liquid or gas, these contaminants collecting on the surface of the insulator and causing failure. By interposing a physical barrier to such transfer of contaminants, insulator failures can be avoided.

If it becomes necessary to inspect, repair or replace any of the bushings **80**, this can be accomplished rapidly and without unpressuring the container **10** as follows. A valve **130** in the corresponding pipe **120** is closed to isolate the upper chamber **81** from the manifold **119**. This upper zone is then drained by opening a valve **131** in a drain line **132** connected to the lower end of the upper zone **81**. The bolts **86** are removed, whereupon the cover member **84** can be removed bodily, the lower end **109** of the conductor being by this movement separated from the hood **103**. The hood **103** can now be removed by loosening the bolts **104**, thus exposing the nut **102**. Retracting this nut will lower the member **75**, bringing the sealing member **94** into sealing engagement with the seat **91**, thus sealing off the lower zone **82**. The valve member **90** at this time supports the corresponding electrode, so that the nut **102** can be completely removed. The lower zone **82** can then be drained by opening the valve **129**. Loosening the screws **97** permits complete removal of the insulator **80**. The upper and lower zones can be steamed out, if desired, before inserting a new or repaired insulator. The lower zone **82** can be flushed with gas from the manifold **116** whereupon closing of the valve **129** will repressure the lower zone **82**. The electrode can now be raised and the valve member **90** unseated by adjusting the nut **102**, after which the hood **103** and the cover member **84** can be attached. Opening of the valve **130** will repressure the upper zone **81**, which previously may have been filled with the dielectric liquid before or after the cover member **84** is secured in place. The whole operation can be performed in a matter of minutes and avoids the previous necessity of unpressuring the vessel and steaming it out each time an insulator was to be inspected.

If desired, the container **10** can be unpressured and disconnected from on-stream operation when a bushing is to be changed or inspected. In this instance, the internal pressure can be made atmospheric and the upper zone **81** vented and drained. The cover member **84** can then be removed as before, whereupon the electrode can be lowered and the lower zone **82** sealed from the contents of the treater by seating of the valve member **90**. Any oil in the lower zone **82** can then be drained and any explosive vapors therein exhausted by aspiration or displaced by gas from the pressure vessel **126**.

The housing **76** and the insulators **80** thus far described are arranged around the vertical axis of the container and serve to support the upper annular electrode of the electrode set **17**. A single insulator serves to energize and support the lower electrode of the set **18** in the lower

treating chamber 16. A central tubular housing 176 is internally connected to the entrapment space 65 and is supported by the container above the pipe 66 in a manner previously described. An insulator 180 forms upper and lower zones 181 and 182 within the housing 176, the zone 181 being closed by a cover member 184. The member 75 extends through the insulator 180 and carries a valve member 190 functioning as previously described. The upper end of the member 75 is threadedly connected to a supporting nut like the nut 102 previously described and is energized through a bushing 206 having a high-voltage conductor 208 extending to the same or a different high voltage source which energizes the electrode set 17.

As before, the pressure in the upper and lower zones 181 and 182 is substantially equalized through an inverted U piping, including a housing or enlargement 218 in the leg communicating with the upper zone 181. This upper zone contains a body of dielectric liquid which extends to a level 219 in the enlargement 218 where it contacts a body of gas trapped in the other leg, here indicated by the numeral 220, and in the upper part of the enlargement 218. The leg 220 is preferably a pipe having an internal diameter smaller than the diameter of the enlargement 218, typically a diameter of one inch or somewhat more. There is another air-oil interface in this leg between the entrapped gas and the treated oil from the lower treating chamber 16. However, the area of this interface is substantially smaller than the interface at the level 219 within the enlargement 218 whereby absorption of trapped gas into the oil in the interface within the leg 220 is held to a minimum and whereby the area available for transfer of contaminants from the treated oil to the gas is minimized.

As concerns the insulator 180, it is usually possible to maintain continuous energization of the lower electrode set 18 even if the treated oil from the lower treating chamber 16 directly contacts the lower portion of the insulator. This is due in part to the quiescent condition in the entrapment space 65 and to electric field therein between the conducting member 53 and the pipe 66, both factors tending to purify any treated oil in the lower zone 182 of the housing 176.

The lower treating chamber 16 may be initially filed with an oil similar to the treated oil that will be later discharged through the valve 58, albeit of greater purity if desired. As this oil rises in the lower chamber 16, it displaces air into the lower end of the pipe 66, the air being vented through a valve 222. When the level reaches the lower end of the pipe 66, any air thereafter entrapped below the dished partition 14 will be vented through the pipe 68 to the pipe 66, thereby avoiding gas accumulation in the upper interior of the lower treating chamber 16.

The oil can be forced into the treating chamber 16 until it fills the lower zone 182 around the insulator 180 or the oil supply can be stopped short of complete filling of the zone 182. In either instance, when the treater is brought up to pressure and operating temperature, the liquid may rise in the leg 220 to compress the air entrapped therein and from the gas-liquid interface previously described. If it is desired to increase the volume of the entrapped gas, additional gas can be supplied under pressure through a valve 224 communicating with the upper interior of the enlargement 218.

In a typical operation of the equipment, an alkali-treated distillate may be forced by the pump 27 through the distributor pipes 30 to rise as an annular column and later as individual streams through the treating spaces 25 of the upper electrode set 17. Much of the dispersed material will be coalesced by the unidirectional electric fields within these treating spaces, which fields may be of a gradient in the neighborhood of 6–12 kv./in., the coalesced material gravitating to the lower end of the treating chamber 15 and being continuously or intermittently withdrawn through the pipe 59. The treated oil is collected by the pipes 32 and flows through the piping heretofore described to the lower treating chamber 16 with or without intermediate pressuring. A small amount of water may be pumped into the treated oil by the pump 40 and mixed therewith in the mixer 38 if it is desired further to wash the treated oil from the upper chamber. The mixture rises through the treating spaces of the electrode set 18, the water and collected material being coalesced, the coalesced material gravitating to the bottom of the lower chamber 16 to be withdrawn continuously or intermittently through the pipe 60. The resulting treated or purified oil is collected by the pipes 54 and discharges through the valve 58 as a continuous stream. The entire equipment can thus be maintained on stream with refinery equipment.

Various changes can be made without departing from the spirit of the invention as defined in the appended claims.

We claim as our invention:

1. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: a container providing an electrode zone therein; a vertically movable electrode in said zone; a housing above said container; a removable closure for said housing, said housing providing an insulator zone communicating at its lowermost end with said electrode zone through an opening but otherwise completely closed, said insulator zone being adapted to entrap therein a body of dielectric fluid; an insulator in said insulator zone entirely within said housing and having a portion exposed to be surrounded by said entrapped dielectric fluid; a rod supported by said insulator and depending through said opening, said rod being connected in supporting relation with said electrode to move in unison therewith; means for moving said rod between two positions; and a valve member carried by said rod and movable therewith, said valve member being sized to close said opening in one of said positions of said rod and open said opening in the other of said positions of said rod.

2. An electric treater as defined in claim 1 in which said means for moving said rod includes position-adjusting means engaging both said insulator and said rod for lowering said rod to said one of said positions, said opening being surrounded by a seat member coacting with said valve member, one of said members providing a sealing member seating against the other of said members in pressure sealing relationship when said rod is in said one of said positions.

3. An electric treater as defined in claim 1 including means for anchoring said insulator in said insulator zone, a high-voltage bushing extending into said insulator zone coaxially with said insulator, said bushing providing a conductor extending therethrough adapted to be connected to said high-voltage source, and including a slip connection for detachably connecting said conductor and said rod.

4. An electric treater as defined in claim 1 in which said removable closure includes a cover member for said housing and means for detachably connecting said cover member to said housing, said electric treater including means for anchoring said insulator in said insulator zone, a high-voltage bushing extending through said cover member, a conductor extending through said bushing, said conductor providing an outer portion adapted to be connected to said high-voltage source and an inner portion, and a slip connection detachably connecting said inner portion to said rod and separable therefrom upon removal of said cover member.

5. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: a container providing an electrode zone therein; an electrode in said zone; a housing extending upwardly from said container and providing upper and lower zones, said lower zone openly communicating with said electrode zone through an opening; an insulator having an inter-

mediate portion between upper and lower portions thereof; partition means separating said upper and lower zones and engaging said intermediate portion for mounting said insulator in said housing with said upper and lower portions respectively exposed to said upper and lower zones; means connecting said insulator and said electrode through said opening; and means for equalizing the fluid pressures in said upper and lower zones comprising a piping communicating between said upper and lower zones, said piping including an enlarged section with upper and lower ends respectively connected to said upper and lower zones, said enlarged section including pressurally contacting bodies of fluids respectively in pressural communication with said upper and lower zones.

6. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: a container providing an electrode zone therein; an electrode in said zone; a housing extending upwardly from said container and providing upper and lower zones, said lower zone communicating with said electrode zone through an opening; an insulator having an intermediate portion between upper and lower portions; partition means engaging said intermediate portion for mounting said insulator in said housing with said upper and lower portions respectively exposed to said upper and lower zones, said last-named means separating said upper and lower zones; means connecting said insulator and electrode through said opening; and means for equalizing the fluid pressures in said upper and lower zones, said pressure-equalizing means including piping between such zones, said piping including an enlarged section, and a movable pressure-transfer member transversely dividing such enlarged section into upper and lower chambers respectively in open communication through said piping with said upper and lower zones, said movable pressure-transfer member being movable in response to differences in pressure on opposite sides thereof and being impervious to the passage of contaminants from either of said zones to the other.

7. An electric treater as defined in claim 6 in which said pressure-transfer member is a flexible bladder separating said upper and lower chambers.

8. An electric treater as defined in claim 5 in which said piping has an inverted generally U-shaped portion having legs respectively communicating with said upper and lower zones, said enlarged section being in one of said legs.

9. An electric treater as defined in claim 8 including a body of dielectric liquid in said upper zone and extending into said enlarged chamber to be in interfacial contact with a body of gas therein, said body of gas extending into the other of said legs and being therein in interfacial contact with a body of liquid from said electrode zone, whereby said body of gas separates said liquids.

10. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: an upright container closed at its upper and lower ends by upper and lower heads; a partition dividing the interior of said container into upper and lower treating chambers, said partition having an opening; an upright pipe connected rigidly and in fluid-tight relationship to said partition with its interior communicating openly with said lower treating chamber through said opening, said pipe extending completely through said upper treating chamber and providing an upper end connected rigidly and in fluid-tight relationship to said upper head, said pipe forming within said upper treating chamber an annular treating chamber between such pipe and said container; a housing communicating interiorally with the upper interior of said pipe; an insulator in said housing; an electrode energizing member suspended from said insulator and extending through said pipe into said lower treating chamber; electrode means in said lower treating chamber electrically connected to said electrode energizing member; and means for connecting said electrode energizing member to said high-voltage source.

11. An electric treater as defined in claim 10 including annular electrode means in said annular treating chamber, a plurality of electrode supports connected to said annular electrode means at spaced peripheral positions, auxiliary insulators respectively connected to said supports, and means for energizing said annular electrode means.

12. An electric treater as defined in claim 11 including a plurality of other housings above said upper head and means for respectively supporting said auxiliary insulators within said other housings, said means for energizing said annular electrode means including a conductor connected to at least one of said electrode supports.

13. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: an upright container closed at its upper and lower ends by upper and lower heads; a partition dividing the interior of said container into upper and lower treating chambers, said partition and said upper head having aligned openings; a pipe joining said openings and secured in fluid-tight relationship to said partition and said upper head, said pipe providing an entrapment space open at its lower end on said lower treating chamber; a high-voltage conductor traversing said entrapment space and extending into said lower treating chamber; electrode means in said lower treating chamber electrically connected to said high-voltage conductor; an annular electrode means surrounding said pipe in said upper treating chamber; and means in the space between said pipe and the container for energizing said annular electrode means.

14. An electric emulsion treater as defined in claim 13 including an influent means for each of said treating chambers and an effluent means for each of said treating chambers, means for supplying a stream of the emulsion to be treated to one of said influent means for treatment by the electrode means in the corresponding chamber to produce a treated oil moving from the corresponding effluent means, and means for connecting such effluent means to the other influent means for further treatment of such oil in the other chamber, the other effluent means withdrawing such further treated oil from such other chamber.

15. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: a container providing an electrode zone; a housing providing an entrapment zone communicating with the upper portion of said electrode zone through an opening at the lower end of the housing, said entrapment zone being much smaller in horizontal cross-sectional area than said electrode zone; electrode means in said electrode zone; an electrode-supporting conducting member extending from said electrode zone to said entrapment zone through said opening, said conducting member being electrically connected to said electrode means; an insulator in said entrapment zone supporting said conducting member; means for energizing said electrode from said high-voltage source; means for delivering the emulsion to be treated to said electrode zone, the treated emulsion separating in said electrode zone into upper and lower phases; means for withdrawing the lower phase from a lower portion of said electrode zone; withdrawal means for withdrawing the upper phase from an upper portion of said electrode zone at a position spaced from said opening; a removable closure for said entrapment zone giving access to said insulator; and means permitting inspecting said insulator without draining and steaming said container comprising a valve member on said conducting member at a position to close said opening upon movement of said conducting member and its connected electrode means to a predetermined position and means for moving said conducting member between said predetermined

position and another position in which said valve member opens said opening.

16. In an electric emulsion treater adapted to be energized from a high-voltage source, the combination of: a container providing an electrode zone, said container having a top wall; a closed-top housing defining an entrapment zone adapted to receive and entrap a body of dielectric fluid; a tubular fitting mounting said housing above said top wall, the interior of said tubular fitting interconnecting said entrapment zone and said electrode zone, there being an annular valve seat adjacent one end of said tubular fitting around an axis thereof; an insulator in said entrapment zone; an emulsion-treating electrode in said electrode zone; means for vertically moving said electrode through a locus of motion between two positions, said last-named means including a rod connected to and extending upward from said electrode through said valve seat into said entrapment zone along said axis of said tubular fitting and means for adjusting the vertical position of said rod, said insulator supporting said rod and at least a part of the weight of said electrode, at least a portion of said insulator being exposed to and surrounded by said body of dielectric fluid; and a valve member larger than said annular valve seat carried by said rod in a position to engage said valve seat at one of said electrode positions and thereby block the communication between said entrapment zone and said electrode zone.

17. In an electric emulsion treater adapted to be energized from a high-voltage source of potential, the combination of: a container providing an electrode zone closed at its upper end by a wall of said container; an upright tubular housing attached to said container wall, the interior of said housing having a horizontal cross-sectional area much smaller than said electrode zone, said housing providing at its lower end an opening; an inwardly-extending flange at a position intermediate the upper and lower ends of said upright tubular housing; a tubular insulator having an intermediate portion supported by said flange, said insulator and said flange dividing the interior of said housing into an upper zone and a lower entrapment zone, upper and lower portions of said insulator extending respectively into said zones, said lower entrapment zone communicating with said electrode zone through said opening and being adapted to receive and entrap a body of dielectric fluid; a closure for said upper zone and means for removably attaching same to said housing, removal of said closure giving access to said insulator; an electrode in said electrode zone; an annular valve seat carried by said housing in a position surrounding said opening; a rod extending upward from said electrode through said valve seat and through said tubular insulator; means for raising and lowering said rod and said electrode relative to said tubular insulator; a valve member carried by said rod and movable therewith from a position sealing said electrode zone from said entrapment zone to a position in which such zones are in open communication; means for delivering to said electrode zone the emulsion to be treated; means for electrically energizing said electrode from said high-voltage source of potential to establish an emulsion-treating electric field adjacent said electrode, said field resolving said emulsion into heavier and lighter phase materials separating in said electrode zone; means for withdrawing from said electrode zone said heavier phase material; and means for withdrawing from said electrode zone at a position spaced from said opening said lighter phase material.

18. An electric treater as defined in claim 17 including means accessible from said upper zone for detachably connecting said intermediate portion of said insulator to said flange.

19. In an electric emulsion treater having a container, electrode means in an electrode zone of the container adapted to resolve an emulsion delivered thereto, a small housing providing an entrapment zone open at its lower end to said electrode zone adapted to entrap a body of dielectric fluid therein, an insulator in said entrapment zone and protected from contact with the material in the electrode zone by said body of dielectric fluid, and a rod supported by said insulator connected to said electrode means, a structure for inspecting and replacing said insulator without draining and steaming said container, said structure comprising: a detachable closure for the upper interior of said entrapment zone giving access to said insulator from a position outside said container; and a valve structure for said open lower end of said entrapment zone for sealing same from said electrode zone, said valve structure comprising an annular valve seat carried by said housing at the lower open end of said entrapment zone through which valve seat said rod extends, a valve member attached to said rod of a size to engage said valve seat in fluid-tight relationship, and means for vertically moving said rod through a locus of motion sufficient to seat and unseat said valve member.

20. An electric emulsion treater as defined in claim 19 in which said annular valve seat faces upwardly and in which said valve member provides a lower surface tapering inwardly and downwardly engageable with said valve seat to center the valve member during its downward seating on said valve seat, said electrode means being supported through said rod by such seating of said valve member on said valve seat.

21. In an electric emulsion treater adapted to be energized from a high-voltage source of potential, the combination of: a container providing an electrode zone, said container providing a top wall closing said electrode zone; a plurality of tubular housings attached to said top wall, each housing having a lower portion communicating with said electrode zone through an opening; a framework and a plurality of electrode members supported thereby and electrically connected thereto; means for adjustably supporting said framework and said electrodes in said electrode zone, said last-named means comprising a plurality of conducting members connected to said framework and respectively extending upwardly through said openings into the interiors of the respective tubular housings, an insulator in the interior of each housing supporting the respective conducting member, and means for separately adjusting the vertical position of each conducting member; a valve seat provided by each housing adjacent its said openings; a valve member carried by each of said conducting members in the interior of the corresponding housing in a position to seat against said valve seat and close the adjacent opening and support a portion of the weight of the framework upon lowering of the corresponding conducting member; means for electrically connecting said electrode framework to said high-voltage source of potential; and influent and effluent means respectively delivering emulsion to and withdrawing separated emulsion constituents from said electrode zone, said effluent means including means for withdrawing an emulsion constituent from the upper end of said electrode zone at a position spaced from each of said openings of said housings.

References Cited in the file of this patent

UNITED STATES PATENTS

1,452,207	Meredith	Apr. 17, 1923
2,041,954	Prutzman	May 26, 1936
2,072,918	Woelflin	Mar. 9, 1937
2,108,259	Cage	Feb. 15, 1938
2,395,011	Perkins	Feb. 19, 1946
2,775,640	Steeves	Dec. 25, 1956

FOREIGN PATENTS

374,473	England	June 13, 1932
1,059,804	France	Nov. 18, 1953

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,892,768 June 30, 1959

Logan C. Waterman et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 58, for "59 and 50" read -- 59 and 60 --; column 4, line 29, for "As some" read -- At some --; column 7, line 44, for "filed" read -- filled --.

Signed and sealed this 1st day of December 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents