Sept. 7, 1965 D. W. TURNER 3,205,161

ELECTRIC OIL DISPERSION TREATER

Filed Feb. 26, 1962

FIG. 1.

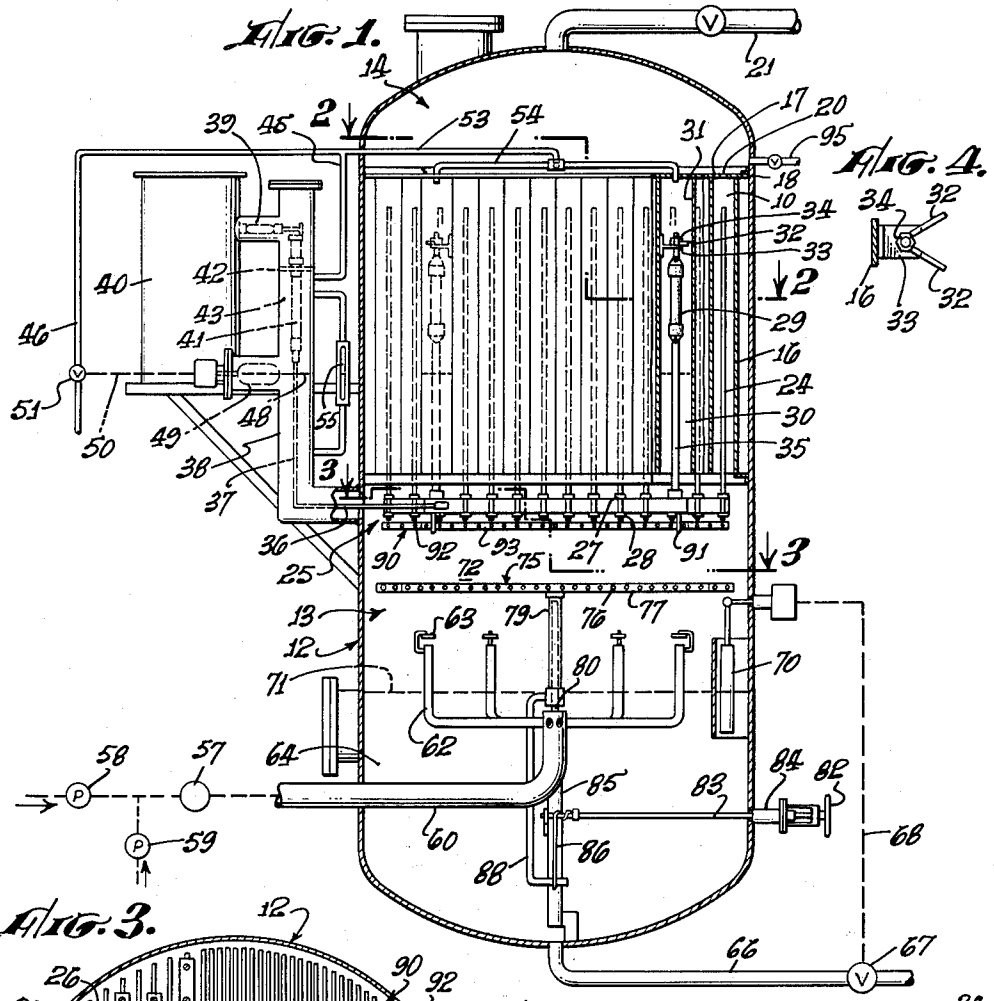


FIG. 4.

FIG. 3.

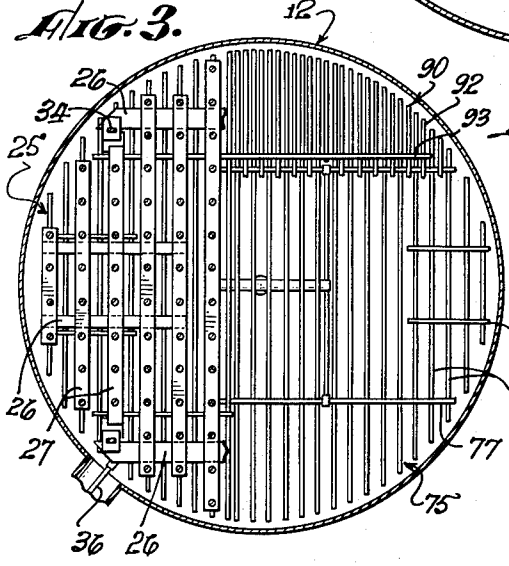
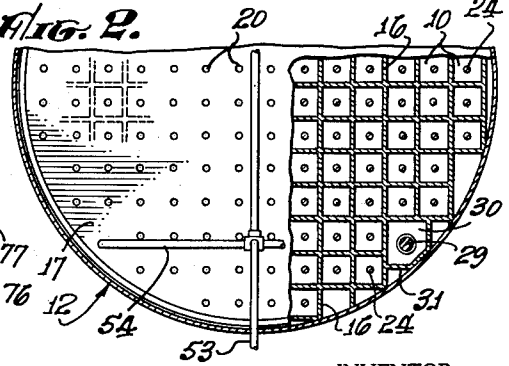


FIG. 2.



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ELECTRIC OIL DISPERSION TREATER

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This invention relates to the electrical resolution of oil-continuous dispersions of the type in which the continuous phase may be any hydrocarbon, often a petroleum distillate, the dispersed phase including small particles sufficiently immiscible with the oil of the continuous phase to exist therein as small masses. The dispersed phase may be liquid or semi-liquid and may be composed in part of solids and will usually be of a material of higher electrical conductivity than the oil of the continuous phase. The material of the dispersed phase is commonly aqueous and may be acidic or alkaline. In many instances it represents reaction products resulting from the reaction of a reagent with certain components of the oil.

It has been proposed to treat such dispersions by subjection to high-voltage electric fields during advancement along a series of long and narrow cells disposed side by side, each cell having a central electrode. The invention provides an improved process wherein a stream of the dispersion enters each cell at an entrance position and a stream of the treated oil leaves each cell at an exit position, one of such streams, usually the stream of treated oil, flowing through one or more metering orifices at the end of each cell.

It is another features of the invention to make the metering orifices rather small with relation to the volume of the fluid passing therethrough to throttle such fluid and build up a pressure drop across each orifice. By such an arrangement it is possible to equalize the flows in the several cells. It is an object of the invention to provide an improved process and apparatus operating in these ways.

Any severe throttling of a stream containing dispersed particulate matter tends additionally to mix the constituents and make more difficult the desired separation thereof. It has heretofore been proposed to introduce the dispersion to be treated into the cells, or into an entrance zone of a container communicating with the cells, by use of a large number of small orifices often corresponding in number to the number of cells. This results in a significant pressure drop across each of such small orifices if streams of equal volume are to issue therefrom. However these pressure drops result in additional mixing of the constituents of the dispersion interfering with the rapid separation desired. It is an object of the invention to transfer to the treated oil any pressure drops desirable to insure equal flows in the cells. A pressure drop at this point is not disadvantageous as there is little or none of the dispersed particles remaining in the treated oil and there is no problem of interfering with later separation of a dispersed material.

Other features and objects of the invention include one or more of the following, namely the use of energized central electrodes supported from their lower ends; insulating the energized electrodes by insulators in a portion of the cross-section of a container not occupied by treating cells; energization of the electrodes of an electric treater through an upright spaced external of the container; protection of insulators and bushings by use of bodies of inert gas so arranged that control of the liquid gas interface of one of such bodies of inert gas will control simultaneously the liquid-gas interfaces of the others; establishment of an auxiliary high-voltage electric field adjacent the entrance ends of the cells by electrodes transverse to the extended axes of the cells; a distinctive adjustment for one of such transverse electrodes whereby the intensity of the auxiliary electric field is adjustable; and introduction of the dispersion into an equipotential or field-free portion of an entrance zone of an electric treater.

Referring to the drawing:

FIG. 1 is a vertical sectional view of one form of electric treater of the invention showing the internal structure with portions broken away to show the interior of one cell and one insulator-support space;

FIGS. 2 and 3 are transverse sectional views taken along corresponding lines of FIG. 1; and

FIG. 4 is a fragmentary view of the insulator bracket.

The invention includes a cellular grid including a plurality of thin-walled side-by-side cells **10** useful in any environment but shown within and electrically connected to a container **12** in an intermediate or dispersion treating zone thereof so that a first or entrance zone **13** exists at one end of the cells and a second or exit zone **14** exists on the opposite end. The container **12** may be cylindrical or of other shape with its main axis upright or horizontal. It is exemplified as an upright cylinder with the cells grouped around an upright axis in which event the zones **13** and **14** will be respectively below and above the cells.

The walls of the cells illustrated include longitudinal walls **16** laterally separating the interiors of the cells and an end wall **17** (FIG. 1) for each cell. The latter may be a portion of a header or deck **18** traversing the complete cross-section of the container and sealed thereto. One or more small holes is drilled through the deck at the top or exit position of each cell, forming metering orifices **20** through the end walls **17** of the cells through which the treated oil must pass in flowing from the upper interiors of the cells to the exit zone **14** and thence through a valved exit pipe **21**. The cells are shown square in cross-section but can be of other cross-sectional shape.

The dispersion enters the cells at entrance positions therein, here at the open lower ends communicating with the entrance zone **13**. An energized central electrode **24** is disposed in each cell with its lower end protruding from the entrance end thereof. The protruding ends are joined to a foraminous structure **25** which supports these electrodes in upstanding relationship with their upper ends terminating short of the end walls **17**. The electrode-supporting portion of the foraminous structure **25** is formed of spaced transverse bars **26** of various length with pairs of upper and lower support members **27, 28** respectively thereabove and therebelow forming a foraminous framework. The upper and lower support members **27, 28** are rigid and have pairs of aligned openings, each pair receiving the lower portion of a corresponding central electrode **24** fixed therein. Support of the electrodes **24** at their lower ends insures more accurate centering thereof in the entrance portions of the cells **10** where a centered relation is more critical than near the exit portions thereof. In the latter the treated oil between the electrodes **24** and the cell walls is of high resistivity and exact centering is not critical. Near the entrance portions of the cells the content of dispersed phase material is higher and the consequent lower resistivity makes accurate centering of the electrodes **24** desirable to prevent arcing or poor operation.

The foraminous structure **25** is hung from insulators **29** respectively in insulator-support spaces **30**, larger than the cells and disposed in portions of the cross-section of the container not occupied by the cells **10**. With the square cell shape shown four areas of the cross-section are conveniently provided in diagonally opposite pairs. Each such insulator-support space **30** is open at its bottom and may be bounded outwardly by the container wall or by an outer wall **31** (FIG. 2) joined to the bank of cells. Each insulator can be inserted from the bottom of its space **30** and can be similarly withdrawn for inspection or repair.

To facilitate this the upper support for each insulator can be laterally guided into position by diverging bars 32 (FIG. 4) attached to a bracket 33 with their rear portions extending above the bracket to form a pocket receiving nuts 34 of the insulator support. Each insulator has a hanger 35 connected at its lower end to the foraminous structure 25 in supporting relation. The top of each space 30 is closed, as by the deck 18, to form a gas pocket containing an inert gas which keeps the oil or dispersion from rising to the insulator.

The foraminous structure and the electrodes 24 are energized through a conductor 36 extending sidewardly and upwardly in an upright space 37 provided by a closed-topped pipe 38 outside the container. A lateral pipe 39 leads therefrom to a high-voltage source 40, usually a power pack delivering a high-voltage unidirectional potential from an alternating-current supply. An inlet bushing 41 carries the conductor to the high-voltage terminal of the source 40, the other terminal thereof being grounded and electrically connected to the container 12. A support flange 42 for the bushing 41 forms a gas pocket 43 therebelow containing an inert gas which keeps the oil or dispersion from rising in the upright space 37 to contact the lower portion of the bushing. The space above the flange 42 can be filled with dielectric oil.

An inert gas such as nitrogen is supplied to the pocket 43 through a branch 45 of a gas supply pipe 46. The gas-liquid interface 48 is maintained approximately at the level shown by a float 49 or other level control device that is operatively connected by any suitable connection means, suggested by the dotted line 50, to a valve 51 in the supply pipe 46. A side pipe 53 from this supply pipe branches at 54 to each of the pockets of the insulator-support spaces 30 and maintains the pressure in each of such pockets equal to the pressure in the pocket 43. The gas-liquid interfaces in all of the five pockets are thus automatically controlled and kept substantially equal by the action of the float 49 in one of the pockets. A gage glass 55 can be used to check the level in the pocket 43.

The dispersion to be treated may be pumped from storage or be the result of mixing in a mixer 57 oil from a pump 58 and water or reagent from a pump 59. The reagent may be an acid or an alkali solution reactive with some component of the oil to form reaction products which constitute the dispersed phase of the dispersion, often with some of the reagent also present if the reaction has not been complete.

This or some other dispersion is pumped through a supply pipe 60 and delivered through orifices of several branch pipes 62 to the entrance zone 13 at laterally spaced positions therein. As shown, each orifice is at the end of a branch pipe and its stream may be spread by a circular baffle 63. A mass of the dispersion rises along the entrance zone 13 and some of its dispersed material may settle therefrom to form a body 64 of the separated material in the bottom of the container. The separated material is withdrawn therefrom through a pipe 66 having a valve 67 connected as indicated at 68 to a level control system shown as having a float 70 responsive to the position of the interfacial zone 71 to maintain same constant.

The dispersion is given a preliminary electric treatment in an auxiliary electric field established in the entrance zone 13 upstream of the foraminous structure 25 before entering the main treating fields established in the annular spaces of the cells 10 around the electrodes 24 thereof. This auxiliary electric field is established in a treating space 72 between the foraminous structure 25 and a flat foraminous auxiliary electrode 75. This electrode is made of parallel pipes or rods 76 mounted in cross bars 77 and carries a depending tubular member 79 which can slide longitudinally on a post 80 extending upward from an upstanding portion of the supply pipe 60.

If the position of the electrode 75 relative to the foraminous structure 25 is to be adjustable from a position outside the container a hand wheel 82 may be provided. This hand wheel has a shaft 83 passing through a stuffing box 84 with its internal end journalled relative to a support 85. A flexible member 86 wraps around the shaft 83 as it turns and lifts the bottom leg of a U-shaped member 88 having its upper leg fixed to the tubular member 79. A reverse turning of the shaft permits the electrode 75 to drop by its weight. The electrode 75 is electrically grounded to the container through its support and forms therebelow an equipotential or field-free space into which the entering dispersion discharges.

The upper boundary of the auxiliary electric field in the space 72 can be the electrode-supporting framework of the foraminous structure 25. It is prefered however that the foraminous structure 25 provide a separate electrode portion. This is shown as an electrode 90 facing the electrode 75 and supported by brackets 91 which electrically connect it to the aforesaid electrode supporting framework. The electrode 90 is made of pipes or rods 92 disposed parallel or at an angle to the similar members 76 of the electrode 75 and held by cross bars 93.

The auxiliary electric field in the space 72 functions to coalesce into larger droplets or masses some of the dispersed particles of the dispersion. The coalesced material drops to the body 64. The residual dispersion enters the lower ends of the cells 10 and rises along the annular treating spaces thereof where it is subjected to further electric treatment as will be described. The treated oil, now almost completely free of dispersed material is forced through the metering orifices 20 and flows from the treater through the pipe 21. The one or more metering orifices 20 for each cell controls the rate of upward flow therein and effectively equalizes the flow rates in the various cells to an extent not possible if the treated oil discharged through open or unrestricted upper ends of the cells.

It is desirable that the pressure drop across each metering orifice be much higher than any small pressure drop in the branch pipes 62. Typically if one metering orifice is employed for each cell its diameter will be in the neighborhood of about .25–.75 inch for large throughput treaters and will be less if there is more than one orifice for each cell. It is desirable that a pressure drop of about 2–24 oz./sq. in. (about 9–105 grams/sq. cm.) be induced across each metering orifice. In most instances the pressure drop will be about 3–10 oz./sq. in. (about 13–44 grams/sq. cm.). It is desirable to select the lowest pressure drop that will give the desired equalization of flow in the several cells. The cell structure should desirably be anchored in the container to resist upward displacement therein particularly if the longitudinal cell walls are formed of thin or light-weight metal. The thickness of these cell walls in the accompanying drawing has for clarity in illustration been abnormally increased.

When using high-voltage unidirectional electric fields the treating action in the cells is the result of a combined coalescing and electrophoretic action. The cells are desirably made sufficiently long that most of the coalescence of the existing dispersed particles takes place in lower portions of the cellular treating spaces. The action in the uppermost portions of such treating spaces is predominantly an electrophoretic action moving residual and minute particles toward one or the other of the electrodes constituting the cell walls and the central electrodes. Coalesced or electrophoresced material settles to the body 64.

If sufficient dispersed material has separated below the cells the dispersion entering the cells will contain less than about .5% dispersed material, as is desirable. The treated oil issuing from the metering orifices 20 will usually contain no more than a few thousandths of a percent residual dispersed material when treating petroleum distillates, sometimes as low as .0001% (1 p.p.m.) but usually in the range of .0002–.001% (2–10 p.p.m.).

There will be little or no separation of dispersed material from the oil in the exit chamber **14** because of the small reisdual amount and because of the turbulence created by the streams rising through the metering orifices **20** which maintain the treated oil in the exit chamber **14** in a turbulent condition. Should any settling take place the settled material can be withdrawn through an appropriately positioned pipe **95** and short nipples can rise around the metering orifices to conduct the rising oil through the resulting settling space on which the pipe **95** opens.

Best results will be obtained if the invention is constructed and used in accordance with the following principles, although the invention is not limited thereto as some features thereof can be used in treaters of quite different design. The treating spaces around the energized central electrodes should desirably have a large length-to-gap ratio. This ratio will usually be in the range of about 12:1–25:1 in commercial treaters but can be in the range of about 8:1–30:1 or more. Cell widths are usually in the range of about 2–16 inches (about 5–40.6 cm.) but seldom more. The central electrodes may range in diameter from about .25 inch (about 6.3 mm.) to a large fraction of the cell width. The most desirable voltage gradients in the main treating spaces within the cells will usually be about 6–30 kv./inch (about 2.36–14.2 kv./cm.). The rate of rise of the dispersion in the main treating spaces may be about 10″/min. or higher (about 25.4 cm./min. or higher) for dispersions of heavier oils such as crude oil but with lighter oils such as light petroleum distillates it may be up to about 50″/min. (about 128 cm./min.). Lower rates can of course be used if high throughput is not essential. Likewise one can depart from the ratios, electrode widths and gradients suggested above if less perfect results can be tolerated.

The following is exemplary of the test operation of the invention when treating a large stream (15,000 barrels/day) of petroleum distillate such as kerosene, heater oil, virgin gas oil etc. boiling in the range of 330–640° F. While at a temperature of 72–90° F. about 5% of water was mixed with the distillate stream, the mixer **57** being a mixing valve across which was maintained a pressure drop ranging from a very low value, almost zero, to about 20 p.s.i. The resulting dispersion was delivered to the equipotential space below the electrode **75** where much of the aqueous dispersed phase separated before entry into the field of the auxiliary treating space **72** where additional aqueous phase material was coalesced and dropped to the body **64**. Square cells of a width of 6½″ (16.5 cm.) and a length of 6 ft. (183 cm.) were used with central electrodes of 1″ (2.54 cm.) diameter and were energized by a unidirectional potential of 30,000–35,000 volts. One .5″ (1.27 cm.) metering orifice **20** was used for each cell and the pressure drop thereacross was about 4 oz./sq. in. (about 18 gms./sq. cm.). The treated oil from the pipe **21** contained only about 0.0005% residual dispersed water.

A similar test treater employed for alkali treating distillates of this type containing residual acidity from a previous treatment will likewise produce treated oils from the pipe **21** containing only about 0.0005% residual dispersed aqueous material when a strong alkali (about 5–10% aqueous caustic soda solution of about 15–50% strength) or a weak alkali (about .2–2% of aqueous caustic soda solution of about 1–5% strength) is mixed with the distillate stream. A similar test treater employed in the acid treating of such distillates at ambient temperature by mixing 90–98° sulfuric acid therewith will produce effluent oils containing less than 0.001% residual acid.

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

What I claim is:

1. An electric treater for electrically resolving oil-continuous dispersions to separate the dispersed-phase material thereof, said treater including in combination:

a closed container having an upright flow axis;

a header extending horizontally across the interior of said container perpendicular to said flow axis dividing the interior of said container into vertically opposed upper and lower zones pressurally separated by said header, said lower zone including a dispersion treating zone;

a plurality of vertical cells in said lower zone compositely occupying substantially the entire horizontal cross-sectional area of said dispersion treating zone and comprising cell electrodes having upper exit portions immediately below said header and lower entrance portions opening on an entrance chamber in the lower interior of said container below the lower ends of said cell electrodes;

a plurality of vertical central electrodes and means for mounting same to extend centrally along said cell electrodes, said means including means for electrically connecting said central electrodes and electrically insulating same from said container, there being an interelectrode treating space between each central electrode and the interior surface of the corresponding cell electrode;

means for establishing a high-voltage unidirectional electric field in each interelectrode treating space;

a large-orifice dispersion inlet means opening on said entrance zone at a level below said lower ends of said cell electrodes and pressure means delivering a large stream of the dispersion to be treated to said inlet means at a rate to create only a very small pressure drop on said dispersion as it enters said entrance chamber from said inlet means, the lower interior of said entrance zone comprising a settling zone adapted to collect as a body any dispersed-phase material separated from said dispersion at a position thereabove, the dispersion rising as smaller streams in said interelectrode treatiing spaces toward the upper exit portions of said cell electrodes while being subjected to the action of said high-voltage unidirectional electric fields acting to induce separation of dispersed-phase material from said dispersion to produce a treated oil containing only a very small residual amount of dispersed-phase material, said cell electrodes and their interelectrode treating spaces forming the sole connection between said entrance chamber and said header;

means for equalizing the upward velocity of said smaller streams in the respective cell electrodes, said last-named means including a large number of relatively small metering orifices through said header forming the sole exit for said treated oil from said exit portions of said cell electrodes to said upper zone above said header and forming with the interelectrode treating spaces the sole communication between said entrance chamber and said upper zone, the number and spacing of said metering orifices being related to the spacing and cross-sectional size cell electrodes to produce at said rate of dispersion inflow a pressure drop on the treated oil flowing through the metering orifices substantially higher than said first-named pressure drop;

treated oil effluent means opening on said upper zone; and

a separated material effluent means opening on said lower interior of said settling zone.

2. An electric treater as defined in claim **1** in which said inlet means includes a small number of relatively large dispersion-inlet orifices, and in which the total cross-sectional area of said metering orifices is substantially less than the total cross-sectional area of said dispersion-inlet orifices.

3. An electric treater as defined in claim 1 in which each of said cell electrodes has a width of about 2–16 inches, in which each central electrode is of a width ranging from about .25 inch up to a large fraction of the cell electrode width, in which the length-to-gap ratio based on the axial length of each cell electrode and the electrode gap therein measured between its central electrode and the closest internal surface of the corresponding cell electrode is at least in the range of 8:1–30:1 and in which said field-establishing means is a source of high unidirectional potential for inducing in each interelectrode treating space a field of a voltage gradient of about 6–30 kv./inch.

4. An electric treater for electrically resolving oil-continuous dispersions to separate the dispersed-phase material thereof, said treater including in combination:

a closed container having a flow axis and entrance and exit zones spaced from each other therealong with a dispersion treating zone therebetween;

a cellular grid at a portion between said entrance and exit zones occupying substantially the entire cross-section of said treating zone and including a plurality of cell passages, said cell passages comprising a large number of long and narrow electrode passages each bounded by longitudinal walls extending parallel to said flow axis and an end wall at one end closing the cell passage and separating same from said exit zone, the other ends of said electrode passages being open to said entrance zone, all said walls being electrically connected to said container;

a foraminous electrode-supporting structure and means for supporting and electrically insulating it from said container in said entrance zone thereof;

a plurality of central electrodes attached to said electrode-supporting structure and extending centrally into and axially along said electrode passages, each central electrode terminating in an end spaced from the end wall of its corresponding electrode passage;

a source of high-voltage electric potential connected to said container and said central electrodes establishing a high-voltage electric field in the interelectrode treating space of each electrode passage between its central electrode and its longitudinal walls and a supplementary electric field between the end of such central electrode and the corresponding end wall of the corresponding electrode passage;

means for introducing a pressured stream of the dispersion to be treated into said entrance zone, the dispersion flowing therefrom into said other ends of said electrode passages to advance as smaller streams along the interelectrode treating spaces thereof, said electric fields separating dispersed-phase material from the dispersion of such smaller streams to produce a treated oil;

means for equaliziing the flows of said smaller streams along said electrode passages and the interelectrode treating spaces thereof, said last-named means including at least one small metering orifice through the end wall of each electrode passage throttling the flow of said treated oil from said supplementary electric field thereof to said exit zone;

means for withdrawing treated oil from said exit zone; and

means for withdrawing separated dispersed-phase material from said container.

5. An electric treater as defined in claim 4 in which the exit ends of said electrode passages are in a plane transverse to said flow axis, and including a header extending in said transverse plane across said exit ends and connected to said cellular grid, portions of said header comprising said end walls closing said electrode passages, said metering orifices extending through said header coaxially with respect to the central axes of the corresponding electrode passages.

6. An electric treater as defined in claim 5 in which the widths of each electrode passage measured in planes parallel to said flow axis intersecting right angularly in the central axis of such electrode passage are substantially equal, in which said central electrodes are long and narrow rods respectively in said electrode passages, and in which there is a single metering orifice through said header for each electrode passage, such single metering orifice being coaxial with respect to the central axis of the electrode passage.

7. An electric treater as defined in claim 4 in which said foraminous electrode-supporting structure comprises a foraminous electrode means insulated from said container, and including a support structure in a portion of said entrance zone electrically connected to said container, said support structure being spaced from said foraminous electrode-supporting structure, and a foraminous auxiliary electrode carried by said support structure in said entrance zone parallel to said foraminous electrode means to provide an auxiliary treating space therebetween.

8. An electric treater as defined in claim 7 in which said support structure is in a central portion of said entrance zone and has an end portion spaced from said foraminous electrode-supporting structure, said foraminous auxiliary electrode being carried by said end portion of said support structure, and in which said means for introducing said dispersion into said entrance zone includes a pipe means having a central portion connected to said support structure in supporting relation therewith, said support structure including means for varying the position of said auxiliary electrode relative to said central portion of said pipe means and thus varying the space between said auxiliary electrode and the foraminous electrode means of said electrode-supporting structure.

9. An electric treater for electrically resolving oil-continuous dispersions to separate the dispersed-phase material thereof, said treater including in combination:

a closed container having an upright flow axis with a lower entrance zone and an upper exit zone spaced from each other therealong;

a cellular grid between said entrance and exit zones providing side-by-side upright cell passages including a number of electrode passages having upright side walls and a number of insulator-support spaces, all of said electrode passages and insulator-support spaces having open lower ends opening on said entrance zone, all of the upper ends of said electrode passages communicating with said exit zone;

walls forming an entrapment space at the upper end of each of said insulator-support spaces;

an insulator support means in each entrapment space;

an insulator in each entrapment space attached to the insulator support means therein;

a hanger carried by each insulator extending downward in the corresponding insulator-support space having a lower portion in said entrance zone;

a foraminous electrode support secured to said lower portions of said hangers;

a plurality of upstanding central electrodes carried by said electrode support and extending upwardly centrally in said electrode passages forming interelectrode treating spaces therein between said central electrodes and the side walls of the corresponding electrode passages;

means for introducing a pressured stream of the dispersion to said entrance zone at a position below said foraminous electrode support to form smaller streams rising in said electrode passages;

means for establishing high-voltage dispersion-treating electric fields in said interelectrode treating spaces, said field acting on said smaller streams to separate dispersed-phase material therefrom and produce a treated oil discharging from the upper ends of said electrode passages into said exit zone, the separated

dispersed-phase material settling to the bottom of said entrance zone; and

means for separately withdrawing treated oil from said exit zone and separated dispersed-phase material from the bottom of said entrance zone.

10. An electric treater as defined in claim **9** in which said walls forming said entrapment space include an end wall closing the upper end of each of said insulator-support spaces, in which each insulator-support space includes a side wall, and in which each insulator support means includes a bracket attached to said side wall and a support member carried by said insulator, and including means for detachably connecting said support member and said bracket.

11. An electric treater as defined in claim **10** in which said bracket includes a bifurcated guide means extending laterally of the corresponding entrapment space adapted to receive and guide said support member to seat on said bracket when said insulator and its support member are inserted upward into the corresponding insulator support space from a position within said entrance zone.

12. An electric treater as defined in claim **9** including a network of small pipes opening respectively on said entrapment spaces, means for supplying an inert gas to said small pipes to displace liquid rising in such entrapment spaces from said entrance zone and form a gas-liquid interface in each entrapment space at a level below the insulator therein, means communicating with said entrance zone and said network of small pipes to establish an auxiliary gas-liquid interface at a position exterior of said container horizontally opposite the levels of said gas-liquid interfaces in said entrapment spaces, and means for maintaining all of said gas-liquid interfaces at the same level, said last-named means including means responsive to changes in level of said auxiliary gas-liquid interface and means operatively connecting said level responsive means to said gas-supply means to maintain said auxiliary interface at a uniform level.

13. An electric treater as defined in claim **12** in which said means establishing said auxiliary interface includes a pipe outside said container having a lateral portion opening on said entrance zone and an upright portion receiving liquid from said entrance zone through said lateral portion, the upper interior of said upright portion constituting an auxiliary entrapment space communicating with said pipe network, an inlet bushing extending into said auxiliary entrapment zone and positioned above said auxiliary interface therein, said inlet bushing having a conducting member extending therethrough, a conductor extending downward in said upright portion and laterally through said lateral portion of said outside pipe into said entrance zone, said conductor being electrically connected to said foraminous electrode support, said means for establishing said electric fields including a source of high-voltage potential having a high-voltage terminal, and means for electrically connecting said high-voltage terminal to said conducting member of said bushing.

14. An electric treater as defined in claim **9** including a horizontal header extending completely across the interior of said container above said cellular grid forming the lower boundary of said exit zone, and including a large number of metering orifices through said header interconnecting the upper interiors of said electrode passages and said exit zone to conduct treated oil from the former to the latter.

15. An electric treater as defined in claim **14** in which said walls forming said entrapment spaces include an end wall closing the upper end of each of said insulator-support spaces, and in which said header includes portions forming said end walls of said insulator-support spaces, said header being disposed immediately above said electrode passages in closing relation therewith, at least one of said metering orifices interconnecting the thus closed upper portion of each electrode passage with said exit zone and forming the sole intercommunication therebetween.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

September 7, 1965

Patent No. 3,205,161

Delber W. Turner

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

Column 7, line 19, for "portion" read -- position --.

Signed and sealed this 5th day of April 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents