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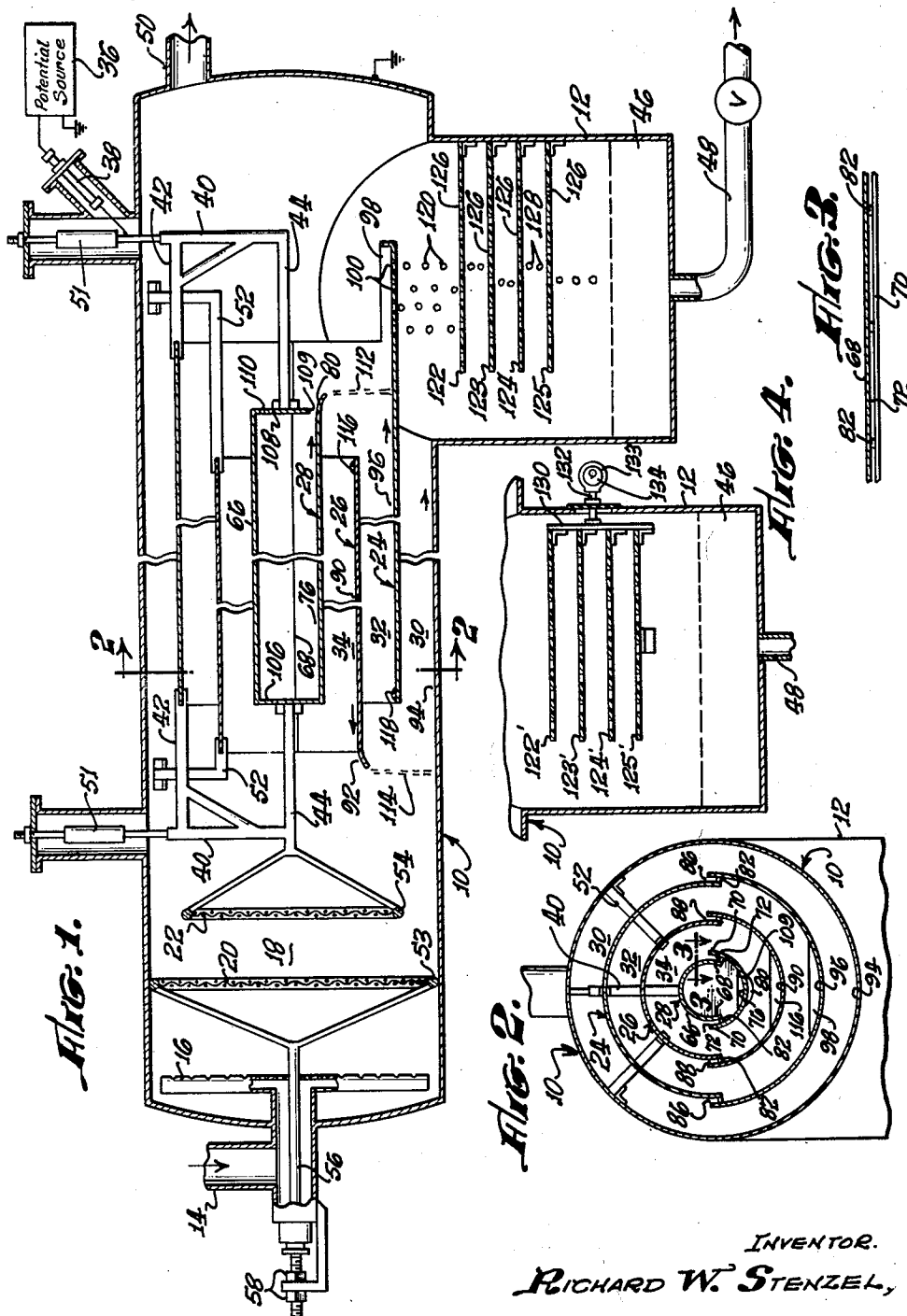
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3,148,134

ELECTRIC TREATER FOR DISPERSIONS

Filed July 11, 1960

3 Sheets-Sheet 1



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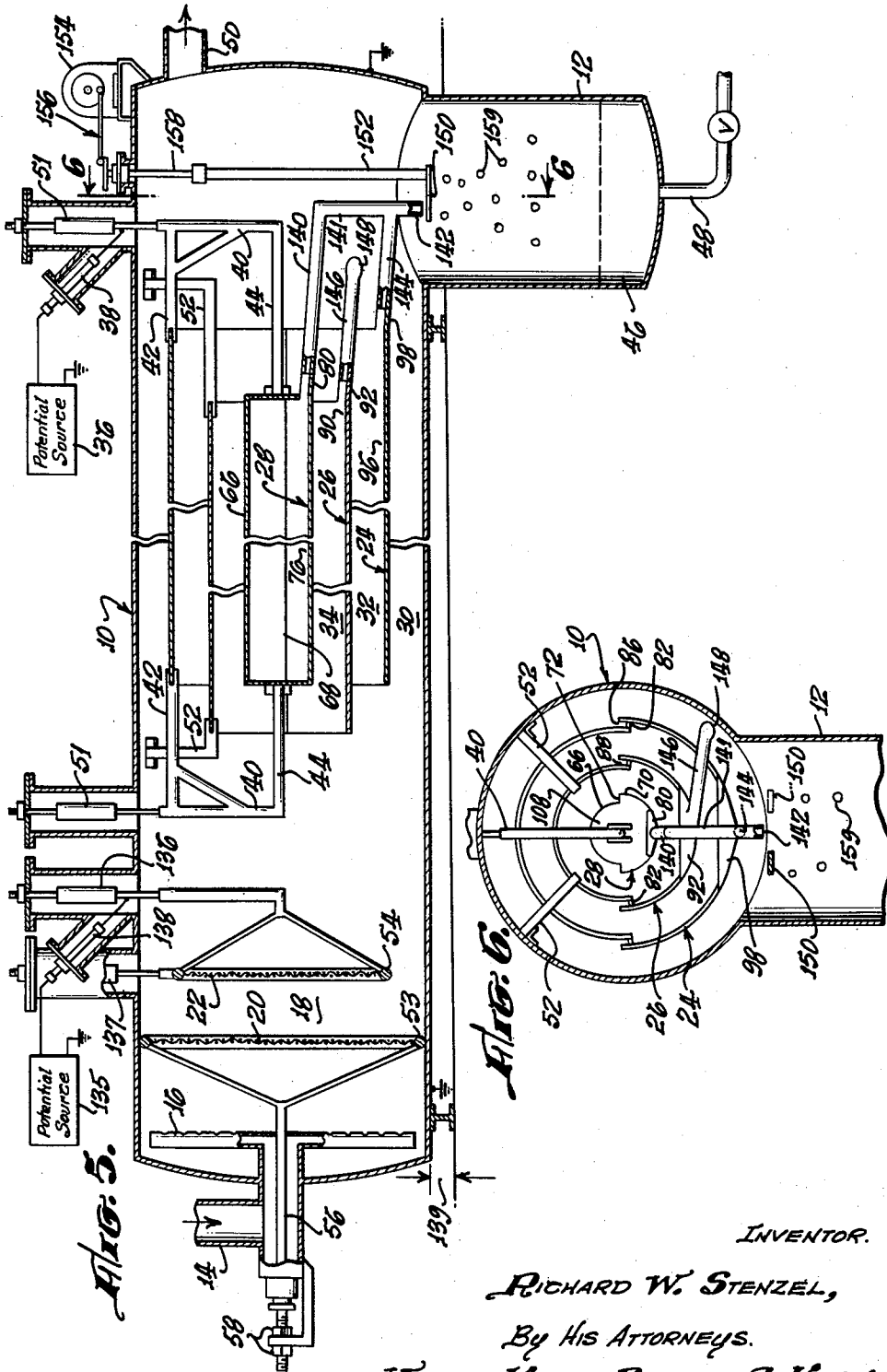
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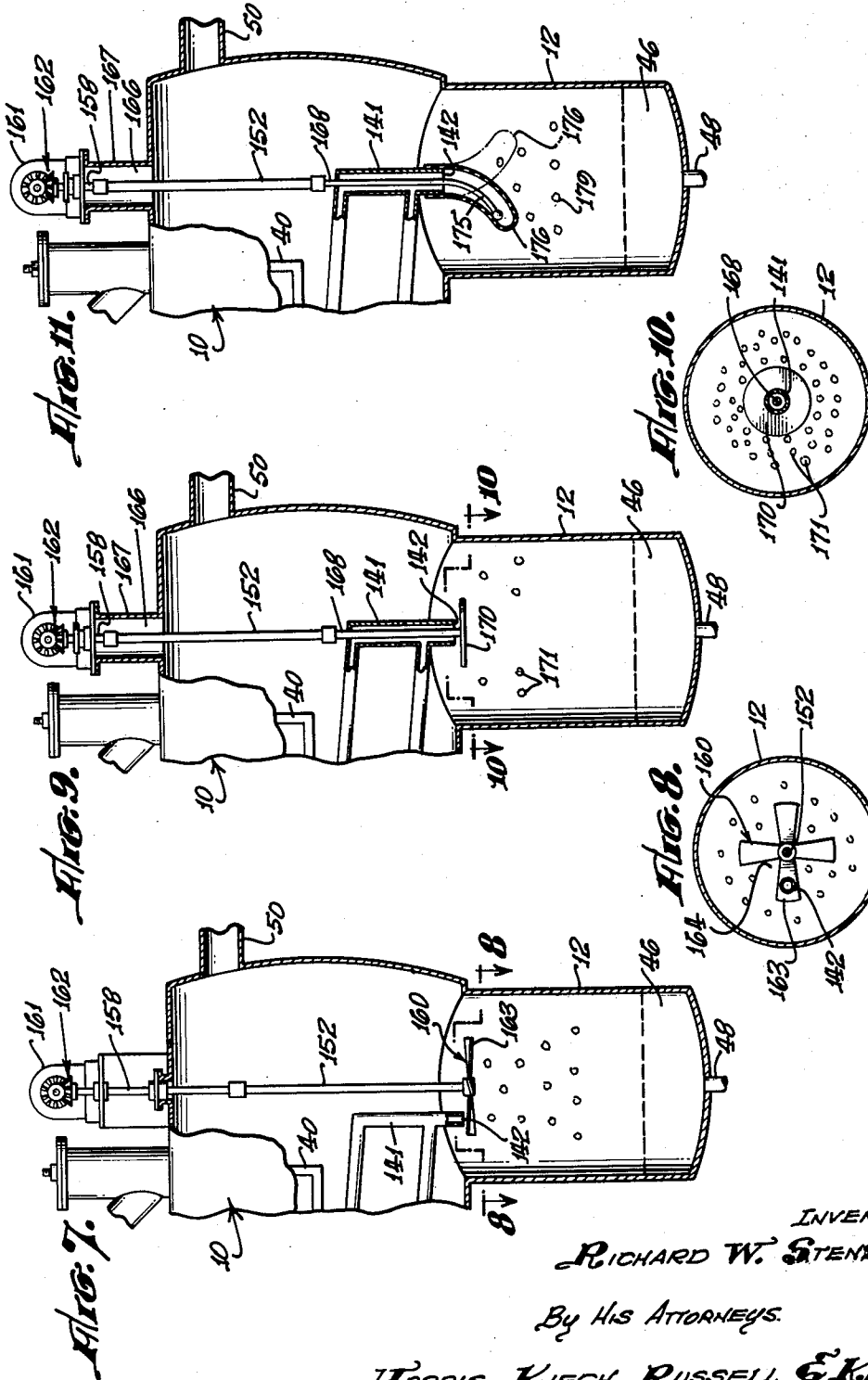
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3 Sheets-Sheet 3



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1

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ELECTRIC TREATER FOR DISPERSIONS

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23 Claims. (Cl. 204—302)

My invention relates to the electric treatment of dispersions of the type in which the dispersed or internal phase liquid is of higher electrical conductivity than the external phase liquid. It will be illustrated with reference to the resolution of dispersions of the type in which the specific gravity of the internal phase liquid is greater than that of the external phase liquid although it is not limited thereto.

It is known that a high-voltage electrostatic field will coalesce the dispersed liquid into droplets of sufficient size to separate gravitationally from the external phase liquid. The problem has existed of discharging from an electrode surface any of the electrically conducting dispersed phase liquid which reaches it by gravitational action or by electric attraction. If this liquid is permitted to drop from an edge of a high-voltage electrode it may become redispersed by the electric blast action at the edge.

Another problem is the dispersion of droplets resulting when using an electric treating system including substantially horizontal concentric cylinder electrodes. The coalesced material collecting on one cylinder will run down the cylinder and must be discharged from the lowest portion without short-circuiting this or an adjacent electrode and without such electric redispersion as will increase separation difficulties.

It is an object of the present invention to collect and localize the discharge of the dispersed phase material reaching an electrode; also to discharge the collected liquid in such a manner as not to short-circuit the electrode. A further object of the invention is to mechanically subdivide the collected dispersed phase material so that no short-circuiting path is formed between the electrode and a surface of different potential.

The invention will be illustrated with reference to electric treatment between substantially concentric tubular electrodes arranged substantially horizontally. The coalesced material in one half of the interelectrode treating space tends to gravitate to an outer surface of the inner of a pair of such electrodes. It is an object of the invention to transfer such internal phase liquid to the interior of such an electrode to collect in a longitudinal trough and to flow the collected material to a discharge position, usually beyond the end of the other electrode of the pair. It is a further object of the invention to sectionalize a tubular electrode longitudinally and provide for transfer of the dispersed phase material from the exterior to the interior thereof at horizontally opposite positions.

Another object is to electrically treat an emulsion in a relatively long electric field of relatively small cross-section, as compared with a relatively short field of large cross-section, while maintaining substantially viscous flow of the dispersion through the field.

Further objects and advantages of the invention will be apparent to those skilled in the art from the following description of exemplary embodiments.

Referring to the drawings:

FIG. 1 is a vertical sectional view of one embodiment of the invention;

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

FIG. 4 is a fragmentary sectional view of an alternative stream-subdividing means;

2

FIG. 5 is a vertical sectional view of another embodiment of the invention;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5;

FIGS. 7 and 8 are fragmentary views illustrating an alternative embodiment of stream-subdividing means, FIG. 8 being taken along the line 8—8 of FIG. 7;

FIGS. 9 and 10 are similar fragmentary views of a further alternative, FIG. 10 being taken along the line 10—10 of FIG. 9; and

FIG. 11 is a fragmentary view illustrating still a further alternative of the stream-subdividing means.

The treater of FIGS. 1 and 2 includes a substantially horizontal container 10 equipped with a well 12 at its exit end. The dispersion to be treated, here a dispersion in which the external phase liquid is of lower conductivity and specific gravity than the internal phase liquid, is delivered under pressure to an inlet pipe 14 connected to a perforated cross-arm distributor 16 to advance rightwardly as a container-filling stream. This stream advances first through a preliminary treating space 18 formed between preliminary electrodes 20 and 22 for partial resolution and then through a set of main electrodes exemplified as substantially horizontal concentric tubular electrodes 24, 26 and 28 forming treating spaces 30, 32 and 34 therebetween, the container 10 serving as the outermost electrode of this set. The container 10 is grounded, as is one terminal of a high-voltage source 36 having its other terminal connected through an inlet bushing 38 to one of a pair of metallic electrode supports 40 having arms 42 supporting the electrode 24 and extending in out-rigger style therebeyond and similar arms 44 supporting the innermost electrode 28. The action of the electric fields thus established in the interelectrode treating spaces is to coalesce the internal phase liquid into droplets of such size as to settle through the external phase liquid in the container 10, ultimately forming a body 46 of the internal phase liquid in the well 12 from which this liquid can be withdrawn continuously or periodically through a pipe 48. The separated external phase liquid is withdrawn from an upper portion of the container 10 through a suitably valved pipe 50.

The electrode supports 40 are respectively supported from insulators 51 in conventional manner and are maintained at high potential above ground by the source 36. The electrode 26 is maintained at ground potential, being supported at its ends by electrode supports 52 which are spaced from the supports 44 and connected to the upper interior of the container 10.

The electrodes 20 and 22 may be of any suitable shape but are shown as spaced foraminous members made of screen or the like mounted in rings 53 and 54. In this embodiment the ring 54 is electrically and mechanically connected to the arm 44 of the left-hand electrode support 40. The ring 53 is slidable relative to the inner surface of the container 10 to change the electrode spacing as the position of a shaft 56 is changed. Lock nuts 58 hold the shaft 56 in a selected position.

The main electrodes 24, 26 and 28 and the container 10 may be of any suitable cross-sectional shape, being shown as substantially cylindrical. One half of each electrode on one side of its horizontal midplane, here the upper side, provides an external surface receiving the coalesced dispersed phase liquid droplets gravitating thereto or electrically attracted thereto, this liquid flowing along this surface to the midplane. Each of the electrodes 24, 26 and 28 is apertured substantially at its midplane and along the length thereof at horizontally opposite sides for conducting to the interior thereof the liquid flowing along the aforesaid external surface.

Considering the innermost electrode 28 as an example, the upper half provides an external surface 66 along which

3

the dispersed phase liquid flows to the midplane. This electrode is illustrated in FIG. 2 as made of upper and lower sections respectively having depending pairs of longitudinal lips 68 and outwardly positioned upstanding pairs of longitudinal lips 70 spaced to define elongated apertures 72 on horizontally opposite sides of the electrode 28. Any coalesced internal phase liquid settling or attracted to the external surface 66 of the upper section as a result of the electric field in the adjacent inter-electrode treating space 34 will be guided along this surface through the apertures 72 and thence along the internal upwardly-facing collecting surface of the lower section to a longitudinal trough 76 in the bottom thereof where it will collect and flow longitudinally as a stream to an overflow means 80 at a discharge position, preferably at one end of the electrode 28. The paired lips 68 and 70 are bridged at intervals throughout their lengths by spacers 82 (FIG. 3) which unitize the electrode sections.

In like manner the electrodes 24 and 26 are sectionalized and provide elongated apertures 86 and 88 in pairs at horizontally opposite positions. The lower interior of the electrodes 26 provides a trough 90 conducting the collected liquid leftward to an overflow means 92 beyond the end of the electrode 24 from whence the collected material may drop as particles or as a stream to a trough 94 formed by the next lower electrode, here the container 10. The lower interior of the electrode 24 provides a trough 96 conducting the collected liquid rightwardly to an overflow means shown as comprising a lipped extension 98 of the electrode having its lowermost wall perforated to form openings 100 which may act as a mechanical subdividing means as later described. Should these openings become clogged or be of insufficient size to pass all the collected liquid the balance will overflow the lip of the extension 98 into the well 12.

The innermost electrode 28 may be closed fore and aft by plates 106 and 108, the latter having an opening 109 feeding the collected material from the trough 76 to the overflow means 80, here comprising a lip extending rightward from the lowermost portion of the electrode 28. The plate 108 also has a small weep hole 110 to release any gas which might have been liberated or collected in the upper interior of the electrode. This innermost electrode 28 can be exactly horizontal or it can slope slightly toward the opening 109 to facilitate drainage of the collected liquid therefrom over the lip to form a stream 112 dropping to the trough 96 of the electrode 24 beyond the end of the electrode 26. The stream 112 may be either continuous or intermittent but no short-circuiting will result because the stream tends to bridge electrodes of equal potential.

In like manner the internal phase liquid reaching the trough 90 of the electrode 26 either through the elongated apertures 88 or because of settling in the interelectrode treating space 34 flows leftward along the trough and drops from the lip of the overflow means 92 forming a stream 114 beyond the end of the electrode 24 to the next lower electrode, here the container 10. Again, no short-circuiting will occur because the stream tends to bridge electrodes of equal potential. To induce the desired leftward flow along the channel 90 the electrode 26 may be tipped or deformed slightly to slope toward the overflow means 92 or if horizontal a small dam 116 may block rightward flow from the trough 90. Such a dam will preferably be made of insulating material that is not wettable by the internal phase liquid, plastic materials such as polytetrafluoroethylene or trifluorochloroethylene being suitable.

The internal phase liquid reaching the trough 96 of the electrode 24 either through the longitudinal apertures 86 or by action of the electric field in the interelectrode space 32 is caused to move rightwardly along the trough either by a slight slope or deformation of the electrode 24 or by use of a dam 118 similar to the dam 116. The apertures 100 in the extension of the electrode 24 are

4

above the well 12 and can be designed to mechanically subdivide the collected material into discrete separate masses 120 dropping toward a surface of different potential, here the surface of the body 46 of internal phase liquid. This is the only portion of the treater where the internal phase liquid tends to drop from an electrode maintained at high potential to a surface of different potential and it is critical that the collected liquid be here subdivided to prevent short-circuiting.

In the embodiment of FIG. 1 the invention preferably provides supplementary mechanical subdividing means insuring subdivision of the internal phase liquid dropping in the well 12. This includes one or more members which may take the form of perforated plates 122, 123, 124 and 125 having staggered openings 126 through which the liquid descends through the surrounding body of external phase liquid, each opening being sized to subdivide the internal phase liquid passing therethrough, forming discrete masses 128 sufficiently separated in the external phase liquid to avoid any electrical bridge or short-circuit between the electrode 24 and the body 46 even if the openings 100 should form one or more streams dropping to the uppermost perforated plate 122 or become clogged to allow overflow from the lip of the extension 98. In some instances a single perforated plate or two plates will suffice rather than the four plates shown. It is desirable that such perforated plates be made of insulating material that is not readily wettable by the dispersed phase liquid. The plastic material of the type mentioned concerning the dam 116 will suffice in this regard. It is further desirable that the perforations be spaced from each other sufficiently that drops issuing therefrom will not coalesce with adjacent drops to the extent that a continuous filament of liquid is formed from one plate to the next lower plate surface.

In the embodiment of FIG. 4, the auxiliary subdividing means includes the aforesaid perforated plates, indicated by the numerals 122'-125' mounted on a frame 130 which is oscillated in a horizontal direction by a shaft 132 connected to a ring 133 encircling an eccentric 134 operatively connected to any suitable drive means. Such plates shift in a direction transverse to the flow of the internal phase liquid in a manner tending to subdivide same into separate and discrete masses. This arrangement can also be used to subdivide any internal phase liquid dropping from the electrode 24 as a stream toward the uppermost plate 122'. In some instances a single plate will suffice but it is preferred to use at least two of such perforated plates.

The embodiment of FIGS. 5 and 6 differs from that of FIG. 1 in mounting the electrode 22 so that it can be energized from a source 135 separate from the source 36. Insulators 136 and 137 support the electrode 22 while the latter is energized through a bushing 138.

The embodiment of FIGS. 5 and 6 differs also in arranging all of the main electrodes to discharge their respective internal phase liquids at their downstream or exit ends. This is especially suitable where the amount of dispersed phase is large, so that its rapid run-off from the electrodes is necessary. Thus, either the electrode system itself or the whole treater may be set at an appreciable angle, sloping downward toward the outlet, to promote more rapid run-off. As illustrated by way of example, the entire treater slopes from the horizontal by an angle indicated at 139.

The overflow means 80 of the innermost electrode 28 is connected to a sloping conduit 140 providing a downcomer portion 141 terminating at a discharge position in a depending open end 142. A sloping conduit 144 similarly connects the overflow means 98 of the electrode 24 to the downcomer portion. The overflow means 92 of the electrode 26 in this embodiment is arranged on the downstream or exit end of the electrode and is connected to a conduit 146 which extends longitudinally and then laterally beyond the end of the electrode 24 to an open end

5

148 exiting at a discharge position immediately adjacent the inner surface of the container 10, see FIGS. 5 and 6. This conduit 146 will not short-circuit the electrodes as it extends from the grounded electrode 26 to the grounded container 10 in spaced relation to the electrode 24, discharging the stream of internal phase liquid to flow along the inner surface of the container into the well 12 and thence directly to the body 46 therein.

The means for mechanically subdividing the stream of internal phase liquid issuing from the open end 142 of the downcomer 141 is here shown as a movable member 150 carried by the lower end of an arm 152 made of insulating material of the type previously described. A drive means, shown as including a motor 154 connected by a crank mechanism 156 to a supporting rod 158, oscillates the member 150 through the path of the stream to subdivide same into discrete separate masses 159. The member 150 may oscillate at a position immediately below the open end 142 to exert a gentle chopping action on the stream, displacing the severed portions in opposite directions to settle in different zones towards the body 46.

In the embodiment of FIGS. 7 and 8 the arm 152 carries a movable member 160 and is slowly rotated by a motor 161 driving the supporting rod 158 through a gear train 162. The movable member 160 is shown as including a plurality of blades 163 separated by spaces 164. The top surfaces of the blades 163 may lie in a single plane but are shown sloping. These blades move successively in the path of the stream from the open end 142 to divert and subdivide the material of this stream and thus destroy its electrical continuity. The reactive force on the blades 163 can be made to assist the rotation of the movable member 160. In this embodiment, as in the embodiment of FIG. 5, the movable member is insulated from the tank and will tend to assure some voltage intermediate that of the electrode 24 and the ground potential of the container, this intermediate voltage being that imposed on the oil in the neighborhood of the movable member.

In the embodiment of FIGS. 9 and 10 the arm 152 extends upwardly into a closed pocket 166 provided by a housing 167 rising from the container. Any suitable insulating fluid is trapped in this pocket. The arm 152 is turned by the motor 161 and the gear train 162 but here carries a shaft 168 which extends into the downcomer 141 and from the open lower end thereof. Below the latter the shaft 168 carries a movable member in the form of a disc 170. The internal phase liquid issues from the open end 142 of the downcomer as an annular stream which is guided by the shaft 158 to a central zone of the disc 170. This disc is rotated at a speed sufficient to displace the liquid outwardly toward and from the periphery of the top surface of the disc as discrete masses or droplets 171 still of sufficient size to settle to the body 46 but spaced from each other so as not to form a short-circuiting path to such body.

In the embodiment of FIG. 11 the arrangement is similar to that of FIGS. 9 and 10 but the shaft 168 provides a lower curved end 175. The downcomer 141 has a movable lower end 176 formed for example by a flexible hose 178. As the shaft 168 turns its bent portion 175 sweeps the end 176 in a circular path to discharge progressively at different positions within the body of external phase liquid in the well 12 thus subdividing the stream into discrete separate masses 179.

While the exemplified embodiments have been disclosed with reference to treatment of a dispersion in which the continuous phase liquid is of lower specific gravity than the dispersed phase liquid, an equivalent structure and method of treatment of reverse-type dispersions, in which the continuous phase liquid is of higher specific gravity than the dispersed phase liquid, result from merely inverting the illustrated embodiments. In the appended claims, use of such terms as "upper," "lower," "trough," "upstanding," "depending" and like terms

6

applied to the exemplified embodiments is not to be construed as limiting the claims thereto as distinct from the equivalent inverted structure.

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

I claim as my invention:

1. In an electric treater for dispersions composed of droplets of an internal phase liquid of higher electrical conductivity dispersed in an external phase liquid of lower conductivity and specific gravity, said treater including: a grounded container; means for delivering the dispersion to be treated to said container and for separately withdrawing treated external phase liquid and separated internal phase liquid from upper and lower zones of said container, said container providing an electrode-effluent zone therein containing external phase liquid; electric-field-establishing means for electrically treating and separating the droplets of the internal phase liquid in a high-voltage electrostatic field, said electric-field-establishing means including an electrode within said container, means for electrically insulating said electrode from said container and a source of high-voltage potential providing one terminal electrically connected to said container and another terminal electrically connected to said electrode electrically energizing same and maintaining same at a high potential relative to said container and establishing said high-voltage electrostatic field adjacent said electrode, said electrode having an upwardly facing collecting surface to which the electrically treated internal phase liquid settles, said electrode including means for discharging the collected internal phase liquid from said collecting surface at a discharge position as a stream into said electrode-effluent zone containing said external phase liquid, said stream tending to settle through said external phase liquid in said electrode-effluent zone toward the bottom of said grounded container; and mechanical means for subdividing said stream after such discharge into large but electrically separate masses to avoid electrical short-circuiting between said electrode and said container through said stream.

2. An electric treater as defined in claim 1 in which said subdividing means includes a movable member in the path of said stream and means for moving said member in a plane transverse to such paths.

3. An electric treater as defined in claim 2 in which said movable member is apertured and made of insulating material and provides holes through which the liquid of said stream drops as discrete separate masses.

4. An electric treater as defined in claim 1 in which said movable member includes at least one solid element bounding at least one space, and in which said moving means includes means for moving said member to position said solid member and said space alternately in the path of said stream.

5. An electric treater as defined in claim 1 in which said subdividing means includes a conduit connected to said discharge means having a movable exit end, and means for moving said exit end to discharge progressively in different portions of said electrode-effluent zone.

6. An electric treater as defined in claim 1 including an insulated support for said movable member electrically insulating such member from said grounded container.

7. An electric treater as defined in claim 1 in which said discharge means includes a conduit connected to said electrode to receive the collected internal phase liquid, said conduit having an exit end, said subdividing means including a movable member mounted to move below said exit end, and means for moving said movable member relative to the stream discharging from said exit end to subdivide same into discrete separate masses.

8. An electric treater as defined in claim 7 in which said member is a blade, and in which said means for moving said member includes means for oscillating said blade through the path of said stream.

9. In an electric treater for dispersions composed of an internal phase liquid dispersed in an external phase liquid of lower specific gravity, said treater including:

inner and outer tubular electrodes having substantially horizontal axes and providing an annular treating space therebetween, said inner electrode providing an upper external surface, said inner electrode being apertured on horizontally opposite sides along the length thereof to pass from the exterior to the interior thereof the internal phase liquid settling on said upper external surface in the upper half of said annular treating space, said inner electrode including lip means guiding said liquid settling on said upper external surface through the apertures of said inner electrode to the interior thereof, the lowermost internal portion of said inner electrode forming a trough in which said internal phase liquid collects and flows longitudinally to a discharge position;

means for establishing a high difference in potential between said electrodes to establish a high-voltage electric field in said treating space; and

means for delivering the dispersion to be treated to said treating space for treatment by said field to provide a treated liquid discharging from the upper interior of said outer electrode.

10. In an electric treater for dispersions composed of an internal phase liquid dispersed in an external phase liquid of lower specific gravity, said treater including:

inner and outer tubular electrodes having substantially horizontal axes and providing an annular treating space therebetween open at its ends, said inner electrode providing an upper external surface in the upper half thereof;

means for establishing a high difference in potential between said electrodes to establish a high-voltage electric field in said treating space;

means for flowing the dispersion to be treated axially along said annular treating space, some of the internal phase liquid treated by said electric field settling from the dispersion to said upper external surface of said inner electrode and flowing therealong toward the horizontal midplane of such electrode, said inner electrode being apertured at its horizontally opposed sides near such horizontal midplane to provide apertures along and substantially throughout the length of such inner electrode, said inner electrode including means for guiding through said apertures from the exterior to the interior of said inner electrode said internal phase liquid settling to and flowing along said upper external surface, the lowermost internal portion of said inner electrode forming a trough in which collects the internal phase liquid passing from the exterior to the interior of said inner tubular electrode, said trough extending to a discharge position; and

means for discharging the collected liquid from the interior of said inner tubular electrode at said discharge position.

11. An electric treater for treating and separating the phases of an oil-continuous dispersion containing an internal dispersed phase of an electrically conductive liquid, said treater including:

a grounded metallic container having upper and lower portions respectively forming an upper separated oil zone and a lower separated conductive liquid zone with an electrode-effluent zone therebetween adapted to contain a body of oil-continuous dispersion, said lower zone containing a body of separated conductive liquid therein;

a separated oil effluent means opening on said upper zone withdrawing separated oil therefrom;

a separated conductive liquid effluent means opening on said lower zone withdrawing separated conductive liquid therefrom;

a first electrode having a trough portion at its bottom and an upwardly facing surface draining thereto, said first electrode having a discharge portion;

means for mounting said first electrode within, spaced from and electrically insulated from said container with said discharge portion opening on said electrode-effluent zone at a position above said lower portion of said container;

means for electrically treating the dispersion at a position above said upwardly facing surface and for collecting the electrically treated conductive liquid of the dispersion in said trough portion, said last-named means including a second electrode in said container spaced from said first electrode defining a treating space therebetween bounded by said upwardly facing surface of said first electrode, means for establishing high-voltage electric fields in said treating space and between said first electrode and said container, said field-establishing means including means for maintaining said first electrode at a high potential above the ground potential of said container, and means for supplying the dispersion to be treated to said treating space, the electrically treated dispersed-phase conductive liquid separating from the oil phase and collecting in said trough portion of said first electrode;

means for flowing the collected conductive liquid along said trough portion as a stream to said discharge portion of said first electrode; and

means for discharging the collected conductive liquid of said stream from said discharge portion of said first electrode toward said lower portion of said container while preventing the liquid of said stream from electrically short-circuiting the first electrode to said lower portion of said container, said last-named means comprising short-circuit-preventing means adjacent said discharge portion of said first electrode and at a position above said lower portion of said container, said short-circuit-preventing means including means for mechanically subdividing the liquid of said stream into discrete separate masses settling as such through said body of oil-continuous dispersion in said electrode effluent zone to said lower portion of said container.

12. An electric treater as defined in claim 11 in which said means for mechanically subdividing said liquid of said stream includes an orificed member communicating with said trough portion at said discharge portion of said first electrode receiving the collected conducting liquid of said stream and discharging same into said electrode effluent zone at said position above said lower portion of said container to drop in said electrode effluent zone from said orificed member to said lower portion of said container.

13. An electric treater as defined in claim 12 including a subdividing member at a level between said orificed member and said lower portion of said container, means for movably mounting said subdividing member to move in said electrode effluent zone transverse to a vertical axis thereof, and drive means for thus moving said subdividing member.

14. An electric treater as defined in claim 13 in which said subdividing member provides perforate and imperforate portions, and in which said movably mounting means and said drive means move said perforate and imperforate portions alternately across vertical lines within said vertical zone.

15. An electric treater as defined in claim 12 in which each of said first and second electrodes extends substantially horizontally and has entrance and exit ends, said electrodes forming a substantially horizontal treating space having open ends, said dispersion supply means including means for flowing the dispersion longitudinally along said treating space toward the exit ends of said electrodes, said orificed member comprising a conduit

opening on said trough portion of said first electrode at said exit end thereof and extending beyond such exit end to said position above said lower portion of said container.

16. An electric treater as defined in claim 15 in which said lower portion of said container includes a well containing said body of separated conductive liquid, and in which said conduit provides a downwardly opening exit orifice opening into the top of said well.

17. An electric treater for treating and separating the phases of an oil-continuous dispersion containing an internal dispersed phase of an electrically conductive liquid, said treater including:

a metallic container having upper and lower portions respectively forming an upper separated oil zone and a lower separated conductive liquid zone, said lower zone containing a body of separated conductive liquid therein;

a separated oil effluent means opening on said upper zone withdrawing separated oil therefrom;

a separated conductive liquid effluent means opening on said lower zone withdrawing separated conductive liquid therefrom;

first, second and third electrodes extending in the same generally horizontal direction within said container each having a bottom trough portion extending to a discharge end of the corresponding electrode and each having an upwardly facing collecting surface draining to such trough portion, the trough portion of said second electrode being at a level above the trough portion of said first electrode and the trough portion of said third electrode being at a level above the trough portion of said second electrode;

means for treating said dispersion to separate and collect the conductive liquid in said troughs, said last-named means including a high-voltage source having two terminals, means for electrically connecting one terminal to said container and to said second electrode, means for electrically insulating said first and third electrodes from said container, means for electrically connecting the other of said terminals of said source to said first and third electrodes, thereby establishing electric fields within said container between said electrodes and maintaining a high potential difference between said container and each of said first and third electrodes with no potential difference between said container and said second electrode, and means for delivering said dispersion to said electric fields for treatment therein, the electrically treated dispersed-phase conductive material separating from the oil phase and collecting in said trough portions of said electrodes;

a first discharge means at the discharge end of said second electrode extending to a position beyond the adjacent end of said first electrode, said first discharge means receiving the collected conductive material from the trough portion of said second electrode and discharging same at said position beyond the adjacent end of said first electrode to settle to said lower portion of said container;

a second discharge means at the discharge end of said trough portion of said first electrode extending to a discharge position beyond the adjacent end of said second electrode;

means conducting the collected conductive liquid from the trough portions of both said first and third electrodes to said discharge position beyond the adjacent end of said second electrode; and

means at said discharge position for mechanically subdividing the collected conductive liquid from the trough portions of said first and third electrodes conducted to said discharge position by said second discharge means into large but electrically separate masses of the conductive liquid gravitating toward said lower portion of said container.

18. In an electric treater for dispersions composed of an internal phase liquid dispersed in an external phase liquid of lower specific gravity, said treater including:

inner and outer tubular electrodes having substantially horizontal axes and providing an annular treating space therebetween open at its ends, said inner electrode providing an upper external surface;

means for establishing a high difference in potential between said electrodes to establish a high-voltage electric field in said treating space;

means for flowing the dispersion to be treated axially along said annular treating space, some of the internal phase liquid treated by said electric field dropping to said upper external surface of said inner electrode, said inner electrode being apertured at its sides along and substantially throughout the length thereof to pass from the exterior to the interior thereof the internal phase liquid settling on said upper external surface, the lowermost internal portion of said inner electrode forming a trough in which collects the internal phase liquid passing from the exterior to the interior of said inner tubular electrode, said trough extending to said discharge position, said inner electrode comprising upper and lower sections, said upper section having depending longitudinal lips at its sides, said lower section having upstanding longitudinal lips at its sides spaced outwardly from said depending lips to form said apertures on horizontally opposite sides of said inner electrodes; and

means for discharging the collected liquid from the interior of said inner tubular electrode at said discharge position.

19. An electric treater for treating and separating the phases of an oil-continuous dispersion containing an internal dispersed phase of electrically conductive liquid, said treater including:

a grounded horizontally elongated container providing an oil-continuous zone, a bottom zone therebelow adapted to contain separated conductive liquid, a separated-oil outlet at the top of said oil-continuous zone, and a conductive-liquid outlet at the bottom of said container opening on said bottom zone;

an outer tubular open-ended electrode;

an intermediate tubular open-ended electrode;

a central electrode;

means for mounting said electrodes substantially concentric with a horizontal axis within said oil-continuous zone of said container, said intermediate electrode being electrically connected to said container, said outer and central electrodes being electrically insulated from said container, there being an open-ended annular treating space between said central and intermediate electrodes and an open-ended annular treating space between said intermediate and outer electrodes;

means for establishing high-voltage electric fields in said annular treating spaces, said field-establishing means including means for energizing said outer electrode to maintain a high potential difference between it and said container;

means for flowing said dispersion longitudinally of said container through said electric fields for electric treatment thereof and separation of said conductive liquid therefrom during such flow,

the bottom interior of each of said intermediate and outer electrodes forming a trough portion along its length, each of said intermediate and outer electrodes having an inwardly-facing electrode surface sloping to its trough portion and draining thereto separated conductive liquid settling to such electrode surface,

the trough portions of each of said intermediate and outer electrodes having an exit end, the exit end of

11

said outer electrode opening on said oil-continuous zone of said container;

means for conducting a stream of the separated conductive liquid in each trough portion to the exit end thereof;

means at the exit end of said intermediate electrode conducting the separated conductive liquid in its trough portion to a position beyond the adjacent end of said outer electrode and discharging same at such position; and

means at the exit end of said outer electrode for mechanically subdividing the conductive liquid in its trough portion into discrete separate masses and for discharging same into said oil-continuous zone to settle therein toward the bottom of said container.

20. An electric treater for treating and separating the phases of an oil-continuous dispersion containing an internal dispersed phase of an electrically conductive liquid, said treater including:

a grounded container having a dispersion inlet, a separated-oil outlet at its top, and a separated conductive liquid outlet at its bottom;

upper, intermediate and lower trough-shaped electrode sections stacked one above the other in spaced relation in a vertical series within said container with said lower electrode section spaced above the bottom of said container, each electrode section having an inner upwardly-facing collecting surface draining to a longitudinal trough in its bottom, each longitudinal trough having an exit end receiving separated conductive liquid collected by the corresponding collecting surface;

means for electrically connecting said intermediate electrode section to said grounded container;

means for electrically connecting said upper and lower electrodes together;

means for delivering the dispersion to be treated to said dispersion inlet;

means for electrically treating said dispersion in said container, said last-named means including means for maintaining a high potential difference between said connected upper and lower electrode sections and said container;

a discharge means at the exit end of the longitudinal trough of said intermediate electrode section extending beyond the adjacent end of said lower electrode section discharging said collected conductive liquid from such longitudinal trough to drop toward the bottom of said container;

a mechanical stream-subdividing means at the exit end of said lower electrode section; and

means delivering collected conductive liquid from the longitudinal troughs of said upper and lower electrode sections to said stream-subdividing means.

21. An electric treater as defined in claim 20 in which said last-named delivery means includes discharge conduits respectively at the exit ends of said longitudinal

12

troughs of said upper and lower electrode sections, and means connecting the interiors of said conduits to combine the liquids flowing therethrough, said last-named means having an opening discharging the combined liquids to said subdividing means.

22. An electric treater as defined in claim 20 in which said last-named delivery means includes an overflow means at the exit end of the longitudinal trough of said upper electrode section extending beyond the adjacent end of said intermediate electrode section discharging collected conductive liquid from such longitudinal trough into the longitudinal trough of said lower electrode section.

23. An electric treater for treating and separating the phases of an oil-continuous dispersion containing an internal dispersed phase of an electrically conductive liquid, said treater including:

a grounded container providing an oil-continuous zone, a bottom zone therebelow adapted to contain a conductive liquid, a separated-oil outlet at the top of said oil-continuous zone, and a conductive-liquid outlet at the bottom of said container opening on said bottom zone;

means for delivering a stream of the dispersion to said oil-continuous zone;

means for electrically treating such dispersion in said oil-continuous zone to separate dispersed conductive liquid therefrom, said last-named means including spaced electrodes in said oil-continuous zone and means for establishing a high-voltage electric field therebetween,

said electrodes including a substantially horizontal trough-shaped electrode providing in the lower interior thereof a trough portion and an upwardly-facing collecting surface draining thereto, said collecting surface and said trough-portion receiving conductive liquid settling from said dispersion under the action of said electric field, said trough-portion having a discharge portion opening on said oil-continuous zone,

said field-establishing means including means for maintaining a high difference in potential between said trough-shaped electrode and said container; and

means for preventing short-circuiting of said electrode to said container through said conductive liquid discharging from said discharge portion comprising means for mechanically subdividing into discrete electrically separate masses the conductive liquid reaching said discharge portion.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,148,134

September 8, 1964

Richard W. Stenzel

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 1, line 38, strike out "a"; column 3, line 22, for "electrodes" read -- electrode --; column 5, line 36, for "assure" read -- assume --; column 10, line 30, for "electrodes" read -- electrode --.

Signed and sealed this 9th day of February 1965.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents