

March 10, 1936.

H. C. EDDY

2,033,129

METHOD OF AND APPARATUS FOR TREATING PETROLEUM

Filed Feb. 7, 1933

3 Sheets-Sheet 1

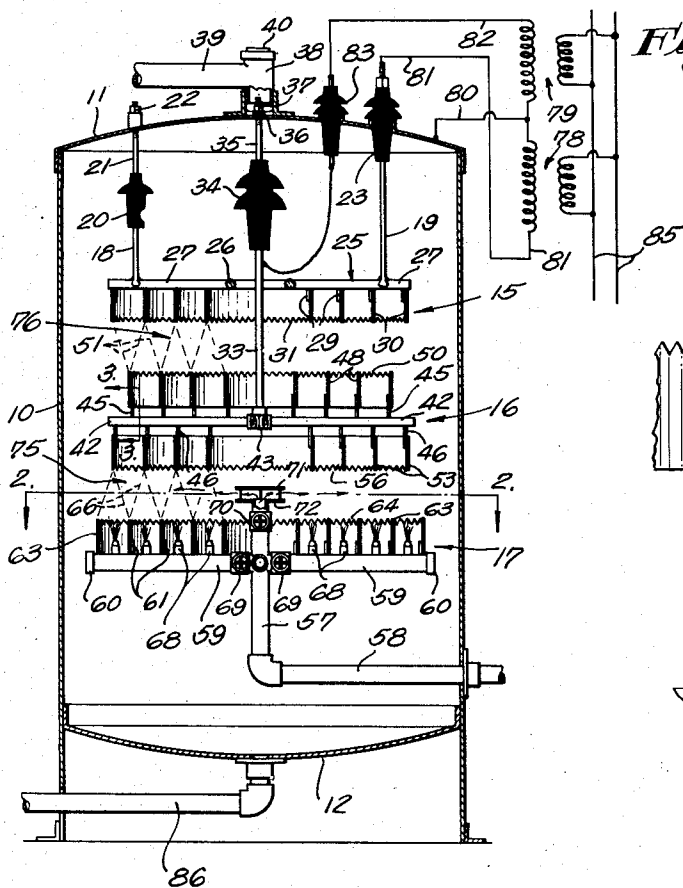


Fig. 1.

Fig. 3.

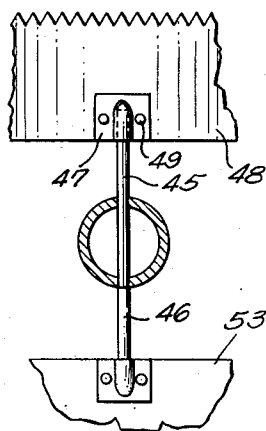
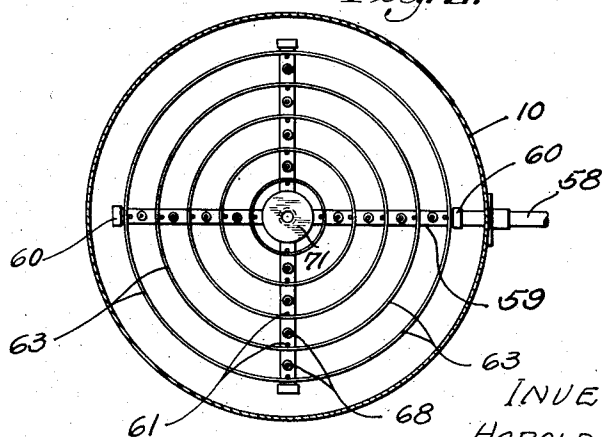


Fig. 2.



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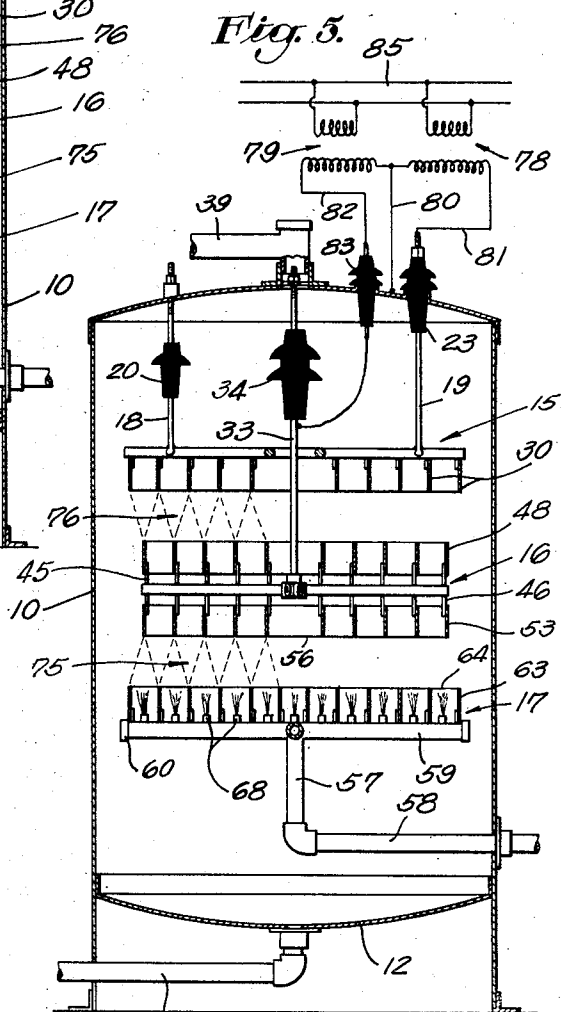
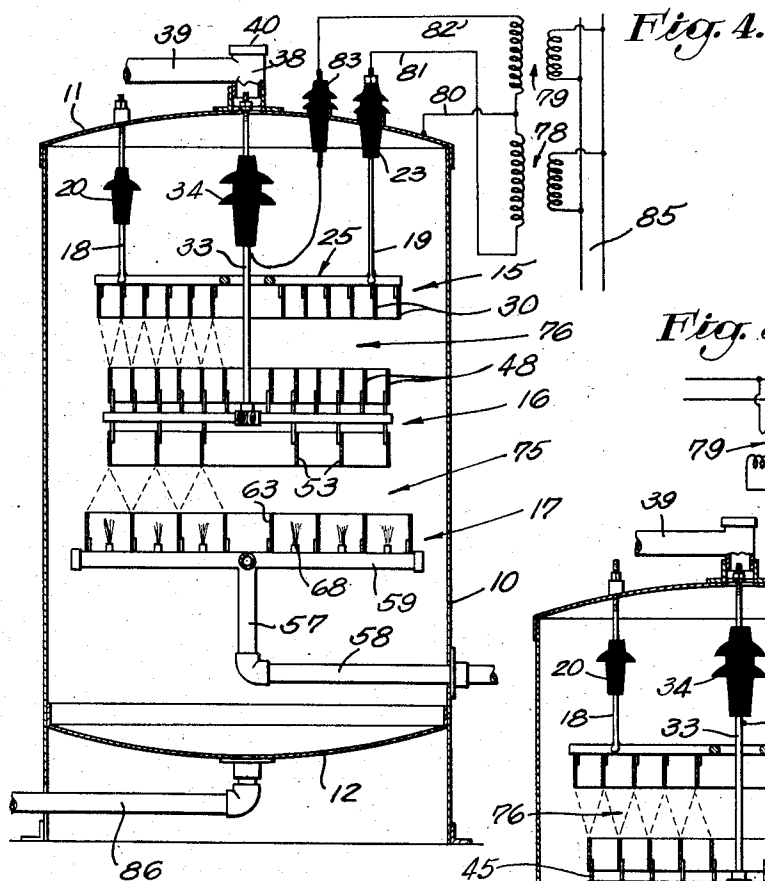
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METHOD OF AND APPARATUS FOR TREATING PETROLEUM

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3 Sheets-Sheet 2



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METHOD OF AND APPARATUS FOR TREATING PETROLEUM

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3 Sheets-Sheet 3

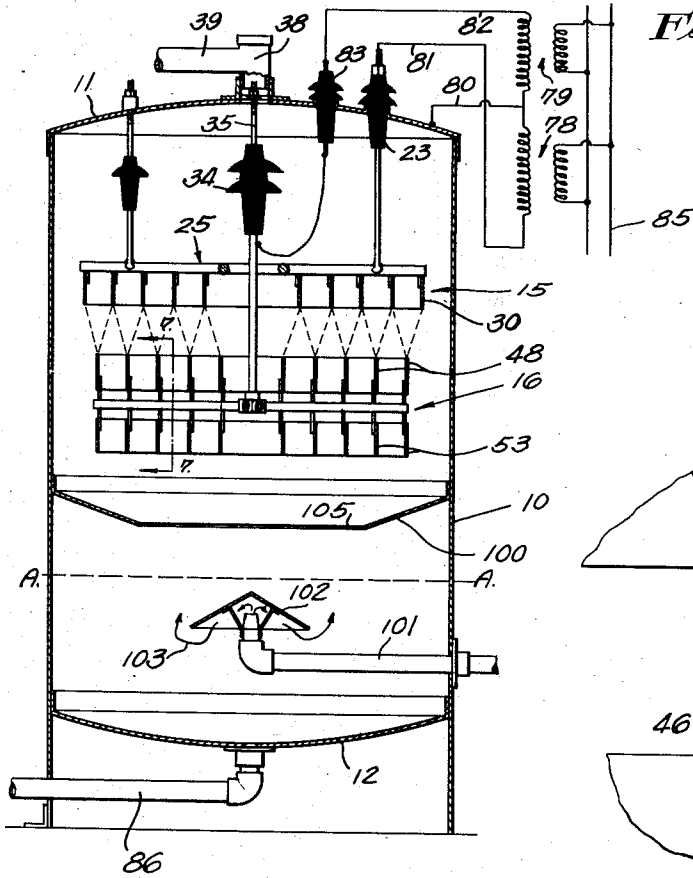


Fig. 6.

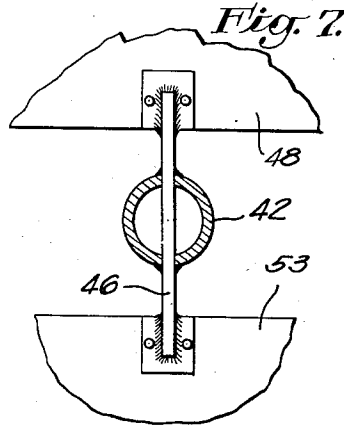


Fig. 7.

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2,033,129

METHOD OF AND APPARATUS FOR
TREATING PETROLEUM

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Application February 7, 1933, Serial No. 655,556

19 Claims. (Cl. 204—24)

My invention relates to electric treaters and more particularly to a novel type of treater finding particular utility in the breaking of petroleum emulsions. While the treater of my invention will be particularly described with reference to the treatment of such petroleum emulsions, it should be understood that it is not limited to this application, but can be used in separating the constituents of other emulsions or treating other liquids.

It is well-known that a high intensity electric field will act to coalesce the dispersed water particles of a petroleum emulsion to such an extent that resulting water masses will gravitate from the oil upon being allowed to settle. Various treaters have been designed for accomplishing this end. It is also generally known that difficulty is often encountered with the so-called short-circuiting tendency when treating such emulsions. This difficulty is ordinarily attributed to the chaining-up action of the water particles between the electrodes so as to form low resistance paths. When such low resistance paths are formed, a relatively large current will flow, thus decreasing the potential between the electrodes to such an extent that satisfactory treatment cannot be obtained.

I have found that with certain treaters a large proportion of the normal treating current required for operating the unit is wasted through leakage paths formed between the electrode surfaces. These leakage currents at best only indirectly assist treating action and usually constitute a distinct disadvantage inasmuch as they greatly increase the current supplied to the treater.

It is an object of the present invention to provide a treater having very small electrode surfaces so that these leakage paths will be reduced to a minimum.

Also included among the objects of this invention is the provision of a novel electrode structure permitting use of small electrode surfaces. This electrode structure includes a plurality of concentric rings or hoops, and it is a further object of the invention to set up an electric field adjacent the edges of these rings or hoops, allowing the spaces between these members to be of a substantially equipotential nature.

It is a further object of the invention to provide a method of treating emulsion wherein emulsion is first moved through an electric field before it enters the equipotential spaces, and in which the emulsion is discharged from the equipotential spaces into another field, separation of

the constituents being permitted during the passage through these fields and through the equipotential space.

Very satisfactory operation has been obtained by the use of two or more such electrode structures spaced from each other, each electrode structure including these concentric rings, and the provision of such a structure falls within the object of the present invention.

In addition, it has been found very advantageous to disalign the hoops of the opposed electrode structures so that the intense portions of the electric fields set up therebetween are angled with respect to the horizontal. It is an object of the present invention to provide a method and apparatus for treating emulsions by the use of a plurality of inclined fields through which the emulsion may be successively passed.

It is an object of the present invention to stagger the opposed electric fields so as to form the greatest number of intense fields with the fewest number of rings.

It is an object of this invention to provide an electrode system where the most intense fields are from an edge to an edge.

A further object of the invention is to provide a treater wherein a plurality of fields of different voltage are set up inside a tank in superimposed relationship.

In addition to the general electrode structure, the fluid-introducing means and the construction of the hoops form important features of the invention. With regard to the latter feature, it is a further object of the present invention to provide an electrode structure including one or more hoops formed with serrated edges adjacent which electric fields are set up.

Still a further object of the invention is to provide a treater having a minimum resistance to the settling action which takes place therein, and in this capacity the electrode structure utilized presents practically no obstruction to the passage of emulsion or to the settling action. This is an important feature of the present invention.

Still further objects and advantages of the invention will be made evident hereinafter.

Several forms of the invention are illustrated in the drawings. Referring to these drawings,—

Fig. 1 is a vertical sectional view of one form of treater incorporating my improvements.

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1, and illustrates the type of electrode support utilized.

Figs. 4, 5, and 6 are sectional views of alternative forms of treaters including different electrode patterns.

Fig. 7 is a fragmentary view taken on the line 7-7 of Fig. 6.

The treater of my invention includes a conventional tank 10 closed by upper and lower heads 11 and 12. In the form of the invention shown in Fig. 1, three electrode structures are utilized, these structures being respectively designated primary, secondary, and tertiary electrode structures 15, 16, and 17, these structures being superimposed one above the other.

The primary electrode structure is adjustably positioned in the upper part of the tank 10 and is supported by rods 18 and 19. An insulator 20 acts to insulate the rod 18 from the tank and carries a rod 21 which extends through the upper head 11 and is adjustable with respect thereto. This adjustment may conveniently comprise a nut 22 threaded to the upper end of the rod 21. A bushing 23 insulates the rod 19 from the tank.

A framework 25 is carried by the rods 18 and 19 and may conveniently comprise a circular ring 26 from which small pipes 27 extend outward, these pipes being connected to the rods 18 and 19. A plurality of holes are drilled through these pipes in a vertical direction and pins or short rods 29 are securely mounted therein. In turn a plurality of annular rings or hoops 30 are suitably secured to the pins 29 so as to be concentric with respect to each other, as best shown in Fig. 1. The lower edges of these hoops are indicated by the numeral 31 and lie in substantially a straight line in the preferred embodiment of the invention, though this it not necessarily the case.

In the preferred embodiment I prefer to make these hoops with serrated edges. These serrated edges are particularly advantageous in treating, possibly due to the fact that they provide a large number of minute points around the periphery of the hoop, thus acting to concentrate the field at this peripheral edge.

The secondary electrode structure 16 is positioned below the primary electrode structure and is supported on a rod 33 which is supported by an insulator 34. This insulator is in turn supported by a rod 35 which extends through a spider 36 and is adjustable with respect thereto so as to change the vertical position of this secondary electrode structure. This adjustment may be effected through the use of a nut 37 threaded to the upper end of the rod 35. In the form shown this adjustment nut is positioned in a T 38 communicating with an oil passage pipe 39, the upper end of the T being closed as by a plug 40 except when adjustments are being made.

Four small pipes 42 extend outward from a hub 43 supported on the lower end of the rod 33. Vertical holes are drilled through these pipes at different radial distances. Alternate holes carry pins or small rods 45 extending upward from these pipes, while the remaining holes carry pins or small rods 46 depending from these pipes. The pins 45 preferably carry attachment members 47 which in turn support a plurality of annular rings or hoops 48 through rivets 49 or other means. The hoops 48 are concentrically arranged so that the upper edges 50 thereof lie in substantially a straight line. In the preferred embodiment these hoops are formed with points as previously described whereby very intense fields can be set up between these points and the points or edges 31 of the primary electrode structure 15.

In the preferred embodiment of the invention

the hoops 48 are not in vertical alignment with the hoops 30, but are instead vertically below the spaces intermediate the hoops 30. It will thus be clear that the most intense portions of the field set up between the primary and secondary electrode structures 15 and 16 will be at an angle with respect to the horizontal. In Fig. 1 the directions of these fields are indicated by the dotted lines 51.

In this form of the invention the pins 46 extend downward in vertical alignment with the hoops 30 and are thus out of alignment with the pins 45. These downward extending pins 46 carry a plurality of annular rings or hoops 53 in a manner previously described, these hoops being also concentrically arranged and providing lower edges 56 in substantial alignment with each other.

The tertiary electrode structure 17 is supported on a riser 57 of an emulsion-introduction pipe 58, the riser 57 supporting and supplying emulsion to a plurality of pipes 59 capped at their outer ends as indicated by the numeral 60. Pins 61 extend upward from these pipes and support a plurality of concentrically arranged hoops 63 similar to those previously described, these hoops providing upper edges 64 preferably in alignment with each other. In this form of the invention these hoops are formed with serrated edges as previously mentioned. So also, I have found it preferable to position the hoops 63 out of vertical alignment with the hoops 53 so that the most intense portions of the field, indicated by the dotted lines 66, are at an angle with respect to the horizontal.

In the form shown, the emulsion supplied to the pipe 58 may be distributed in one of two ways. With most emulsions the most advantageous method is to provide a plurality of orifices communicating between the interior of the pipes 59 and the exterior thereof. In the preferred embodiment these orifices are formed by nipples 68 which may be directed vertically upward or may be slightly inclined from the vertical as desired. These nipples extend upward in the equipotential spaces between the hoops 63, and preferably do not extend beyond the edges 64 of these hoops. If, however, this type of fluid-introduction means is not desired, valves 69 positioned in the pipes 59 may be closed, and a valve 70 in the upper end of the riser 57 may be opened. This will permit the emulsion to be introduced between upper and lower plates 71 and 72 spaced from each other to provide an annular discharge passage which directs the emulsion radially outward and substantially across the edges of the hoops 53 and 63. Either form of introduction may be utilized, or in some instances both of these introduction means may be utilized simultaneously. In any event the emulsion will move directly into the electric field between the secondary and tertiary electrode structures. The emulsion-introduction system in which the plates 71 and 72 guide a radially-flowing, outward-moving stream of emulsion into an electric field is not per se a part of the present invention, being specifically claimed in a co-pending application of Claudius H. M. Roberts, Serial No. 654,175, filed January 30, 1933, entitled Electric dehydration system.

In the preferred embodiment of the invention I prefer to utilize fields of successively higher potential through which the emulsion passes. In the form shown the tertiary electrode structure 17 is electrically connected to the tank so that

the lowermost field will be set up in a treating space 75 between the secondary and tertiary electrode structures 16 and 17. In addition, it is desirable to impress a more intense electric field across a treating space 76 defined between the primary and secondary electrode structures 15 and 16.

Fields of this character may very advantageously be set up by the potential supply system shown. This system includes transformers 78 and 79 respectively providing high potential secondary windings which are interconnected and connected to the tank 10 and to ground through a conductor 80. The remaining terminal of the secondary winding of the transformer 78 is connected by a conductor 81 to the rod 19 while the remaining terminal and the other secondary winding is connected by a conductor 82 extending through an insulator 83 to the rod 33. These transformers may be energized from the supply line, indicated by the numeral 85. The secondary windings of these transformers are preferably connected in additive relation so that the potential difference between the primary and secondary electrode structures 15 and 16 equals the combined potentials produced by the transformers, while the potential difference between either of these electrode structures and the tank will be substantially less. If the transformers are of identical construction, the latter potentials will be substantially one-half of the potential between the primary and secondary electrode structures 15 and 16. So also, with such a design the potential across the lower treating space 75 will be substantially one-half of that across the upper treating space 76. For the purpose of definiteness, I have termed the field in the treating space 76 as a main field, while the treating space 75 has been designated an auxiliary field.

In the operation of this form of the invention, it will be clear that if the nipples 68 are being used for introducing the emulsion, this emulsion will be introduced into the equipotential spaces between the hoops 63. The emulsion will move upward from these spaces and into the auxiliary field due both to the direction of introduction and to the fact that the incoming emulsion is ordinarily much hotter than the liquid in the tank 10, so that an upward flow through thermal means is set up. It will be clear that each and every portion of the rising stream of emulsion will be subjected to a very intense electric field between the edges of the hoops 53 and 63 in the direction of the dotted lines 66. This result is made possible by the fact that the hoops 53 are not in vertical alignment with the hoops 63.

When the emulsion is moved upward through the auxiliary field this emulsion will enter the neutral or equipotential spaces between the hoops 53 of the secondary electrode. In these spaces no treating action will take place. Further, the emulsion will subsequently move upward into the equipotential spaces between the hoops 48, and it is only after the emulsion is moved into the upper treating space 76 that it will again be subjected to the action of an electric field. Ordinarily the emulsion is subjected to a very intense field directed along the dotted lines 51, and due to the disalignment of the hoops 30 and 48 every portion of this emulsion will be subjected to this intense field. Thereafter the emulsion will move into the equipotential spaces between the hoops 30 and will subsequently move into the space above the primary electrode structure 15 where it will be subjected to the electric field present

between this electrode structure and the upper head 11 of the tank.

During this entire upward movement of the emulsion it will be clear that any water masses which coalesce sufficiently will immediately drop downward to the lower end of the tank and accumulate in the form of a body of water which can be drained through a pipe 86. Extensive tests have shown that the water content of the rising emulsion will materially decrease as the emulsion moves upward in the tank due to this settling out of the water. It thus becomes possible to utilize a much more intense field in the treating space 76 than in the treating space 75. This feature in part accounts for the superior action of this treater.

It will be further clear that the electrode structures 15, 16, and 17 are so formed as to offer substantially no obstruction to the rising emulsion or to the settling water masses. The electrode surfaces which would normally tend to retard this settling or upward movement of the emulsion comprise very small members; namely, the small supporting pipes and the edges of the hoops. The combined area of these pipes and edges of the hoops is almost negligible with respect to the total cross-sectional area of the tank 10. This is one of the features of the present invention.

In addition, it will be clear that the leakage paths between the electrodes and the tank are relatively small in this type of treater. In fact, the only leakage paths from the tank will take place at the outermost hoops 53, 48, and 30, the inner hoops of these electrodes offering no exposed surface to the tank. The showing of Fig. 1 is greatly exaggerated for the purpose of clearness, and in actual practice I have found it preferable to utilize hoops having a vertical dimension of substantially two inches or less. Hoops having a vertical dimension of one inch and a thickness of .05 inch have been found to be very successful. It will at once be apparent that with such small hoops no excessive leakage currents will flow to the tank.

Another very important feature of the invention is the rest period between treatments which is made possible when the emulsion passes through the equipotential spaces between the hoops of the secondary electrodes 16. This preliminary treatment in the treating space 75 followed by a quick removal from the field and a subsequent quick building up of the field as the emulsion moves into the main treating space is believed to be one of the reasons why this type of treater will handle a throughput several times as high as existing treaters.

The most appropriate electrode spacing can be determined empirically by adjusting the position of the primary and secondary electrodes 15 and 16 with respect to the tertiary electrode structure 17 and with respect to each other. This spacing will vary with different types of emulsion.

If a radial flow of the incoming emulsion is desired the valve 69 may be closed and the valve 70 may be opened. The emulsion will then be moved outward across the edges of the hoops 53 and 63 so that treatment in the auxiliary field will take place. Due both to the fact that this incoming emulsion is hotter than the liquid in the tank and due to the fact that as the water settles out this emulsion becomes lighter, the emulsion will move upward as previously described through the equipotential spaces of the secondary electrode structure 16 and into the main treating field. If desired both types of in-

roduction means may be utilized simultaneously. So also, if the nipples 68 are slightly inclined, it is possible to set the liquid in the tank into a slow rotation.

It will be understood that I am not limited to the use of hoops formed with serrated edges. Thus, in Fig. 4 I have illustrated an alternative form of the invention wherein these hoops are formed of bands of spring steel or other conducting material. So also, the field pattern shown in Fig. 4 is slightly different from that shown in Fig. 1. The field in the treating space 75 is substantially the same as that previously described, but it will be noted that in Fig. 4 twice as many of the hoops 48 are utilized. This is also true with respect to the number of hoops 30 utilized on the primary electrode structure 15. The staggered relationship of these hoops is maintained with the net result that substantially twice as many very intense fields are set up in the treating space 76 as is possible with the form of invention shown in Fig. 1. With certain types of emulsions this construction is more advantageous than the previously described embodiment.

In Fig. 5 I have illustrated still another field pattern. In this form of the invention the field pattern in the main treating space 76 is substantially the same as that shown in Fig. 1. However, in this form the pins 46 are made integrally with the pins 45 so that the hoops 53 are disposed immediately below the hoops 48. In order to maintain the staggered relationship of the edges 56 and 64 it is necessary to correspondingly change the radial spacings of the hoops 63 of the tertiary electrode structure 17 so that the hoops 63 and 53 are not in vertical alignment with each other. This type of field pattern is also very desirable in certain instances.

In Fig. 6 I have illustrated a modified form of invention in which the primary and secondary electrode structures 15 and 16 are substantially the same as disclosed in Fig. 5. However, the auxiliary field is set up by means quite distinct from those previously described. In this form of the invention a baffle 100 extends inward from the tank 10 so as to partially enclose the space immediately below the secondary electrode structure 16. The emulsion is forced through a pipe 101 and discharged beneath a hood 102 which distributes the emulsion as indicated by the arrows 103, this emulsion then rising and being further guided by the baffle 100 through an opening 105 thereof. In the normal operation of this form of the invention, the water level is indicated by the line A—A so that the incoming emulsion is subjected to a preliminary washing action before moving into the auxiliary field. This auxiliary field is formed below the secondary electrode structure 16 and between this structure and the baffle 100 and the water level. In some instances the treatment from the edges of the hoops 53 to a water level therebeneath is advantageous regardless of whether these edges are serrated, inasmuch as it sets up an auxiliary field which acts upon the settling emulsion until the water has entirely separated to join the water body below the level A—A.

While I have illustrated a dual transformer system connected to each of the forms of the invention disclosed, it will be clear that this system may be modified by utilizing a single transformer with a center-tapped secondary. In other instances it is possible to dispense with this particular mode of connection and utilize a single transformer connected across the primary and

secondary electrode structures. While such structures will not give the same treating efficiency, they are nevertheless quite successful on certain emulsions. With such a system one or the other of the electrode structures may be grounded if desired.

So also any of the forms of the invention may be equipped with serrated or straight-edged hoops as desired, both forms falling within the scope of the present invention. Nor is it invariably necessary that the edges of the adjacent hoops should lie in the same straight line, for the hoops may be of varying width or may extend unequal distances from their supports.

I claim as my invention:

1. In an electric treater for emulsions, the combination of: a tank; means for moving emulsion upward in said tank; electrode means comprising two electrodes each electrode including a plurality of hoop means of different diameter, the hoop means of said electrodes being spaced axially from each other; means for setting up a potential difference between said electrodes thereby establishing a plurality of edge-to-edge fields in said tank, said fields being superimposed one above the other and inclined with respect to the horizontal whereby said upward moving emulsion moves upward through said inclined fields in succession and separates into its constituents during said upward movement; and means for separately withdrawing the constituents of said emulsion from said tank.

2. In an electric treater for emulsions, the combination of: a tank; a primary electrode structure in said tank comprising a plurality of concentric rings electrically connected together; a secondary electrode structure comprising a plurality of concentric rings electrically connected together, said secondary electrode structure being spaced below said primary electrode structure whereby the rings of said primary electrode structure are above the rings of said secondary electrode structure and cooperate therewith in defining a treating space, the rings of at least one electrode structure being spaced from each other to define substantially unobstructed spaces through which emulsion may move; means for insulating said electrode structures from each other; means for establishing a potential difference between said electrode structures to set up an electric field in said treating space; and means for introducing emulsion into said field.

3. A combination as defined in claim 2 in which said concentric rings of said primary electrode structure are disposed opposite the spaces between said rings of said secondary electrode structure but do not extend therein whereby the fields set up between the rings of these electrode structures are inclined from the horizontal.

4. In an electric treater for emulsions, the combination of: a tank; a primary electrode structure in the upper portion of said tank; a secondary electrode structure in said tank below said primary electrode structure, both said primary and secondary electrode structures including a plurality of concentric rings electrically connected together to provide equipotential spaces therebetween; means for establishing a potential difference between said electrode structures to establish a main electric field therebetween, the most intense portion of said field being from the rings of one electrode structure to the rings of the other electrode structure; means for establishing an auxiliary electric field below said secondary electrode; and means for moving

the emulsion to be treated upward in said auxiliary electric field wherein said emulsion is subjected to a preliminary treatment after which said emulsion moves through said equipotential spaces of said secondary electrode structure wherein it is subjected to a rest period and then flows into said main field.

5. In an electric treater for emulsions, the combination of: a tank; a primary electrode structure in the upper portion of said tank and insulated therefrom; a line secondary electrode structure in said tank below said primary electrode structure and including a plurality of concentric rings electrically connected together to provide equipotential spaces therebetween; means for establishing an auxiliary electric field below said secondary electrode; means for establishing a main electric field between said electrode structures which is substantially higher in potential than said auxiliary electric field; and means for moving the emulsion to be treated upward in said auxiliary electric field wherein said emulsion is subjected to a preliminary treatment after which said emulsion moves through said equipotential spaces wherein it is subjected to a rest period and then flows into said main field.

6. A combination as defined in claim 4 in which said means for establishing an auxiliary electric field below said secondary electrode includes a tertiary electrode structure spaced below said secondary electrode structure and cooperating therewith in providing said auxiliary field, and in which said means for moving said emulsion upward directs said emulsion into said auxiliary electric field.

7. In an electric treater for emulsions, the combination of: a tank; an electrode structure comprising a plurality of hoops concentrically mounted with respect to each other to provide equipotential spaces therebetween; means for establishing an electric field at one end of said electrode structure, said field being concentrated adjacent the edges of said hoops; and fluid-introduction means moving emulsion into said equipotential spaces, said emulsion flowing directly from said equipotential spaces and into said electric field.

8. In an electric treater for emulsions, the combination of: a tank; an electrode structure in said tank and comprising a plurality of supporting arms and a plurality of concentric hoops electrically connected together and supported thereon in spaced relationship with each other to define one or more equipotential spaces between said hoops whereby said arms form the only obstruction extending across said one or more equipotential spaces between said hoops, said hoops extending parallel to the inner wall of said tank but being of a vertical dimension of substantially two inches or less whereby the electrode surface adjacent said tank is small; means for establishing an electric field at one end of said electrode structure adjacent the edges of said hoops, said means maintaining said electrode structure at a potential different from said tank whereby an electric field is set up between the outermost hoop and said tank; and means for delivering emulsion to be treated to said first-mentioned field.

9. In an electric treater for emulsions, the combination of: a tank; a plurality of supporting arms extending at least partially across said tank; short rods retained by said supporting arms and extending a distance therefrom; a plurality of concentric hoops secured to said rods; means

for establishing an electric field at the edges of said hoops farthest from said supporting arms; and means for introducing the emulsion to be treated into said electric field.

10. In combination in an electric treater for treating emulsions: a first ring electrode providing an edge; a second ring electrode of a diameter smaller than said first ring electrode and providing an edge; means for mounting said electrodes about a common axis and in a position such that said edges are spaced from each other; means for establishing a potential difference between said electrodes whereby a field is set up therebetween which field is most concentrated along a line joining said edges and thus inclined with respect to said axis; and means for moving an emulsion through said field in a direction substantially parallel to said axis.

11. In combination in an electric treater for treating emulsions: an electrode structure comprising a mounting means and a plurality of concentric rings spaced from each other to define equipotential spaces; means for setting up an electric field above said electrode structure, said field concentrating at the uppermost portions of said rings; means for setting up an electric field below said electrode structure, said last-named field concentrating at the lowermost portions of said rings; and means for flowing an emulsion into said fields, said emulsion flowing through said equipotential spaces when moving between said fields.

12. In combination in an electric treater for treating emulsions: an electrode structure comprising a mounting means and an intermediate electrode means including an upper edge and a lower edge; upper electrode means above said upper edge and providing a pair of edges spaced above said upper edge and respectively positioned on opposite sides of a vertical extension of said upper edge whereby lines joining said upper edge and said edges of said upper electrode means diverge upward from said upper edge; lower electrode means below said lower edge and providing a pair of edges spaced below said lower edge and respectively positioned on opposite sides of a vertical extension of said lower edge whereby lines joining said lower edge and said edges of said lower electrode means diverge downward from said lower edge; and means for establishing emulsion-containing fields between said upper edges and said edges of said upper and lower electrode means.

13. In combination in an electric treater for treating emulsions: an electrode structure including a mounting structure and an intermediate electrode means including a pair of upper edges and a pair of lower edges; an upper electrode means above said upper edges and providing a lower edge spaced above said upper edges of said intermediate electrode means and positioned vertically above the space between said upper edges whereby lines joining said upper edges and said lower edge converge upward from said upper edges; a lower electrode means below said lower edges of said intermediate electrode means and providing an upper edge spaced below said lower edges and positioned vertically below the space between said pair of lower edges whereby lines joining said lower edges of said electrode means and said upper edge of said lower electrode means converge downward; and means for establishing electric fields between said edges of said electrode means whereby the most

intense portions of said fields lie along said lines, said fields containing emulsion to be treated.

14. In combination in an electric treater for treating emulsions: a tank; means in the upper portion of said tank for setting up a plurality of electric fields the most intense portions of which lie along lines inclined with respect to the horizontal, said means including a primary and a secondary electrode structure each including a plurality of rings, the rings of said primary electrode structure being vertically disaligned from the rings of said secondary electrode structure and positioned at a section above the rings of said secondary electrode whereby lines joining said rings of said electrode structures are inclined; means for introducing emulsion into said tank at a position below said secondary electrode structure; and means for treating said incoming emulsion in a portion of said tank below said secondary electrode structure whereby a preliminary treatment and separation of the constituents of said emulsion takes place, the lighter preliminarily treated liquid rising from the zone of preliminary treatment to said inclined fields through the spaces between said rings of said secondary electrode.

15. In combination in an electric treater for emulsions containing a dispersed phase and a continuous phase and including a tank in which said phases can gravitationally separate after electric treatment: means for introducing emulsion into said tank; an upper, an intermediate, and a lower electrode structure in said tank and positioned one above the other to define treating spaces therebetween, each of said electrode structures being disposed transverse to the vertical movement of said phases when gravitationally separating and each of said electrode structures comprising a supporting means with a plurality of metallic members supported by said supporting means and spaced from each other to define equipotential spaces, said metallic members being small so that substantially the whole surface of each electrode structure exposed to the vertically moving phases during separation consists of said equipotential spaces whereby said electrode structures present a minimum of impedance to the gravitationally separating phases moving in said tank; means for establishing electric fields in said treating spaces, said fields concentrating at the most extended portions of said metallic members of the two electrode structures bounding either of said treating spaces whereby the most intense portions of said fields lie along lines joining the metallic members of the electrode structures; means for withdrawing one of said phases from one end of said tank; and means for withdrawing the other of said phases from the other end of said tank.

16. In combination in an electric treater for emulsions containing a continuous phase and a dispersed phase: a tank providing a side wall and in which said phases can gravitationally separate after electric treatment; means for introducing emulsion into said tank; a primary electrode structure inside said tank but spaced from said side wall; a secondary electrode structure inside said tank but spaced from said side wall and spaced from said primary electrode structure to define a treating space therebetween; means for electrically insulating said electrode structures from each other, each of said electrode structures comprising a supporting means with a plurality of metallic members supported by said support-

ing means and spaced from each other to define equipotential spaces, said metallic members being small as measured transverse to the movement of said phases when undergoing gravitational separation so that the surface presented by each electrode structure to the movement of the gravitationally separating phases is a minimum, the portions of each electrode structure lying closest to said side wall being small in vertical surface to present a minimum surface for leakage currents to said side wall; means for establishing an electric field in said treating space, said field concentrating at those portions of said metallic members of the two electrode structures which are closest together whereby the most intense portions of said field lie along lines joining said metallic members of said two electrode structures; means for withdrawing one of said phases from one end of said tank; and means for withdrawing the other phase of said emulsion from the other end of said tank.

17. In combination in an electric treater for emulsions: a tank; a supporting means extending at least partially across said tank; a plurality of upper concentrically-disposed hoops extending upward from said supporting means and electrically connected thereto, said hoops providing upper edges; a plurality of lower concentrically-disposed hoops extending downward from said supporting means and electrically connected thereto and providing lower edges; means for setting up electric fields above said upper hoops and below said lower hoops, said fields concentrating at said upper and lower edges; and means for introducing emulsion into said tank to be treated by said fields.

18. In an electric treater, the combination of: a tank containing emulsion to be treated; an intermediate live electrode in said tank but insulated therefrom and including an electrode structure extending substantially horizontally in said tank and providing a plurality of electrically-connected members and providing upper and lower surfaces formed by the most extended portions of said members, there being equipotential spaces extending through said electrode structure and bounded by said members; a live upper electrode above said intermediate live electrode and insulated from said tank, and cooperating with said upper surfaces of said intermediate live electrode in bounding an unobstructed upper treating space in which an electric field may be established of a maximum potential determined by the difference in potential of said live electrodes; lower electrode means below said intermediate live electrode and cooperating with said lower surfaces of said intermediate live electrode in defining a lower treating space communicating with said upper treating space through the equipotential spaces of said intermediate live electrode; and potential-supply means electrically connected to said upper and intermediate live electrodes and to said lower electrode means and including a pair of transformer windings connected in additive relation for building up between said upper and intermediate live electrodes a high potential, one of said transformer windings being connected between said lower electrode means and said intermediate live electrode to establish therebetween a lower potential.

19. In a treater for treating emulsions, the combination of: a tank; a plurality of electrodes in said tank but insulated therefrom, said electrodes defining a treating space therebetween, 75

at least one of said electrodes being of an interstitial character; discharge means directed toward said interstitial electrode for forcing a stream of emulsion through said interstitial electrode and into said treating space; means for insulating said discharge means from said interstitial electrode; and means for establishing a high potential difference between said electrodes and for establishing a relatively lower potential difference between said discharge means and said

interstitial electrode whereby said emulsion is subjected to an electric field when moving between said discharge means and said interstitial electrode but is moved through a substantially equipotential space when moving through the interstices of said interstitial electrode and is hence moved into the intense electric field between said electrodes. 5

HAROLD C. EDDY.

CERTIFICATE OF CORRECTION.

Patent No. 2,033,129,

March 10, 1936.

HAROLD C. EDDY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 11, claim 5, for "line" read live; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of April, A. D. 1936.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.