

Dec. 29, 1931.

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DEHYDRATOR HAVING RADIAL VENTURI TYPE ELECTRODES

Filed Oct. 9, 1928

2 Sheets-Sheet 1

Fig. 1.

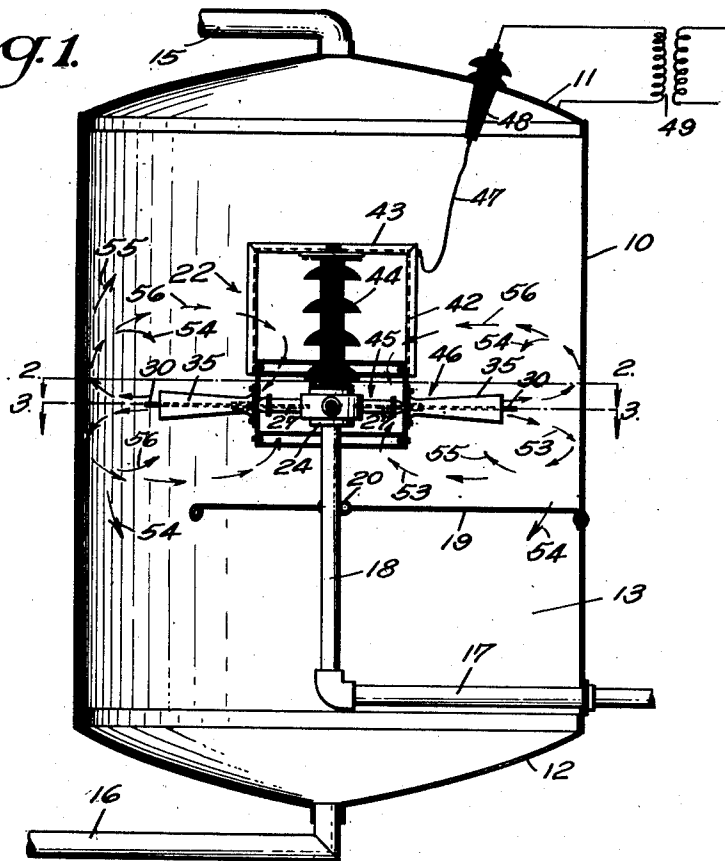
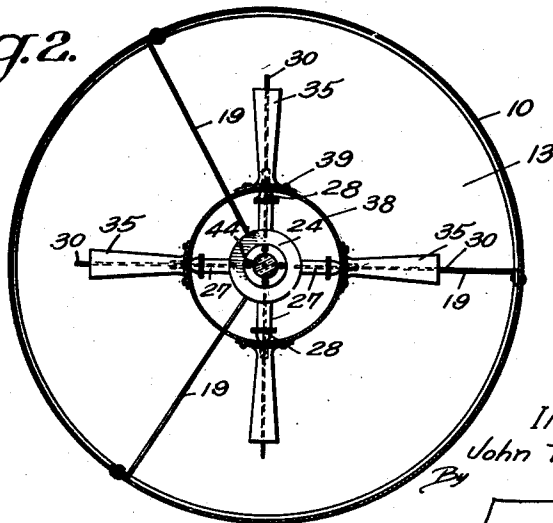


Fig. 2.



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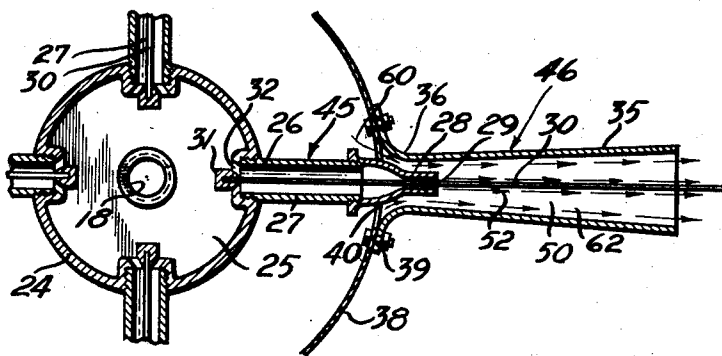
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2 Sheets-Sheet 2

Fig. 3.



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DEHYDRATOR HAVING RADIAL VENTURI-TYPE ELECTRODES

Application filed October 9, 1928. Serial No. 311,389.

My invention relates to electric treaters, and more particularly to a novel form of electric dehydrator which is useful in separating the phase of an emulsion.

3 The crude petroleum, as it comes from the well, is often associated with water or other foreign substances. If the oil and water is in the form of an emulsion, the water particles are so small that they will not separate from the oil by the action of gravity. Such emul-
10 sions are often passed through a high potential electric field which agglomerates the water particles into masses of sufficient size to gravitate from the oil.

15 It is an object of this invention to provide a novel form of electric treater which is more efficient and which has a larger capacity than previous types.

20 A further object of this invention is to provide a plurality of horizontally disposed sleeve electrodes into which the emulsion is injected through nozzle structures adjacent the sleeves.

25 A further object of this invention is to provide a dehydrator having a plurality of treating spaces into which the emulsion is injected in such a manner as to recirculate treated oil therethrough.

30 A further object of this invention is to provide a dehydrator having a plurality of fluid-circulating electrode structures, the fluid circulated being taken from substantially the same plane and from substantially the same radial point so as to render its dielectric
35 strength substantially uniform.

Still another object of this invention is to provide an electric dehydrator in which there is no danger of the electrodes being short-circuited.

40 Further objects and advantages of this invention will be made evident hereinafter.

Referring to the drawings in which I illustrate two forms of my invention,—

45 Fig. 1 is a vertical sectional view of one form of my invention.

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

50 Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 1.

Referring particularly to Fig. 1, I prefer to incorporate my invention in a shell 10 having upper and lower drums 11 and 12, these elements cooperating to define a space 13 which is normally filled with one or more
55 liquids. The upper drum is provided with a dry oil outlet pipe 15, while the lower drum 12 is provided with a water outlet pipe 16.

Extending through the shell 10 near the lower end thereof is an inlet pipe 17 having
60 a vertical leg 18 axially aligned with the shell 10 and supported therein by supporting arms 19 extending between a clamping structure 20 secured around the leg 18 and the
65 shell 10.

The leg 18 acts as a supporting member for a unitary electrode structure 22 of my invention. This structure includes an inlet
70 member 24 threaded to the upper end of the leg 18 and having an inlet chamber 25 therein.

Threaded into a plurality of sockets 26 disposed around the inlet member 24 and in the same horizontal plane are pipes 27 to which nozzles 28 are threaded, these nozzles
75 having restricted openings 29. Extending centrally through each of these restricted openings 29 is a tongue 30 which is rigidly held in a boss 31 formed on the back portion of each socket 26. The emulsion entering the
80 inlet chamber 25 reaches the interior of the pipes 27 through ports 32 and is injected from the annular space between the tongues 30 and the walls of the restricted openings 29, this emulsion being in the form of a fluid
85 envelope surrounding the tongues 30 and in contact therewith.

Each of the tongues 30 extends through an adjacent sleeve 35, these sleeves being of a shape best shown in Figs. 1 to 3 inclusive. This shape may be likened to that of a Ven-
90 turi-tube having a throat 36 into which the nozzle 28 discharges.

The sleeves 35 are each mounted on a drum 38 by means of bolts 39, this drum having
95 openings 40 through which the nozzles 28 extend, these openings being substantially larger than the outer diameter of the nozzles at this point. The drum 38 is open at its upper and lower ends, the upper ends there-
100 of being secured to a supporting structure

42 having a top bar 43 resting on an insulator 44. This insulator in turn is secured to the upper end of the inlet member 24, as best shown in Fig. 1. This novel form of unit type construction is particularly advantageous in that the insulator 44 is subjected only to compressive stress and holds the supporting structure 42 and the inlet member 24 so that any movement of the pipe 18 which carries the tongues 30 is also transmitted to the sleeves 35 so that the tongues are maintained in correct alignment with their respective sleeves at all times. The supporting structure 42, drum 38, and sleeves 35 are formed of metal, as are also the inlet member 24, pipes 27, nozzles 28, and tongues 30. This latter group of elements comprises a primary electrode 45 which is grounded to the shell 10 through the supply pipe 17, while the former group of elements comprises a secondary electrode 46 which is connected by a wire 47, passing through an insulator 48, to one terminal of the secondary of a transformer 49. The other terminal of this secondary is connected to the shell 10 so that a high potential is maintained between the primary and secondary electrodes.

Substantially all of the treating action takes place inside the sleeves 35, the space between these sleeves and their respective nozzles and tongues being termed treating spaces 50 into which the emulsion is injected. The electric field in this space tends to agglomerate the suspended water particles so that after leaving the treating spaces 50, the water may separate from the oil as by the action of gravity.

Due to the fact that the area of the tongues 30 is much smaller than the area of the inside of the sleeves 35, and due to the axial positioning of these tongues relative to the sleeves, the field set up in the treating spaces 50 will be of non-uniform voltage gradient, that portion of the field around the tongues being of much higher intensity than that portion adjacent the sleeves 35. It should thus be understood that the emulsion is subjected to the maximum field intensity when being injected in a fluid envelope around the tongues 30. The action taking place as the emulsion passes through this high intensity field is much greater than that which would take place should the emulsion be injected through the outer portion of the field of lower intensity.

A very important part of this invention is the positioning of a plurality of electrodes in the same substantially horizontal plane. The purpose of this particular placement may best be understood by a reference to Figs. 1 and 3. Referring particularly to the latter figure, the emulsion passing from the nozzles 28 follows paths indicated by arrows 52.

The fluid envelope thus formed travels outward along the tongue 30 until it passes be-

yond the influence of the electric field in the treating space 50. The velocity imparted thereto causes this treated but unseparated liquid to follow a path indicated by arrows 53.

The shell 10 causes this liquid to flow upward, downward, and sideward from the axes of the tongues 30, as indicated by the arrows 53. After leaving the treating spaces, the phases of the liquid tend to separate, the water particles dropping downward, as indicated by arrows 54, and the clean oil passing upward, as indicated by arrows 55, this separating action taking place while the liquid is moving inward, as indicated by arrows 56. I prefer to utilize four sleeves 35 so that the segmental space therebetween will be large in order to permit fast settling of the water particles and easy rising of the clean oil.

Due to the high velocity with which the emulsion is injected into the treating spaces 50, an injector action is set up which tends to draw any liquid adjacent the openings 40 into the treating space, as indicated by the arrows 60. This action helps to move the liquid inward, as indicated by the arrows 56, the farther this liquid moves in this direction, the more complete the separation of the oil and water. Thus, by the time this liquid reaches a position adjacent the openings 40 substantially all of the water has been separated therefrom so that the liquid drawn into the sleeve 35 by the injector action is a relatively dry oil having high dielectric strength.

It should be understood that this oil contacts the outer surface of the fluid envelope formed by the emulsion in passing through the treating space; in fact, the dry oil drawn into the treating space itself forms a fluid envelope, as indicated by arrows 62 of Fig. 3, this fluid envelope engaging the inner walls of the sleeve 35 and acting as a dielectric barrier to prevent a lining-up of the water particles in the emulsion to short-circuit the electrodes. Such short-circuiting cannot take place due to the fact that this fluid envelope of oil is maintained adjacent the inner walls of the sleeve 35, this portion of the treating space being of lower voltage gradient than that immediately surrounding the tongues 30.

By actual laboratory and field tests, I have found that a dehydrator such as the one illustrated will give a more thorough separation than types heretofore used, and that its capacity is very much greater than in these other types. This is due to the type of electrode utilized, to the high intensity field through which the emulsion is passed, and to the horizontal positioning of the electrodes whereby relatively dry oil is drawn through the openings 40 in the drum 38 as a dielectric barrier. A vertical positioning of identical

sleeves and nozzles does not give the efficient treatment that I have found inherent in the design illustrated. This is probably due to the even distribution and uniform dryness of the dry oil just before it is drawn through the openings 40.

Thus, in reiteration, the radial position of the electrodes, the high field intensity through which the emulsion passes, and the particular recirculating paths formed, are important features of this invention. So also, the equal radial position of the openings 40 is important, due to the uniform dryness of the dry oil being recirculated through all of the treating spaces. Similarly, the particular unitary electrode construction is important, both from the standpoint that no relative movement between electrodes is possible (a feature important when narrow treating spaces are provided) and from the viewpoint of insulator economy. Previous dehydrators have utilized insulators which were subjected to tensile stresses, and the ordinary type of insulating material is very weak in tension compared to its strength in compression. Thus, the type of unitary electrode structure permits the use of smaller, less expensive insulators, and increases the life of these insulators by changing the previous tensile stresses into compressive stresses.

The treater herein shown is an improvement on the treaters shown in the copending applications of Harmon F. Fisher, Serial No. 135,804 and Serial No. 203,253, which contain claims to the combination of a sleeve and central electrode, together with a nozzle or distributor means for flowing the emulsion along the surface of the central electrode, the present invention being directed to a novel positioning and mounting of such an electrode structure, as well as to other improved features not claimed in said copending applications.

I claim as my invention:

1. In a dehydrator, the combination of: an inlet member adapted to receive a supply of the emulsion to be treated; a plurality of nozzles communicating with an inlet chamber of said inlet member; and a plurality of sleeves, each of said sleeves being positioned in alignment with one of said nozzles and electrically treating the emulsion as it moves therethrough.

2. A combination as defined in claim 1 in which each of said nozzles has a tongue extending into said sleeve, and in which said nozzles and said tongues are electrically insulated from said sleeves to permit the establishment of an electric potential between said tongue and said sleeve.

3. In combination: a shell; an inlet member supported in said shell; a plurality of primary electrodes communicating with an inlet chamber of said inlet member; secondary electrodes positioned to direct emulsion

from said primary electrodes toward the walls of said shell; and means for establishing a difference in potential between said primary and secondary electrodes.

4. A combination as defined in claim 3 in which said secondary electrodes lie in the same horizontal plane.

5. In combination: a shell; an inlet member in said shell; and a plurality of fluid-circulating electrode structures radially disposed around said inlet member and directing a fluid toward the walls of said shell; and means for impressing a difference of potential between said shell and a portion of each fluid-circulating electrode structure.

6. In combination: an inlet member; a plurality of nozzles secured to said inlet member and communicating with an inlet chamber therein; a drum surrounding said inlet member; an insulated support for said drum; a plurality of sleeves mounted on said drum and into which said nozzles inject an emulsion to be treated; and means for establishing an electric field between said nozzles and said sleeves.

7. A combination as defined in claim 6 in which each of said nozzles includes a tongue extending through the discharge opening thereof and through the sleeve into which said nozzle discharges, the emulsion discharged by said nozzle forming a fluid envelope around said tongue.

8. A combination as defined in claim 6 in which each of said sleeves is formed in the shape of a Venturi-tube having throats into which said nozzles discharge in a manner to draw a fluid envelope into said sleeve and in contact therewith.

9. In a dehydrator, the combination of: a shell; a supporting member in said shell; a primary electrode secured to said supporting member and electrically connected thereto, said primary electrode including a tongue; an insulator supported by said supporting member; and a secondary electrode supported by said insulator and including a sleeve through which said tongue axially extends.

10. A combination as defined in claim 9 in which a treating space is defined between said electrodes, and in which said supporting member includes means for delivering a fluid to said treating space.

11. In a dehydrator, the combination of: a shell containing a body of primary fluid; a sleeve electrode submerged in said fluid, the axis of said sleeve being substantially horizontal; a tongue extending into said sleeve electrode along said axis; and nozzle means for injecting a secondary fluid through said sleeve and in the form of a fluid envelope around said tongue and moving toward said shell, the injector action of said secondary fluid discharging from said nozzle circulat-

ing a portion of said primary fluid through and around said sleeve electrode.

12. In a dehydrator, the combination of: a cylindrical shell containing a body of primary fluid; an inlet member disposed centrally in said shell and providing an inlet chamber; a plurality of sleeve electrodes equally spaced around and extending substantially horizontally away from said inlet member; a plurality of nozzles communicating with said inlet chamber and adapted to respectively direct fluid through said sleeve electrodes and into contact with said shell, whereby said primary fluid is drawn into said sleeve electrodes around said nozzles.

13. In a dehydrator, the combination of: a sleeve electrode; means for passing the emulsion to be treated through said sleeve electrode at high velocity; a central electrode in said sleeve electrode and insulated therefrom; a member electrically insulated from said sleeve electrode and spaced axially from the discharge end of said sleeve electrode but extending substantially across the path of movement of the stream of treated emulsion issuing from said discharge end whereby said treated emulsion impinges thereagainst as it leaves said sleeve electrode; and means for establishing a difference in potential between said sleeve electrode and said member.

14. In a dehydrator, the combination of: a sleeve electrode submerged in a primary fluid of relatively high dielectric strength; a central electrode extending centrally into said sleeve and cooperating therewith in defining a treating space; nozzle means associated with said central electrode and adapted to inject a fluid envelope of a secondary fluid into said treating space around and in contact with said central electrode, whereby a portion of said primary fluid is drawn into said field; and a member electrically connected to one of said electrodes and spaced axially from the discharge end of said treating space to extend across the path of flow of the fluid issuing from the discharge end of said treating space, the fluid passing through said treating space impinging on said member after leaving said sleeve electrode.

15. In a dehydrator the combination of: a shell containing a liquid; a plurality of sleeve electrodes radially disposed in said shell and positioned at equal distances from the vertical axis thereof; means for drawing liquid into those ends of said sleeve electrodes closest to said vertical axis, said liquid being moved therethrough in a direction toward the walls of said shell; and means for setting up electric fields in said sleeves through which fields said liquid moves.

16. In a dehydrator the combination of: a tank having a vertical axis; a plurality of sleeve electrodes positioned around and at equal distances from said vertical axis and directed toward the inner walls of said tank;

an electrode means comprising a nozzle means for each sleeve electrode and directing an emulsion therethrough; means for supplying said emulsion to each of said nozzle means; and means for establishing a difference of potential between said electrode means and said sleeve electrodes whereby said emulsion is treated in passing through said sleeve electrodes.

In testimony whereof, I have hereunto set my hand at Long Beach, California, this 2nd day of October, 1928.

JOHN T. WORTHINGTON.

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