Aug. 13, 1929. W. O. EDDY 1,724,263

ELECTRICAL DEHYDRATOR

Filed July 5, 1928

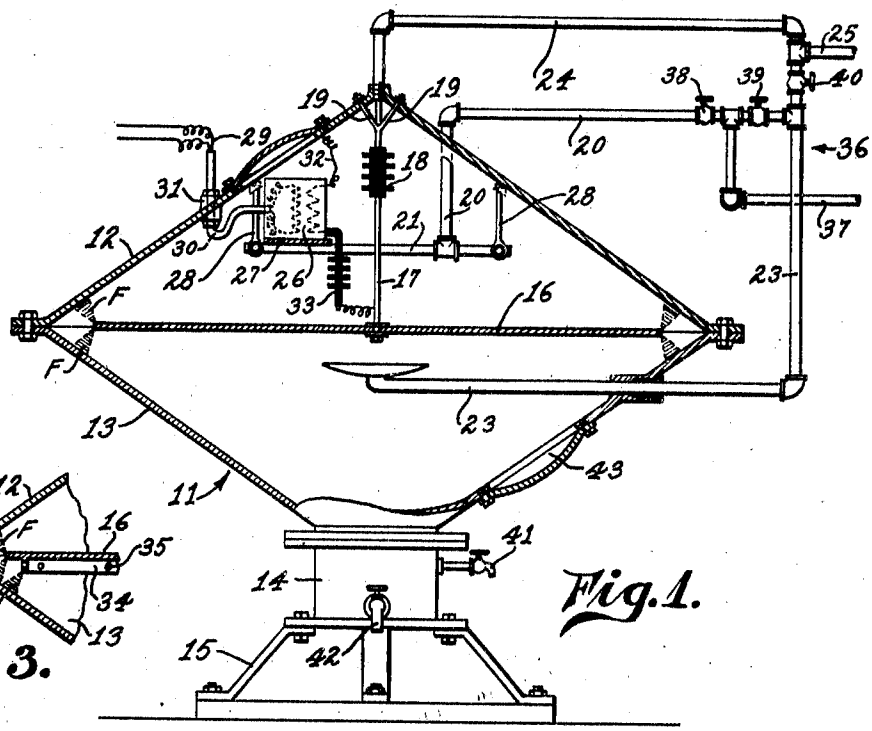



Fig. 1.

Fig. 3.

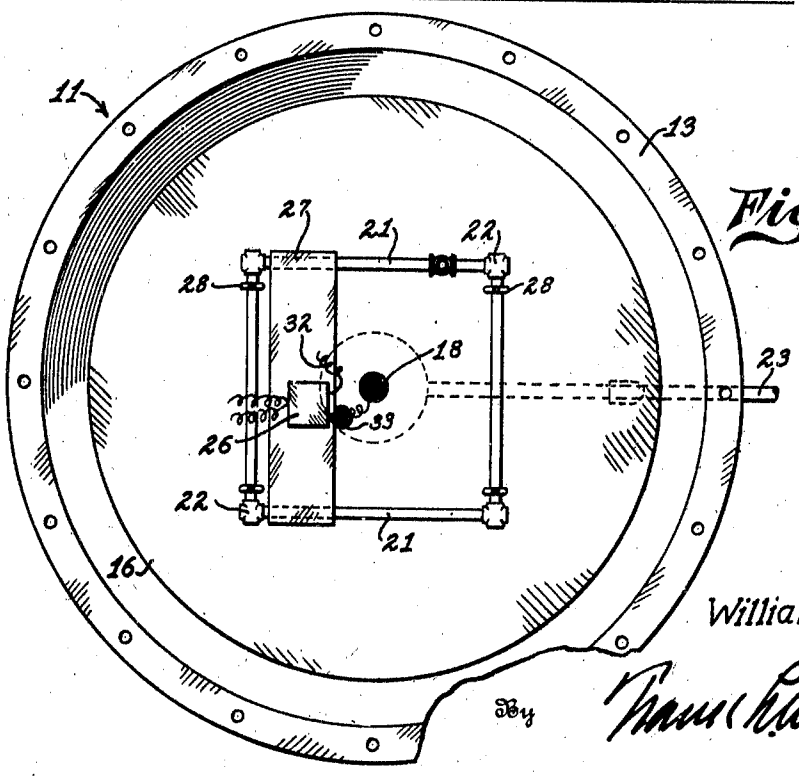



Fig. 2.

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Patented Aug. 13, 1929. 1,724,263

# UNITED STATES PATENT OFFICE.

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## ELECTRICAL DEHYDRATOR.

Application filed July 5, 1928. Serial No. 290,423.

This invention relates to the type of dehydrator commonly used in the dehydration or breaking of petroleum emulsions, and relates more particularly to improvements in such dehydrators, rendering them more economical in their construction and more efficient in their operation.

It is well known to those familiar with the art to which this invention relates that petroleum emulsions are nothing more nor less than a colloidal mixture or suspension of finely divided particles of water, in oil. Such emulsions may also contain a small amount of sediment in the form of waxes and mineral salts, and sand, which sediment, by itself or in combination with the suspended water, is commonly designated as BS or "bottom sediment."

Due to the great degree of subdivision of the water particles in the oil, the problem of its extraction has met with considerable difficulty of solution, and while I am aware of the fact that numerous electrical dehydrators have been developed for this purpose and have met with varying degrees of success, this invention relates to particular improvements in the construction of such dehydrators, whereby the breaking of the emulsion may be more efficiently carried out.

The general construction and principles upon which electrical dehydrators of this type operate comprise the use of a plurality of electrodes, which are suspended within the emulsion or between which the emulsion circulates, during which suspension or circulation an electric potential of high voltage is maintained between the electrodes.

The particles of water, when subjected to the great electrostatic force of this maintained voltage, tend to unit or agglomerate, forming globules of sufficient size to be carried to the bottom of the dehydrator by the force of gravity. The oil, of course, rises to the top and is withdrawn as finished or dry oil, the water in turn being withdrawn from the bottom of the dehydrator.

In all of the dehydrators with which I am familiar, the mentioned electrodes are either horizontal or vertical, and I have found that either of these arrangements of electrodes is attended by certain difficulties, tending to produce short circuits in the dehydrator.

If the electrodes are arranged in horizontal planes, the lines of force therebetween being in vertical planes, the flow of current is in the same line with the falling water particles, and the chains of descending water globules form conductors between the electrodes, which will, of course, produce short circuits, rendering the organization inoperable.

It will also be apparent that if the electrodes are in vertical planes, the lines of force there between being horizontal, will be in line with the planes of "BS" or emulsion, which always tends to stratify and will establish short circuits between the electrode plates in horizontal planes.

It is therefore necessary in dehydrators of the two general classes above described to maintain a continual agitation or circulation during the treatment of the emulsion, and it is obvious that such agitation retards the settling of the water which has been released by the electrostatic action, besides adding to the expense and complication of the system.

It is also well known to those familiar with this art that the so-called "wet" emulsions which contain a large proportion of "free" water must, for the most efficient treatment, be treated somewhat differently than a "dry" emulsion. The dry emulsions, being a more perfect colloidal suspension containing no "free" water, are more difficult to break (the water contained therein being more finely subdivided, the particles are naturally more difficult to be brought together).

It is desirable, therefore, to employ two different types of dehydrators for wet and dry emulsions, the former being arranged to permit a rapid settling of the "free" water, not forcing it to pass through the entire field, and the latter being arranged to prevent the globules of water which are formed by the action of the dehydrator from settling too rapidly, thus permitting a greater accumulation of the minute water particles to form globules and accept the electric charge.

In the event that an electrical dehydrator of the class above described should "short out," due to the mentioned short circuiting, the potential across the field is lost, and it is necessary in this case to replace all of the short circuiting liquid within the field with dry or treated oil, which makes it desirable for the most economical and efficient opera-

tion of such a dehydrator, to have the ratio of the liquid holding capacity to the dehydrator field area as small as possible.

It has been a primary object of my invention to overcome the above mentioned difficulties in dehydrator construction by an improved and simple organization in which the electrostatic field of force is of varying intensity in either a vertical or horizontal plane, and in which the lines of force of greatest magnitude are at an acute angle with the horizontal. It will thus be seen that the lines of force are neither parallel to the stratified layers of bottom sediment, nor are they parallel with the chains of water formed during its precipitation after release from the emulsion.

To accomplish this result, I employ one electrode which is substantially horizontal and a second electrode which is arranged at an angle less than 90° relative to the horizontal electrode. It will appear hereinafter from the detailed description of this invention that this arrangement provides means for developing two or more angularly disposed fields of force, the intensity of which varies relative to a perpendicular plane, thus obviating the necessity of agitating the emulsion during its treatment.

It is a further object of my invention to develop a dehydrator which may be efficiently and effectively used upon either a wet or a dry emulsion merely by altering the course of circulation of the emulsion through the dehydrator shell.

It is a still further object of this invention to develop a treater which has a large ratio of field to capacity. This result is accomplished by forming the shell of two conical sections which are oppositely disposed and converge to a substantially horizontal central plane where they are united. It will also be noted that, by disposing an electrode plate in the plane of intersection of the two cones, this cone construction provides the above mentioned angular field, as will be hereinafter more clearly explained.

Another object of this invention is to develop a dehydrator, in which there is a minimum vertical drop through which the water released from the emulsion in the electrostatic field must descend until it comes in contact with a metallic surface. This is, of course, also accomplished by the arrangement of conical shells mentioned above, it being well known that the water will descend more rapidly while flowing over a sloping metallic surface than will be the case in the event it is falling the same vertical distance through a comparatively viscous oil.

Another difficulty frequently experienced in the use of closed electric dehydrators of the class commonly used is encountered in the introduction of the high potential electric current through the walls of the dehydrator. Extremely heavy insulation must necessarily be used, and due to the strain to which it is subjected, the insulation frequently breaks down, rendering the dehydrator inoperable and necessitating costly repairs. Consequently, it is another object of my invention to eliminate this undesirable feature by placing the transformer within the dehydrator shell, bringing the low voltage current into the dehydrator through an ordinarily conduit, and increasing the potential within the dehydrator. This is a particularly desirable feature, both from the standpoint of safety and economy.

Other objects and advantages of this invention will be better understood from the following description of the accompanying drawings, which are chosen for the purpose of illustration only, and in which

Fig. 1 is a sectional elevation of a dehydrator, embodying my invention.

Fig. 2 is a plan view corresponding to Fig. 1, but with the upper cover section removed, and

Fig. 3 is a partial sectional elevation corresponding to Fig. 1, but showing a modified form of central electrode.

More particularly describing the invention as herein illustrated, reference numeral 11 indicates a dehydrator shell, comprising an upper conical section 12, and a lower conical section 13, the latter of which terminates in a substantially cylindrical water chamber or reservoir 14. The shell may be provided with any suitable means of base support, as indicated at 15.

The conical sections 12 and 13 are so constructed and mounted that the walls of the shell converge toward and are connected in a substantially horizontal plane, and an electrode plate 16, which is preferably circular in form, is suspended substantially in the plane of intersection of the two conical sections, the periphery of the plate being spaced from the inner walls of the chamber.

The conducting plate 16 may be supported in any preferred manner, as by means of the conducting rod or shaft 17, which is suspended from an insulator 18, the insulator in turn being supported in any preferred manner, such as by means of the three adjustable bolts 19, from the top of the upper section 12. The system comprised of parts 17, 18 and 19 forms a rigid support, centralizing the electrode.

An emulsion intake pipe 20 is illustrated as entering the chamber near the top of upper section 12, and is adapted to deliver untreated emulsion to the manifold of delivery pipes 21 from which the emulsion may be "distributed" into the chamber through the eight points of entrance provided by a "cross" fitting 22 at each corner of the square manifold, as is perhaps best illustrated in Fig. 2.

A skimming pipe 23 is mounted beneath the electrode 16 in a manner such that it may be used in the treatment of dry emulsion for removing the treated oil from the chamber. If, however, the emulsion is one of the so-called wet type which contains an appreciable amount of "free" water, this pipe is used as an inlet pipe, as will be explained later in this specification.

A so called gas outlet pipe 24 is mounted in the apex of the upper cone 12. This gas outlet pipe normally (in the dehydration of wet emulsions) serves only to remove the gases resulting from the preheating and electrostatic action upon the oil, and is connected with a "finished oil" outlet pipe 25, as shown in Fig. 1. If, however, a dry oil is being treated as mentioned above, the pipe 24 is employed as a finished oil outlet from the dehydrator.

For the purpose of providing a compact unit, and to eliminate the necessity of bringing the high potential circuit through the treater shell, a transformer 26, the case of which it is understood may be made of insulating material if so desired, is supported within the shell in any suitable manner, as by means of a shelf or plate 27, mounted upon the emulsion delivery pipes 21, which in turn may be suspended from the top section 12 by means such as the bolts 28.

The low potential "leads" 29 for the primary of the transformer are contained in a suitable conduit 30, which extends through a packing gland 31 and into the transformer case.

One side of the secondary coil in the transformer 26 is connected with the shell 11 by means of a conductor 32, and the other side of the secondary is connected through a conductor 33 with the electric plate support 17.

When a difference in potential is established between the electrode plate 16 and the shell 11, as by the excitation of the primary in transformer 26, an electrostatic field is established between the periphery of the electrode plate 16 and the inner surface of the shell 11, somewhat as shown by the shaded sections indicated by the letter "F" in Fig. 1.

It will thus be apparent that during the circulation of emulsion through the region of electric discharge identified above, the emulsion flows through two distinct fields of varying intensity, each of which is substantially perpendicular to the direction of flow of fluid, and neither of which is in line with either the line of precipitation of water globules or the line of stratification of the BS.

The electrode 16 may comprise a single circular flat conducting plate, in which case the two major peripheral fields of force mentioned above and indicated at F—F in Fig. 1 will be established, but in the event it is desirable to use the dehydrator upon very stubborn emulsions, three or more fields may be set up by extending an annular flange 34 (Fig. 3), or a plurality of such flanges arranged in a stepped relation (not shown) from the upper or lower surface of the plate 16. Such a field is indicated at G in Fig. 3. In the event the mentioned flange 34 is used, it should be provided with a plurality of apertures 35 to prevent the accumulation of gas below the electrode plate 16.

In the treatment of very wet emulsions as was mentioned above, it is desirable to circulate the emulsion in such a manner that the "free" water is permitted to settle before the emulsion is brought entirely through the region of the above mentioned fields of force, and that water which is freed by the initial action at the lower shaded portion of the field settles without the necessity of travelling through the upper field.

In this event, the skimming pipe 23, as was mentioned above, is used as a delivery or feed pipe, and pipe 24 acts as the outlet for the finished oil.

On the other hand, in the event a very dry emulsion is being treated, it is necessary to subject the emulsion to the most intense electrostatic action before permitting any possible accumulation of "free" water formed by such action to settle. In the latter case, the emulsion is introduced through the intake 20 and the treated oil is "skimmed" off through the pipe 23.

The valve organization indicated at 36 provides convenient means for readily adapting this dehydrator to use upon either a "wet" or a "dry" emulsion. An emulsion inlet pipe 37 is connected through a T-fitting with the delivery pipe 20 which in turn is connected by means of a T-fitting with the skimming pipe 23. Valves 38 and 39 may be used to direct the flow of emulsion into either of the respective pipes 20 or 23, and valve 40 is used to prevent the mixture of the emulsion in pipe 25 when valve 38 is closed with the finished oil in pipe 24 entering the outlet pipe 25.

The water reservoir 14 is provided with a gauge tap 41 and a main drain 42, and both upper and bottom sections 12 and 13 of the shell 11 may be provided with man holes, as indicated at 43 in Fig. 1. For convenience of assembly, a trap doorway (not shown) may be placed in the electrode plate 16.

It will be apparent from the foregoing description that I have developed an electric emulsion dehydrator which is compact and efficient, and embodies such features of novelty as an electrode construction whereby "angular" electrostatic fields are maintained, the "combination" feature of being adaptable

for use either with a wet or a dry emulsion, the feature of enclosing the transformer within the shell, etc., and although this description has been limited to a single embodiment of my invention, it will be understood that the scope of the invention is not confined to the precise construction set forth, but includes any changes which fairly come within the spirit of the appended claims.

I claim as my invention:

1. An apparatus for dehydrating petroleum emulsions comprising: a shell having converging walls forming a surface of angular cross section; an electrode positioned substantially in the plane defined by the vertex of said angular section; and means for establishing a difference in potential between said electrode and said shell.

2. An apparatus for dehydrating petroleum emulsions comprising: a shell having converging walls forming a surface of angular cross section; a plate-like electrode positioned substantially in the plane defined by the vertex of said angular section; and means for establishing a difference in poten tial between said electrode and said shell.

3. An apparatus for dehydrating petroleum emulsons comprising: a shell having converging walls forming a surface of angular cross section; an electrode positioned substantially in the plane defined by the vertex of said angular section; and means for estab lishing a difference in potential betwen said electrode and said shell, said last mentioned means including a transformer contained within said shell.

4. An apparatus for dehydrating petroleum emulsions comprising: a shell having converging walls forming a surface of angular cross section; a plate-like electrode positioned substantially in the plane defined by the vertex of said angular section; an auxiliary electrode mounted upon said plate-like electrode and extending angularly therefrom toward an inner surface of said shell; and means for establishing a difference in potential between said electrode and said shell.

5. An electrode organization for use in the dehydration of petroleum emulsions comprising: a substantially horizontal electrode plate; an annular electrode spaced from the periphery of said plate, the inner surface of said annular electrode being angular in cross section and the faces thereof converging to the plane defined by said electrode plate; and means for establishing a difference in potential between said electrodes.

6. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; a plate-like electrode positioned substantially in said plane of intersection, the periphery thereof being spaced from said shell; and means for establishing a difference in potential between said electrode and said shell.

7. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; a plate-like electrode positioned in said plane of intersection, the periphery thereof being spaced from said shell; means for establishing a difference in potential between said electrode and said shell; means for delivering petroleum emulsion into said shell; means for conducting water from said shell; and means for conducting treated oil from said shell.

8. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; an electrode plate positioned in said plane of intersection, the periphery thereof being spaced from said shell; means for establishing a difference in potential between said electrode plate and said shell; means for delivering petroleum emulsion into said shell below said electrode plate; means for conducting water from said shell; and means above said electrode plate for conducting treated oil from said shell.

9. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; an electrode plate positioned in said plane of intersection, the periphery thereof being spaced from said shell; means for establishing a difference in potential between said electrode plate and said shell; means for delivering petroleum emulsion into said shell above said electrode plate; means for conducting water from said shell; and means for conducting treated oil from said shell, said last mentioned means comprising a skimming pipe below said electrode plate.

10. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; a plate-like electrode positioned in said plane of intersection, the periphery thereof being spaced from said shell; and means for establishing a difference in potential between said electrode and said shell, comprising a transformer mounted in said shell, insulated conductors for delivering current through said shell to the primary of said transformer, and conducting

means for connecting opposite poles of the secondary of said transformers to said plate electrode and said shell.

11. An electric organization for use in the dehydration of petroleum emulsions comprising: a substantially horizontal electrode plate; an angularly extending flange formed on said plate; an annular electrode spaced from the periphery of said plate, the inner surface of said annular electrode being angular in cross section, the faces thereof converging to the plane defined by said plate electrode; and means for establishing a difference in potential between said electrodes.

12. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; an electrode plate positioned in said plane of intersection, the periphery thereof being spaced from said shell; means for establishing a difference in potential between said electrode plate and said shell; means for optionally delivering petroleum emulsion into said shell above or below said electrode; oppositely disposed means for conducting treated oil from said shell above and below said electrode; and means for conducting water from said shell.

13. An apparatus for dehydrating petroleum emulsions comprising: a shell; a substantially horizontal electrode plate positioned in said shell; means for establishing a difference in potential between said electrode plate and said shell; means for optionally delivering petroleum emulsion into said shell above or below said electrode; oppositely disposed means for conducting treated oil from said shell above or below said electrode; and means for conducting water from said shell.

14. A method of dehydrating a petroleum emulsion which comprises: circulating such emulsion between electrically charged electrodes so positioned that the electrostatic lines of force of greatest intensity diverge at an acute angle with the horizontal.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 21st day of April, 1928.

WILLIAM O. EDDY.