

[54] **TREATER FOR RESOLVING DISPERSIONS**

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[51] Int. Cl. **B01d 21/10, B01d 21/24**

[58] Field of Search **210/83, 521, 522, 519**

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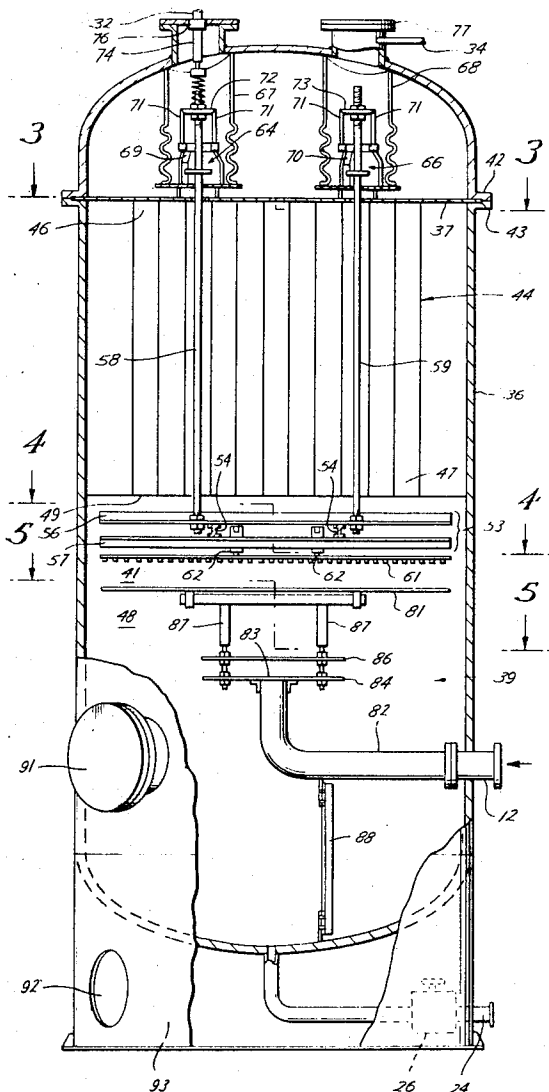
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[57] **ABSTRACT**

A treater for resolving a dispersion containing immiscible external (hydrocarbon) and internal (water) liquid phases in a closed container with an upright flow axis. Upper and lower outlets, and an intermediate distributor inlet, open into the container. A plurality of unobstructed vertical cells having open-ended inlets provide the sole fluid communication between the upper outlet and the distributor inlet. Each cell terminates at a transverse header having metering orifices which provides for substantially uniform flow conditions in the cells whereby fluid flows upwardly at uniform rates in all fluid flowing through the cells toward the upper outlet of the container.

8 Claims, 8 Drawing Figures



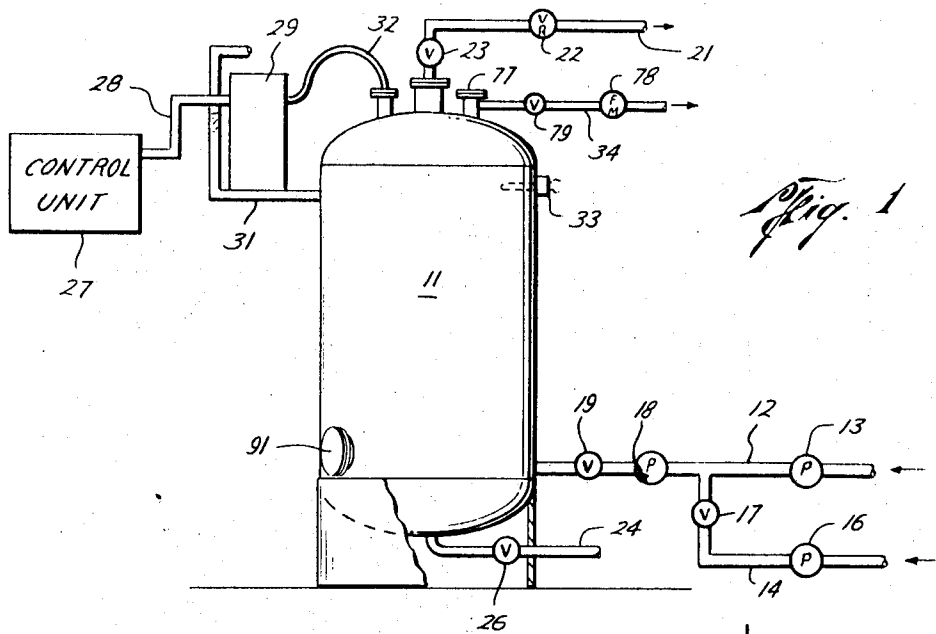


Fig. 1

Fig. 3

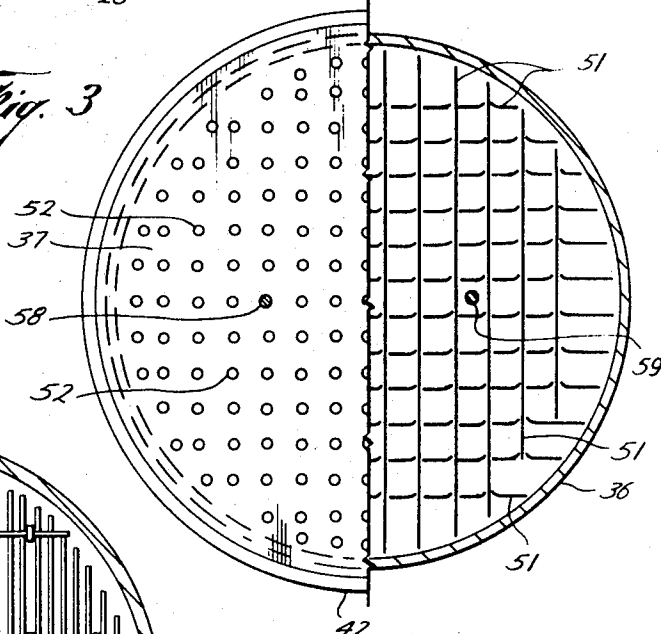
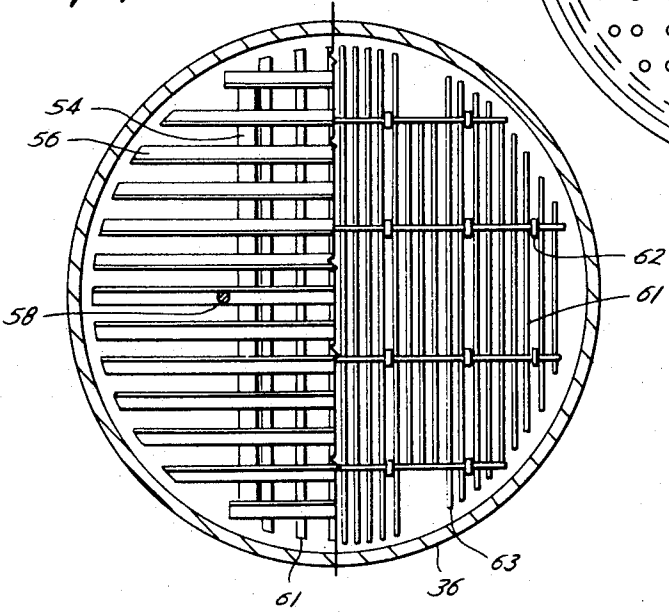


Fig. 4



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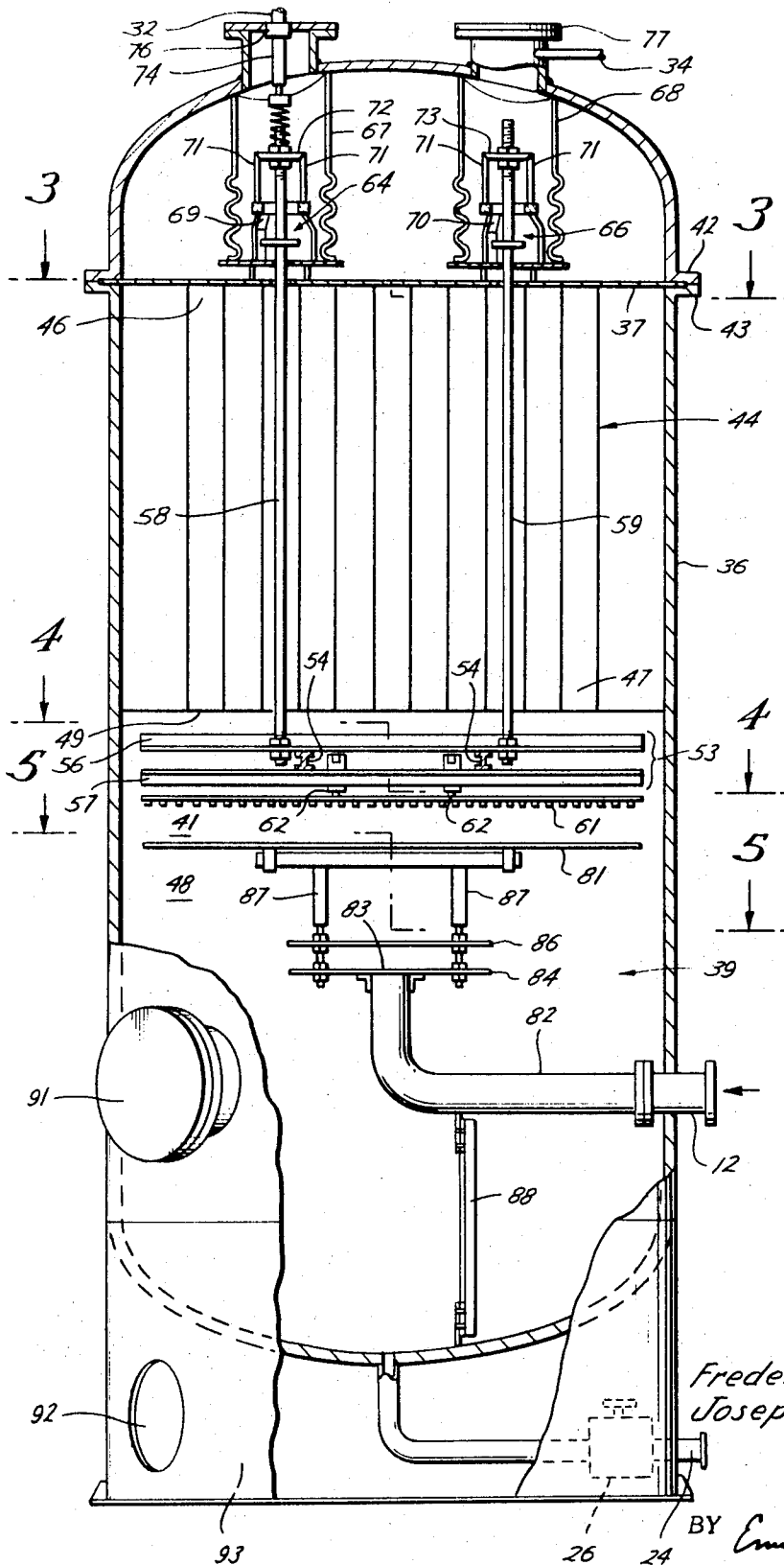


Fig. 2

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Fig. 5

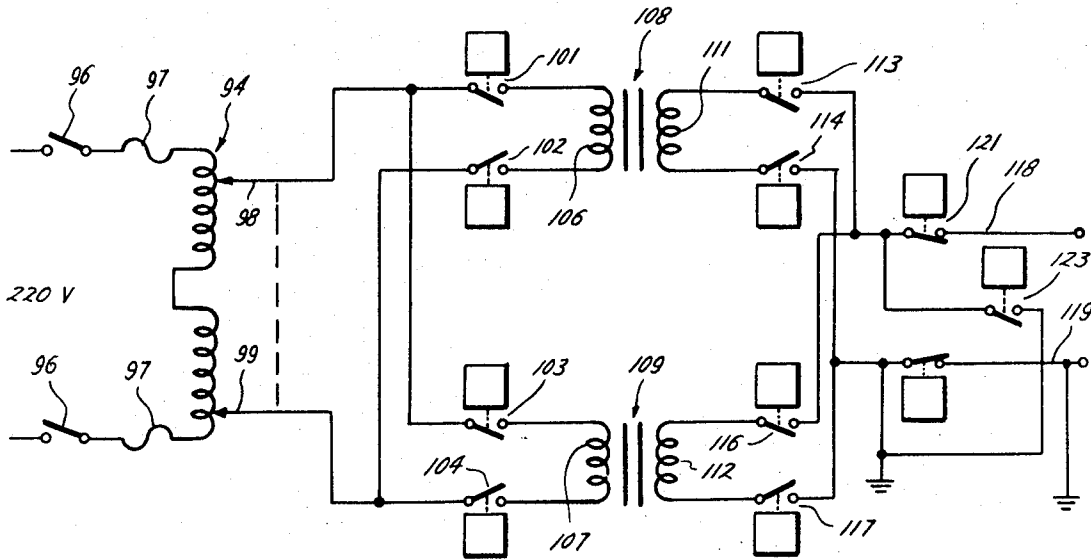
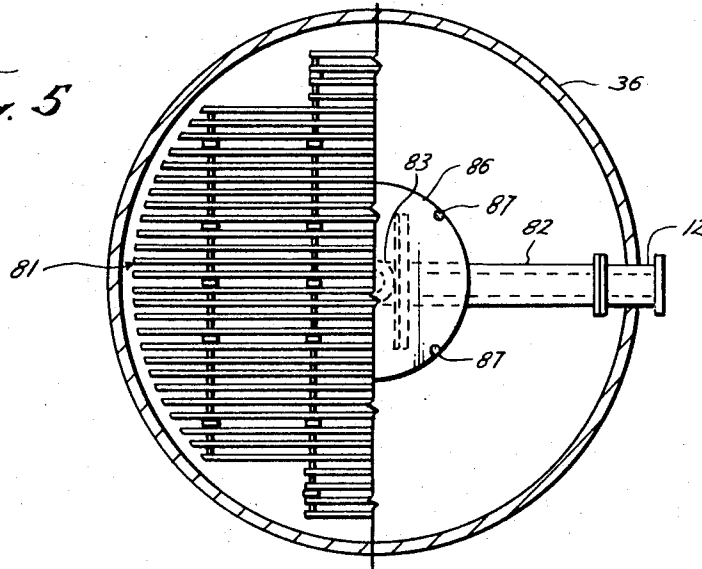
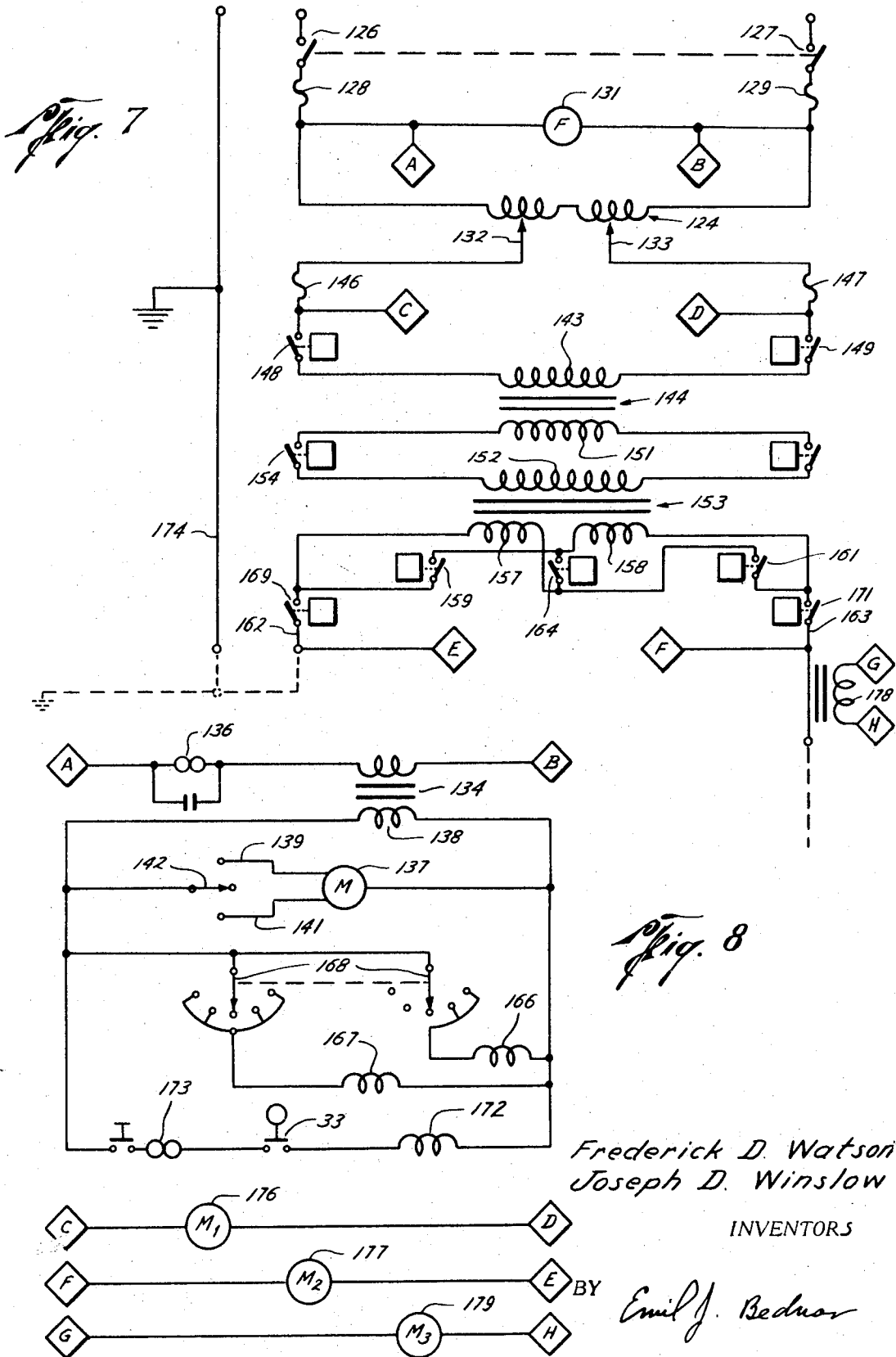


Fig. 6

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TREATER FOR RESOLVING DISPERSIONS

This is a division of application Ser. No. 717,133, filed Mar. 29, 1968, now U.S. Pat. 3,528,907.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to resolving dispersions consisting of immiscible external and internal liquid phases. More particularly, the invention relates to treatment for resolving such dispersions in which the internal phase has a higher dielectric constant than the external phase.

2. Description of the Prior Art

It is commonplace to employ electric fields for resolving many dispersions in which the internal phase is an aqueous material, such as water, caustic, or acids, etc. and the external phase is a hydrocarbon, such as crude oil. Passing these dispersions between electrodes to which is applied a high voltage field causes the internal phase to coalesce. The term "coalesce" as used herein refers to the agglomeration of the dispersed internal phase while in situ in the continuous external phase. Thusly, larger particle sizes of the internal phase are created which can readily separate from the external phase by a difference in their specific gravities.

In the conventional "electric field" techniques for resolving water and crude oil dispersions, the high voltage field applied to the electrodes of the treater must be of a certain magnitude, otherwise the electrical treatment of the dispersion is considered not to be practical. For example, in conventional treaters the high voltage applied to the electrodes is between about 11,000 volts and about 33,000 volts, or even higher. Usually, the electrodes are spaced apart between about 4 and about 11 inches. This electrode-spacing high-voltage criterion exists whether the electric field is formed by alternating or direct voltages. Thus, conventional practices generally produce voltage gradients between the electrodes in the range of about 2.5 kv to about 8.5 kv per inch spacing therebetween.

In carrying out these conventional electrical treatments for resolving dispersions, a variety of electric treaters were developed. Reference may be taken for electric treaters to the following U.S. Pats. Nos. 2,182,145, 2,855,356, 2,880,158, 2,976,228, 3,205,160 and 3,205,161.

Although the electric treatment for resolving many dispersions has proved to be a tremendous commercial success, certain dispersions were found not to be treatable. Dispersions of this nature are so highly conductive that the high voltage field (11-33 kv) between the electrodes produces excessive current flows. Also, the internal phase (aqueous) becomes continuous at times to short-out the electrodes. Commercial treatment of these dispersions is economically impractical with electric fields under high voltage and with excessive current flows between electrodes. In view of these results with highly conductive crude oil and water dispersions, it has been assumed that electrical treatment for resolving non-crude oil types of highly conductive dispersions would not be successful.

In addition, the flow conditions after the dispersions exit the electric field have not been always satisfactory for optimum separation of the phases from the dispersion. For example, circulating flows, or other disruptive flow conditions, created differential flow velocities in the dispersion making phase separation more difficult.

It is the purpose of this invention in one aspect to apply commercially electric fields for resolving dispersions, especially those of high electrical conductivity (e.g., greater than about 1×10^{-8} mhos/centimeters) which dispersions heretofore were considered untreatable with high voltage electric fields. Dispersions may be generally categorized as: (a) formed of immiscible external and internal liquid phases; (b) the internal phase has a higher dielectric constant, and conductivity, than the external phase; (c) the internal phase is an aqueous material; and (d) the external phase is an organic material. In another aspect of the invention, the dispersion passes from the electric field under uniform flow conditions for optimum

phase separation. In yet another aspect of the invention, electric fields having certain voltage gradients are employed in resolving dispersions.

The terminology "liquid organic material," as used herein, means one or more organic compounds formed with carbon and hydrogen atoms such as all types of hydrocarbons, or that also includes other atoms such as oxygen, sulfur, and nitrogen to form substances such as naphthenic acids, organic sulfides and amines, whether any of these compounds are formed synthetically or exist in nature such as the hydrocarbonous substances obtained by processing crude oil.

More particularly, one dispersion of high electrical conductivity with which the present invention is concerned is formed with synthetic organic chemicals, alone or in a solution. In this dispersion, the electrical conductivity is provided principally by the external phase which may be characterized as a liquid organic material. The organic liquid material may include solvents such as benzene, or other hydrocarbon derivatives. The organic liquid material is impure in the sense of containing dissolved and/or dispersed substances. The internal phase is an aqueous material which may contain various water-soluble impurities such as chloride ions. The dispersion may already exist as a stream associated with the production of synthetic chemicals or other materials. However, the dispersion may be formed, or further altered, by mixing an aqueous medium (water) with the liquid organic material. The present invention applies a novel treater to the dispersion for the separation of the aqueous material and the impurities from the external phase of the liquid organic material.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a treater for resolving a dispersion containing immiscible external and internal liquid phases. The treater includes a closed container having an upright flow axis, effluent means opening into the upper and lower ends of the container, and dispersion inlet means opening into the container. Flow straightening means provide communication in a dispersion treating zone residing between the dispersion inlet means and the upper end of the container. The flow straightening means include a plurality of vertically aligned, elongated cells within the container. These cells have open-ended inlets and form side-by-side, unobstructed flow channels occupying substantially the entire horizontal cross-sectional area of the container. The flow straightening means also provide substantially uniform flow condition in these cells whereby fluid flows upwardly at uniform rates throughout all fluid flowing in the dispersion treating zone from said dispersion inlet means toward the upper end of the container.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation of a treater for treating dispersions in accordance with this invention;
FIG. 2 is a vertical cross-section of the treater shown in FIG. 1;
FIG. 3 is a cross-section taken along line 3—3 of the treater shown in FIG. 2;
FIG. 4 is a cross-section taken along line 4—4 of the treater shown in FIG. 2;
FIG. 5 is a cross-section taken along line 5—5 of the treater shown in FIG. 2;
FIG. 6 is a schematic of a circuit for producing an electric field in the treater shown in FIG. 1;
FIG. 7 is a schematic of an improved circuit for providing low intensity voltages to the treater shown in FIG. 1; and
FIG. 8 is a control circuit employed in conjunction with the circuit illustrated in FIG. 7.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Referring to the drawings, there is shown in FIG. 1 a treater 11 arranged for resolving emulsions, or dispersions, and especially those having an electrical conductivity greater than

about 1×10^{-8} mhos/centimeter. The dispersions contain immiscible external and internal liquid phases. These phases are an organic material and a more conductive aqueous material, respectively. The dispersion is passed into the treater 11 through a conduit 12 containing a pump 13. The dispersion may be from any source such as a product stream in a plant producing synthetic chemicals. Water may be intermixed with the dispersion to facilitate electrical treatment. For this purpose, water from any suitable source, is passed through a conduit 14 by a pump 16, through a metering valve 17 and then, into the conduit 12 carrying the dispersion. The dispersion and water may be intimately mixed with a suitable mixing device such as a centrifugal pump 18. The flow of the dispersion, or dispersion and water mixture, into the treater 11 may be regulated by a valve 19 in the conduit 12.

Within the treater 11, the dispersion is separated into the relatively pure organic material which becomes an overhead effluent. The overhead effluent is removed from the treater 11 through a conduit 21. The conduit 21 carries a regulating valve 22 for maintaining sufficient back pressure upon the fluids in the treater 11 to insure safe and proper operation. If desired, a valve 23 may be included in the conduit 21 for regulating the flow of the overhead effluent. The aqueous material, carrying water-soluble impurities, separated within the treater 11 is taken from its lower portion as a bottom effluent through a conduit 24 which includes a valve 26 for regulating flow therein.

Electric power for providing the electric field in the treater 11 is supplied by a control unit 27 which may be located some distance from the treater 11. The control unit 27 is interconnected by a conductor cable 28 to a switch box 29 mounted upon a platform 31 at the top of the treater 11. An insulated lead 32 interconnects the switchbox 29 to an internally energized electrode within the treater 11.

The treater 11 may also carry various types of monitoring and process control equipment which is conventional in the art. For example, a low level switch 33 mounted in the treater 11 insures that the electric field is not applied unless the treater 11 is suitably filled with fluid. Thus, no arcing can take place within the treater 11 to cause a disastrous explosion. A flow line 34 may be connected to the treater 11 for monitoring flow through an internal flow channel. This arrangement will be described more fully hereinafter.

As shown in FIG. 2, the treater 11 includes a container 36 which may be cylindrical, or other shape, with an upright flow axis. The container 36 is a pressure vessel for containing the dispersion to be resolved by electrical treatment. A header 37 extends horizontally across the interior of the container 36 and perpendicular to its flow axis. The header 37 divides the interior of the container into vertically opposite upper and lower zones, 38 and 39, respectively, which zones are separated from one another by the header. The lower zone 39 includes a dispersion treating zone 41. The container 36 can be formed in two portions interconnected by flanges 42 and 43. The header 37 is then held by any means, such as by welding, in fluid tight relationship between the flanges 42 and 43.

A plurality of vertical cells 44 reside within the lower zone 39 of the container 36 and compositely occupy substantially the entire horizontal cross-sectional area of the upper part of the dispersion treating zone 41. The cells 44 have upper exit portions 46 immediately below the header 37. The cells 44 have lower entry portions 47 opening into an entrance chamber 48. The cells 44 may be electrically connected to the container 36 so that their lower ends 49 serve as a grounded electrode. However, other structure can provide the grounded electrode, such as conductive parts, or even liquids, electrically connected to the container 36.

With momentary reference to FIG. 3, the cells 44 can be seen to be provided by intersecting structural walls 51. Preferably the cells 44 are square in cross-section. If desired, the cells 44 can be of other cross-sectional shapes. The cells 44 should be at least three times as long as their maximum width. The cells 44 are secured integrally to the underside of

the header 37. The header 37 is provided with a plurality of metering orifices 52, at least one orifice to each of the cells. These orifices serve to regulate at substantially identical rates, the flow of fluids between the cells 44 and the upper zone 38 of the treater 11. The cells 44 and the orifices 52 in the header 37 provide the only fluid communication between the entrance chamber 48 and the upper zone 38. The pressure drop across the orifices 52 is greater than at any downstream portion of the treater 11, especially as the dispersion flows into the entrance chamber 48. With this structure, fluids flow through the cells 44 under substantially uniform flow conditions. More particularly, the upward flow of fluids occurs at substantially a uniform velocity through all the cells 44. Stated in another manner, this structure provides for a substantially uniform flow of fluids upwardly throughout a horizontal section taken across the cells 44.

An energizable electrode 53 is mounted within, but electrically insulated from, the container 36. The electrode extends horizontally within the dispersion treating zone 41 at an equidistant spacing below the lower entrance portions 47 of the cells 44. The electrode 53 is preferably planar and has its upper and lower surfaces residing substantially in horizontal planes. Thus, the electrode 53 may have any vertical thickness as required by construction, or for other reasons. More particularly as shown by reference also to FIG. 4, the electrode 53 can be formed of spaced transverse bars 54 with pairs of upper and lower electrode members 56 and 57, respectively, thereabove and therebelow forming a foraminous framework. The upper and lower electrode members 56 and 57, respectively, are rigid and have openings to receive suspension rods 58 and 59, by which arrangement the electrode 53 is suspended within the container 36. The lowermost portion of the electrode 53 is a rodlike grid 61 which is supported by brackets 62. The grid 61 is made of elongated rods 63 disposed in a framework similar to the uppermost framework of the electrode 53. Thus, the electrode 53 at its lower portion is covered with a more densely arranged grid of rods 63 whereas the upper portion thereof is formed by a less dense arrangement of traversing bars 54 and electrode members 56 and 57. If desired, the electrode 53 can be formed of small vertical dimension by a single-layer grid network of rods, support members, and the like.

The support rods 58 and 59 extend upwardly through suitable openings from a pair of the cells 44 above the header 37 into insulator supports 64 and 66. The supports 64 and 66 include tubular members 67 and 68 extending from the header 37 to enclose insulator support brackets 69 and 70. Electrical insulators 71 are mounted upon the insulator brackets 64 and 66, and carry at their upper extremities support rod flanges 72 and 73. The support rods 58 and 59 extend upwardly through the support brackets 69 and 70 and the flanges 72 and 73 to which they are secured by threaded connections. With this arrangement, the support rods 58 and 59 are electrically insulated from the container 36.

The electrode 53 is energized by a conductor 74 electrically connected to the upper end of the support rod 58. The conductor 74 passes out of the container 36 through an entrance bushing 76 which provides a fluid seal.

The flow line 34 is connected via nozzle 77 to the tubular member 68 enclosing the insulator support 66. Flow line 34 has a flow metering device 78. The fluid from the flow line 34, after being metered, may be passed to any utilization. A valve 79 in the flow line 34 allows flow through the device 78 to be varied and regulated at will. This flow line 34 provides a convenient method to monitor flow through one of the cells 44 which contains support rod 59.

In many instances, it is desirable to use a separate grounded electrode 81, which preferably is planar, within the container 36. This electrode 81 extends horizontally within the dispersion treating zone 41 below the energizable electrode 53 and at an equidistant spacing therefrom. This spacing is desirably substantially equal to the spacing of the energizable electrode 53 from the lower ends 49 of the cells 44. FIG. 5 illustrates the

grounded electrode 81 which is very similar to that of the lower section of the energizable electrode 53.

For example, good results are obtained when the energizable electrode 53 is spaced about 4 inches below the lower entrance portions 47 of the cells 44. Then, the grounded electrode 81 desirably should be spaced about 4 inches below the lower surface of the energizable electrode 53. Other spacings between the electrodes and/or the cells 44 may be employed. Obviously, by suitable arrangement of the energized and grounded electrodes, the electric field may be between the electrode 53 and either the cells 44 or grounded electrode 81 or both the cells 44 and grounded electrode 81. The voltage gradients established by energizing the electrode 53 should be of a certain magnitude to be hereinafter described for optimum electric field treatment of the dispersion.

A large stream of the dispersion enters the container 36 from the conduit 12 through the inlet distributor piping 82. The piping 82 terminates in a vertical outlet 83 within the entrance chamber 48 in the container 36. An apertured disc 84 is mounted coaxially upon the outlet 83. Spaced vertically from the outlet, by suitable means, is a second disc 86. The grounded electrode 81 and the disc 86 may be mounted to the apertured disc 84 by tubular members 87 secured together by threaded interconnection. The arrangement of the discs and the inlet distributor piping may be also viewed in FIG. 5. The flow of dispersion through the outlet 83 passes between the discs 84 and 86 under a relatively small pressure differential. This arrangement causes a turbulent flow through the entrance chamber 48 of the container 36 as the dispersion flows in an upward direction towards the electrode 53. The inlet distributor piping 82 is rigidly secured by structural bracing 88 to the lower portion of the container 36.

The treater 11 is provided with a manway entrance 91 into its lower portion for interior servicing of the unit. An access way 92 opening into a support skirt 93 of the treater 11 allows inspection below the container 36.

The treater 11 has been found to be an excellent decanter for resolving dispersion in which the phases can separate, at least in part, without the application of an electric field. More particularly, the electrode 53 is not energized, or the electrodes may even be omitted, for this use. The cells 44 provide an excellent environment for the gravitational separation of a coalesced internal phase from the external phase of a dispersion. This separation is obtained as a result of the uniform flow conditions in the cells 44. Thus, this structure is especially useful in the treater 11 but may be used in any decanting operation. The sizes of the cells 44 may be adjusted so that under the operating conditions in the treater, upward fluid flows are always under viscous rather than turbulent flow. Also, the cells 44 may have a length, for a given rate of flow, to provide a residence time therein sufficient to permit a desired reaction (coalescence, precipitation, etc.) to occur before the fluid exits from the orifices 52.

A power supply in the control unit 27, for establishing an electric field in the treater 11, is illustrated in FIG. 6. The electric field is produced by applying a non-direct current voltage between the electrode 53 and the grounded cells 44. By "non-direct current voltage" as used herein, this term means an alternating current voltage or a pulsed D.C. voltage varying positive and/or negative on successive pulses and with no pulse of sufficient duration to become the equivalent in the treater 11 of non-pulsed, D.C. voltage. In the power supply circuit, a dual-section adjustable Auto-transformer 94 is connected to a primary power source, such as 240-volts A.C., by line switches 96 and fuses 97. Adjustable taps 98 and 99 of the transformer 94 connect through relay contacts 101-104 to paralleled primaries 106 and 107 of Sola transformers 108 and 109. The Sola transformers are devices for providing constant output voltage with variable cut-off of short circuit currents. Secondaries 111 and 112 of the Sola transformers 108 and 109 connect through relay contacts 113-114 and 116-117 to output conductors 118 and 119. The contacts 113-114 and 116-117 are arranged through suitable relay action that the

secondaries 111 and 112 of the Sola transformers can be placed individually or in parallel connection with respect to the conductors 118 and 119. By this arrangement, the conductors 118 and 119 may be energized at the output voltage of the individual Sola transformers 108 and 109, and at twice their individual current carrying capabilities. Alternatively, the conductors 118 and 119 may be energized at the individual voltage and current rating of one Sola transformer. A safety interlock is provided by additional relay contacts 121 and 122 in series with the conductors 118 and 119, and an additional set of relay contacts 123 shunted across these conductors. The series-connected contacts 121 and 122 are normally closed, and the shunting contacts 123 are normally open. With this arrangement, the power output of the Sola transformers is applied to the conductors 118 and 119. However, suitable relay action opens the series contacts 121 and 122 and closes the shunting contacts 123 so that the output conductors 118 and 119 are short circuited. With this latter situation, the proper operation of the Sola transformers at short circuit currents may be readily determined.

As is shown in FIG. 1, conductors 118 and 119 pass through the conduit cable 28 to a switchbox 29 mounted on the treater 11. The conductor 118 is connected by the insulated lead 32 through the entrance bushing 76 to the energized electrode 53 within the container 36. The conductor 119 is connected to a ground common to the container 36, the cells 44 and the grounded electrode 81.

In many instances, a more complex power supply may be desired which includes remote adjusting features and comprehensive monitoring circuits. Such a power supply is shown in FIGS. 7 and 8. An adjustable dual-section auto-transformer 124 is connected through switches 126 and 127, and fuses 128 and 129, to a suitable source of power which may be, for example, 240-volts A.C., single phase. A fan 131 provides for cooling the various components of the power supply housed in the control unit 27. The taps 132 and 133 on the transformer are connected with a suitable motor-drive mechanism for remote adjustment. For this purpose, a motor control circuit shown in FIG. 8 is connected at A-B across the primary of the transformer 124. The motor control circuit includes a voltage regulating Sola transformer 134 whose primary is protected by a thermostat-type circuit breaker 136. The breaker 136 opens the motor control circuit when the temperature rises excessively within the control unit 27. A motor 137, coupled to the adjustable tap drive mechanism, is connected across the secondary 138 of the Sola transformer 134. The motor's operating windings 139 and 141 are selectively energized with a single pole, double throw switch 142. The switch 142 in one position causes the motor 137 to advance the adjustable taps 132 and 133 towards one another on the transformer 124. The switch in the other position causes the motor 137 to move the adjustable taps 132 and 133 away from one another on the transformer 124. Thus the taps 132 and 133 on the transformer 124 can be adjusted remotely to a suitable output voltage.

The taps 132 and 133 of the transformer 124 are connected to the primary 143 of a Sola transformer 144 through protective fuses 146 and 147 and relay contacts 148 and 149. The secondary 151 of the Sola transformer 144 is connected to the primary 152 of a power transformer 153 through relay contacts 154 and 156. The secondaries 157 and 158 of the power transformer are connected in parallel through relay contacts 159 and 161 to output conductors 162 and 163. Relay contacts 164 provide for interconnecting in series the secondaries 157 and 158 with the conductors 162 and 163. These several relay contacts are activated by relays 166 and 167 connected in the motor control circuit. More particularly, a dual-section single pole, 5-position, switch 168 selectively energizes the proper relays so that the secondaries 157 and 158 of the power transformer 153 are connected in series or in parallel with the conductors 162 and 163.

For example, the conductors 162 and 163 may be energized at 230 volts, or 460 volts, A.C. For this purpose, the switch

168 is first set in the "OFF" position. Then the motor 137 operates through the switch 142 to adjust the taps 132 and 133 of the auto-transformer 124 to the desired input voltage to the Sola transformer 144. Then, the switch 168 is placed into the desired position, for example 230 volts. In this position it will be apparent that both relays 166 and 167 are energized so that contacts 164 are opened and contacts 159 and 161 are closed. The secondaries 157 and 158 of the power transformer 153 are now in parallel across the conductors 162 and 163. Alternatively, the switch 168 is placed into the 460-volt position which energizes only relay 167. This results in the closing of contacts 164, and the opening of contacts 159 and 161. Thus, the secondaries 157 and 158 of the power transformer 153 are connected in series across the conductors 162 and 163.

An additional safety feature of the power supply is provided by relay contacts 169 and 171 in series with the conductors 162 and 163. These contacts 169 and 171 are actuated by a relay 172 connected in series with the low level switch 33 on the treater 11. Additionally, a series-connected resettable circuit breaker 173 protects the circuit against current overloads. If the liquid level within the treater 11 falls below a certain level, the low level switch 33 opens, thereby de-energizing the relay 172. This results in opening the contacts 169 and 171 in the conductors 162 and 163.

The output conductors 162 and 163, and a common ground conductor 174 pass from the control unit 27 to the switch box 29 atop the treater 11. There, the conductors 162 and 174 are connected to the common ground, and the treater 11. The conductor 163 is connected to an insulated lead and passes through the entrance bushing 76 into electrical interconnection with the energized electrode 53. Thus, a desired voltage may be applied between the energized electrode 53 and the grounded cells 44 and the grounded electrode 81. In the event of an emergency, or for other reason, this potential may be quickly removed from the energized electrode 53 by opening the circuit breaker 173 connected in series with the relay controlling the contacts 169 and 171 in the conductors 162 and 163.

The power supply is provided with suitable voltage and current monitoring features. More particularly, a voltmeter 176 is connected at C-D across the adjustable taps 132 and 133 of the transformer 124 to provide a direct reading of the voltage applied to the Sola transformer 143. A second voltmeter 177 is connected at E-F across the conductors 162 and 163 to provide a direct reading of the output potential applied to the energized electrode 53 within the treater 11. Additionally, a current sensing winding 178 on the conductor 163 connects at G-H to an ammeter 179. Thus, pertinent voltages and currents which are produced from the power supply may be readily monitored.

Although specific power supplies suitable for use with the present invention have been described, other suitable circuit arrangements may be made for providing a desired potential to the energized electrode 53 within the treater 11.

The operation of the treater in the electric treatment of a conductive dispersion is as follows. In summary, the dispersion is formed of immiscible external and internal phases consisting of an organic liquid material and an aqueous material, respectively. A water-soluble impurity may be present in these phases, which includes impurities that can be water-wetted. The aqueous material has a higher dielectric constant than the external phase. The dispersion can have an electrical conductivity greater than 1×10^{-6} mhos/centimeter and yet be treated in accordance with this invention.

The dispersion is passed through the inlet distributor piping 82 within the treater 11 for continuous delivery to the entrance zone 48 in a large stream advancing upwardly in turbulent flow along the upright flow passage formed within the container 36. Then, the dispersion is passed continuously from the entrance zone 48 between the energized electrode 53 and the vertical cells 44, and the grounded electrode 81, if one is employed. The treater 11 is energized with an electric field

from a non-direct current voltage of a magnitude to provide a voltage gradient usually not above about 1,000 volts per inch of spacing between energized electrode 53 and the cells 44. Preferably, the voltage gradient is above about 50 volts per inch of spacing between the electrode 53 and the cells 44. The voltage gradient is taken as the voltage producing the electric field divided by the linear distance (in inches) between the electrode 53 and the cells 44 or the grounded electrode 81.

As a result of subjecting the dispersion to the electric field between the electrode and the cells, the internal phase undergoes a coalescent action of sufficient intensity that in time it can separate from the external phase by gravity. The internal phase then accumulates within the lower portion of the container 36. However, some of the internal phase is believed to separate from the dispersion in the region of the electric field.

The dispersion discharged from between the electrode and cells is passed continuously into the plurality of side by side, open ended, flow-channels which are defined by the vertical cells 44. In the cells 44, the electric field-treated dispersion carrying the remainder of the coalescing internal phase, flows upwardly under substantially uniform flow conditions. Thus, the cells 44 provide optimum flow conditions to permit further coalescence and final separation of the coalesced internal phase aqueous material from the external phase organic liquid.

The upward flow of fluid in each of the cells 44 passes continuously through the orifices 52 which are arranged to regulate the flow from each of the vertical cells to substantially identical rates. The fluids flowing from the orifices 52 join above the header 37 into a large stream of the organic material substantially free of the internal phase and impurities. The organic material is taken from the treater 11 as an overhead effluent.

The aqueous material and impurities, separated from the dispersion, accumulate within the lower portion of the container by gravitational effects and are taken as a bottom effluent from the treater 11.

It has been found that in the present process, a voltage gradient of between about 50 and about 120 volts per inch spacing between the energized electrode 53 and the cells 44 provides most acceptable results in resolving highly conductive dispersions. More particularly, where the electrode 53 is spaced about 4 inches from the lower portions 47 of the cells 44, and also the grounded electrode 81, the potential applied to the electrode 53 should be in a range of about 200 and about 500 volts for good results. Usually, the gradient need not be above about 1000 volts per inch spacing between the electrodes establishing the electric field for acceptable results.

It has been found that large amounts of impurities can be removed from the organic material if the dispersion is intermixed with water before being subjected to the electric field. More particularly with reference to FIG. 1, water is passed through the conduit 14 to merge with the dispersion being supplied to the treater 11. The pump 18 and valve 19 in the conduit 12 intimately mix the water with the dispersion. Any amount of water intermixed with the dispersion, within reasonable limits, assists in removing the impurities from the organic material. However, good results have been obtained where the water is employed in an amount from about 5 to 35 volume percent of the dispersion being sent to the treater 11.

From the foregoing it will be apparent that there has been provided an apparatus for resolving conductive dispersions. Various changes may be made in the apparatus without departing from the spirit of this invention. The foregoing description is to be taken as illustrative and not limitative of the present invention. Reference should be made to the appended claims for definition of the scope of the present invention.

What is claimed is:

1. A treater for resolving a dispersion containing immiscible external and internal liquid phases, said treater including in combination;

a. a closed container having an upright flow axis;

- b. an impermeable header dividing the interior of said container into vertically opposed upper and lower zones separated by said header;
 - c. said lower zone within said container including a dispersion treating zone;
 - d. a plurality of vertical cells within said container and residing in said lower zone, said cells compositely occupying substantially the entire horizontal cross-sectional area of said dispersion treating zone, and said cells having upper exit portions immediately below said header, an unobstructed central portion and lower entrance portions opening onto an entrance chamber in the lower interior of said container below the lower ends of said cells;
 - e. a dispersion inlet means opening into said entrance chamber at a level below said cells;
 - f. the lower interior of said entrance chamber comprising a settling zone adapted to collect as a body any internal phase separated from said dispersion at a position thereabove;
 - g. said vertical cells providing the sole connection for fluid flows between said entrance chamber and said header and in which cells the dispersion rises as small streams toward the upper exit portions thereof to induce separation of said internal phase from said dispersion to produce a treated external phase of the dispersion containing only a small residual amount of said internal phase;
 - h. means for equalizing the upward velocity of said small streams rising in the respective vertical cells, said last-named means including a plurality of relatively small metering orifices provided in said header for forming the sole exit for said external phase from said upper exit portions of said cells into said upper zone above said header, the number and spacing of said metering orifices being related to the spacing and cross-sectional size of said vertical cells for a rate of dispersion inflow to produce on said external phase flowing through the metering orifices a pressure drop substantially higher than the pressure drop developed on fluids flowing through said vertical cells;
 - i. treated external phase effluent means opening on said upper zone; and
 - j. separate internal phase effluent means opening on said lower interior of said settling zone.
2. A treater for resolving a dispersion containing immiscible external and internal liquid phases, said treater including in

combination;

- a. a closed container having an upright flow axis;
 - b. effluent removing means opening into the upper and lower ends of said container;
 - c. dispersion inlet means opening into the container; and
 - d. flow straightening means providing fluid communication in a dispersion treating zone residing between said dispersion inlet means and the upper end of said container, said flow straightening means including a plurality of vertically aligned elongated cells within said container forming side-by-side open-ended and unobstructed flow channels occupying substantially the entire horizontal cross-sectional area of said container, said vertical cells at their upper ends engaging an impermeable header in substantially fluid tight relationship, said header dividing the interior of said container into fluid-isolated, vertically opposed upper and lower zones, and flow equalizing means including orifices in said header forming the sole fluid communication between said vertical cells and said upper zone, and said flow straightening means thereby providing substantially uniform flow conditions in said vertical cells whereby fluid flows upwardly and continuously at uniform rates in each vertical cell throughout all fluid flowing in said dispersion treating zone from said dispersion inlet means toward the upper end of said container.
3. The treater of claim 2 wherein said vertical cells are formed by spaced-apart opposing parallel planar walls which walls are vertically oriented in said container.
4. The treater of claim 3 wherein each of said vertical cells has a length at least three times its maximum width.
5. The treater of claim 3 wherein said orifices are arranged to regulate the flows from said vertical cells to substantially identical rates.
6. The treater of claim 3 wherein said walls of said vertical cells have a rectangular cross-sectional configuration in a horizontal plane.
7. The treater of claim 5 wherein said walls of said vertical cells define a square cross-sectional configuration.
8. The treater of claim 3 wherein the number of spacings of said orifices are related to the spacing and cross-sectional size of said vertical cells for a rate of dispersion inflow to produce on said external phase flowing through said orifices a pressure drop substantially higher than the pressure drop developed on fluids flowing through said vertical cells.

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