

Jan. 22, 1946.

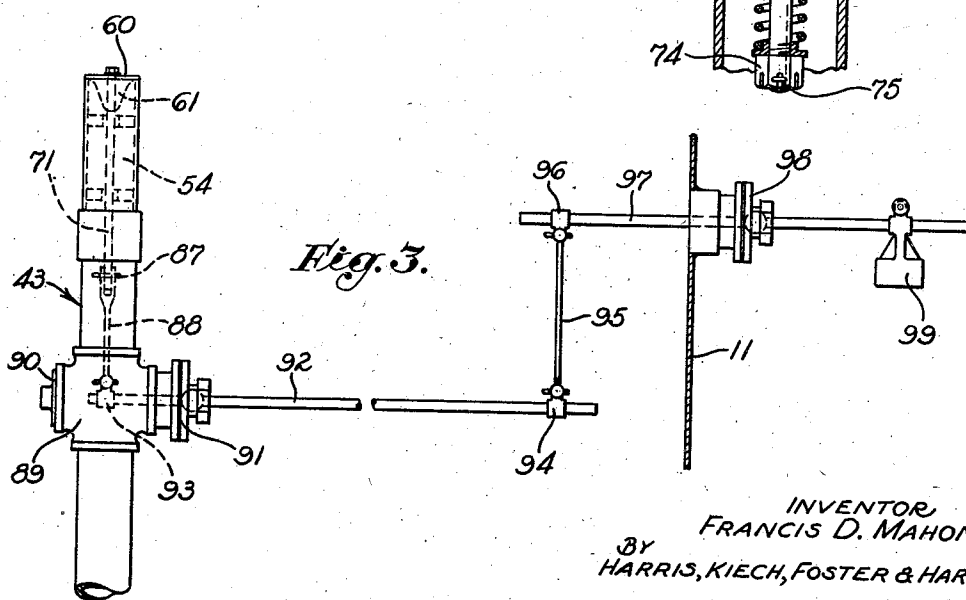
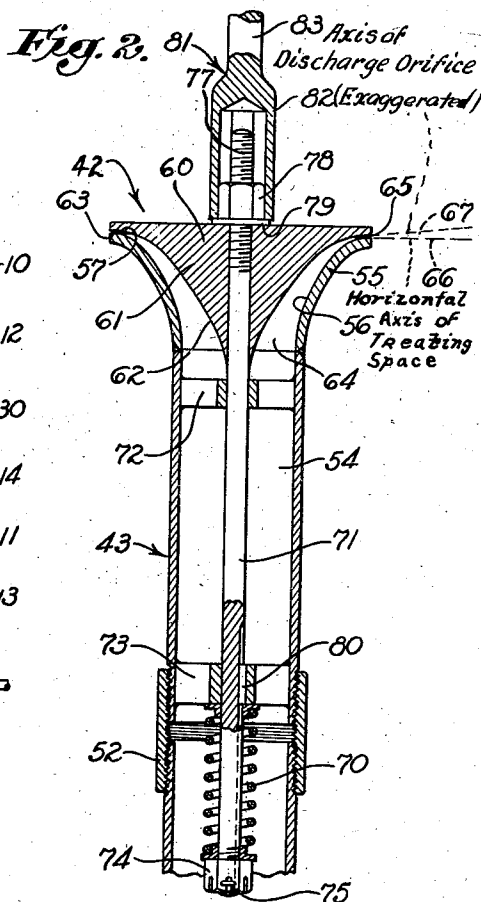
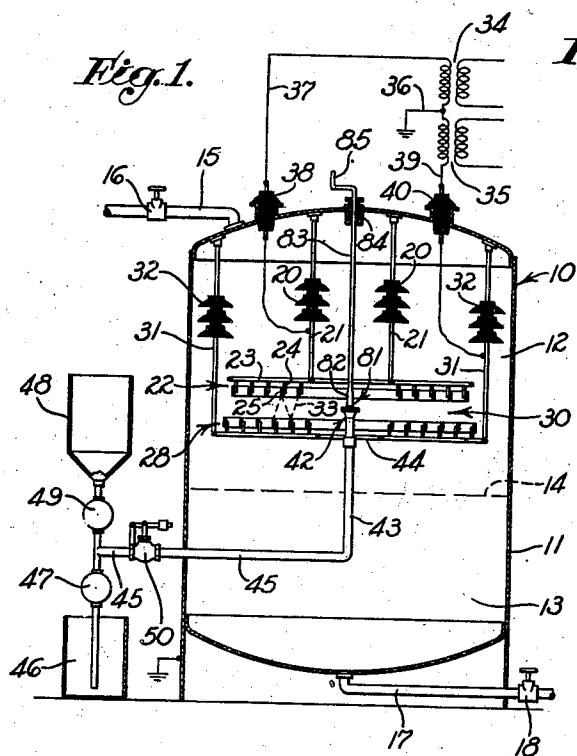
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2,393,328

EMULSION INTRODUCTION SYSTEM FOR ELECTRIC EMULSION BREAKERS

Filed July 26, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

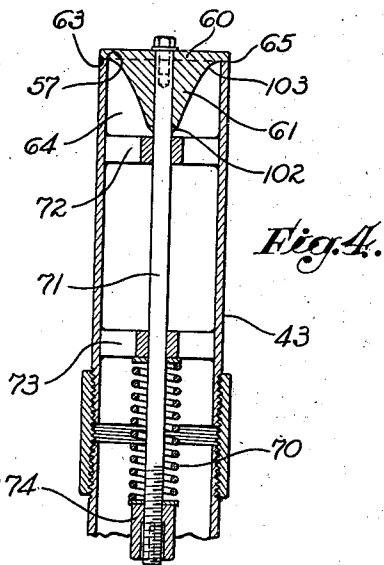


Fig. 4.

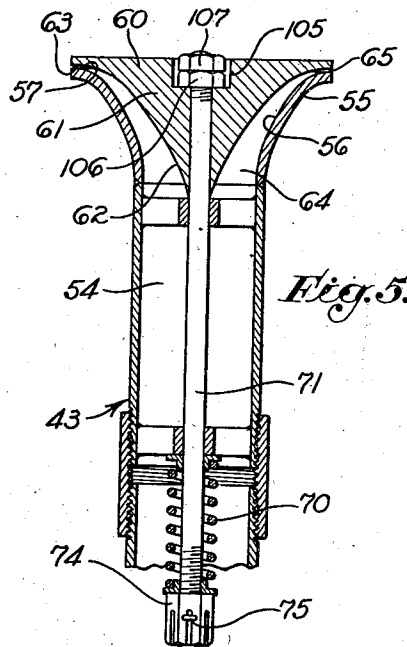


Fig. 5.

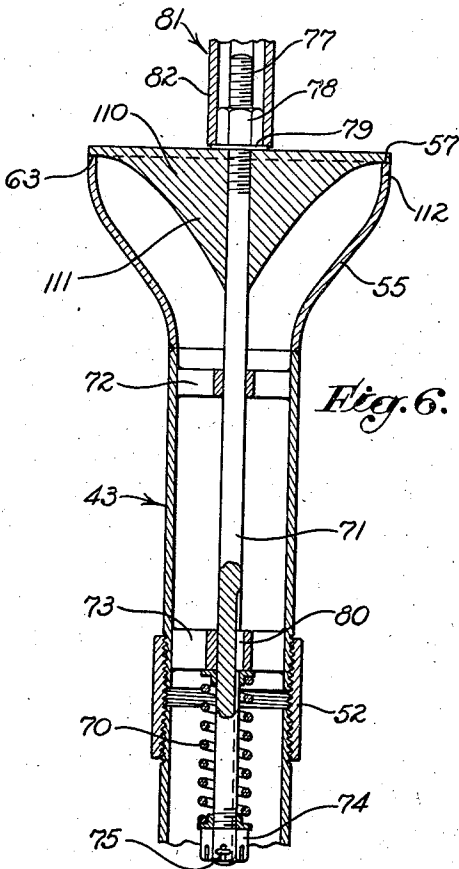


Fig. 6.

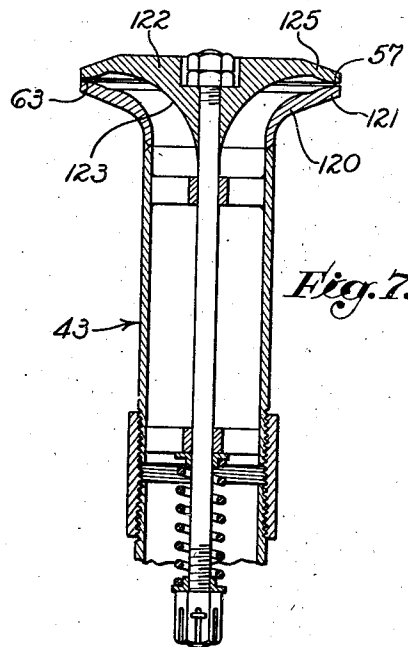


Fig. 7.

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2,393,328

EMULSION INTRODUCTION SYSTEM FOR
ELECTRIC EMULSION BREAKERS

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8 Claims. (Cl. 204—302)

My invention relates to electric treaters and, more particularly, to a novel system for distributing emulsions or other fluid to a treating space.

In the electric treatment of emulsions, whether naturally-occurring or artificially formed, it is often desirable to discharge the emulsion as a thin sheet into the treating space. Often, this treating space is formed by horizontally-disposed electrodes superimposed to define an annular treating space in which is established an electric field.

It is an object of the present invention to provide an improved distributor for emulsions or other fluids in which excessive mixing or emulsification is avoided even though the stream is flattened into a thin sheet preparatory to discharge into a treating space, the thickness of this sheet being only a small fraction of an inch.

This I accomplish by guiding the fluid or emulsion toward the point of discharge through a passage which gradually decreases in cross-sectional area to accelerate the fluid or emulsion preparatory to discharge.

It is another object of the invention to provide a distributor for emulsions or other fluids including a pipe means open at one end and a head member extending across this open end, this head member providing a tapered portion extending centrally into the pipe means to pierce the stream and effect a desirable spreading thereof.

Another object of the invention is to provide such a distributor for emulsions or other fluids in which the pipe means is flared adjacent the open end thereof whereby the diameter of the discharge orifice is larger than the diameter of the pipe means. This permits discharge of the fluid or emulsion at a position closer to the electrodes without danger of short-circuiting between the distributor and one or both electrodes.

Another object of the invention is to provide a variable orifice distributor within a tank and a novel means for varying the size of the orifice from the exterior of the tank.

Still another object of the invention is to provide a distributor in which a resilient force is exerted on one portion of a distributor to control the throttling action thereof, and to provide an adjustment operable from a position exterior of the tank for changing the amount of the resilient force.

Additional objects of the invention reside in the constructional details of the distributor per se.

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

Referring to the drawings:

Figure 1 is a vertical sectional view of one form of electric treater illustrating one embodiment of the invention;

Figure 2 is a vertical sectional view of the distributor shown in Figure 1;

Figure 3 is a fragmentary view indicating an alternative adjustment system for a distributor; and

Figures 4, 5, 6, and 7 are, respectively, vertical sectional views of different alternative forms of distributors.

By way of example, the invention will be described with reference to an electric treater for artificially-formed emulsions such as are produced in the electrical process for purifying liquids. It should be understood, however, that the invention is applicable also to the treatment of naturally-occurring emulsions or to other fluids.

Referring particularly to Figure 1, I have shown a closed-type pressure treater, indicated generally by the numeral 10, including a tank 11 containing emulsion constituents. If this treater is used to coalesce the dispersed water phase of a water-in-oil emulsion, the upper portion of the tank, indicated by the numeral 12, provides an oil environment in which treatment and separation of the emulsion constituents take place. In the bottom of the tank will be a body of separated water 13, the upper surface of which is indicated approximately by the dotted line 14. The water content in the upper zone 12 decreases toward the upper end of the tank so that the purified oil can be withdrawn through a pipe 15, as controlled by a valve 16, the water content of this being relatively low, often being only a small fraction of 1% and usually not exceeding about 3%. Similarly, the separated water is withdrawn from the lower portion of the tank through a pipe 17, as controlled by a valve 18. The valves 16 and 18 are usually throttled to such an extent as to maintain a superatmospheric pressure within the tank 11.

Suspended from insulators 20 and rods 21 within the tank 11 is an upper electrode 22. This electrode may consist of a foraminous frame 23 with pins 24 depending therefrom to retain in concentric relationship a plurality of rings 25. The effective portion of the electrode is defined by the lower edges of these concentric rings 25.

Similarly, a lower electrode 28 is suspended below the upper electrode 22 to define a treating

space 30, this suspension being through rods 31 and insulators 32. The lower electrode 28 may provide concentric rings similar to the upper electrode 22, but preferably positioned below the spaces between the rings 25 of the upper electrode. If, in this construction, a difference in potential is established between the upper and lower electrodes 22 and 28, an electric field will be established in the treating space 30 and the most intense portions of this field will be inclined as indicated by the dotted line 33.

Various other forms of electrodes can be utilized and it is not always essential to insulate both of the electrodes from the tank. In some instances, one of the electrodes can be grounded and the remaining electrode insulated from the tank but, in general, the distributor of the invention finds particular utility in combination with a treating space defined between two live electrodes.

High potentials are applied to the electrodes by the electrical system diagrammatically shown in Figure 1. This includes transformers 34 and 35 connected in additive relationship, one terminal of each of the two secondary windings being connected to ground as indicated by the numeral 36. The remaining high-voltage terminal of the transformer 34 is connected by a conductor 37, extending through a bushing 38, to one of the rods 21 and thus to the upper electrode 22. The remaining high-voltage terminal of the transformer 35 is connected by a conductor 39, extending through a bushing 40, to one of the rods 31 and thus to the lower electrode 28. Such potentials are used as will establish a field in the treating space 30 of sufficient intensity to coalesce the dispersed water droplets and, if the process is used for electric purification, to bring the dispersed impurities into association with the water. Each of the transformers 34 and 35 may develop a potential of several thousand volts, if desired, and, in many instances, potentials as high as 33,000 volts have been used with success.

The invention is particularly concerned with the manner in which the emulsion is delivered to the annular and outward-extending treating space 30. It has previously been proposed to move this emulsion through an open-ended pipe with a flat plate extending across the open end and against which the emulsion impinges preparatory to being discharged outward into the treating space 30. On certain emulsions, difficulty has been encountered in treating the emulsion to the extent desired, and I have found that such a distributor tends to emulsify excessively the constituents adjacent the point of discharge into the electric field. On some oils containing relatively large amounts of emulsifying agents or containing even small amounts of a powerful emulsifying agent, the mixing at this point resulting from the use of such a distributor will tend to form an emulsion which is difficult to treat in the electric field.

In solving this problem, I have used with great success a distributor means, indicated generally by the numeral 42, which spreads the emulsion before discharge outward into the treating space 30 and decreases the mixing action and the turbulence in the distributor means preparatory to discharge. As shown in Figure 1, this distributor means 42 is disposed to direct the emulsion outward into the treating space 30 and consists of a pipe means 43 extending upward through an opening 44 of the lower electrode 28. This pipe means is fed by a pipe 45 extending to a position outside the tank. If the treator is to be used for elec-

trically purifying oils of low water content, such oils may be withdrawn from a tank 46 by a pump 47 and delivered to the pipe 45. Water may be withdrawn from a tank 48 and proportioned into the oil stream by a pump 49. Sufficient mixing may take place at the junction of the oil and water streams but, in many instances, it is desirable to dispose a mixing valve 50 in the pipe 45 to mix or emulsify the oil and water additionally. The details of the electrical purification process need not be described in detail as reference may be had to the patent to Harold C. Eddy, No. 2,182,145, in this connection. Suffice it to say for the purpose of the present application that an emulsion, however formed, moves along the pipe 45 and is discharged radially outward into the treating space 30 by the distributor means 42.

This distributor means 42 is best shown in Figure 2, in which the pipe means 43 is shown as being formed in sections connected by a coupling 52. The upper portion of the pipe means 43 defines a passage 54 and provides a flared portion 55 constituting a lower member of the distributor means 42. The inner surface 56 of this flared portion 55 diverges upward and outward to provide an end wall 57 which, in this embodiment of the invention, comprises a seat. Adapted to engage this seat in surface-to-surface contact when no emulsion is being delivered through the pipe means 43 is an upper or head member 60 providing a tapered portion 61 extending downward into the pipe means 43 to pierce the rising stream of emulsion. This tapered portion 61 provides a tapered wall 62 for guiding the emulsion outward to a wall 63 opposite the end wall 57. When emulsion is delivered under pressure through the pipe 43, it thus flows through a tapered passage 64 formed between the walls 56 and 62 so that its velocity gradually increases and its direction of flow is gradually changed. The upper portion of the tapered passage 64 comprises, or feeds into, an annular discharge orifice 65 formed between the walls 57 and 63 which are spaced slightly from each other by the emulsion flow.

In the preferred embodiment of the invention, the walls 57 and 63 are substantially parallel but are inclined slightly above the horizontal axis of the treating space 30. This horizontal axis is indicated in Figure 2 by the dotted line 66 and the axis of the annular discharge orifice 65 is indicated (greatly exaggerated in inclination for purpose of clarity) by the numeral 67. In other words, the emulsion is preferably discharged toward the field at an angle which is slightly above the horizontal, the direction of initial discharge corresponding to the dotted line 67. This angle of inclination should not be more than a few degrees. Usually it is in the neighborhood of one degree but should never exceed more than three or four degrees.

It has been found that considerably better treatment takes place if the direction of initial discharge is slightly inclined. While I do not intend to be bound by any theory in this regard, I believe this is due to a lengthened trajectory of the discharged emulsion. Usually, the water content of the material in the electric field is considerably lower than the water content of the incoming emulsion so that the incoming emulsion is of greater density. Thus, there is a tendency, immediately upon discharge of the thin sheet, for the discharged emulsion stream to drop under gravitational action in the oil environment in the field. Preferably, the direction of initial discharge is inclined so as to compensate for

this and thus maintain the emulsion in a more central position in the treating space during its travel therethrough. If the initial discharge were horizontal, the sheet of emulsion would tend to droop toward the lower electrode and the stream velocity would decrease rapidly. Measurements of velocity in the treating space show considerably higher velocities when the stream is slightly inclined, as mentioned above, this being another factor contributing to better treatment.

The inner surface 56 and the tapered wall 62 are preferably formed of such configuration as to accelerate the emulsion gradually as it flows along the passage 64, with a minimum of turbulence or eddy formation such as would tend unduly to mix or re-emulsify the oil and water constituents of the stream. In the form shown in Figure 2, this is accomplished by forming the major portion of the length of the inner surface 56 and the tapered wall 62 of general parabolic shape, for example in the shape of a parabolic section such as would be generated by turning a parabola about the axis of the pipe means 43. Correspondingly, throughout a substantial portion of the length of the passage 64, a plane extending radially from this axis will intersect the inner surface 56 and the tapered wall 62 to form a parabolic curve. In some instances, conic sections differing from a parabolic configuration can be used to form the tapered passage 64 if the configuration is such as to gradually accelerate and deflect the stream. It is quite important in this connection to use a head member providing a tapered portion extending into the pipe means 43 to pierce the rising stream.

It is desirable to impress on the head member 60 a resilient force in a downward direction, this force being opposed by the force exerted by the incoming stream. In this manner, the distance across the annular discharge orifice 65, while always small, will vary with variations in the amount of emulsion introduced through the pipe 45. In Figure 2, this resilient action is obtained by a spring 70 surrounding a rod 71 which is slidably mounted in the pipe means 43 by guide means comprising spiders 72 and 73 welded or otherwise secured at spaced positions in the passage 54. The spring 70 is compressed between the spider 73 and the lower end of the rod 71, which is shown as including a nut 74 appropriately secured thereto as by a cotter pin 75.

The upper end of the rod 71 is shown as extending through the head member 60 to provide an upper threaded portion 77 thereabove. On this portion is threaded a nut 78 separated from the head member 60 by a washer 79 or other means permitting rotation of the nut 78 relative to the head member. The rod 71 is preferably kept from turning by a key 80 extending into corresponding keyways of the rod and the spider 73. Correspondingly, by turning the nut 78, the rod will be pulled upward to increase the compression of the spring 70, thus increasing the resilient force tending to move the head member 60 downward.

It is desirable to be able to adjust the resilient downward force from a position outside the tank 11. In Figure 2, this is accomplished by use of a suitable control means including an adjustment member 81 extending to a position outside the tank 11. This adjustment member includes a socket 82 connected to a rod 83 extending upward through a stuffing box 84 to a position outside the tank. A crank 85 or other means can be used for turning the rod 83 and thus the socket 82.

The downward resilient force can thus be adjusted from the exterior of the tank 11 even while the treater is in operation.

Another way of exerting a downward resilient force on the head member 60, this force being adjustable from the exterior of the tank, is shown in Figure 3. Here, the spring 70 is eliminated and the lower end of the rod 71 is pivotally connected by a pin 87 to a link 88 extending downward in the pipe means 43 to the interior of a cross fitting 89 disposed therein, there being a plug 90 which closes one of the openings thereof. In the opposite opening is disposed a gland means 91 which pivotally retains and acts as a fulcrum for a lever 92 extending inward and carrying an attachment member 93 which is pivoted to the link 88. The outer end of the lever 92 carries an attachment member 94 pivoted to a link 95 which, in turn, is pivoted to an attachment member 96 secured to a lever 97 extending to a position outside the tank 11. A gland means 98 adjacent the tank 11 serves as a fulcrum and as a sealing means for the lever 97. The outer portion of the lever 97 carries an adjustable weight 99, or is otherwise urged downward by a resilient force. This tends to pivot the lever 97 in a manner to raise the outer portion of the lever 92, resulting in a resilient downward force being applied to the head member 60.

The system shown in Figure 3 can be used in conjunction with the distributor means shown in Figure 2 but has been shown in combination with a distributor means of slightly different configuration in which the upper end of the pipe means does not flare but extends upward to form the end wall 57 previously described. The head member 60 in this embodiment still provides a tapered portion 61 extending downward into the pipe means 43 and is of a configuration best shown at the upper end of Figure 4.

Referring particularly to Figure 4, the lowermost portion of the tapered portion 61 is rounded, as indicated by the numeral 102, above which the tapered portion 61 is substantially conical for a distance and then flares outward as indicated by the numeral 103 to form the end wall 63 which cooperates with the end wall 57 in forming the annular discharge orifice 65. In this embodiment, the passage 64 is still tapered and this embodiment can be used where it is not objectionable to accelerate the stream less uniformly than in the embodiment shown in Figure 2.

Also in Figure 4, the rod 71 is journaled in the spiders 72 and 73 and the spring 70 is compressed between the spider 73 and the nut 74. This embodiment can be used with or without an external adjustment, as previously described.

Figure 5 shows the distributor of Figure 2 as employed when no external adjustment is desired. It differs primarily from Figure 2 in providing a recess 105 in which is positioned a nut 106 threaded to the rod 71, a lock nut 107 being used to retain the predetermined adjustment.

In Figure 6, the distributor means includes a parabolic head member 110 formed similar to that described with reference to Figure 2, the tapered portion being indicated by the numeral 111. This is disposed in the pipe means 43, the upper end of which is flared in a manner slightly different from that shown in Figure 2. In this embodiment, the portion 55 is flared at first outward and then returns upward to form a portion 112 which extends vertically to form the end wall 57 opposite the end wall 63 of the head member. This embodiment is externally adjustable in the same manner as described with reference to Figure 2.

It produces somewhat more turbulence and mixing than does the embodiment shown in Figure 2 but can be used on various emulsions.

The distributor means shown in Figure 7 uses a flared portion 120 ending in an inclined wall 121 forming the end wall 57 previously described. The head member is indicated by the numeral 122 and includes a tapered portion 123 extending downward into the pipe means 43. The curve of this tapered portion may be such as would be generated by turning a quadrant of a circle about the axis of the pipe means 43. At the upper extremity of this curve, the member 122 provides an inclined wall 125 which is inclined downward to form the end wall 63 previously defined.

It will be apparent that any of the embodiments shown in Figures 4 to 7 can be used in conjunction with the resilient and externally-adjustable means of Figures 1 and 3 without departing from the spirit of the invention.

I claim as my invention:

1. In combination in an electric treating system for forming and resolving emulsions: a pair of electrodes extending outwardly from an axis and spaced from each other in the direction of said axis to define an annular treating space; pipe means extending along said axis through one of said electrodes toward the center of said annular treating space, said pipe means being open at that end adjacent said treating space and providing an end wall; means for delivering to said pipe means a stream comprising oil and water; a head member extending across said open end of said pipe means and cooperating with said end wall in defining an annular discharge orifice directed toward and along said treating space, said head member providing a tapered portion extending centrally into said pipe means and tapering inwardly and downwardly from a position adjacent said annular discharge orifice to spread the stream flowing therein and guide said stream to said discharge orifice, said stream tending to move said head member away from said end wall; and means for exerting a resilient force on said head member tending to oppose stream-induced motion of said head member away from said end wall, said resilient force being insufficient to prevent discharge of said stream but being sufficient to retain said head member close to said end wall to form a narrow annular stream issuing at high velocity from said annular discharge orifice and discharging into said treating space.

2. A combination as defined in claim 1, in which said end wall is annular and is of larger diameter than said pipe means, and in which said pipe means flares outward toward said end wall whereby the stream is guided between said tapered portion of said head member and said flared portion of said pipe means in moving toward said discharge orifice.

3. In combination in an electric treater: a pair of electrodes defining a treating space; pipe means extending to a position adjacent said treating space, said pipe means providing an open-ended flared portion having an inner surface terminating in an end wall; a head member extending across said open-ended flared portion of said pipe means and providing a tapered portion extending axially into said flared portion of said pipe means, said tapered portion having a tapered outer surface terminating in a wall substantially parallel with and adapted to seat against said end wall of said flared portion; means for mounting said head member to move

away from said flared portion to provide an annular discharge orifice between said end wall of said flared portion and said wall of said head member, said annular discharge orifice being directed to deliver an outwardly-flowing stream into and along said treating space, said tapered outer surface of said tapered portion cooperating with said inner surface of said flared portion to provide a stream-conducting passage which gradually decreases in cross-sectional area toward said annular discharge orifice; means for exerting a resilient force on said head member tending to move same toward said flared portion; and means for advancing along said pipe means under pressure a stream comprising oil and water, said stream tending to move said head member away from said flared portion and said pressure being sufficient to overcome said resilient force, said stream-conducting passage progressively increasing the velocity of flow of said stream toward said annular discharge orifice for discharge from said orifice into said treating space.

4. A combination as defined in claim 3, in which said walls of said tapered portion and said flared portion are substantially parabolic in shape in planes extending radially outward from the axis of said pipe means.

5. In combination in an electric treating system for emulsions: electrode means defining an outward-extending treating space; and a distributor means for receiving an emulsion and discharging a stream thereof into and along said treating space, said distributor means providing upper and lower members including substantially parallel walls defining an emulsion discharge orifice, said walls being slightly inclined upwardly with respect to the axis of said outward-extending treating space to discharge said emulsion into said treating space in an initial direction which is inclined upwardly by not more than four degrees from the axis of said outward-extending treating space.

6. In combination in an electric treating system for forming and resolving water-in-oil emulsions: a tank containing emulsion constituents comprising oil and water undergoing separation; a pair of substantially horizontal electrodes spaced vertically from each other to define a treating space in said tank; a conduit extending into said tank; means for delivering a stream comprising oil and water to said conduit under pressure; a mixing-type distributor means comprising a stationary member providing a passage communicating with said conduit to receive said stream comprising oil and water, and a movable member extending across said passage and providing a tapered portion extending into said passage to spread said stream, said members providing substantially parallel outwardly-extending walls cooperating in defining a discharge orifice receiving said spread stream for radial discharge thereof as a thin sheet into and along said treating space; a spring means connected operatively to said members to exert a resilient force on said movable member tending to move same toward said stationary member and to bring said walls closer together to decrease the thickness of the radially-discharged stream and to exert on such stream a spring-means-controlled mixing action at the instant of discharge into said treating space; and means for adjusting the mixing action of said distributor means from a position outside said tank and during the time that said stream is delivered thereto under pressure through said conduit, said

means including means for adjusting said resilient force exerted by said spring means from a position outside said tank.

7. A combination as defined in claim 6, in which said spring means is disposed in said passage and in which said means for adjusting said resilient force comprises a member operatively associated with said spring means and disposed partially within said passage and partially within said tank at a position beyond said passage.

8. In combination in an electric treating system for resolving water-in-oil emulsions: a tank containing emulsion constituents comprising oil and water undergoing separation; a pair of substantially horizontal electrodes spaced vertically from each other to define a treating space in said tank; a conduit extending into said tank; means for delivering a stream comprising oil and water to said conduit under pressure; a distributor means comprising a stationary member providing a passage communicating with said conduit to receive said stream comprising oil and water, a movable member extending across said passage and providing a tapered portion piercing said stream to spread same progressively as it moves along said tapered portion, said mem-

bers cooperating in defining a discharge orifice receiving said spread stream and for discharging same as a thin sheet into and along said treating space; a rod extending from said movable member; a spring means; connection means for operatively connecting one end of said spring means to said rod to exert a resilient force on said rod tending to move said movable member toward said stationary member to decrease the size of said discharge orifice and decrease the thickness and increase the velocity of said thin sheet discharged into said treating space; and means operable at a position outside said tank and during the time that said stream is delivered to said distributor means under pressure through said conduit for adjusting the resilient force exerted by said spring means on said rod. said last-named means including adjustment means for changing the deformation of said spring means and a control means extending from said adjustment means to a position outside said tank for operating said adjustment means to change the resilient force exerted on said movable member by said spring means.

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