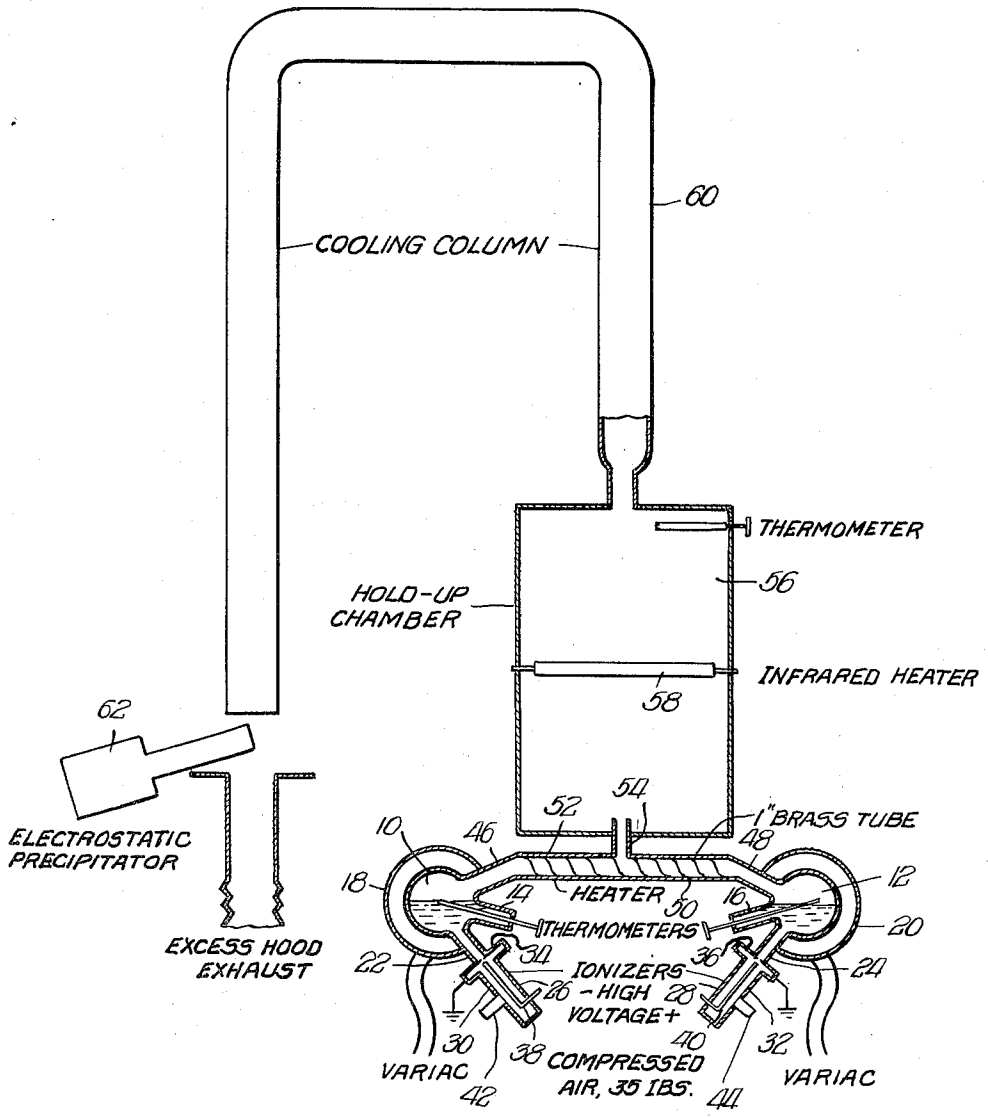
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APPARATUS FOR ELECTROSTATIC ENCAPSULATION

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APPARATUS FOR ELECTROSTATIC ENCAPSULATION

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This invention relates in general to an encapsulation apparatus and in particular to apparatus for encapsulating minute particles within a coating of an encapsulating substance.

In accordance with this invention encapsulation apparatus is provided wherein aerosol particles in the submicron and micron range are encapsulated by an encapsulating substance for the purpose of protecting the encapsulated material from the external environment and for the purpose of reducing the encapsulated substance to a fine powder which is readily transported and stored. Encapsulation of an encapsulable material by an encapsulating substance can be accomplished by separately forming aerosols of the material to be encapsulated and the encapsulating substance and mixing the materials to be encapsulated with the encapsulating substance so as to cause the collision and ultimate surrounding by the encapsulating substance around the material to be encapsulated. This can be accomplished by directing aerosol streams of material to be encapsulated into aerosol streams of encapsulating substance with the result that certain of the particles to be encapsulated will collide with the encapsulating substance to thereby form the resultant desired particles which will be composed of the material to be encapsulated surrounded by the encapsulating substance.

It has been proposed in co-pending patent application of Berger et al., Serial No. 148,574, filed on October 30, 1961, and assigned to the same assignee, that aerosol encapsulation be performed through the use of electrostatic charging of the material to be encapsulated and the encapsulating substance and to charge the material to be encapsulated with a charge opposite to the charge on the encapsulating substance. In the previously identified patent application a specific type of electrostatic atomization was disclosed and this type of atomizing or forming of aerosol particles with a predetermined charge thereon was utilized to prevent the formation of free ions that would accompany the charged aerosol particles. It was observed that if a number of ions were produced at the same time that the charged aerosol particles were produced and were permitted to accompany the charged aerosol particles into the coagulating region, that is, the space wherein the oppositely charged aerosol particles are directed for collision, that these ions would have an undesired and noticeable neutralizing effect on the aerosol particles charged with the opposite sign.

Further, it was observed that there would be a greater coagulation of oppositely charged aerosol particles if the kinetic energy of the aerosol particles was reduced; in other words, the higher the velocity of the cloud or stream of aerosol particles, the lower the collision or coagulation rate, and consequently the less encapsulation that would occur.

Also, it was observed that the presence in the coagulating region of the lines of force of the electrostatic field used to charge the aerosol particles had a detrimental effects upon the collision of coagulation rate of the aerosols.

Previously it was believed that charging aerosols through the use of a corona discharge device was inadvisable inasmuch as an excess of ions also would be

produced which eventually would have a neutralizing effect in the coagulating or collision chamber thereby reducing the efficiency of the encapsulation process. It also was believed that pneumatic atomization, or pneumatic aerosol generation, would result in aerosol particles possessing an undesired quantity of kinetic energy which would reduce the probability of the charged aerosols colliding with one another in the coagulating chamber.

It is an object of this present invention to provide apparatus for causing the encapsulation of an aerosol material in an encapsulating substance.

Another object of this invention is to provide apparatus for the encapsulation of aerosol material in an aerosol encapsulating substance wherein the material being encapsulated and the encapsulating substance are charged with opposite electrostatic charges in isolated chambers before they are mixed for collision or coagulation.

It is another object of this invention to provide apparatus for the encapsulation of material to be encapsulated by an encapsulating substance wherein oppositely charged aerosol particles comprising material to be encapsulated and the encapsulating substance are formed through the use of individual corona discharge devices.

It is another object of this invention to provide apparatus for the encapsulation of a material to be encapsulated by an encapsulating substance wherein oppositely charged aerosol particles of material to be encapsulated and encapsulating substance are formed through the use of a pneumatic aerosol generator.

It is another object of this invention to provide apparatus for the generation of aerosols of a given charge wherein a combined corona discharge device and a pneumatic aerosol forming device is utilized to provide the charged aerosols.

Another object of this invention is to provide apparatus for encapsulating a material to be encapsulated in an encapsulating substance wherein the material to be encapsulated and the encapsulating substance are formed into oppositely charged aerosol particles which are directed to a collision or coagulation region and then subsequently to a cooling chamber and a collection station where the encapsulated end product is withdrawn from the system.

Briefly, in a preferred embodiment of the invention liquid material to be encapsulated is formed into charged aerosol particles in the submicron and micron range in a first chamber and a liquid encapsulating substance is formed in a second separate chamber into oppositely charged aerosol particles in the submicron and micron range. The oppositely charged aerosol particles to be encapsulated and the encapsulating particles are permitted to enter a coagulation or collision region wherein the oppositely charged aerosol particles collide with one another to form the resultant encapsulated end product. Next, the encapsulated end products are permitted to cool to enable the encapsulating liquid to return to its normal solid state. Finally, the aerosol particles are delivered to a collector where the coagulated particles are removed from the system.

The charged aerosol particles are formed in the first and second chambers through the use of a combination corona discharge device and pneumatic aerosol forming apparatus. The liquid material to be encapsulated and liquid encapsulating substance are maintained in the liquid state if necessary by means of heating coils. A pair of corona discharge devices adapted to emit streams of charged ions are positioned contiguous with said first and second chambers and in contact with the liquid material to be encapsulated and the encapsulating substances, respectively.

A stream of compressed air enters the corona discharge device at a comparatively high velocity and passes through the area of corona discharge where copious ions are

formed in the air stream. The air stream then impinges and penetrates into the liquid material to be encapsulated in one of the aforementioned chambers and into the encapsulating substance in the other of the two aforementioned chambers wherein the force of the air stream causes aerosol particles in the submicron range to be formed in the first and second chambers, respectively. At the same time that the aerosol particles are being formed in the first and second chambers these aerosol particles are charged by diffusion by the stream of ions accompanying the air stream. In other words, the free ions leaving the corona discharge device are deposited on the liquid drops being formed into aerosols. In the preferred embodiment of the invention heat is applied to the materials being encapsulated and the encapsulating substance for the purpose of insuring that the encapsulating material is in a liquid state and also so that all the aerosol particles will be approximately at the same temperature so that there will be no heat exchange between the aerosol particles as they collide with one another thereby enabling the encapsulating substance to more readily form around the material being encapsulated.

Other advantages, objects and features of this invention will be more clearly understood if the following is viewed in light of the accompanying drawing wherein a preferred embodiment of the encapsulation apparatus is diagrammatically illustrated.

Referring now to the drawing, there is illustrated a system for forming and collecting an encapsulated end product comprising an encapsulated liquid aerosol falling in the submicron or micron range and an encapsulating substance preferably forming a solid covering under normal atmospheric conditions for the encapsulated liquid aerosol so that the collected end product is dry to the touch and can be handled and stored as a fine dry powder.

There is illustrated a pair of three-neck round glass flasks **10** and **12**, positioned as shown and containing the material to be encapsulated and the encapsulating substance, respectively. The three-neck flasks **10** and **12**, which in one embodiment of the invention were 500 milliliter flasks, are positioned as illustrated in the drawing and the center necks **14** and **16** of the flasks **10** and **12**, respectively, have thermometers positioned therein, and the necks **14** and **16** are sealed so that the liquid contained within the flasks **10** and **12** cannot flow out through the necks **14** and **16**, respectively.

A pair of heating mantles **18** and **20** are wrapped around the glass flasks **10** and **12**, respectively.

It is desired to have the material to be encapsulated and the encapsulating substance in the liquid state. It also is preferred that after the material to be encapsulated had been encapsulated by the encapsulating substance that the encapsulating substance then harden to a solid. Therefore, in some instances, it will be necessary to heat the encapsulating substance until it is in a liquid state before the encapsulating processes is begun.

It also is desired to have the material to be encapsulated and the encapsulating substance at approximately the same temperature. Therefore, even though the substance or materials being encapsulated may be originally in a liquid form, it also is heated if the encapsulating substance is heated so as to be at the same temperature as the encapsulating substance.

The heating mantles **18** and **20** contain heat producing resistance wires and can be of any type known to those skilled in the art. The heat emanated from the heating mantles **18** and **20** and consequently the temperature of the materials being encapsulated in the encapsulating substance can be manually adjusted by variable power supplies (not shown).

Connected to the lower necks **22** and **24** of the round flasks **10** and **12**, respectively, are a pair of ionizers **26** and **28**, respectively. The ionizers **26** and **28** comprise elongated cylindrical plastic tubes **30** and **32**, respectively, having attached to the upper ends thereof brass caps **34** and **36**, respectively. The brass caps **34** and **36** are secured to the tubes **30** and **32** in any desired manner and each is provided with a small hole in the center such as that hole produced by a number 60 or number 65 drill. The comparative size of the holes are exaggerated for purposes of clarity in the drawing. Axially positioned in the tubes **30** and **32** are a pair of tungsten rods **38** and **40**, respectively. The tungsten rods **38** and **40** can be supported in any suitable manner known in the art and the upper ends of the tungsten needles **38** and **40** are sharpened to a very fine point and are positioned coaxially adjacent the above-mentioned small holes in the brass caps **34** and **36**.

A direct current power source (not shown) is connected across the caps **34** and the tungsten rod **38** in the ionizer **26** thus providing a corona forming direct current potential between the edges of the hole in the cap **34** and the tip of the tungsten rod **38**. Another direct current power source is connected across the caps **36** and the tungsten rod **40** of the ionizer **28**, also providing a corona forming direct current potential between the edges of the hole in the cap **36** and the tip of the tungsten rod **40**. Direct current is utilized inasmuch as it is desired to produce aerosol particles of the same charge in the ionizer **26** and of the opposite charge in the ionizer **28**. The potential of the power source must be sufficient to cause a corona discharge field between the cap **34** and tungsten needle **38** and the cap **36** and the tungsten needle **40** of the ionizers **26** and **28**, respectively. To produce aerosol particles of opposite charges in the respective flasks the potential across ionizer **26** is oppositely polarized to that across ionizer **28**.

The tungsten needles **38** and **40** are positioned so close to their associated caps **34** and **36** that an arcing would occur, if it were not for the fact that a stream of air is passing between the above-mentioned tungsten needles and their associated plates. A source of compressed air (not shown) is connected to ionizer **26** at the inlet **42** and another source of compressed air (not shown) is connected to the ionizer **28** at the inlet **44**. In one particular embodiment of the invention 35 pounds of compressed air was connected to both the inlet **42** and the inlet **44**.

The ionizers **26** and **28** can be connected to the necks **22** and **24** of the round flasks **10** and **12**, respectively, by any means known in the art such as, for example, Tygon tubing. The upper necks **46** and **48** of the round flasks **10** and **12**, respectively, are each connected to one end of tube **50** and these couplings can be made of Tygon tubing also. Tube **50** in one particular embodiment in the invention is a one-inch brass tube. Heating tape **52** is diagrammatically illustrated as being wound about the tube **50** and the heating tape **52** has heating wires embedded therein and the purpose thereof is to maintain the material to be encapsulated and the encapsulating substance in liquid states and also at approximately the same temperatures.

The heating tape **52** is connected to a power source (not shown) and the power source can be provided with manual controls for adjusting the amount of heat released from the heating tape **52**. Connected to the brass tube **50** at the center portion thereof is a small mixing tube **54**, which is of a smaller diameter than the brass tube **50** and which, in one embodiment of the invention, is a ⅜ inch diameter copper tubing. The aerosol particles emanating from the round flasks **10** and **12** move through the pipe **50** and up through the mixing tube **54** and because of the reduced diameter of the mixing tube **54** are in close proximity with one another. The mixing tube **54** leads into the hold-up chamber **56**. In one preferred embodiment of the invention the hold-up chamber **56** is a plastic cylinder approximately 18 inches in height and 12 inches in diameter and is provided with an infra-red heater **58** to maintain the aerosol particles in their liquid state and at approximately the same temperature.

The purpose of the hold-up chamber 56 is to enable the oppositely charged aerosol particles to collide or congeal before they are cooled and collected in the latter part of the system. Inasmuch as the aerosol particles are heated a natural convection is provided and the aerosol particles, after collision and coagulation, flow into the cooling column 60. The cooling column 60 in one embodiment of the invention is a Pyrex tube approximately 4 inches in diameter and is U-shaped as seen in the drawing. The coagulated aerosol particles then pass through the cooling column 60 which can be cooled by the atmosphere or by any desired means. This enables the encapsulating substance, which is in the liquid form during the coagulation period, to harden to a solid form under atmospheric conditions. Thereafter, the coagulated particles pass to the collection station 62 in the system where in this particular embodiment of the invention the coagulated particles are precipitated for collection by an electrostatic precipitator which can be of any commercial type and, for example, can be the well-known Cottrell type of precipitator.

Operation

Initially, material to be encapsulated is placed in the three-neck round flask 12 and an encapsulating substance is placed in the three-neck round flask 10. If, for example, the material to be encapsulated is glycerin and the encapsulating material is a wax, the wax itself will not be in a liquid state under atmospheric conditions and must be heated until it is in a liquid state. The heat is provided by heating mantle 18 and can be manually adjusted to a desired temperature. As previously stated, it is preferable to have the material to be encapsulated also at the same temperature and this can be done by adjusting the output of heating mantle 20 associated with the round flask 12. A source of compressed air is connected to the input 42 and to the input 44 of the ionizers 26 and 28, respectively, as previously stated, and a stream of air passes into ionizer 26 and another stream of air passes into ionizer 28, and up through and out through the small holes provided in the caps 34 and 36 of the ionizers 26 and 28, respectively. These streams of air pass through the strong electric fields existing between the end of the tungsten needle 38 of the ionizer 26 and the tungsten needle 40 of the ionizer 28 and their associated caps 34 and 36, respectively. The tungsten needles 38 and 40 are positioned so close to their associated plates 34 and 36 that a natural arcing would occur if it were not for the fact that a stream of air is passing between these elements. The potentials applied across the tungsten needles 38 and 40 and their associated caps 34 and 36 must be sufficiently great to create an electric field exhibiting the corona discharge effect. Air passing between the tungsten needles and their associated plates is ionized and, therefore, the output of the ionizer 26 and the ionizer 28 is a stream of air having a copious amount of ions provided therein.

The holes in the caps 34 and 36 are so small that the problem of the wax, for example, under operating conditions leaking into the ionizer 26 from the flask 10 and the glycerin in the flask 12 leaking into the ionizer 28 does not occur. If the system is to be turned off it is desirable to remove the ionizers from their contiguous position with respect to the wax and glycerin before the stream of air is cut off.

The streams of air carrying the copious ions passes into the wax in the flask 10 and into the glycerin in the flask 12 and this high velocity stream creates agitation in flasks 10 and 12 thereby providing large amounts of aerosol particles in the submicron and micron ranges. In one particular embodiment of the invention the particle size fell into the range of one-tenth to two microns. No difficulty is envisioned in creating aerosol particles falling into other ranges inasmuch as this can be accomplished by varying the parameters of the system such as the hole size in caps 34 and 36, the velocity of the streams of air and so on.

It is not desired that the aerosol particles which are formed possess high kinetic energy. Therefore, the ionizers 26 and 28 are arranged as illustrated in the drawing, that is, pointed away from the intended direction of movement of the aerosol particles. Therefore, if the aerosol particles emerging from the liquids in flasks 10 and 12 have an excess of energy some of that energy will be dissipated in the flasks 10 and 12, respectively, by bouncing off various surfaces of the flasks 10 and 12. Also, if any comparatively large drops of the liquid are propelled out of the liquid they would normally bounce back into the liquid or settle back into the liquid because of the arrangement of flasks 10 and 12. Also, the pressure of the compressed air can be lowered if the agitation is too great and also the amount of liquid in flasks 10 and 12 can be increased. After the aerosol particles have been formed, a slight pressure head from the streams of air forming the aerosol particles causes the movement of the aerosol particles into tube 50 from the flasks 10 and 12, and into the mixing tube 54 where the particles having opposite charges have an opportunity to mix and be dispersed and even to collide or to coagulate.

The clouds of the aerosol particles then enter the hold-up chamber 56 where they are given a further opportunity for collision or coagulation, and from the hold-up chamber 56, the aerosol particles travel into and through the cooling column 60 to the electrostatic precipitator 62 wherein the encapsulated particles are collected.

It has been observed that even when the ionizers 26 and 28 do not have any potential applied between their respective tungsten needles and plates that a certain amount of coagulation takes place. It is postulated that the pneumatic or jet method of atomizing the wax and glycerin liquid itself produces charges on the aerosol particles. However, the coagulation is greatly increased when a corona potential is applied to the ionizers 26 and 28.

What has been described is believed to be the preferred embodiment of the invention and many alterations and modifications can be made therein without departing from the scope of the invention and it is intended that the appended claims be limited only by the prior art.

What is claimed is:

1. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas into contact with said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; a second reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas into contact with said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

2. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas into contact with said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; a second reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas into contact with said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; a common mixing chamber; third means for guiding said charged aerosol particles of

said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; means for guiding the encapsulated particles from said mixing chamber to a collection station; and means for collecting the encapsulated particles.

3. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas into contact with said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; said means comprising, means for creating a first electric field of high enough intensity to produce a corona, and means for passing a stream of gas through said first electric field whereby ions are formed in said gas as it passes through said first electric field; a second reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas into contact with said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; said second means comprising means for creating a second electric field of opposite polarity to said first electric field and of a high enough intensity to produce a corona, and means for passing a stream of gas through said second electric field whereby ions are formed in said gas as it passes through said second electric field; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

4. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a first unipolar ionized stream of gas into contact with said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; said first means comprising a first chamber having a first and a second electrode, said first electrode having a first hole formed therein and said second electrode positioned so that a first corona is formed when a predetermined potential is applied to said electrodes, and means for passing a stream of gas through said first corona and said first hole whereby ions are formed in said gas as it passes through said first corona; a second reservoir containing an encapsulating liquid; second means for delivering a second ionized stream of gas into contact with said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; said second means comprising a second chamber having a third and a fourth electrode, said third electrode having a second hole formed therein and said fourth electrode positioned so that a second corona is formed when a predetermined potential oppositely polarized with respect to the potential of said first means, is applied to said electrodes, and means for passing a stream of gas through said second corona and said second hole whereby ions are formed in said gas as it passes through said second corona; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

5. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas into contact with a first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; said first means comprising, a first enclosure positioned contiguous with said liquid to be encapsulated, a first electrode and a second electrode, said first electrode in contact with said liquid to be encapsulated and having a first hole formed therein, said second electrode positioned close enough to and coaxial with said first hole so as to enable a first corona to be formed under operating circumstances when a predetermined potential is applied to said electrodes, and means connected to said first enclosure for delivering a stream of air into said first enclosure and between said first and second electrodes and through said first hole into said liquid to be encapsulated; a second reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas into contact with said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; said second means comprising, a second enclosure positioned contiguous with said encapsulating liquid, a third electrode and a fourth electrode, said third electrode in contact with said encapsulating liquid and having a second hole formed therein, said fourth electrode positioned close enough to and coaxial with said second hole so as to enable a second corona to be formed under operating circumstances when a predetermined potential is applied to said electrodes, said predetermined potential of an opposite polarity to the predetermined potential of said first means, and means connected to said enclosure for delivering a stream of air into said second enclosure and between said third and fourth electrodes through said second hole into said encapsulating liquid; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

6. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas below the level of and up through said first reservoir of liquid to be encapsulated whereby unipolar charged aeosol particles are released from said first reservoir; a second reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas below the level of and up through said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation take place; and fourth means for collecting the encapsulated particles that are formed.

7. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas below the level of and up through said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; a second reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas below the level of and up through said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; means for guiding the encapsulated particles from

said mixing chamber to a collection station; and means for collecting the encapsulated particles.

8. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas below the level of and up through said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; said first means comprising, first means for creating a first electric field of high enough intensity to produce a first corona, and means for passing a stream of gas through said first electric field whereby ions are formed in said gas as it passes through said first electric field; a second reservoir containing encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas below the level of and up through said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; said second means comprising, second means for creating a second electric field of opposite polarity to the electric field created in said first means and of a high enough intensity to produce a second corona, and means for passing a stream of gas through said second electric field whereby ions are formed in said gas as it passes through said second electric field; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

9. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas below the level of and up through said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; said first means comprising a first chamber having a first hole formed therein and said second electrode positioned so that a first corona is formed when a first predetermined potential is applied to said first and second electrodes, and means for passing a stream of gas through said first corona and said first hole whereby ions are formed in said gas as it passes through said first corona; a second reservoir containing encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas below the level of and up through said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; said second means comprising a second chamber having a third and a fourth electrode with said third electrode having a second hole formed therein and said fourth electrode positioned so that a second corona is formed when a second predetermined potential, oppositely polarized with respect to said first potential of said first means, is applied to said third and fourth electrodes, and means for passing a stream of gas through said second corona and said second hole whereby ions are formed in said gas as it passes through said second corona; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

10. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: a first reservoir containing a liquid to be encapsulated; first means for delivering a unipolar ionized stream of gas below the level of and up through said first reservoir of a liquid to be encapsulated whereby unipolar charged aerosol particles are released from said first reservoir; said first means comprising, a first enclosure positioned contiguous with said liquid to be encapsulated, a first electrode and a second electrode, said first electrode in contact with said liquid and having a first hole formed therein, said second electrode positioned close enough to and coaxial with said first hole so as to enable a corona to be formed under operating circumstances when a first predetermined potential is applied to said first and second electrodes, and means connected to said first enclosure for delivering a stream of air into said first enclosure and between said first and second electrodes through said hole into said liquid to be encapsulated; a second reservoir containing encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas below the level of and up through said second reservoir of an encapsulating liquid whereby oppositely charged aerosol particles are released from said second reservoir; said second means comprising, a second enclosure positioned contiguous with said liquid, a third electrode and a fourth electrode, said third electrode in contact with said encapsulating liquid and having a second hole formed therein, said fourth electrode positioned close enough to and coaxial with said second hole so as to enable a second corona to be formed under operating circumstances when a second predetermined potential is applied to said third and fourth electrodes, said second predetermined potential of an opposite polarity to said predetermined potential of said first means, and means connected to said second enclosure for delivering a stream of air into said second enclosure and between said third and fourth electrodes through said second hole into said encapsulating liquid; a common mixing chamber; third means for guiding said charged aerosol particles of said liquid to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

11. A system for encapsulating a materal to be encapsulated by an encapsulating substance comprising: first means for generating unipolar charged aerosol particles to be encapsulated; a reservoir containing an encapsulating liquid; second means for delivering an oppositely charged ionized stream of gas into contact with said reservoir of encapsulating liquid whereby oppositely charged aerosol particles are released from said reservoir; a common mixing chamber; third means for guiding said charged aerosol particles to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said chamber wherein encapsulation takes place; and fourth means for collecting the encapsulated particles that are formed.

12. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising: first means for generating unipolar charged aerosol particles to be encapsulated; second means for generating unipolar charged liquid aerosol encapsulating particles; a common mixing chamber; third means for guiding said charged aerosol particles to be encapsulated and said oppositely charged aerosol particles of said encapsulating liquid into said chamber wherein encapsulating takes place; and fourth means for collecting the encapsulated particles that are formed.

13. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising:

a first reservoir containing a liquid to be encapsulated;

first means for delivering a first jet stream of gas into contact with said first reservoir whereby first aerosol particles are released from said first reservoir;

a second reservoir containing an encapsulating liquid;

second means for delivering a second jet stream of gas into contact with said second reservoir whereby second aerosol particles are released from said second reservoir;

a common mixing chamber;

means for guiding said first aerosol particles of said liquid to be encapsulated and said second aerosol

particles of said encapsulating liquid into said common mixing chamber wherein encapsulation takes place;

and means for collecting the encapsulated particles that are formed.

14. A system for encapsulating a material to be encapsulated by an encapsulating substance comprising:

a first reservoir containing a liquid to be encapsulated;

first means for delivering a first jet stream of gas below the level of and up through said first reservoir of the liquid to be encapsulated whereby first aerosol particles are released from said first reservoir

said first means comprising,

a first enclosure positioned contiguous with said liquid to be encapsulated,

a first member and a second member in said enclosure,

said first member being in contact with said liquid and having an aperture formed therein,

said second member positioned close to and coaxial with said aperture,

and means connected to said first enclosure for delivering a stream of air into said first enclosure and between said first and second members up through said aperture and into said liquid to be encapsulated;

a second reservoir containing encapsulating liquid;

second means for delivering a second jet stream of gas below the level of and up through said reservoir of encapsulating liquid whereby second aerosol particles are released from said second reservoir;

said second means comprising,

a second enclosure positioned contiguous with said liquid in said second reservoir;

a first member and a second member in said second enclosure,

said first member being in contact with said encapsulating liquid and having an aperture formed therein,

said second member in said second enclosure being positioned close to and coaxial with said aperture,

and means connected to said second enclosure for delivering a stream of air into said second enclosure and between said first and second members of said second enclosure through said aperture into said encapsulating liquid;

a common mixing chamber;

means for guiding said first and second aerosol particles of said liquid to be encapsulated and encapsulating liquid into said common mixing chamber wherein encapsulation takes place;

and means for collecting the encapsulated particles.

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