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METHOD OF PRODUCING AN AEROSOL

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FIG. 1

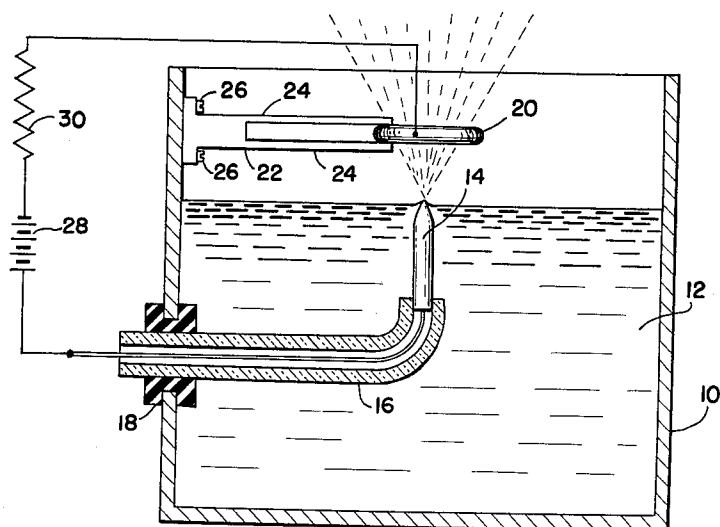
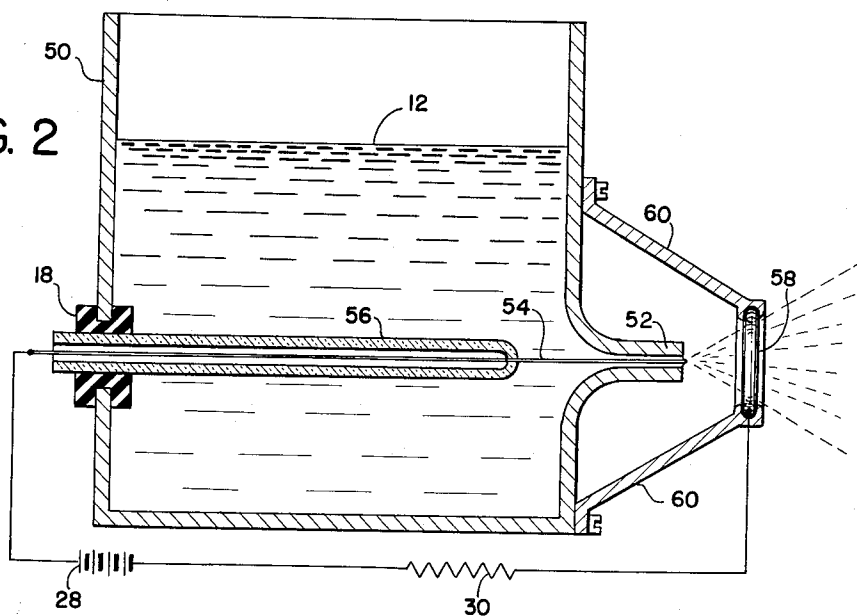


FIG. 2



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METHOD OF PRODUCING AN AEROSOL

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This invention relates generally to methods for producing aerosols, and pertains more particularly to a method utilizing electrostatic forces in contradistinction to commonly used hydrostatic pressure gradients.

Quite briefly, the invention contemplates placing a corona discharge point electrode within a liquid having a low electric conductivity and closely adjacent to the surface thereof. One or more collecting electrodes are employed in a spaced relationship with the corona electrode. A voltage is applied between the two electrodes which is sufficiently high so that a corona or arc discharge will break through the surface, thereby gradually taking the liquid material along in the form of fine droplets or a liquid beam which will quickly break up into droplets depending on the voltage, electrode configuration, and viscosity of the liquid that is to provide the aerosolized medium.

One object of the invention is to break up highly viscous materials into small droplets without the use of currently employed devices operating on a drop in pressure principle.

Another object of the invention is to obviate the need for a fine nozzle and avoiding any clogging due either to the type of liquid or to sizable impurities that may be entrained in such liquid.

A further object of the invention is to provide a method that will involve very little electric power for its proper operation, this being principally due to the fact that no friction losses are necessary.

Another object of the invention is to provide a method for aerosolizing a liquid that is all electrical and which involves no moving parts.

Still further, another object of the invention is to provide a method for aerosolizing a liquid that can be readily turned off and on so that a change in droplet size can be easily effected.

Other objects will be in part obvious, and in part pointed out more in detail hereinafter.

The invention accordingly consists in the method which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

Referring first to FIGURE 1, it will be observed that there has been depicted a vessel 10 containing a liquid 12. This liquid is of an electric insulating type and for the sake of discussion can be considered to be light machine oil. A corona point electrode 14 is positioned in the liquid 12 and is held at a preferred elevation by means of a glass tube 16 or the like, the glass tube extending into the liquid 12 through a grommet 18. The specific manner in which the electrode 14 is held is relatively immaterial, but as the description progresses it will be seen that the upper point of the electrode 14 should project about 0.5 millimeter from the top surface of the liquid 12.

Coacting with the corona discharge point electrode 14 is a collecting electrode 20 which may be in the form of a grid or ring, the latter having been depicted for the sake of illustration. This electrode 20 is oriented approximately opposite the pointed electrode 14. It is held in position by a bracket 22 having a pair of resilient fingers 24, the bracket being bolted to the inner side of the vessel 10 by a pair of screws 26. Here again, the particular manner in which the electrode 20 is held in position

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above the electrode 14 is capable of a rather wide variation.

The voltage source for energizing the electrodes 14 and 20 in the illustrated situation is in the form of a battery labelled 28. The battery is connected across the electrodes 14 and 20 through a relatively large resistor 30.

While the spacing of the electrode 20 above the electrode 14 is susceptible to variation, it can be explained that a satisfactory spacing of the electrodes is on the order of one centimeter. It is to be emphasized, though, that this is not a critical figure. Likewise, the voltage applied to the electrodes 14 and 20 will depend upon certain circumstances, for instance, the type of liquid 12 and quite obviously the electrode spacing that has been alluded to above. For an electrode spacing of approximately one centimeter and a potential of 5,000 volts, assuming that light machine oil is employed, small droplets will break away from the surface of the liquid 12 to provide a mist. The electric current drawn from the battery 28 under these circumstances would be only about 10^{-7} amperes, so it can be appreciated that the power needed is only approximately 0.5 milliwatt. At higher voltages, say 10,000 volts, a continuous beam of liquid is shot away from the surface of the liquid 12, breaking through the ring electrode 20, and thereafter disintegrating into droplets. This will entail the use of current of the order of one microampere. The value of the resistor 30 can be selected so that for given potentials the appropriate ionizing current will result.

In the embodiment just described it will be apparent that the surface of the liquid 12 will be lowered as the aerosolizing occurs. Suitable replenishment can be made so that the projection of the point of the electrode 14 is maintained at approximately the 0.5 millimeter figure.

In order to avoid having to replenish the liquid 12 in such a manner as mentioned above, it is possible to utilize a differently configured apparatus for achieving the aerosolization. Accordingly, attention is now directed to FIGURE 2 in which a somewhat modified vessel 50 is pictured. This vessel 50 has a capillary outlet at 52 so that the liquid 12 will escape in very small amounts. As with the first described embodiment, a pointed corona discharge electrode is again utilized, such electrode being in the form of a wire 54 which is held concentrically within the outlet 52 by a glass tube 56 or the like.

A collecting electrode 58 is here again employed, this electrode being the same as the electrode 20 of FIGURE 1. Suitable bracket members 60 may be employed for holding the electrode 58 in a proper relationship with the outlet 52. The battery 28 and the resistor 30 are again utilized in the energizing circuit for the electrodes 54 and 58.

It will be appreciated from the information that has been given that the liquid 12 in FIGURE 2 flows in a controlled manner through the outlet 52 and that the electrode 54 projects slightly beyond the end of the outlet 52 but not sufficiently far out as to break the surface tension of the liquid. The size of the capillary outlet 52 will depend upon the viscosity of the liquid 12 and can be designed of the appropriate size to accommodate the given liquid.

Considering both embodiments that have been described to illustrate the method of practicing my invention, it is to be understood that while a D.-C. source 28 has been incorporated into these embodiments, nonetheless A.-C. sources may be utilized if desired. For example, higher resonant frequencies will assist materially in breaking up the liquid into small droplets, thereby contributing to the overall efficiency of operation.

Having presented the two embodiments, it will be ap-

parent that my method of producing an aerosol is exceedingly simple. All that one has to do with the electrode arrangement that has been referred to is to apply an appropriate potential across the two electrodes for causing the degree of ionization that is desired for the particular type of aerosolization.

After the proper potential has been applied, it will be understood that the liquid 12 will be quickly broken up into small particles, these particles or droplets being carried through the intervening air between the electrodes by the electrostatic discharge action.

As certain changes could be made in the above construction, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed:

1. A method of producing an aerosol from a low electrical conductivity liquid comprising the step of applying an electrical potential between a corona discharge point electrode disposed in the liquid to be aerosolized, the

point of which electrode is closely adjacent the surface of said liquid, and a collecting electrode spaced somewhat away from said surface.

2. The method of claim 1 in which said point projects slightly beyond the normal surface of said liquid but not to such an extent that the surface tension of the liquid is broken.

3. The method of claim 2 in which said point projects approximately 0.5 millimeter.

4. The method of claim 1 in which said liquid constitutes a body of liquid in a container with said corona discharge electrode pointing upwardly and with said collector electrode being spaced above said body of liquid.

5. The method of claim 1 in which said liquid constitutes a body of liquid in a container having a capillary outlet beneath the surface of said liquid with said corona discharge electrode being located concentrically within said opening and said collector electrode being spaced exteriorly of said outlet.

6. The method of claim 1 in which the spacing of said electrodes is approximately one centimeter and said electrical potential is on the order of from 5,000 to 10,000 volts.

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