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METHOD AND APPARATUS FOR CREATING COLLOIDAL ATOMIZATIONS

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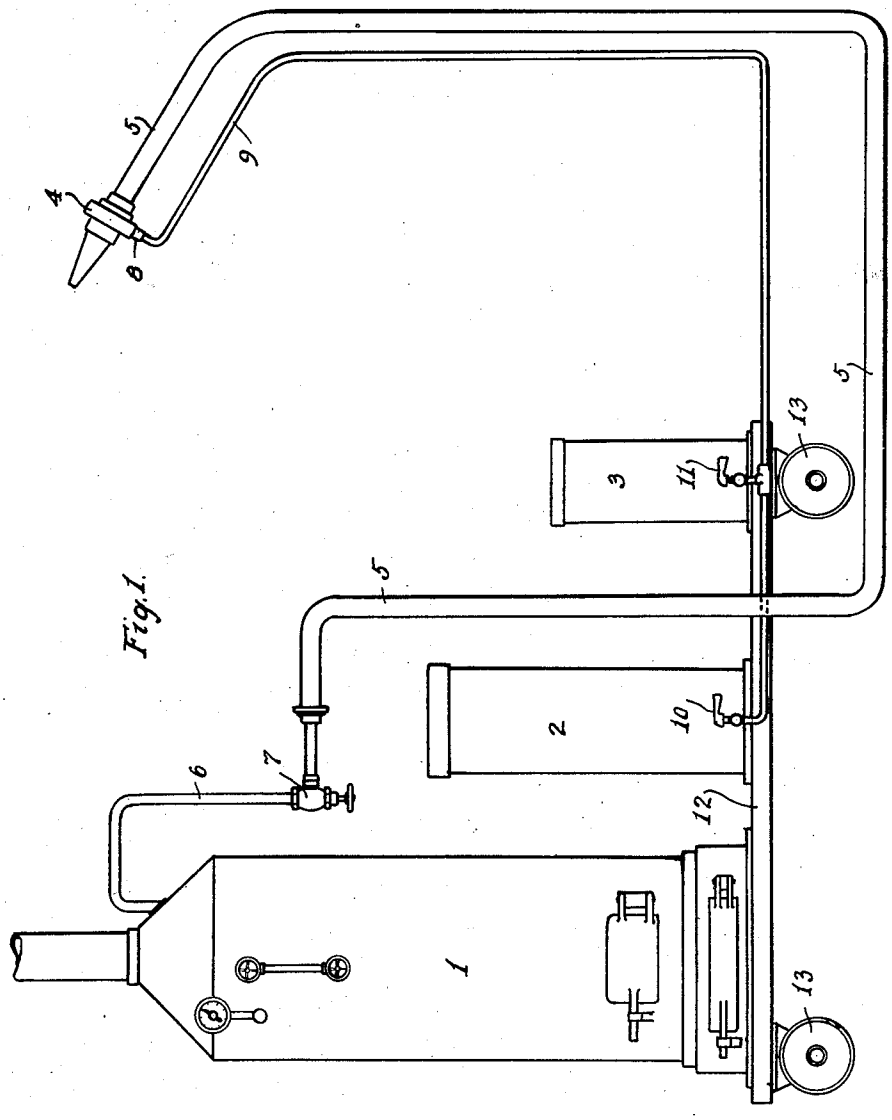


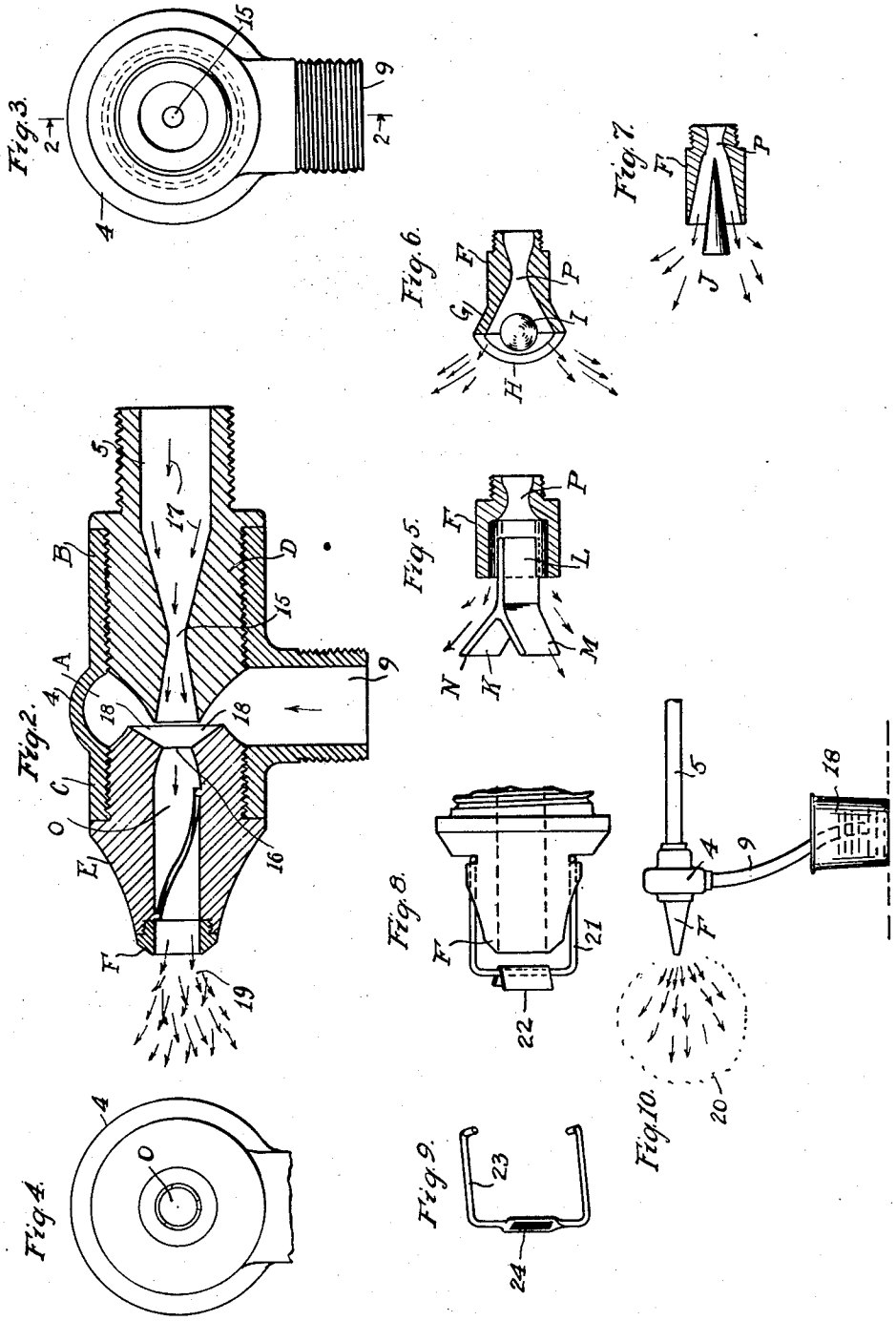
Fig. 1.

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METHOD AND APPARATUS FOR CREATING COLLOIDAL ATOMIZATIONS

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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR CREATING COLLOIDAL ATOMIZATIONS

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My present invention relates to an improvement in atomizing devices, such as are utilized for creating a fine mist-like spray, and in some respects the apparatus herein disclosed is similar to a pending application Serial No. 677,964 filed Dec. 1, 1923, entitled Apparatus and method for agricultural spraying, and pending application Serial No. 683,515 filed Dec. 29, 1923, both of said applications being in the names of John E. Shepherd and Edwin K. O'Brien.

More particularly, however, my device relates to an improved method, including apparatus, whereby I am enabled by means of the same to create an extremely fine mist by the use of the heat energy contained in a gas which has been made from a liquid by boiling said liquid, such as steam for example, and the pressure of such gas at a temperature which is under control. This steam or other vapor is developed at a temperature sufficient to supply the heat energy and gas pressure necessary to give such motion to the constituent particles of the material to be atomized as will convert such material into a mist of any desired fineness of subdivision after it leaves the orifice of the device; and such gas pressure being also sufficient to project the atomized material to the place of desired application. By the passage of the steam or other gas through a certain sequence of parts of the device hereinafter to be more specifically outlined, it is made to create a partial vacuum in certain parts of the device, into which parts the material to be atomized flows from a source of supply under induction action. The said steam and the said material are so intimately mixed within the device by an arrangement of the several parts that the material absorbs a large proportion of the heat energy that was contained in a controlled quantity of the steam, which absorbed heat energy and the gas pressure of the steam constantly supplied imparts to the constituent particles of the material to be atomized an energy of motion sufficiently great to cause its constituent particles to expand rapidly and produce a fine mist outside the device. The rapid expansion of the finely divided material causes the mist to become cool at a short distance from the orifice. The steam pressure ejects the material from the orifice to the desired point of application. The heat energy imparted to a liquid which causes it to be gasified, the vapor pressure generated by this heated gas, and the arrangement of the several parts of the device, acting together under control, cause a spray material to be sucked into the device, cause the spray material to absorb a desired quantity of heat energy and cause it to issue from the device in such manner and with such energy content and at such speed as to set up an internal motion of its constituent particles rapid enough to convert the spray material into a mist after it issues from the orifice, the said mist being made so fine that it floats in the air like a smoke cloud. This mist is projected to and deposited on the plants, trees, etc., without undue momentum and in such a manner as to completely envelop the object in a mist of any desired fineness of subdivision, thereby covering all portions of the object thus exposed.

One of the distinct advantages of this form of spraying relates especially to its use in spraying fruit trees, especially when they are in the blossoming or flowering stage, as I have in the past ascertained that if certain forms of spray apparatus were utilized for this purpose that the mere mechanical breaking up of the spraying material by any form of pressure from behind created merely small globules of the spray mixture and the impact of these globules upon the calyx of the open fruit flower or blossom not only injured the blossom but in many instances gave rise to a distorted fruit.

In my present apparatus the mist is so impalpably fine and of such a true colloidal nature that it will float for long distances before settling, unless interfered with in its flight. In actual practice, this fine colloidal mist is created at sufficient height from the ground to enable it to float freely and gently through an orchard whereby to coat everything that it comes in contact with without force and therefore without disruptive effect on the fruit flowers or the component parts of said flowers, at the same time coating to

the desired extent and creating the desired results without any disturbance of the natural condition of the trees in any shape or form whatsoever.

Another advantage of my device more particularly relates to the form of nozzle which I have adapted for this purpose and the sequence of expansions and velocity increasing means whereby they are coordinated with the natural expansibility and heat content of steam itself to create the desired colloidal form of mist or spray.

Another advantage of my device relates to the means whereby in certain forms of spray, such as the treatment of cotton for boll weevil, it may become desirable to split a stream of issuing colloidal means into two streams at a point below the foliage of said cotton plants so that a nozzle brought up between rows of cotton will simultaneously treat opposite rows and the under sides of the leaves of the plant with the mist treatment thereby acting with greater efficiency than heretofore accomplished and lessening the cost of the application of the spray.

These and other capabilities will be fully disclosed as the herein specification proceeds.

In the accompanying drawings, Fig. 1 is an elevational view, somewhat diagrammatic of my apparatus;

Fig. 2 is a sectional view of the nozzle taken on the line 2—2 of Fig. 3;

Fig. 3 is a rear view of the nozzle;

Fig. 4 is a front view of the nozzle;

Figs. 5 to 7 are partial sectional views of modified jet nozzle distributors;

Figs. 8 and 9 are side elevations of other forms of distributors; and

Fig. 10 is a fragmentary view of one form of nozzle to illustrate the distributing features thereof.

In Fig. 1 I have shown a simplified form of apparatus which is outlined as follows:

1 represents a steam boiler, hand fired or otherwise; 2 and 3 are material tanks for carrying a plurality of any desired form of spray material; 4 represents my new form of nozzle which has preferably two points of attachment, namely 5 representing a steam hose which is connected to a valved pipe connection 6, the valve 7 of which controls the amount of steam issuing from the nozzle 4, and obviously a control valve such as 7 may also be located conveniently to the nozzle 4. The second connection 8 is connected up to a duct 9 which in turn connects the material tanks 2 and 3 respectively, the said duct being under the control of valves 10 and 11 in order to supply either one or the other mixture or both in combination, as desired, and obviously a control valve for the mixture passing through the duct 9 may be located conveniently to the nozzle 4.

While it is within the possibilities that this set may have to be portable in certain forms of use, this particular feature is more or less illustrated by a truck generally denoted by 12 upon which the boiler 1 and tanks 2 and 3 are mounted, said truck being provided with wheels 13 so that the apparatus may be moved from place to place. In actual practice, the apparatus may be mounted upon any suitable vehicle and move up and down the rows of trees or plants for spray purposes.

In Fig. 2 which is a sectional view of one form of my atomizing nozzle and which is taken on line 2—2, Fig. 3, there is shown the steam duct 5 and the material duct 9 connected to the body of the nozzle generally denoted by 4 and which in the present instance is made up of a series of parts which will now be described.

The body or casing of the nozzle comprises an annular mid portion forming a chamber A for receiving fluid, the casing having a boss B at its rear end and a smaller boss C at its front end, both of which are threaded or otherwise arranged to engage with coacting parts. The boss B is shown in threaded engagement with a steam jet nozzle D the chamber or interior of which is tapered inwardly to the reduced or constricted portion 15 and is then flared outwardly to the outlet end of the chamber where it communicates with the chamber A, the nozzle being connected at its rear end to the steam duct 5.

The forward boss C is threaded to receive the jet nozzle E the chamber or interior of which communicates at its intake end with the chamber A and tapers inwardly from its intake end to the reduced or constricted portion 16 from which it flares outwardly and is extended as a straight portion of the interior to the discharge end thereof, the before mentioned portions of the interiors of the nozzles D and E constituting substantially alined venturi spaced apart by a passage from the chamber A communicating with the space or chamber formed between the outwardly flared end of the interior of the nozzle D and the inwardly tapered end of the interior of the nozzle E.

In practice, and according to requirements, any one of a number of different jet ends F may be applied to the end of the nozzle E, depending upon the desired dispersal of the colloidal mist and the use to which it is put. For instance, in Fig. 6, there is shown the well known type of ball jet spray nozzle in which the jet nozzle F is shown as being flared at G and having a bridge piece H across the front thereof and enclosing a ball I therein whereby to disperse the colloidal mist in the manner characteristic of this type of nozzle.

In Fig. 7, there is shown a modification of this type in which the nozzle F is provided with a cone-shaped deflector J which also causes another formation of spray head and in Fig. 5 is shown a modified form which is

turned partly out of plane in order to show the Y-shaped distributor K which comprises an interior straight deflecting portion L having two divergent wings M and N which are at any suitable angular plane to one another so that when this device is in use, it may be trailed low under the growing plants near the ground and it causes two divergent streams to issue from the jet nozzle F, thereby enabling treatment on two rows of close growing plants to be effectively operated.

In Fig. 8, there is shown a nozzle jet end such as F having secured thereto the frame 21 provided across its outer end with the V-shaped baffle member 22 spaced away somewhat from the jet end and carried thereby for deflecting the mixture of material and steam discharged from the jet end F.

In Fig. 9, there is shown a frame 23 adapted to be secured to a nozzle jet end such as F (Fig. 8) provided at its outer end with the reticulated or gauze member 24 spaced away somewhat from the jet end and carried thereby through which the mixture of material and steam discharged from the jet end F passes.

Reverting to Fig. 1, steam may be created in a boiler 1 and upon the rise of pressure to a desired point, and upon filling the material containers with two different types of desired spray mixture, the steam is turned on at the valve 7 and the nozzle is directed, according to the direction of the wind, either straight up or at the plant growth desired to be treated. The ducts 5 and 9 being of flexible material such as flexible metallic steam hose, the nozzle may be manually or mechanically manipulated in any desired manner for creating the best effect and upon issuing of steam from the jet nozzle E, the material being turned on from either one or both of the tanks 2 or 3, the steam, passing forwardly of the direction of the arrows 17 in Fig. 2, is constricted by the reduced portion 15 of the induction nozzle D and due to induction action, through expansion of the steam in the interior of the nozzle E near the communication of the chamber A with the interior of the nozzle E a partial vacuum is created in the chamber A and this in turn reacts upon the duct 9 causing a flow of the spray material from the tanks 2—3 in the direction of the arrow 18'. At the meeting point of steam and material about at the plane of the discharge end of the nozzle D, the steam expands at high velocity, is suddenly constricted by the abruptly flaring portion 18 and the reduced portion 16 of the interior of the nozzle E, flows into the expansion chamber O of the nozzle E and exerts a suction action to draw up the material and due to its increased velocity, a thorough admixture and atomization of the steam and incoming spray material is effected at this point, the heat of the steam is communicated to the spray material, and the combined material not yet atomized is thereafter passed out through the jet nozzle E at its discharge end P and expanding as indicated by the arrows 19 causes complete colloidal emulsification of the moist steam and the volume of spray material and at this point the highly divided smoke-like mist expands with a great disruptive velocity, becomes rapidly cool and passes off to atmosphere there to be precipitated upon plant growth and perform its desired work.

The wall of the expansion chamber O is provided with a helical rib o' of long pitch for imparting a whirling motion to the mixture of steam and spray material.

It will therefore be noted from the foregoing description that I have provided in the present form of spray head, a series of velocity increasing means for the steam and material stream and a plurality of expansion actions succeeding each velocity increase, and while I have herein only shown two such nozzles and expansions, it is understood that a sequence of these of three or more may be provided. I have found, in actual practice, however, that two steps of velocity increasing and expansion stages are sufficient for my purpose, and that in the present form the nozzle is economical in manufacture and extremely efficient in in operation.

The form of jet nozzle as indicated by Figs. 5 to 9 inclusive does not affect the colloidal action due to the disruptive expansion of the steam in the final stage of expansion as the mechanical diverting baffles therein shown have no appreciable effect upon the structure of the mist but only upon the form of the spray cloud at and adjacent to the nozzle.

In every instance, as is illustrated in view Fig. 10, when material is drawn from any receptable such as a pail of fluid 18, the second expansion of the steam and its commingled spray material tends to expand in a globular form through the instantaneous expansion of the steam and heated material, and this is more or less indicated by the zone of the dotted line 20 containing arrows which indicate the spray action. Arsenical compounds or other substances which when applied by any of the usual methods scald or burn the foliage of the plants or trees, when applied by my method, probably on account of highly colloidal state of the admixture of moist fluid (steam) with the arsenical compound or other substance, do not have this scalding or burning effect.

Having thus described my invention it should be understood that there may be modifications thereof and variations therein without departing from the spirit of the invention or exceeding the scope of the appended claims.

What I claim and desire to protect by Letters Patent is:

1. A spraying apparatus provided with an induction nozzle having a forwardly pointed

forward end and a duct therethrough having an intermediate constricted portion and a forward portion rearwardly tapering toward the restricted portion; a jet nozzle just forward the induction nozzle adapted to discharge a blast of mist directly therefrom and having a passage passing therethrough alined with said duct and provided with a constricted intermediate portion, an abruptly flaring rear end portion having outer and inner diameters respectively larger and smaller than the forward diameter of said duct, and a forwardly flaring portion just forward of the restricted portion; and means forming an annular chamber around said pointed end and rear end portion and a material duct for supplying material to the chamber.

2. An apparatus for spraying rows of vegetation comprising means for forming a high velocity smoke-like mist including a jet nozzle for violently projecting said mist; and a wedge shaped deflector secured forward of, and pointing toward, the jet nozzle for dividing said mist into isolated divergent streams whereby said rows may be sprayed while keeping free the space between the streams of mist.

3. A method of spraying rows of vegetation with liquid comprising forming and liberating a high velocity smoke-like mist and violently projecting said mist; and dividing the projected mist into isolated divergent streams, the space between the streams being kept free of mist, whereby the streams of mist are projected on said rows of vegetation at the same time without presence of any of the streams between said rows.

4. A spraying apparatus comprising means for producing a high velocity stream of gaseous fluid; means for constricting the stream for increasing the velocity of said stream; means for expanding and diverging said stream beyond the constriction; means for enclosing the space around the expanding stream and supplying liquid to said space, whereby the stream creates an induction and partial vacuum in said space for drawing the liquid into the space, the expansion of the stream causing the liquid to be drawn into the stream; means for violently jarring the outer portion of the expanded stream and liquid therein to disrupt and atomize the liquid; means for abruptly constricting the expanding stream, thereby causing the particles of liquid to be intimately pressed against the particles of said fluid; and means for again expanding the stream after it has been constricted, thereby to cause the sudden expansion of the particles of said fluid, thereby causing a violent disruption and atomization of the liquid to form smoke-like mist.

5. A spraying apparatus comprising, an induction nozzle having a duct therethrough having an intermediate constricted portion and a rearwardly tapering portion forward of the restriction; the rearwardly tapering portion serving to expand the stream and discharge it therefrom in diverged form; a jet nozzle having a passage therethrough alined with said duct and provided with a constricted portion near the rear end and an abruptly flaring rear abutment face near the forward end of said rearwardly tapered portion and having an inner diameter smaller than said forward end and an outer diameter larger than that of said forward end, and a liquid supply chamber around said abutment face and duct; said passage provided with a long forward unobstructed, unrestricted cylindrical portion and a flaring portion just forward of the restricted portion.

6. A spraying apparatus comprising, an induction nozzle having a duct therethrough having a rearwardly tapering forward portion serving to expand the stream and discharge it therefrom in diverged form; a jet nozzle having a passage therethrough alined with said duct and provided with a constricted portion near the rear end and an abruptly flaring rear abutment face near the forward end of said rearwardly tapered portion and having an inner diameter smaller than said forward end and an outer diameter larger than that of said forward end; and a liquid supply chamber around said pointed end and abutment face and duct for supplying liquid to the chamber.

7. A spraying apparatus comprising, an induction nozzle having a duct therethrough having an intermediate constricted portion and a rearwardly tapering portion forward of the restriction; the rearwardly tapering portion serving to expand the stream and discharge it therefrom in diverged form; a jet nozzle having a passage therethrough alined with said duct and provided with a constricted portion near the rear end and an abruptly flaring rear abutment face near the forward end of said rearwardly tapered portion and having an inner diameter smaller than said forward end and an outer diameter larger than that of said forward end; and a liquid supply chamber around said pointed end and abutment face and duct for supplying liquid to the chamber; said stream creating an induction whereby liquid is drawn into the chamber and stream; the expansion of the stream causing the liquid to draw into the outer portion of the stream, thereby to be expanded and disrupted by the expanding stream and then dashed violently against the abutment face thereby to further disrupt and atomize the liquid as it is drawn into the expanding stream, to produce a finely divided intimate mixture; said abruptly flaring and constricted portion again converging the stream, causing the atomized particles of liquid and the stream to be intimately pressed together as they pass through the restricted portion.

8. A spraying apparatus comprising means for projecting a high velocity mist including a jet nozzle for projecting said mist; and means forward of the jet nozzle for dividing said mist into isolated divergent streams while keeping free of mist the space between the streams.

9. A spraying method comprising forming and liberating a high velocity mist and violently projecting said mist; and dividing the projected mist into isolated divergent streams; the space between the streams being kept free of mist.

10. A spraying method comprising producing a high velocity stream of gaseous fluid; constricting the stream for increasing the velocity of said stream; then expanding and diverging said stream beyond the constriction; enclosing the space around the expanding stream and supplying liquid to said space, whereby the stream creates an induction and partial vacuum in said space for drawing the liquid into the space, the expansion of the stream causing the liquid to be drawn into the stream; violently jarring the expanded stream and liquid therein to disrupt and atomize the liquid; abruptly constricting the expanding stream, thereby causing the particles of liquid to be intimately pressed against the particles of said fluid; again expanding the stream after it has been constricted, thereby to cause the sudden expansion of the particles of said fluid, thereby causing a violent disruption and atomization of the liquid to form smoke-like mist.

Signed at Charlottesville in the county of Albemarle and State of Virginia this fifth day of January, A. D. 1925.

JOHN E. SHEPHERD.