Aug. 19, 1952 J. W. HESSION, JR 2,607,575

AEROSOL GENERATOR

Filed Feb. 26, 1947 5 Sheets-Sheet 1

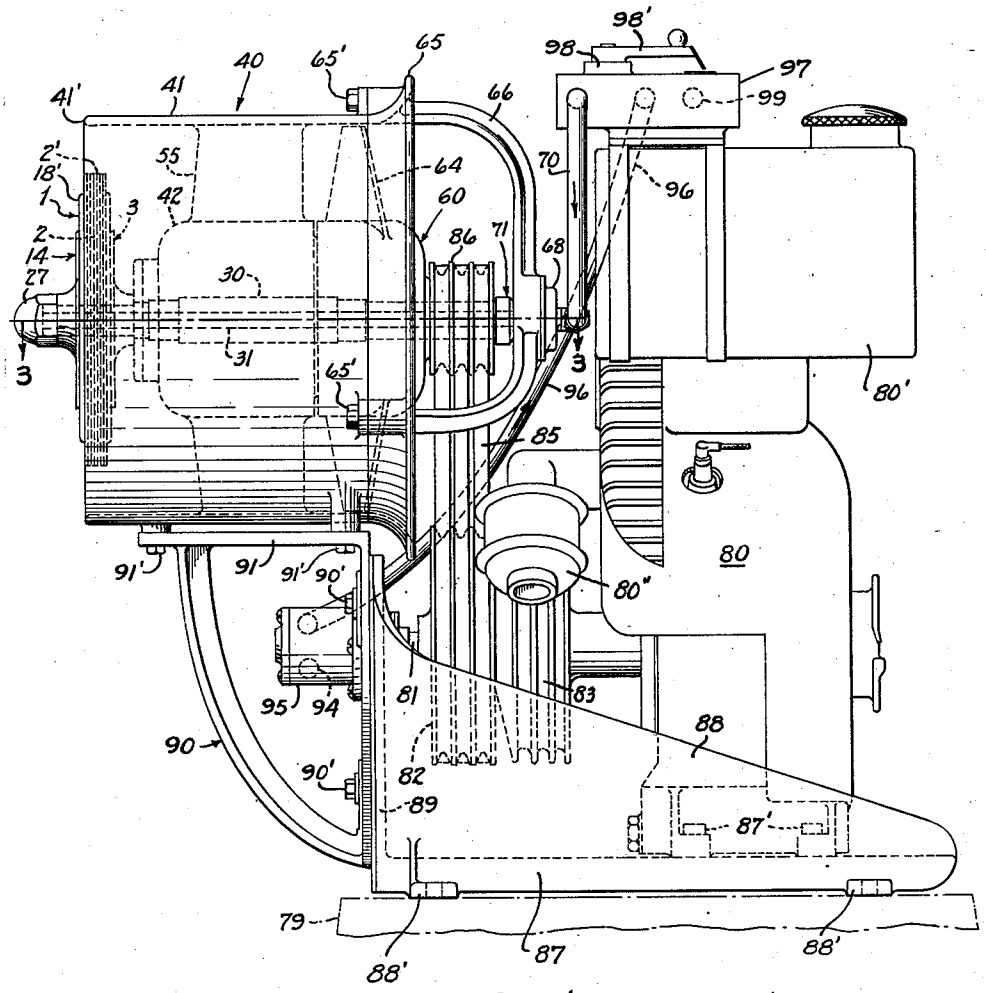


Fig. 1

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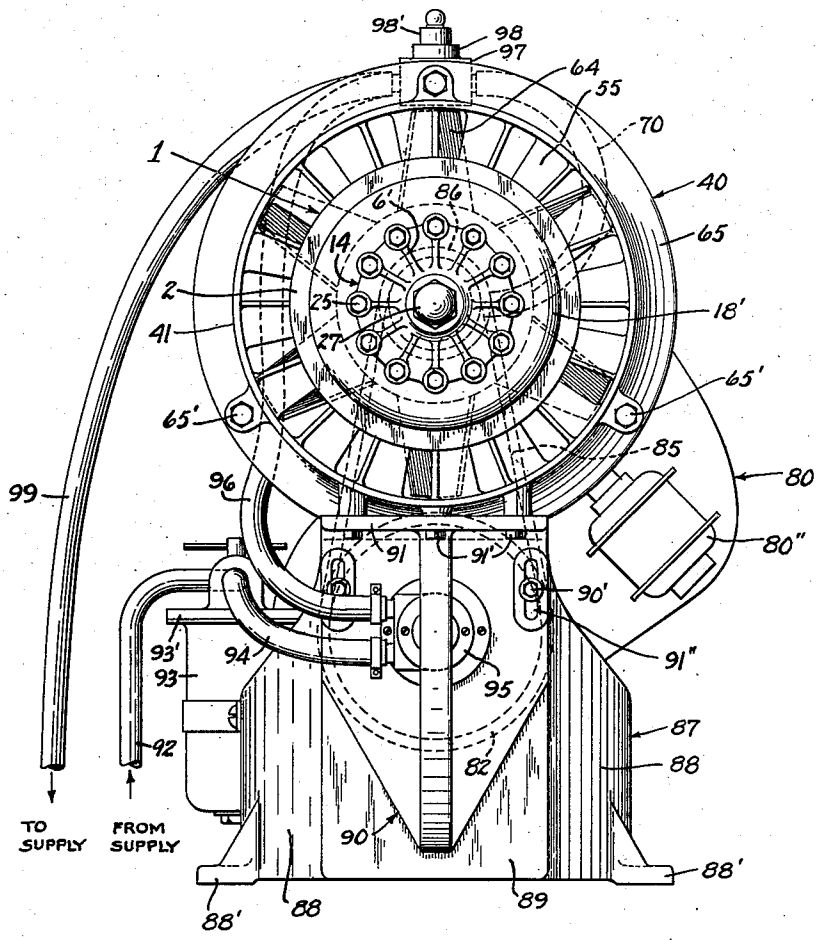


Fig. 2.

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AEROSOL GENERATOR

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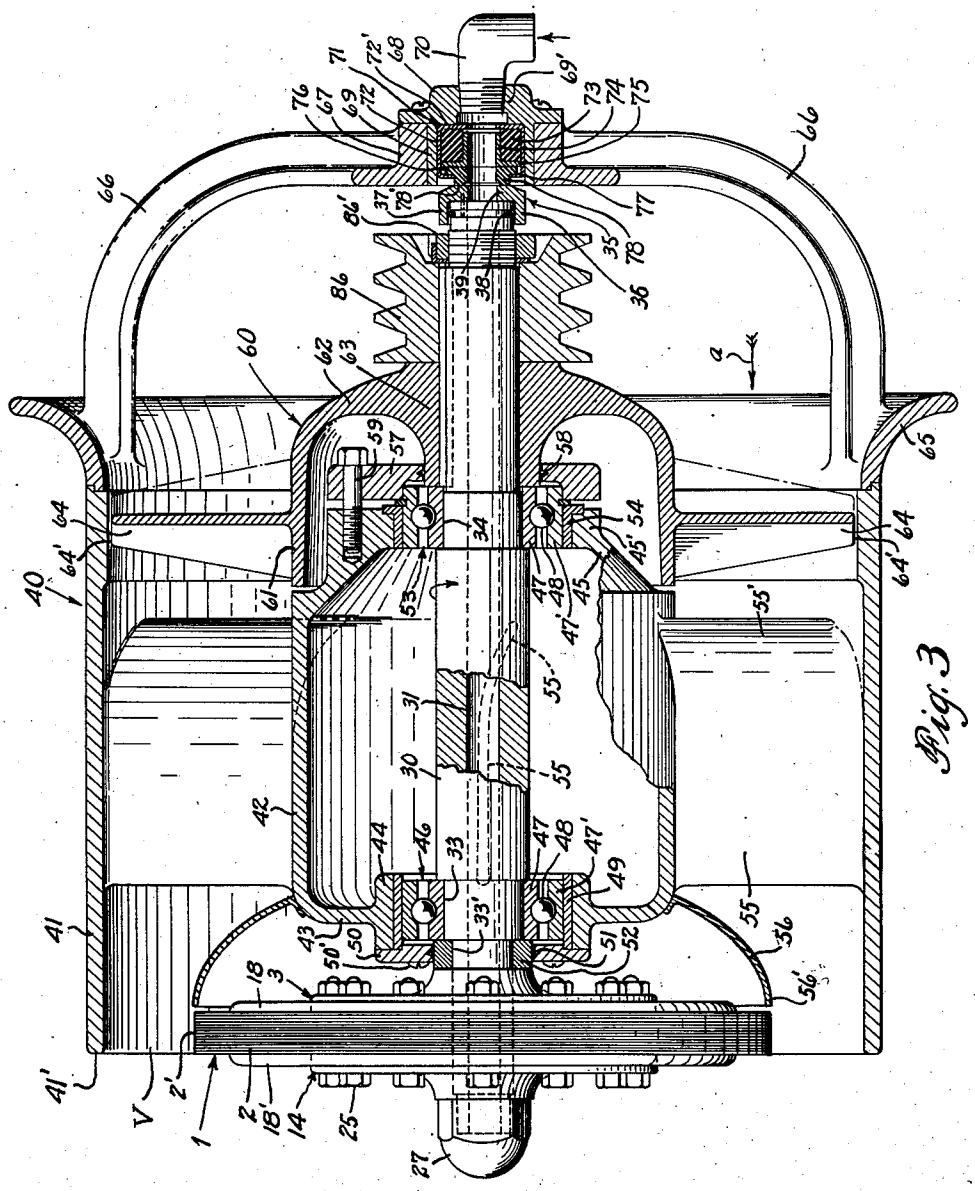


Fig. 3

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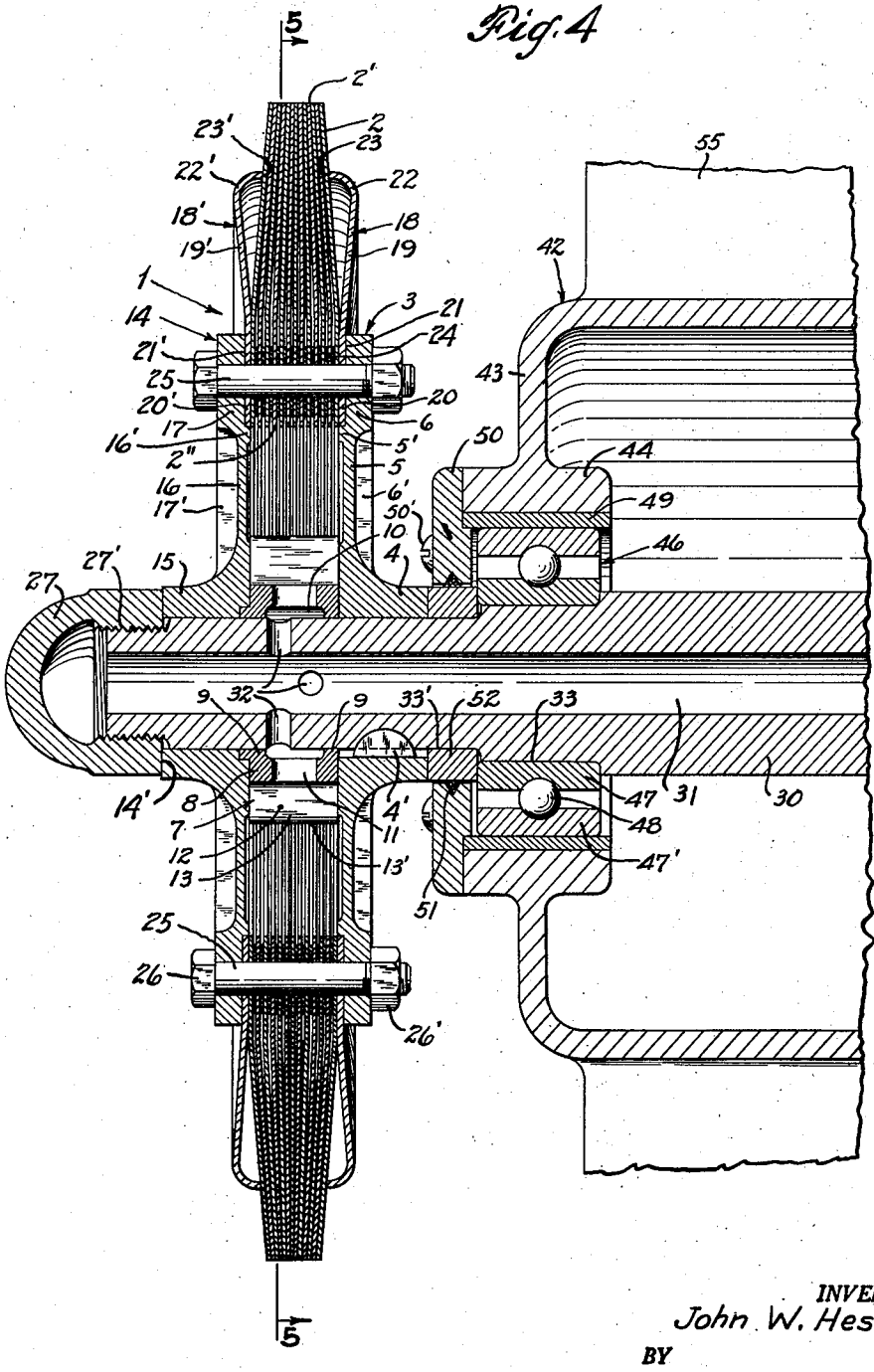
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AEROSOL GENERATOR

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Fig. 4



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AEROSOL GENERATOR

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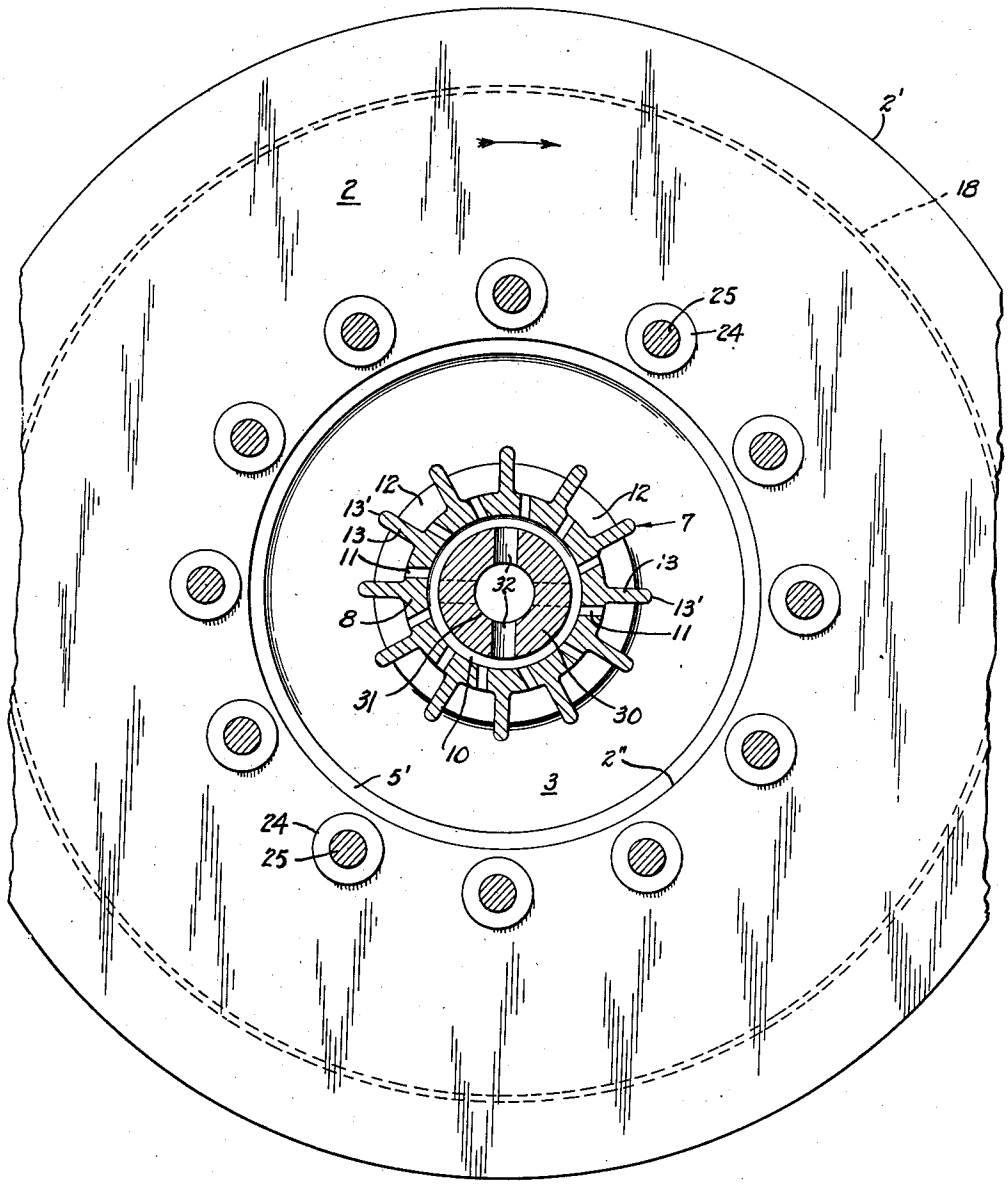


Fig. 5

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UNITED STATES PATENT OFFICE

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AEROSOL GENERATOR

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Application February 26, 1947, Serial No. 731,132

9 Claims. (Cl. 261—90)

1

This invention relates to aerosol generators and more particularly to a machine designed to effect a dispersion or diffusion of a selected liquid into particles which are extremely minute and substantially homogeneous in size and adapted to be readily air-borne for substantial distances. This application has certain features in common with my copending application Serial Number 654,610 filed March 16, 1946.

The term "aerosol" is generally accepted in scientific circles as a generic term to describe the size of particles which may be air-borne in varying degrees. Air-borne or aerosal particles may vary in size from one tenth (.1) micron diameter or less, to upwards of fifty (50) microns diameter. The extent to which an aerosol particle may be air-borne varies with its size or mass. As a rough approximation, it may be said that the cubic mass of a particle is approximately the cube of its diameter, and accordingly a particle which is one hundred (100) microns in diameter would possess approximately one thousand time the cubic mass of a particle of ten (10) microns diameter.

The drift of fine particles in normal air currents is largely determined by the size of the particle, or more particularly, its cubic mass. According to Stokes law of falling particles, it has been determined that in a medium of still air, a particle of six microns in diameter will require approximately five minutes to fall one foot or thirty centimeters; a particle of ten microns diameter will require approximately two minutes to fall thirty centimeters; a particle of twenty microns diameter will require approximately one half minute to fall thirty centimeters; while a particle of sixty microns diameter will require approximately three seconds to fall thirty centimeters. Aerosol particles which are fifty microns and larger in diameter normally remain suspended in air for a relatively short time period, will drift comparatively very short distances only, and may be aptly classified as sprays. Therefore it may be said that a true aerosol has generally been considered as descriptive of particles which will be borne by normal air currents, and less than fifty microns diameter.

These scientific considerations are guiding factors in effecting diffusion of liquid insecticides, germicides, deodorants, fungicides, sterilizing agents, hormones and medicaments of the greatest importance to agriculture, industry and public health. The particle size of the diffused liquid in many instances determines the effectiveness of the liquid treatment, the quantity or volume of liquid necessary to effect the treatment, the area over which the dispersed liquid is effective, the uniformity of deposition and concentration, the cost of effecting the dispersion and the avoidance of concentrations to a degree which are harmful or objectionable.

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In the field of entomology, for example, highly valuable insecticides have been developed whose effectiveness and applicability are to a large extent controlled and determined by particle size considerations. Localized concentrations of some insecticides as obtained by sprays generating particles of fifty (50) microns diameter and greater, may cause damage to useful life forms, such as bees and pollinating insects.

Entomologists have therefore appreciated the essential importance of effecting liquid insecticide dispersions in extremely fine particle size, wherein the required small quantity of effective insecticide is uniformly dispersed over the treated area, and in concentrations and particle size wherein the enemy insect is effectively destroyed, without damaging effects on useful insects and other useful life. Such effective light treatments can be practically obtained by aerosol dispersions wherein the particle size of the treating material ranges in the approximate mean average of eight to twenty microns in diameter, with an optional or mean average of eight to ten microns in diameter in the case of certain insect pests, while other hardier insect pests may require dispersions having particle size ranges in the approximate mean average of sixteen to twenty microns.

Aerosol dispersions having extremely fine and substantially homogeneous particle size have further extensive uses in fumigating, sterilizing, deodorizing, medication, and scenting and conditioning room and building interiors. Aerosol treatment of rooms and interiors is markedly effective where the particle size is properly controlled and reasonably homogeneous, since the liquid aerosol dispersion will drift and uniformly disperse through the atmosphere of the confined space, moving into all the spaces and crevices where air currents may enter and, finally be uniformly deposited above and beneath projecting surfaces which, when properly controlled, leaves no visible or objectionable deposit. The air in rooms and interiors can thus be sterilized, fumigated, deodorized, scented and tempered by use of controlled amounts of the liquid material containing the chemical ingredients desirable for the purpose. Building interiors and livestock may also be treated with liquid insecticides to destroy

flies and other insects by proper aerosol treatment in controlled concentrations for either present or residual effects. Germicides, medicaments and hormones can also be effectively dispersed with highly successful effects in the treatment and medication of both plant and animal life. The effectiveness and desirability of a particular aerosol treatment is governed by the uniformity of the dispersion in proper and allowable amounts, depending in turn on the propagation of aerosol particles of controlled and substantially homogeneous size.

Monumental efforts have been devoted to the development and invention of aerosol generators which will generate a liquid aerosol dispersion of controlled and substantially uniform particle size. Various machines and devices have been developed and tested, including spray nozzles through which the liquid material is ejected under high pressures, machines utilizing combustion gases and superheated steam, and aerosol bombs. Prior art machines and devices heretofore developed have either failed to produce aerosols having the particle size uniformity which proper treatment conditions require, or which create fire or health hazards, or which require the dispersion of the liquid material in gases which are so highly heated as to damage the effectiveness and usefulness of the treating liquid, or which are cumbersome, expensive, difficult to control and operate, or which require expensive propelling agents and adulterants.

In accordance with this invention, an aerosal generator is provided which is simple in design and construction, economical to manufacture, substantially foolproof in operation and which propagates an aerosol whose particle size may be adjusted and regulated, with the particles having an extremely high degree of size uniformity.

An important feature of this invention is the provision of an improved dispensing head comprising a series of stacked dispensing discs of almost any desired number which are preferably made of wear-resistant metal and preferably present substantially smooth facing surfaces. Spacing elements are provided to space the inner peripheries of the dipensing discs in a manner to present thin open seams for the admission of the aerosol liquid therebetween. The peripheral facing portions of the dispensing discs are preferably in substantially face-to-face contact and so held by resilient compression members which form a part of the dispensing head assembly. A distributor member of unique design is positioned centrally of the dispensing head and adjacent to the inner peripheries of the stacked dispensing discs which operates to distribute the aerosol liquid supplied to the distributor member substantially evenly and uniformly into the open seams defined between the inner peripheral edges of the dispensing discs. The aerosol liquid thus injected between the adjacent surfaces of the dispensing discs, is sheeted and filmed therebetween as the film layers move outwardly to the disc peripheries under the impelling influence of the high speed rotation of the dispensing head. The material is discharged from the disc peripheries in fine aerosol particles possessing remarkable size uniformity.

The surface forming members may be fixed to a common shaft rotated at high speed by any suitable power unit or driving device such as an electric motor, gas or steam turbine, or combustion engine. The aerosol liquid may be supplied to the distributor member by any suitable liquid feed tube, and may be advantageously conducted through the hollow drive shaft. The rotating dispensing discs develop a vacuum area therebetween which serves to draw the liquid aerosol material through the feed tube and into the seams defined between the inner peripheries of the dispensing discs. Means are provided to control the flow of the liquid aerosol material through the feed tube and into the space between the rotating surfaces. With a given diametric size of rotating surfaces, rotating at a given speed, the particle size of the aerosol produced can be nicely regulated by the simple expedient of controlling the amount of flow of the liquid to the dispensing discs. The particle size of the propagated aerosol may also be varied by varying the diametric size of the dispensing discs, or by varying the speed of rotation, or both.

An object of this invention is to provide an aerosol generator designed to produce and generate an aerosol having particle size of substantial homogeneity.

Another object of this invention is to provide an aerosol generator having an improved dispensing head which may be made to deliver almost any desired volume of aerosol output, and by means of which the particle size of the propagated aerosol may be nicely predetermined and controlled.

Another object of this invention is to provide an aerosol generator having an improved blower assembly of high air volume output and low power consumption in cooperative combination with the dispensing head, the shaft bearings being fully inclosed and protected.

Another object of this invention is to provide an aerosol generator having an improved aerosol liquid supply assembly connected in leak-proof relation to the dispensing head, the liquid supply assembly having means for accurately controlling the volume flow to the dispensing head whereby the particle size and volume output of the projected aerosol may be delicately controlled and regulated.

A further object of this invention is to provide an aerosol generator which is simple and compact in design and construction, which may be constructed in various sizes and forms best suited for the particular aerosol treatment for which the generator is to be used, which may be powered and driven by almost any desired power unit, and which is highly practical in use, economical to manufacture, and flexibly adapted to the various purposes of aerosol propagation.

Other objects and advantages of this invention will become apparent as this description proceeds.

Although the characteristic features of the invention will be particularly pointed out in the claims appended hereto, the invention itself, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part hereof, in which

Fig. 1 is a side elevational view of this improved aerosol generator having a high output capacity dispensing head, driven by a combustion engine.

Fig. 2 is a front elevational view of the aerosol generator shown in Fig. 1.

Fig. 3 is a side view partly in section of the essential parts of this aerosol generator as the same appears when viewed along line 3—3 of Fig.

1, this view showing a side view of the improved dispensing head and the tubular drive shaft, and a cross sectional view of the blower assembly and the aerosol liquid supply connection to the tubular shaft.

Fig. 4 is an enlarged cross sectional view of the dispensing head and a fragmentary portion of the aerosol liquid supply shaft; and

Fig. 5 is a cross sectional detail of the dispensing head as the same appears when viewed along line 5—5 of Fig. 4.

Similar reference characters refer to similar parts throughout the several views of the drawings and specification.

Referring to the drawings, this improved aerosol generator may be said to comprise a dispensing head 1 attached to a tubular drive shaft 30, the drive shaft being encased within the outer casing 41 of a blower assembly 40. The tubular shaft 30 is supplied with aerosol liquid from stationary supply conduit 70 through a connecting device 71 which provides a non-leaking connection between the stationary supply conduit 70 and the adjacent end of the tubular drive shaft 30. The tubular drive shaft 30 may be driven by any suitable source of power such as an electric motor, gas or steam turbine or combustion engine; the particular aerosol generator illustrated in the drawings being shown as driven by a combustion engine 80.

An important feature of this invention is the provision of an improved dispensing head assembly 1 which is shown in detail in Figs. 4 and 5. The dispensing head assembly comprises essentially a series of stacked dispensing discs 2 of almost any desired number which are made of hard wear resistant metal preferably presenting smooth and polished facing surfaces. The dispensing discs 2 may be formed substantially flat, and preferably present a circular outer periphery 2' and a circular inner periphery 2''. The discs are stacked together, with means provided to maintain their inner peripheries 2'' separated a few thousandths of an inch to admit the aerosol liquid therebetween. The peripheral facing surfaces of the dispensing discs are preferably in substantially face-to-face contact and so held by compression members which form a part of the dispensing head assembly.

The stacked dispensing discs are supported upon an inner hub member 3 having a hub portion 4 which is secured as by a key 4' to the tubular drive shaft 30. The hub member is provided with a flange portion 5 which provides a support for the stacked dispensing discs and which is also provided with a raised boss 5'. To lighten the weight of the hub member 3 and still provide adequate strength, the flange portion 5 thereof may be provided with a plurality of equally spaced thickened collar portions 6 through which the clamp bolts 25 extend, strengthening webs 6' radiating inwardly from each of the collar portions 6 to the hub portion 4.

An outer hub member 14 substantially conforms to the hub member 3, the hub members 3 and 14 providing means between which the dispensing discs may be clamped together in assembled position. The hub member 14 is provided with a hub portion 15 which embraces the tubular drive shaft 30. The hub member 14 is provided with a flange portion 16, also having a plurality of spaced thickened collar portions 17 through which the clamp bolts 25 extend. Reinforcing webs 17' radiate inwardly from each of the collar portions 17 to the hub portion 15 of

the clamp member 14. It will be noted by referring more particularly to Figs. 4 and 5, that the clamp bolts 25 extend through aligned holes in the collar portions 6 and 17 of the relatively rigid hub members 3 and 14, which holes align with corresponding holes in the stacked dispensing discs 2. Thin metal washers 24 are interleaved between the adjacent surface of the dispensing discs and kept in stacked alignment by the clamp bolts 25. The washers 24 should be extremely thin and no more than a few thousandths of an inch thick and serve to retain the inner peripheries 2'' of the dispensing discs in uniform spaced relationship in an amount conforming to thickness of the washers 24.

The peripheral facing portions of the dispensing discs 2 should be preferably resiliently retained in substantially face-to-face contact so that the disc peripheries 2' reveal only barely perceptible seams therebetween. To effect the propagation of aerosol particles of controlled and substantially homogeneous size, it is desirable that the adjacent disc surfaces be smooth and polished, with the adjacent peripheral surfaces thereof in substantially face-to-face contact. As shown more particularly in Figs. 4 and 5, the outer peripheral portions of the stacked discs are resiliently clamped between a pair of clamping discs 18 and 18' made of tough resilient metal of predetermined stiffness characteristics. The clamping discs 18 and 18' present somewhat dish-shaped wall portions 19 and 19' respectively, the inner circular rims 20 and 20' abutting against the adjacent shoulders defined by the raised boss portions 5' and 16' of the hub members 3 and 14 respectively. The inner rim portions of the clamping discs 18 and 18' seat against the flat face 21 and 21' of the hub members 3 and 14, the clamping discs 18 and 18' presenting spaced aligned holes through which the spaced clamp bolts 25 extend. The outer rim portions 22 and 22' of the clamping discs 18 and 18' are rounded to provide rounded rims, with the terminal edges 23 and 23' thereof abutting against the outer surface of the adjacent dispensing disc.

It will be appreciated that the head portion 26 and the threaded nut 26' of each of the clamp bolts 25 may be manipulated to clamp the dispensing discs, spaced apart by the thin washers 24, in rigid and firm assembly so as to leave an open seam between the inner peripheries 2'' of the discs, each seam being preferably no more than a few thousandths of an inch in depth. The rounded rim portions 22 and 22' of the clamping plates 18 and 18' serve to resiliently press the adjacent peripheral faces of the dispensing discs 2 in substantially face-to-face contact. A cap nut 27 having an internal thread 27' is removably secured to the projecting end of the tubular drive shaft 30 and seats against the end face 14' of the hub member 14 to further retain the dispensing head in operative assembly.

A distributor member 7, as shown more particularly in Figs. 4 and 5, is contained within the central space defined by the inner peripheries 2'' of the dispensing discs. The distributor member 7 serves to evenly distribute the aerosol liquid discharged from the plurality of radially extending holes 32 in the tubular drive shaft 30, to the limited seaming spaces defined between the inner peripheral edges 2'' of the dispensing discs. The distributor member 7 comprises a tubular body wall 8 which fits over the tubular drive shaft 30 adjacent the radial passages 32 therein. The tubular body wall 8 of the distributor member is

provided with spaced inwardly extending rim portions 9 which seat snugly against the outer surface of the tubular shaft 30. A circular cavity space 10 is defined between the spaced inwardly extending rim portions 9, the cavity space 10 receiving the aerosol liquid discharged from the radially extending shaft port holes 32. A plurality of spaced discharge slits 11 provide passages for the discharge of the aerosol liquid from the cavity space 10 to outer cavity space 12. Radially extending fins 13, forming a part of the distributor member, project for a distance into the cavity space 12.

As the dispensing head revolves at relatively high speed, the centrifugal force generated drives out the air contained within the cavity spaces 10 and 12, the air escaping from the outer peripheries 2' of the dispensing discs, thereby creating substantial suction or vacuum within the dispensing head which draws the aerosol liquid through the passage 31 in the tubular drive shaft 30. The aerosol liquid discharges through the radial port holes 32 in the tubular shaft, thence into the central space 10 defined by the tubular wall 8 of the distributor member. The aerosol liquid escapes from the cavity space 10 through the elongated slits 11 in the tubular wall 8 of the distributor hub. The escaping aerosol liquid enters the cavity space 12 and is evenly distributed between the inner peripheries 2'' of the dispensing discs. Even and substantially uniform liquid feed to the several filming spaces between the inner peripheries of the discs is effected by making the combined discharge areas of the discharge slits 11 not substantially greater than the combined liquid input areas of the shaft ports 32. Thus the liquid is discharged from the full length of the discharge slits 11, which discharge is agitated by the radial fins 13 into spray form which fills the cavity space 12, and then moves uniformly into the seaming spaces between the spaced inner peripheral edges 2'' of the dispensing discs at substantially equal rates of flow throughout the stack of dispensing discs.

The aerosol liquid thus sheeted between the adjacent faces of the dispensing discs, is driven outwardly between the contracting seaming spaces between the adjacent disc surfaces, filming the liquid into an almost imperceptible film which discharges from the outer periphery of the dispensing discs as aerosol particles which are extremely fine and uniform in size. By the use of a plurality of stacked dispensing discs as above described and illustrated, any desired number of layers of aerosol particles may be projected from the peripheries of the rotating dispensing discs, thereby attaining almost any desired aerosol output. The diametric size of the aerosol particles propagated may be controlled by controlling the volume of aerosol liquid supplied to the inner peripheries of the dispensing discs, which is in turn controlled by the volume of aerosol liquid permitted to be sucked through the passage 31 in the tubular shaft 30.

An increased volume of aerosol liquid supplied to the dispensing discs would create a correspondingly increased pressure against the adjacent faces of the dispensing discs, which increased pressure may serve to slightly spread the adjacent peripheral faces of the dispensing discs to a corresponding degree as may be permitted by the inherent resiliency of the outer peripheries of the dispensing discs and the cooperating clamping plates 18 and 18'. By thus controlling the volume of aerosol liquid supplied to the discs, the peripheral speed of rotation of the dispensing discs, and the resilient characteristics of the dispensing discs 2 and clamping plates 18 and 18', aerosol particles of controlled size may be propagated having remarkable size uniformity.

The aerosol particles will flow from the periphery of the dispensing discs in the approximate plane of rotation of the discs until modified or changed by the surrounding atmospheric currents by which the aerosol particles are strongly influenced. In many aerosol treatment operations, it is desirable to provide a stream of air or other gas to cradle the aerosol particles discharged from the dispensing head and direct the aerosol particles forwardly of the dispensing head for some desired distance. This invention incorporates a blower assembly 40 whereby this directive result can be accomplished to the desired degree. As shown more particularly in Fig. 3, the blower assembly 40 may comprise a tubular casing 41 whose upper edge 41' terminates in the approximate plane of the dispensing discs 2 and is spaced therefrom to provide a surrounding throat v defined between the outer periphery 2' of the dispensing discs and the terminal edge 41'' of the casing 41. The size of the aerosol passage v is determined by the number of dispensing discs incorporated into the dispensing head and the air stream velocity at the throat v necessary to carry the propagated aerosol particles the desired distance before being dispersed in the normal atmospheric currents.

The outer tubular casing 41 may contain a bearing housing 42 centrally thereof which presents an inturned flange portion 43 terminating in a circular collar portion 44 which supports a bearing assembly 46. The bearing assembly 46 comprises an inner bearing ring 47 fixed to the reduced neck portion 33 of the tubular shaft 30, and an outer bearing ring 47' fixed to a stationary sleeve 49 carried by the collar portion 44 of the bearing housing 42. The bearing rings 47 and 47' are provided with complementary bearing raceways which receive the ball bearings 48. A closure plate 50 secured as by screws 50' to the stationary collar portion 44 is provided with a sealing ring 51 which bears against a rotatable bearing ring 52 which encircles the adjacent contracted neck portion 33' of the tubular shaft 30. The ring bearing 52 provides a snug seat for the adjacent end of the hub portion 4 of the hub member 3.

The other end of the bearing housing 42 is provided with an inclined flange or end wall portion 45 terminating in a collar portion 45' which receives a bearing assembly 53 which is complementary to the bearing assembly 46. The bearing assembly 53 comprises an inner bearing ring 47 fixed to the adjacent reduced neck portion 34 of the drive shaft 30, and an outer bearing ring 47' fixed within a tubular sleeve 54, the sleeve 54 being fixed to the collar portion 45' of the bearing housing 42, these bearing rings 47 and 47' having complementary bearing raceways which contain the ball bearings 48.

A plurality of radially extending straightener vanes 55 extend between the tubular bearing casing 42 and the tubular outer casing 41. The straightener vanes 55 may be cast integrally with the outer casing 41 and the bearing casing 42 to provide a rigid construction which can be economically manufactured. Each of the straightener vanes 55 may be provided with a curved inner end 55' to facilitate pick-up of the air stream projected by the blower fan 60 and to

then direct the air stream to flow axially and outwardly through the discharge throat *v*. A conically shaped air baffle **56** suitably secured to the tubular bearing casing **42** has its terminal end **56'** adjacent the outer periphery **2'** of the dispensing head **1**.

A blower fan **60** is fixed to the tubular drive shaft **30** adjacent the bearing assembly **53**. The blower **60** may comprise a tubular body wall **61** of substantially the same diameter as the tubular bearing housing **42**. The tubular blower wall **61** has an inturned end wall portion **62** which terminates in a hub portion **63** fixed to the tubular drive shaft **30**. A closure plate **57** has a sealing ring **58** which encircles the hub portion **63** of the blower casing **61**, the closure plate **57** being secured to the collar portion **45'** of the motor housing **42** as by removable bolts **59**. The closure plates **50** and **57** and their associated sealing rings **51** and **58** serve to retain the bearing lubricant within the bearing housing **42**. The tubular body wall **61** and the end wall **62** of the blower **60** encase the flange portion **45** of the bearing housing and the closure plate **57** as shown more particularly in Fig. 3.

Spaced impeller vanes **64** extend radially from the tubular body wall **61** of the blower **60** and may be cast integrally therewith. The impeller vanes **64** are preferably tilted to extend in a plane inclined at an angle of approximately 30° to 45° with respect to the longitudinal axis of the blower body wall **61**. The outer ends **64'** of the vanes are preferably square cut and extend close to the adjacent inner surface of the outer casing **41**, providing only operating clearance therebetween.

Air enters the blower assembly axially thereof in the general direction of the arrow *a* shown in Fig. 3. A flared skirt **65**, secured to the adjacent outer casing **41** as by bolts **65'**, may be provided to assist in funneling the air stream into the tubular blower casing **41**. A spider frame, presenting a plurality of spaced arms **66** extending from the skirt member **65** and terminating in a collar portion **67**, may be cast integrally with the spider frame. The collar portion **67** is shaped to receive the tubular body wall **69** of a fitting **68**, the fitting having a bottom wall **69'** to which the threaded end of the liquid supply conduit **70** is secured.

A connecting device **71** provides a leak-proof passage connection between the passage in the stationary liquid supply conduit **70** attached to fitting **68** and the passage **31** in the tubular drive shaft **30**. The connecting device **71** comprises a cup shaped member **72** snugly fitted within a conforming cavity in the fitting **68**. The cup shaped member **72** has a tubular body wall and an inturned bottom wall **72'** within which a cushion ring **73**, formed of rubber or like resilient material, is contained. A tubular metal sleeve **74**, contained within the cushion ring **73**, provides a passage for the aerosol liquid flowing from the end of the supply conduit **70**. The sleeve **74** is provided with an outturned flange portion **75** upon which a graphite, carbon or other non-metallic bearing member **76** snugly seats, the bearing member **76** being retained within the tubular body wall of the cup member **72** by an inturned flange portion **77** associated with the cup member **72**. The bearing member **76** has a raised boss portion **78** presenting a flat rim **78'** which provides a bearing surface for a companion connecting part **35** which is fixed to the end of the rotatable drive shaft **30**.

The connecting part **35** of the connecting device **71** comprises a cup member **36** having a tubular body wall **37** which embraces the tubular drive shaft **30** and is sealed thereto by a gasket ring **38** seating within a conforming groove formed in the circumference of the drive shaft **30**. The cup member **36** presents a bottom wall **39** presenting a smooth and polished outer face against which the rim face **78'** of the bearing member **76** may snugly seat to provide a leak-proof seal therebetween. The connecting device **71** as above described thus provides a passage connection for the aerosol liquid flowing from the end of the stationary supply conduit **70** and fitting **68**, to the adjacent end of the tubular drive shaft **30**.

The dispensing head **1** and its associated tubular drive shaft **30** and blower fan **60** may be driven by any desired power unit such as an electric motor, gas or steam turbine, combustion engine or the like. For purposes of illustration, the aerosol generator is shown in Figs. 1 and 2 as driven by a combustion engine **80** whose drive shaft **81** is connected to a drive pulley **82** through a suitable clutch mechanism **83**. The fuel supply tank **80'** may be conveniently mounted on top of the engine block, the engine exhaust muffler **80''** being arranged so as not to interfer with the flow of air into the blower assembly **40**. The drive pulley **82** may be provided with driving V-belts **85** which are trained around a pulley sheave **86** suitably secured to the tubular drive shaft **30** as by a threaded collar assembly **86'**.

The driving engine **80** may be mounted upon a suitable base member **87** secured thereto as by suitable bolts **87'**. The base member **87** is provided with protective side walls **88** between which the lower end portion of the driving engine **80** is positioned, the side walls **88** having flared lugs **88'** by means of which the base may be secured to any desired foundation support **79**. The base member **87** may also be provided with a front wall **89** having a bracket **90** secured thereto as by bolts **90'**. The bracket **90** has a top plate **91** which is secured as by bolts **91'** to the tubular outer casing **41** of the blower assembly **40**. It will be noted that the bolts **90'** extend through elongated slots **91''** in the bracket **90** whereby the bracket **90** may be vertically adjusted along with the blower assembly **40** as belt conditions require.

The aerosol liquid is supplied from a tank supply to a feed pipe **92** which leads into a filter chamber **93** in which the aerosol liquid is thoroughly filtered to remove any sediment before the aerosol liquid reaches the dispensing head **1**. The filter **93** is provided with a removable cover **93'** whereby access to the filter body may be had for cleaning purposes. The aerosol liquid flows from the filter **93** through tubing **94** to a liquid pump **95** which may be provided to insure adequate liquid feed to the dispensing head. The aerosol liquid leaves the pump **95** through feed tube **96** and thence flows into a reservoir **97** which may be mounted above the tubular drive shaft **30** to provide gravity feed of the aerosol liquid to the tubular shaft **30** through the supply conduit **70**. The reservoir **97** is provided with a metering valve **98** provided with a control handle **98'** by means of which the rate of flow of the aerosol liquid through the supply conduit **70** and thence to the dispensing head **1**, may be controlled as desired. The receptacle **97** is also provided with an overflow discharge conduit **99** which may lead back to the aerosol liquid supply tank so that the aerosol liquid in the receptacle **97** may be maintained under constant predetermined pressure.

In operation, the driving motor **80** connected to

the pulley sheave 86 by the V-belts 85, rotates the shaft 30 to which the dispensing head 1 is attached. As the dispensing head rotates, air contained within the cavities of the dispensing head is ejected and escapes between the closely fitted dispensing discs 2, thus creating a substantial vacuum or suction in the interior head cavities 10 and 12. The vacuum thus created draws the aerosol liquid from the reservoir 97, through the supply conduit 70, and through the passage 31 in the tubular drive shaft 30. The aerosol liquid escapes from the radial ports 32 in the drive shaft and gushes into the cavity 10 of the distributor member 7, thence through the elongated slits 11 in the tubular wall 8 of the distributor member, and thence into the cavity 12, where the liquid is highly agitated by the revolving fins 13.

The increasing centrifugal force drives the aerosol liquid into the unobstructed seam-like spaces between the spaced inner peripheries 2'' of the dispensing discs 2. As the aerosol liquid travels outwardly between the closely fitted surfaces of the dispensing discs 2, the liquid is sheeted into a series of films of minute thickness and emerges in a series of layers of aerosol particles from the outer periphery 2' of the dispensing discs 2.

The aerosol particles centrifugally discharged from the outer periphery 2' of the dispensing discs 2, will be picked up by the air stream generated by the blower 60 as the air travels through the throat opening *v* defined between the upper edge 41' of the outer casing 41 and the periphery of the stacked discs. The aerosol particles discharge from the outer periphery of the discs in substantially the plane of rotation of the discs. The discharging aerosol particles are almost immediately cradled by the gaseous stream moving through the throat opening *v*, the gaseous stream directing the aerosol particles generally forwardly of the dispensing head. It will be appreciated that the direction given to the propagated aerosol particles may be varied as desired by changing the contour of the outer casing 41 of the fan assembly 40. It will also be appreciated that the velocity of the air stream travelling through the throat *v* determines the distance the aerosol particles will be driven by the gaseous stream developed by the blower before being dissipated in the surrounding atmosphere, leaving the aerosol particles air-borne in the normal atmospheric currents.

Where a large number of stacked dispensing discs are employed having a high volume output, the throat opening *v* should accordingly be increased, the air velocity at the throat *v* also being increased in accordance with the distance it is desired to blow the aerosol particles before they are air-borne by the normal atmospheric currents. It has been found that the size-controlled aerosol particles propagated by this improved dispensing head, are substantially homogeneous in size, and do not agglomerate or combine into large particles, even though twenty or more stacked dispensing discs are used to propagate nineteen or more streams of aerosol particles discharging from the disc peripheries.

The stacked dispersion discs should present their adjacent peripheral face portions in substantially surface-to-surface contact if an aerosol of relatively small particles of uniform size are to be expected. The dispersion discs 2 should be made of strong, tough and preferably non-corroding metal, but may be made relatively thin so that the peripheral portions thereof are held in resilient face-to-face contact by the rounded rim portions 22 and 22' of the clamping plates 18 and 18'.

The dispensing discs are preferably, but not essentially, circular in form, and may vary from two to three inches in diameter to twenty or more inches in diameter. The dispersion discs should be mounted to rotate at relatively high speed to effect the peripheral velocity of approximately fifty feet per second to eight hundred feet per second and upwards, depending upon the aerosol liquid used, the particle size to be produced, and the volume rate at which the aerosol liquid is fed to the dispensing head.

The size of the aerosol particles may be controlled by controlling the volume of aerosol liquid admitted to the dispensing discs. It will be appreciated that an increased volume of aerosol liquid supplied to the dispensing head will exert a correspondingly greater pressure against the adjacent disc surfaces as the liquid films move outwardly therebetween. The increased pressure may be such as to cause a slight separation of the adjacent peripheral surfaces of the dispensing discs, which will result in the propagation of an aerosol of larger particle size. The volume of aerosol liquid admitted to the dispensing discs may be conveniently controlled by the provision of an adjustable valve which controls the flow of aerosol liquid admitted to the tubular feed shaft 30. In the exemplification shown in Figs. 1 and 2, the control valve 98 is associated with the aerosol liquid reservoir 97, the valve 98 being manipulated by a metering arm or dial 98 which indicates the volume flow of the aerosol liquid supplied to the dispensing head 1.

Aerosol generators may be made in accordance with this invention to produce aerosols of any selected particle size ranging from one to two microns in diameter, up to the upper ranges of aerosol particle sizes, and the selected size of the aerosol particles produced may be maintained substantially uniform. Where aerosols having particle size of only a few microns in diameter are to be produced, the adjacent peripheral faces of the dispersion discs 2 should be polished and closely lapped so as to present smooth surfaces in substantial face-to-face contact, and the volume of aerosol liquid fed between the discs should be controlled so that the pressure exerted by the liquid moving outwardly between the adjacent faces of the discs will not appreciably separate the contacting surfaces of the dispensing discs.

By increasing the liquid flow to the dispensing discs, a corresponding increase in the separating pressure may be exerted against the adjacent peripheral surfaces of the dispensing discs to thereby increase the size of the aerosol particles produced. Aerosol generators may be made in accordance with this invention having any desired aerosol output capacity of a selected particle size, by increasing or decreasing the diametric size of the discs, and/or increasing or decreasing the number of dispensing discs assembled into the dispensing head, and/or increasing or decreasing the speed of rotation of the dispensing discs.

It will be appreciated that this improved dispensing head may be driven by any selected power unit such as an electric motor, gas or steam turbine, combustion engine, air compressor or the like, and may be made as a small compact unit for interior use or as a high capacity unit for field use. While the blower assembly

may be varied in type and design, a blower assembly 40 of the type above generally illustrated and described is particularly economical in power consumption and may be designed to produce a high volume, high velocity air stream which will give substantial direction to the projected aerosol. Aerosol generators constructed in accordance with the teachings of this invention are ideally suited for numerous aerosol treatments in the fields of entomology, agronomy, animal husbandry, public health, sanitation and medicine.

It is understood that the principles of this invention may be embodied in various modifications and adaptations, and it will be accordingly appreciated that this invention is not limited to the particular embodiments described and illustrated, and that various omissions, substitutions and changes may be made by those skilled in the art without departing from the teachings of this invention.

What I claim is:

1. A machine for converting liquids to aerosols which includes, a dispensing head comprising dispensing discs arranged in stacked relationship, said dispensing discs being substantially of equal exterior diameter and having resilient peripheral portions and presenting adjacent filming surfaces, means for maintaining the adjacent inner surface areas thereof in spaced relationship and means for urging the adjacent peripheral surface areas thereof into resilient contiguous relationship, a distributor member positioned centrally of said dispersion discs, a tubular shaft fixed to said dispensing discs and distributor member, said tubular shaft havig a discharge outlet through which the aerosol liquid is supplied to said distributor member, said distributor member having a tubular wall presenting radiating discharge passages, and impelling fins radiating outwardly from said tubular wall to distribute the aerosol liqiud into the plurality of spaces presented by the paired inner surfaces of said dispensing discs, and means for rotating said dispensing discs.

2. A machine for converting liquids to aerosols which includes, a dispensing head comprising a plurality of dispensing discs arranged in stacked relationship, said dispersion discs being substantially of equal exterior diameter and having resilient peripheral portions and presenting adjacent filming surfaces, means for maintaining the adjacent inner surface areas thereof in spaced relationship and means for urging the adjacent peripheral surface areas thereof into resilient contiguous relationship, a distributor member positioned centrally of said dispensing discs, a tubular shaft fixed to said dispensing discs and distributor member, said tubular shaft having a discharge outlet through which aerosol liquid is supplied to said distributor member, said distributor member having a tubular wall presenting an interior cavity space into which the liquid is discharged from the discharge outlet in said shaft, a plurality of spaced fins radiating from said tubular wall and presenting an outer cavity space between the fins, said tubular wall having a plurality of radiating passages extending therethrough for conducting the liquid from said inner cavity space into said outer cavity space, said spaced fins distributing the aerosol liquid between the spaced inner surface areas of said dispensing discs, and means for rotating said dispensing discs at predetermined speed.

3. In a machine for converting liquids into finely divided particles, a rotatable head comprising a pile of substantially flat dispersion plates, the plates near the center of the pile being dished with their concavities disposed toward each other, succeeding adjoining plates on either side being dished progressively to a greater degree, with their concavities facing the center plates, whereby the central portions of the plates are spaced apart to form clearance spaces, the peripheral margins of the plates being substantially smooth and in contact with adjoining plates, said plates having large central openings, clamping plates, one at either end of the pile, said clamping plates having hub portions, a hollow shaft on which said hub portions are mounted, distributor means surrounding said shaft and located in said large central openings between said clamping plates to equalize supply of liquid from the hollow shaft to said clearance spaces, spacing devices between the several plates adjacent their inner margins, clamping rings disposed between the clamping plates and the dispersion plates, said clamping rings having outer rim portions directed toward each other and exerting resilient pressure on the dispersion plates, and a series of fastening members passing through the clamping plates, the clamping rings and the dispersion plates, to clamp the assembly tightly together.

4. A machine for converting liquids to aerosols comprising a tubular main casing, a bearing housing within said main casing, straightening blades connecting said bearing housing and main casing to support said bearing housing, said bearing housing having bearing portions at either end, a hollow drive shaft having an internal duct, said drive shaft being journaled in said bearing portions, a dispersion head mounted on one end of the shaft and having communication with said duct, the periphery of said dispersion head being spaced from, and disposed substantially directly opposite, the terminal edge of the main tubular casing to define a discharge throat therebetween, a blower impeller mounted on said shaft on the other side of the bearing housing from said dispersion head, said impeller having a hub casing secured to said shaft, said hub casing having a diameter approximately equal to that of the bearing casing, impeller blades secured to said hub casing and extending toward said main casing, a drive pulley on said shaft adjacent said impeller, a support secured to said main casing, a tubular sealing ring secured to said support, said hollow shaft having engagement with said sealing ring, and a supply conduit connected to said sealing ring.

5. A machine for converting liquids to aerosols comprising a tubular main casing, a bearing housing within said main casing, straightening blades extending between said bearing housing and main casing, said bearing housing having bearing portions at either end, a hollow drive shaft having an internal duct, said drive shaft being journaled in said bearing portions, a dispersion head mounted on one end of the shaft and having communication with said duct, the periphery of said dispersion head being spaced from, and disposed substantially directly opposite, the terminal edge of the main tubular casing to define a discharge throat therebetween, a blower impeller mounted on said shaft on the other side of the bearing housing from said dispersion head, and drive means on said shaft adjacent said impeller, a support secured to said main casing, a sealing device secured to said support and engaging said hollow shaft adjacent said impeller, and a supply conduit connected to said sealing device.

6. In a machine for converting liquids into

aerosols, a rotatable dispersion head presenting a plurality of dispersion discs having resilient peripheral portions and arranged in stacked relationship, said discs having axially aligned openings therein whereby the inner peripheries of said discs present a central cavity in said head, means for spacing the inner peripheries of said discs in substantially uniform spaced relationship, a hollow liquid supply shaft extending into said central cavity and presenting a laterally extending liquid discharge port for supplying liquid to the spaces defined by the inner peripheries of said discs, cover members closing the cavity defined by the inner peripheries of said discs, means for clamping the pile of dispersion discs together into a unitary assembly, and means for urging the adjacent peripheral surfaces of said discs into resilient contact.

7. In a machine for converting liquids into aerosols, a rotatable dispersion head presenting a plurality of resilient dispersion discs of substantially equal diameter and arranged in stacked relationship, said discs having axially aligned openings therein whereby the inner peripheries of said discs present a central cavity in said head, means for maintaining the inner peripheries of said discs in substantially uniform spaced relationship, a hollow liquid supply shaft extending into said central cavity and presenting a plurality of liquid discharge ports therein, a distributor member having radiating liquid discharge passages positioned within said central cavity and fixed to said shaft for distributing the liquid discharged from said shaft ports to the spaces defined by the inner peripheries of said discs, a pair of plate members closing the cavity defined by the inner peripheries of said discs, means for clamping the pile of dispersion discs together into a unitary assembly, and means for urging the adjacent peripheral surfaces of said discs into resilient contact.

8. A machine for converting liquids to aerosols including a tubular main casing, a bearing housing within said main casing, straightener vanes extending between said bearing housing and main casing, said bearing housing having bearing portions at both ends thereof, a hollow drive shaft having an internal duct journaled in said bearing portions, a dispersion head mounted on said shaft adjacent one of said bearing portions and having communication with said duct, said dispersion head being centrally positioned with respect to said tubular casing and having its periphery disposed substantially opposite the terminal edge of said tubular casing to define a discharge throat therebetween, a blower impeller mounted on said shaft adjacent the other bearing portion, means for rotating said shaft and dispersion head, and means for supplying aerosol liquid to said hollow shaft.

9. A machine for converting liquids to aerosols including a tubular casing, a bearing housing within said casing, straightener vanes connecting said bearing housing and casing and supporting said bearing housing, said bearing housing having bearing portions at both ends thereof, a hollow drive shaft having an internal duct journaled in said bearing portions, a dispersion head mounted on one end of said shaft adjacent one of said bearing portions and having communication with said duct, the periphery of said dispersion head being spaced from, and disposed substantially directly opposite, the terminal edge of the tubular casing to define a discharge throat therebetween, a blower impeller mounted on said shaft adjacent the other bearing portion, means for rotating said hollow shaft and dispersion head, a stationary liquid supply conduit, and means for hermetically connecting the adjacent ends of said liquid supply conduit and said hollow shaft.

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