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3,270,711

ELECTROSTATIC COATING SYSTEM

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2 Sheets-Sheet 2

FIG. 2

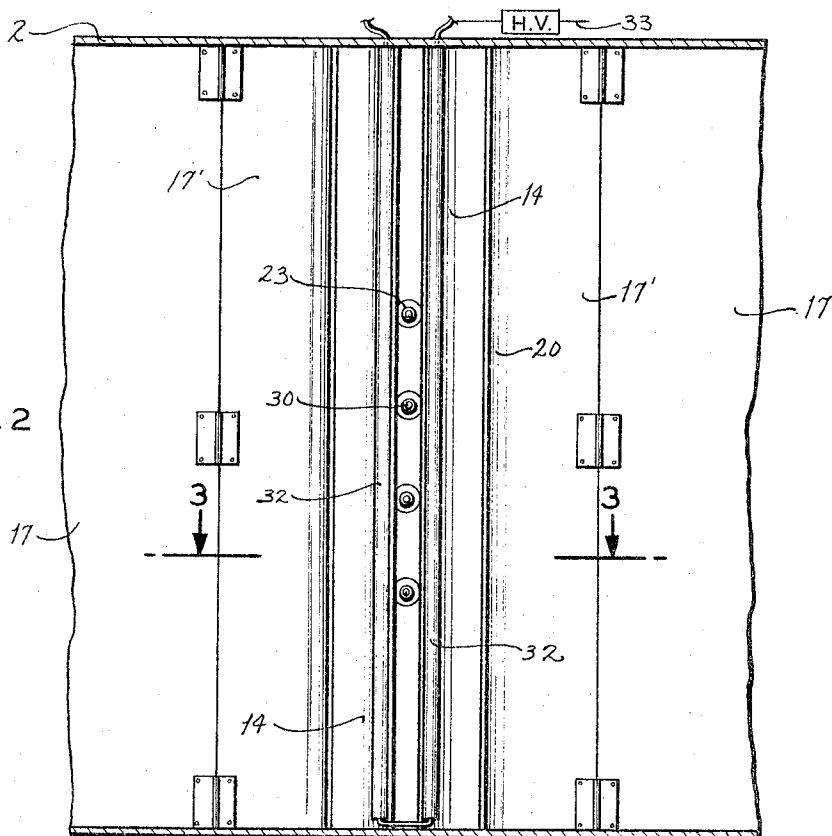
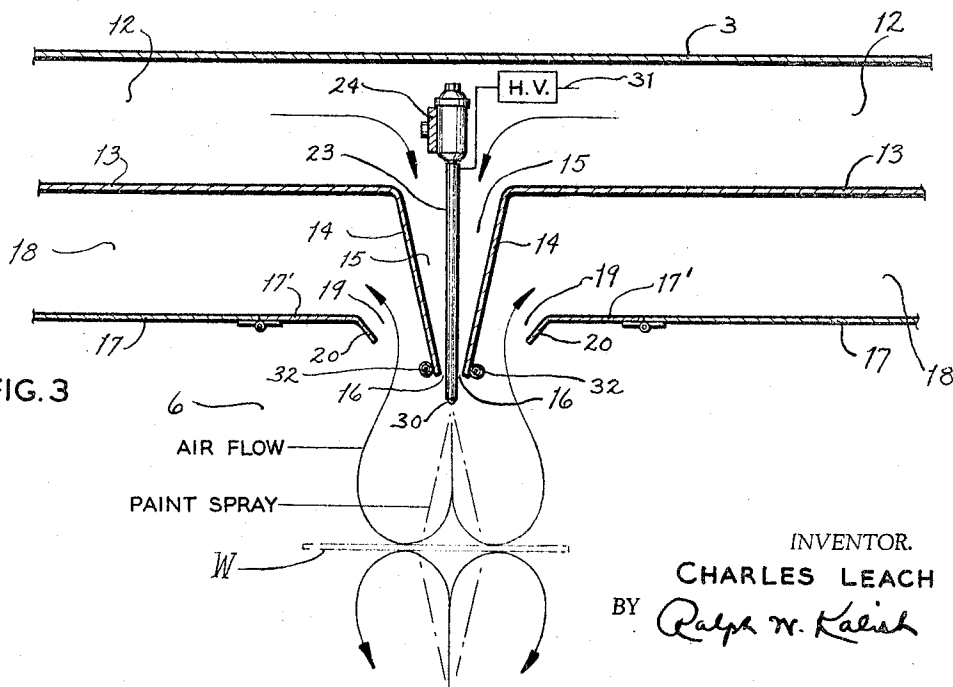


FIG. 3



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3,270,711

ELECTROSTATIC COATING SYSTEM

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13 Claims. (Cl. 118-627)

This invention relates in general to spray coating and, more particularly, to a system for effecting electrostatic deposition of coating material upon articles in a highly efficient, evenly distributed, and completely covering manner.

Heretofore, the utilization for electrostatic spray coating of myriad types of articles and devices has become a widespread practice and has had general acceptance in industry. However, there has ever been present the problem of attempting to develop means and expedients for reliably assuring of the coating material being deposited in an evenly distributed manner and one which covers all exposed surfaces, edges and the like of the device, as well as to assure that the device will be devoid of the reception upon its surfaces of any dust particles, foreign matter and the like which severely adversely affect the resultant appearance of the finished item. It has thus been found that to achieve a finish to the coated article of consistently high quality and attractive appearance, numerous factors must be considered with a plurality of closely controlled features integrated into systems of the character under study so as to jointly bring about the long sought results. It is recognized that the improvement in only certain aspects or elements of systems heretofore developed will not in and of themselves conduce into fully commercially accepted finishes.

It is an object of the present invention to provide an electrostatic coating system adapted for the deposition of coating material upon suitable articles to bring about a finish thereon which is of even thickness; which has a smooth surface; which completely covers all surface or edge portions; and which is devoid of any surface irregularities or other appearance-detracting agents or features, such as dust particles, foreign matter, paint, threads, etc.

It is another object of the present invention to provide an electrostatic coating system which incorporates a novel means for air circulation so that the system is at all times fully ventilated thereby providing a markedly clean atmosphere for the coating operation; and which effectively continuously removes from the system undeposited paint, dust, foreign matters and the like.

It is a further object of the present invention to provide an electrostatic coating system embodying banks of directly opposed spray guns connected to high voltage sources for imparting an electrostatic charge of high potential upon coating material discharged therefrom in a highly atomized state for attraction to articles to be coated which are grounded.

It is an additional object of the present invention to provide a system of the character stated wherein zones of potential are provided adjacent the spray guns so as to effectively counter the tendency of the discharged coating matter from grounding on portions of the system proximate the gun with the development of undesired coating or paint threads or streamers, resulting in costly loss of coating material; loss of efficiency by decrease in the impressed voltage from the guns by current flow through the threads to ground; and fouling of the atmosphere in the system by introduction therinto of debris from the coating threads.

It is a still further object of the present invention for providing a system of the type indicated wherein a plurality of forces simultaneously act upon the coating

material emitted from the spray guns so as to present same to the article to be coated in a highly agitated state to assure full distribution throughout all exposed portions of the article to be coated.

It is a still further object of the present invention to provide an electrostatic coating system wherein the articles to be coated are subjected on opposite side faces with coating material discharged from opposed spray guns which are in co-axial relationship so that the articles are substantially stabilized in position during coating thereby eliminating swaying and the danger of conflagration caused by sparking through movement of the articles into undesired immediate proximity with the high potential field about the nozzle ends of the discharge guns.

It is an additional object of the present invention to provide an electrostatic coating system which can be relatively economically constructed; the novel features of which may be incorporated into existing systems without costly rebuilding; which in operation is markedly efficient and highly durable; and the use of which conduces to substantial economies in production.

Other objects and details of the invention will be apparent from the following description, when read to connection with the accompanying drawings (two sheets) wherein:

FIGURE 1 is a perspective view of an electrostatic spray coating booth constructed in accordance with and embodying the present invention.

FIGURE 2 is a fragmentary elevational view taken on the line 2-2 of FIGURE 1.

FIGURE 3 is a horizontal transverse section taken on the line 3-3 of FIGURE 2.

Referring now by reference characters to the drawings which illustrate the preferred embodiment of the present invention, A designates, in general, an electrostatic coating system comprising an enclosure or, more commonly called, spray booth 1 having a top wall 2, opposed side walls 3 and end walls 4. Provided centrally of each end wall 4 are aligned, vertical openings 5 extending the full height of booth 1 for connecting the exterior with a passageway indicated broadly 6 extending axially of booth 1 for movement therethrough of articles, as indicated at W in FIGURE 3, to be coated; said articles W being carried through passageway 6 by means of an overhead conveyor (not shown) adapted for travel along a track 7 disposed adjacent to, and beneath, top wall 2. As shown in FIGURE 1, and for purposes presently appearing, track 7 is grounded as at 8. It will be seen that booth 1 is bilaterally symmetrical so that the side portions thereof, on either side of passageway 6, are of like construction and in direct correspondence to the portions of the opposed side. Thus, in the description set forth hereinbelow this symmetric relationship should be firmly observed since, for the most part, structural detail will be limited to but primarily one side of the booth 1. Furthermore, it is recognized that booth 1 may be of any preselected length so that the number of system components may be increased or decreased commensurate with the selected booth length. Thus, booth 1 comprises opposed side sections designated broadly 9, 9'.

Located above top wall 2 is a pair of air supply manifolds 10, 10', preferably in side-by-side relation and axially parallel, each of which communicates with a plurality of longitudinally spaced-apart take-offs or air-feeding conduits 11, 11', respectively, which are of elbow design and at their lower ends extend through top wall 2 for communication with the respective side portions 9, 9' of booth 1. Each conduit 11, 11' at its lower end opens into the upper end of an air inlet chamber 12 defined by the adjacent portions of the proximate side wall 3 and a partition member 13 the central portion of which

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is in planar parallel relationship to the proximate side wall 3 and which partition extends the full height of booth 1. Each partition 13 is provided with terminal portions 14 which are in planar inclined relationship to the central portions of said partitions 13, extending inwardly toward passageway 6 and toward the proximate terminal section 14 of the immediately adjacent partition 13, so that the same are in a mutual converging relationship to define a passage 15 progressing from chambers 12 to passageway 6 in decreasing cross-section to a relatively narrow slot-like discharge opening 16 extending the height of booth 1 and thus forming a nozzle so that air moved therethrough from chambers 12 will be of relatively increased velocity.

Presented spacedly inwardly from each partition 13 is a wall-forming member 17 being in substantial planar parallel relationship to the proximate partition 13 with the outwardly directed surface thereof defining with the confronting or inner face of the latter an air exhaust compartment 18. The inner face of said wall-forming members 17 thus forms the lateral boundaries of passageway 6. Each wall-forming member 17 terminates at its ends spacedly from the terminal sections 14 of the associated partitions 13 for creating therebetween an ingress or opening 19 for permitting air flow into compartment 18. The vertical marginal portions of wall-forming member 17 may be turned slightly inwardly as at 20 for providing outwardly flared character to opening 19. If desired, each wall-forming member 17 may embody a swingably mounted section as at 17' so that inward swinging of the latter will allow of facile access to compartment 18 for cleaning, inspection and like purposes. For reasons to be discussed hereinbelow, partitions 13 and wall-forming members 17 are preferably constructed of non-conductive, dielectric material.

Compartments 18 at their upper ends open into air outlet conduits 21 mounted upon top wall 2 and which communicate with the associated air return ducts 22, 22'. Suitably positioned with relationship to said air return ducts 22, 22' are air exhaust blowers or fans (not shown) for creating a forced draft through the system A. Thus, air will be drawn from manifolds 10, 10' through conduits 11 for introduction into air inlet chambers 12, thence into passage 15 for discharge into passageway 6 through the nozzle-like opening 16 wherein the same will be brought into turbulence producing contact with the air mass flowing into said passageway from the opening 16 on the opposite side of booth 1. By the collision of the opposed air masses the same will tend to be turned and directed returningly outwardly as in the manner indicated by arrows in FIGURE 3 for flow through opening 19, chamber 18, and then upwardly into conduits 21 for discharge into ducts 22, 22'. Accordingly, the foregoing sets forth a novel air circulating system within booth 1 which, as will become all the more apparent hereinbelow, maintains the interior of booth 1 in a state of highly developed cleanliness conducing in substantial part to the achievement of finishes of outstanding excellence upon the articles W.

Disposed within each passage 15 is a bank or series of horizontally presented, axially parallel and vertically aligned spray guns 23 the base or butt ends of which are suitably secured in vertical spaced relationship upon an upright frame member 24 which at its upper end, beneath top wall 2, is connected to the adjacent uprights 24 by a horizontal bar 25 and with the same being simultaneously connected by transverse beams 26 extending across passageway 6, upwardly of conveyor 7 to the frame element 24 carrying the opposed bank of spray guns on the opposite side of booth 1. Thus, members 24, 25 and 26 integrate the banks of guns 23 into a stable, rigid unit for simultaneous vertical reciprocating motion by means of a single auxiliary power source (not shown) connected by eccentric lever means (not shown) to the said unified gun bank frame. Such reciprocating motion is permitted

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by the provision of a elongated milled slot 27 in the lower end of each frame element 24 within which is engaged an adjustment pin (not shown) for controlling the stroke of such motion; said pin being carried within a slide housing 28 mounted upon a support bracket 29 affixed to the floor or base of booth 1. Thus, in operation, the spray guns 23 will be continuously moved reciprocatingly vertically so that the coating materials discharged therefrom will cover an area of relatively greater extent than would be so covered if the guns were stationary.

Each gun 23 is connected to a source of coating material or paint under pressure, as well as with a source of pressurized air, in the customary manner, so that the coating material discharged from the gun nozzle 30 will be highly atomized or in a fine spray; the said air discharge of guns 23 being constructed so as to impart a swirling movement to the air which, in turn, will cause the sprayed coating material to create a pattern which is of generally conical or increasing cross-section but yet being turned about a central discharge axis thereby conducing to an agitated state of the coated material as the same is propelled toward the article to be coated. The path of such articles is substantially midway between the opposed banks of guns 23 so that the discharge patterns of the atomized coating from opposed guns will impinge upon the article to be coated at approximately corresponding points of development. It will thus be seen that such discharged material will have a tendency to more or less stabilize the articles in their suspended state, being subject to substantially like forces on either side and thereby preventing undesired swaying with consequent approach of the articles W into relative immediacy to one gun bank or the other in which condition a sparking might occur with the attendant danger of conflagration.

Each gun 23 is heavily insulated throughout its extent and with only the portions of the metallic guns barrels at the nozzle or spraying tips 30 being exposed. Guns 23 are connected by suitable leads to a source of high voltage as shown at 31 for developing a field of high potential in the guns imparting an electrostatic charge to the coating material ejected therefrom. Thus, travel through the field of high intensity within the guns 23 will cause the sprayed material, traveling toward the articles W, to likewise have a high potential. Since articles W are connected to ground through the conveyor (not shown) and track 7, the emitted particles of coating material will be highly attracted thereto for electrostatic deposition on the surfaces of article W. It will be seen that the coated material discharged toward articles W from opposite banks of guns 23 will cause an envelopment of the articles W so as to fully cover all exposed portions or fragments thereof and provide comprehensive covering, as well as an even distribution of coating material thereover. The discharged material from the opposite guns will meet in the plane of the article being coated and thus tend to create a zone of turbulence which will materially conduce to the distribution of the coated material about the article W for full encasement thereof. Thus, the meeting of these two streams of coated material in their ever increasing swirling patterns will enhance the desired agitation of the same. Furthermore, the reciprocating movement of the banks of guns 23 will assure of distribution of coated material over a relatively increased vertical area and assure that upper and lower portions of articles W will be as effectively coated as the intermediate portions. The up and down movement of the banks of guns 23 provides another coating-agitating producing medium.

In light of the above described coating operation, the critical character of the novel air circulation system of the present invention becomes all the more manifest. The pattern of air flow, as set forth hereinabove, will also tend to produce an added dynamic quality to the charged atomized coating material by the flow past guns 23 through the nozzle-like slot 16, as well as by the turbulence developed substantially in the plane of the

articles W by encounter with the air streaming from the directly opposite side of booth 1. Furthermore, the air will entrain any coating particles failing to be deposited upon articles W, as well as any dust or foreign matter within the booth atmosphere and carry same through the ventilating system for discharge through ducts 22, 22'. Thus, the novel air circulation means of the present invention provides a climate of marked cleanliness within the passageway 6 so that only the charged particles are deposited upon articles W to present an evenly distributed, surface smooth finish, unmarred by any surface irregularities, undesired exposed regions, or relatively excessive accumulation of coating material in disparate portions. Accordingly, by means of the present invention, articles W will be reliably and consistently coated in a fully commercially desirable and acceptable form with the obvious economies in operation being achieved since rerunning of articles discharged is to all intents and purposes eliminated.

Since the particles discharged from gun nozzles 30 are highly charged, the same have an inherent tendency to seek grounding through conductive agencies in the immediate vicinity, such as adjacent portions of the booth; which grounding would be productive of at least two markedly undesired results: one, being to diminish the quantum of coating material for deposit on the articles W and the other, being to form streamers or so-called threads between the spray guns 23 and the grounding material which eventually develop into bridges of considerable thickness. Such threads and/or bridges provide undesired current paths, as well as constituting a source of debris for potential surface marring deposition upon articles W. In order to avoid this short circuiting action with its attendant critical defects, there is provided on either side of spray guns 23 a field of electric potential to repel the charged particles emitted from gun nozzles 30 in order to inhibit the grounding of the same upon structures adjacent to guns 23. Such a counter potential field may be developed by means of a continuous conductor 32 located about the inner margins of terminal sections 14 of the partitions 13, or in other words, about slot-like nozzle 16 so as to surround the entire associated bank of guns 23; said conductor 32 being connected to a source of high voltage as indicated at 33 in FIGURE 2.

As may best be seen in FIGURE 3, conductors 32 are located spacedly outwardly, as well as laterally, from the nozzles 30 of guns 23. Such outward spacing is of exceeding importance in that if the said conductors 32 were laterally aligned with nozzles 30, a plane-like potential field would be developed and it has been found that the same would tend to impede an effective flow of the charged coating particles toward the work pieces W. Despite the fact that the guns 23 are insulated, a potential will be developed at a point outwardly of nozzles 30, albeit such will have a value of less than that at the said nozzles. Therefore, conductors 32 must necessarily have an impressed voltage, so as to counter the potential field in the area of guns 23 immediately therebetween. It has also been found that such potentials on the guns at these parts, are due to surface leakage, which exists normally on a gun barrel, as well as insulation leakage. Thus, the potential between conductors 32 would be normally less than one-half of the nozzle voltage. Therefore, the voltage impressed upon conductors 32 need be but of the order sufficient to counter the relatively reduced voltage of the gun barrel portion therebetween and which most often has been approximately one-third of the nozzle voltage. The field of high intensity developed in conductor 32 inhibits the formation of coating threads or streamers so that no inadvertent conductive paths are created between guns 23 and the adjacent structural components of booth 1 thereby further conducing to the cleanliness of the booth atmosphere and preventing the development of a heretofore accepted source of debris or foreign matter.

In view of the foregoing, it will be seen that the

system of the present invention uniquely integrates a plurality of novel expedients which conjoin to effect electrostatic deposition in a manner which consistently produces finishes of high quality and in a most economic fashion.

It should be understood that changes and modifications in the formation, construction, arrangement, and combination of the several parts of the electrostatic coating system may be made and substituted for these herein shown and described without departing from the nature and principle of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. An electrostatic coating system comprising an enclosure having a top wall, side walls, and end walls, there being aligned ingress and egress openings in said end walls, means for effecting movement lengthwise through said enclosure of articles having at least two surfaces to be coated, aligned transversely opposed coating discharge means disposed on either side of the path of travel of said articles to be coated, and transversely aligned means located on opposite sides of the travel path of articles moving through said system for emitting air for collision of the emitted air masses within the zone of the travel path of such articles for effecting return flow of said air toward the emitting means, and passage-forming means for directing the return air for exhausting same from said system.

2. An electrostatic coating system as defined in claim 1, and further characterized by said coating discharge means comprising a series of horizontally presented, vertically aligned spray-producing members, the longitudinal axes of said members being normal to the axes of travel of the articles to be coated, the spray-producing members in one series being co-axial with like members in the series on the other side of said path of travel, and means for effecting vertical reciprocal movement of the series of spray-producing elements on both sides of the path in unison.

3. An electrostatic coating system as defined in claim 1, and further characterized by means for impressing a potential field on said coating discharge means for effecting a charge upon the coating material discharged therefrom, and means presented adjacent said coating discharge means for creating a potential field for countering the tendency of the discharged material to effect grounding on portions of the system adjacent said coating discharge means.

4. An electrostatic coating system as defined in claim 2, and further characterized by the provision of longitudinally spaced, planar aligned wall-forming members located on either side of the path of travel of the articles to be coated, means presented between adjacent wall-forming members for defining a vertically extending nozzle-like opening, said nozzle-like opening comprising said air directing means, said spray-producing members extending at their discharge ends through said nozzle-like opening.

5. An electrostatic coating system as defined in claim 3 wherein the articles to be coated are connected to ground for attracting the charged coating material discharged from the coating discharge means.

6. An electrostatic coating system as defined in claim 1 and further characterized by an air circulating means for directing a stream of air through the enclosure and exhausting same therefrom for entrainment of dust, foreign matter and undeposited coating materials.

7. An electrostatic coating system as defined in claim 2 and further characterized by a first source of high voltage, means connecting said first source of high voltage to each spray-producing member in each series for impressing a potential field thereon for effecting a charge upon the coating material to be discharged therefrom, a second source of high voltage, conductor means disposed on opposite sides of, and adjacent to, the discharge

end of each spray-producing member, said conductor being connected to said second source of high voltage for development of a field of high potential therethrough.

8. An electrostatic coating system comprising an enclosure having a top wall, side walls, and end walls, there being aligned ingress and egress openings in said end walls, means for effecting movement lengthwise through said enclosure of articles having at least two surfaces to be coated, aligned transversely opposed coating discharge means disposed on either side of the path of travel of said articles to be coated, longitudinally spaced, planar aligned wall-forming members located on either side of the path of travel of the articles to be coated, means presented between adjacent wall-forming members for defining a vertically extending nozzle-like opening, means for providing air to said nozzle-like opening for emission toward the travel path of said articles to be coated, said spray-producing members extending at their discharge ends through said nozzle-like opening.

9. An electrostatic coating system as defined in claim 8 and further characterized by said nozzle-like openings on one side of the path of travel of the articles being transversely aligned with a nozzle-like opening on the opposite side of said path whereby the air emitted by aligned nozzle-like openings will collide and be returned in the direction of the emitting nozzle-like opening, and passage-forming means provided adjacent said nozzle-like openings for receiving the returning air.

10. In an electrostatic coating system having an enclosure with a top wall, side walls and end walls, and means for conducting therethrough an article to be coated, the improvement comprising air-circulating means for removal from said system of dust, foreign matter, undeposited coating materials, and the like, comprising means provided on opposite sides of, and within, said enclosure in opposed, transversely aligned relationship for defining nozzle-like openings, means for directing air through said nozzle-like openings for collision of the air masses emitted by aligned nozzle-like openings whereby through the impact of collision the air will be returned in the general direction of the emitting nozzle-like opening, and passage-forming means provided laterally of said nozzle-like openings for receiving the returning air for discharge.

11. In an electrostatic coating system, air-circulating means as defined in claim 10 and further characterized by an air supply means, means connecting said air supply means with said nozzle-like openings, an air exhaust manifold, and means connecting said passage-forming means with said air exhaust manifold.

12. In an electrostatic coating system, air circulating means as defined in claim 10 and further characterized by air supply means, conduit forming means connecting said air supply means with said nozzle-like openings, means for creating a forced draft through said enclosure for drawing air thereinto through said nozzle-like openings, an air exhaust manifold, and said passage-forming means being connected to said air exhaust manifold.

13. In an electrostatic coating system, air circulating means as defined in claim 10 and further characterized by first and second air intake manifolds, said first and second air intake manifolds being in communication with the nozzle-like openings on the respective side of said enclosure, first and second air exhaust manifolds on opposite sides of said enclosure connected to the passage-forming means provided laterally of the respective nozzle-like openings, and means for effecting discharge of air from said nozzle-like opening under force.

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