United States Patent [19]

Dalhaus

[11] **3,762,649**

[45] **Oct. 2, 1973**

[54] **SPRAY APPARATUS FOR SPRAYING HERBICIDES, INSECTICIDES AND THE LIKE**

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[22] Filed: **Dec. 8, 1971**

[21] Appl. No.: **206,095**

[52] **U.S. Cl.** **239/391**, 239/171, 239/552

[51] **Int. Cl.** **B05b 1/14**

[58] **Field of Search** 239/171, 552, 553, 239/5, 554, 555, 391

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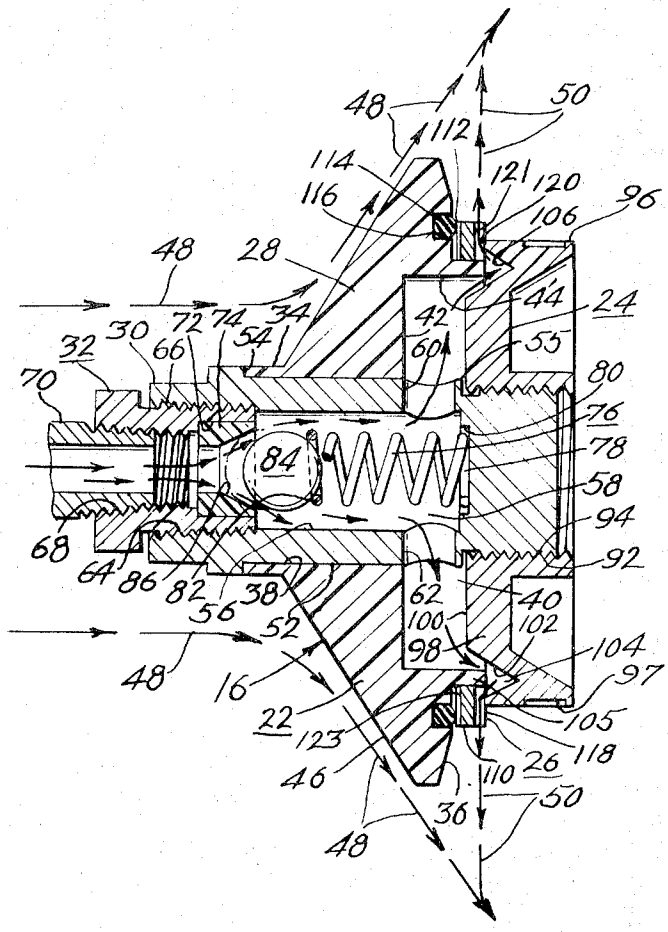
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Assistant Examiner—John J. Love
Attorney—Dexter N. Shaw et al.

[57] **ABSTRACT**

A spray apparatus for spraying herbicides, insecticides and the like from a vehicle in movement through air is provided having an air deflecting configuration for deflecting an air stream outwardly around the apparatus, and liquid passing through the apparatus is discharged in a manner to produce a plurality of uniform jets directed outwardly and transversely to the air stream. The spray apparatus includes a housing having means for producing a turbulent flow of liquid therethrough and means for directing the turbulent flow of liquid to a plurality of discharge openings spaced in an annular array around the apparatus.

13 Claims, 11 Drawing Figures



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SHEET 1 OF 3

FIG. 1.

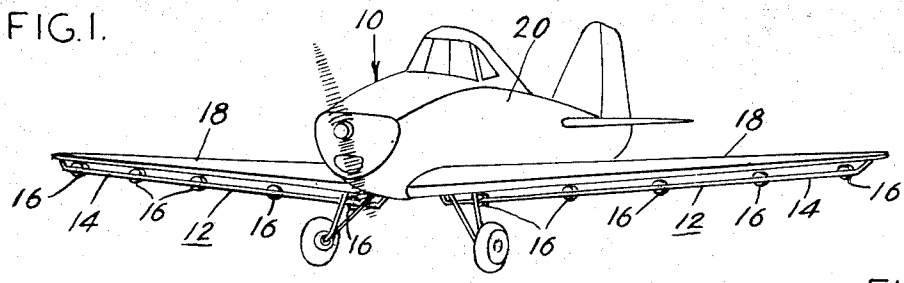


FIG. 2.

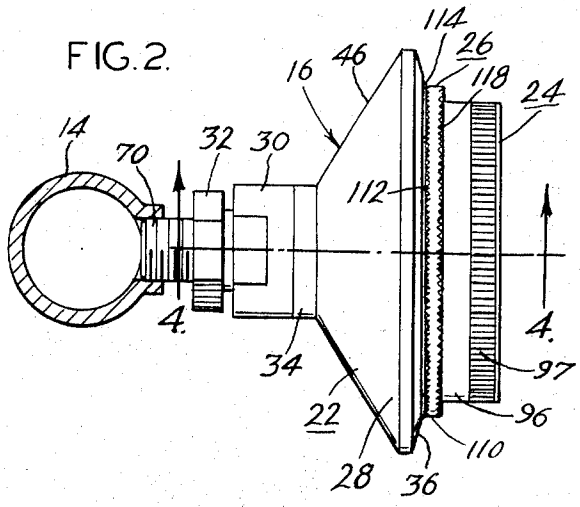


FIG. 3.

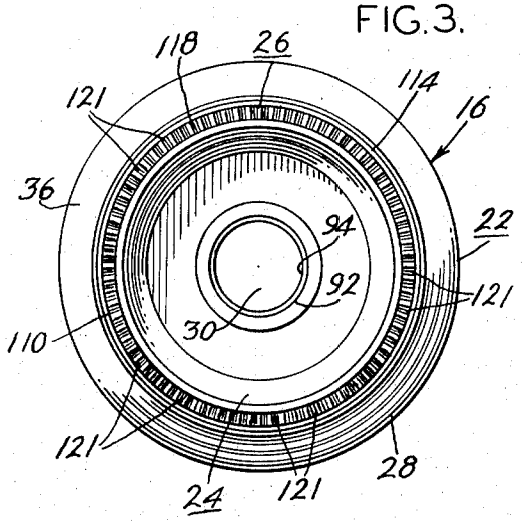


FIG. 4.

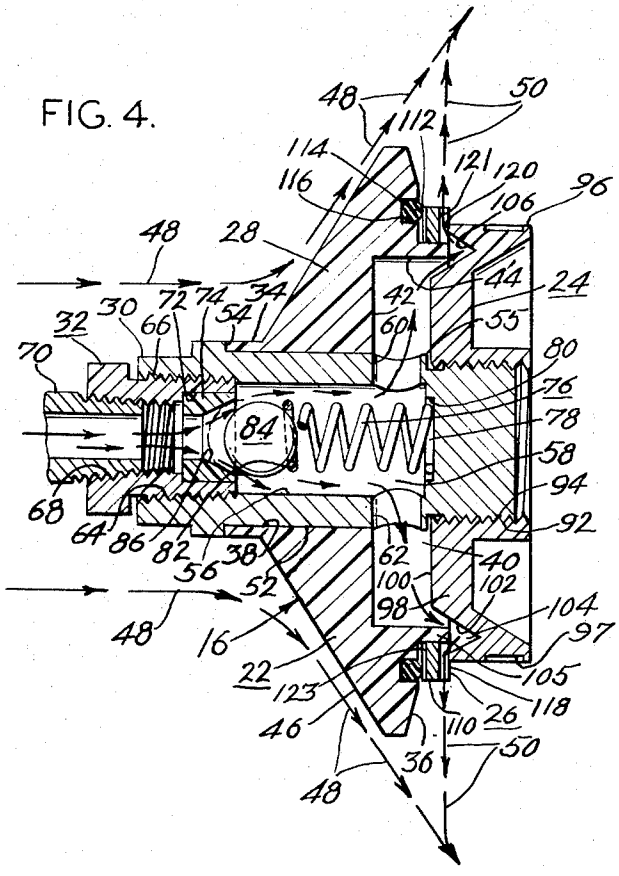
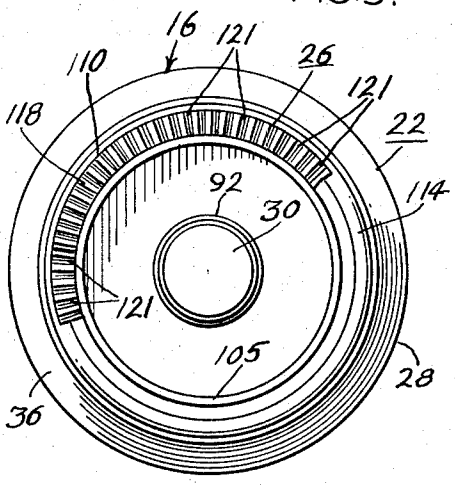


FIG. 5.



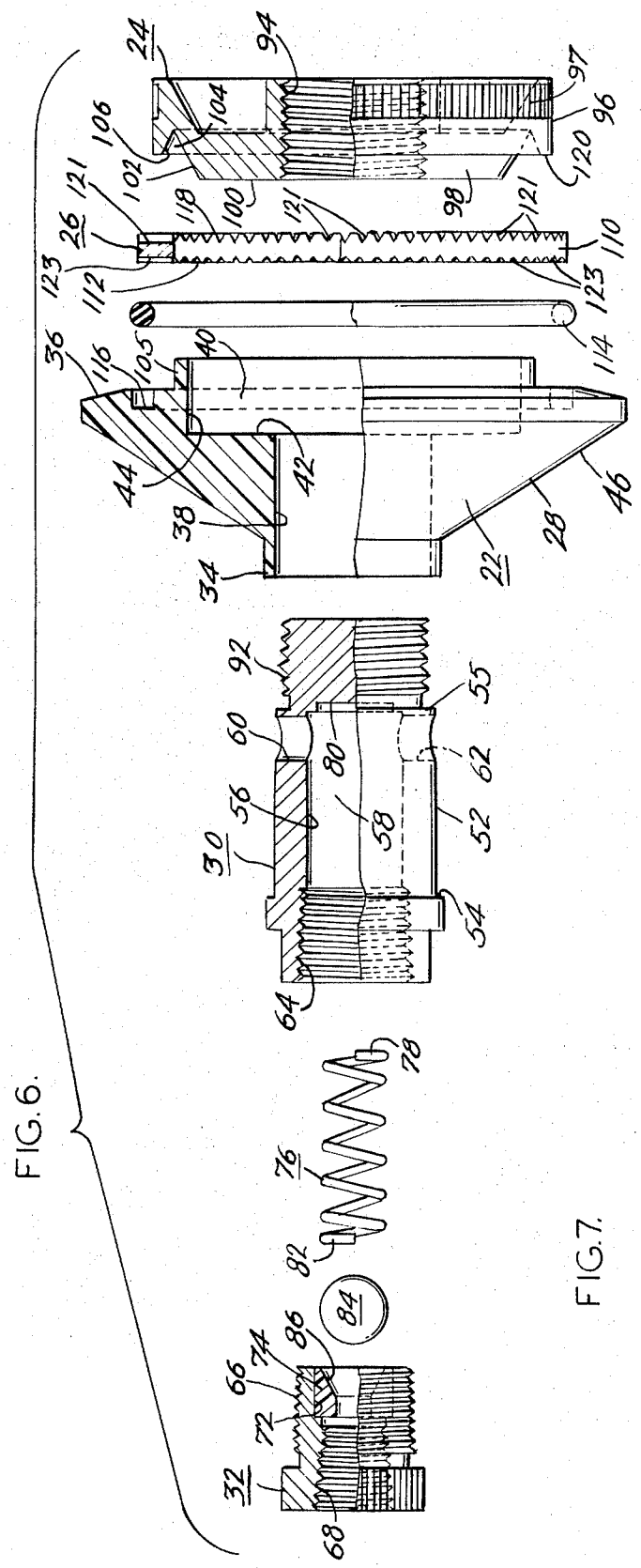

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FIG. 6.

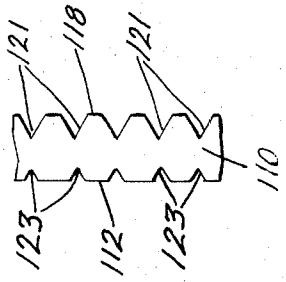

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FIG. 7.

FIG.8.

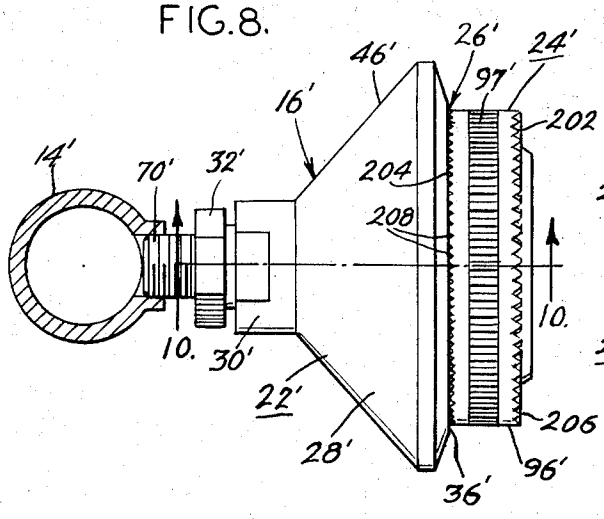


FIG.9.

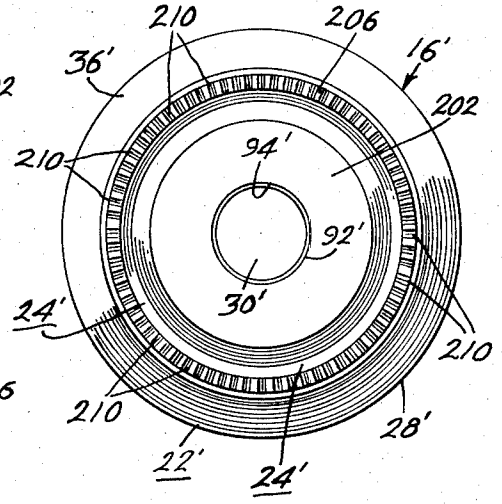


FIG.10.

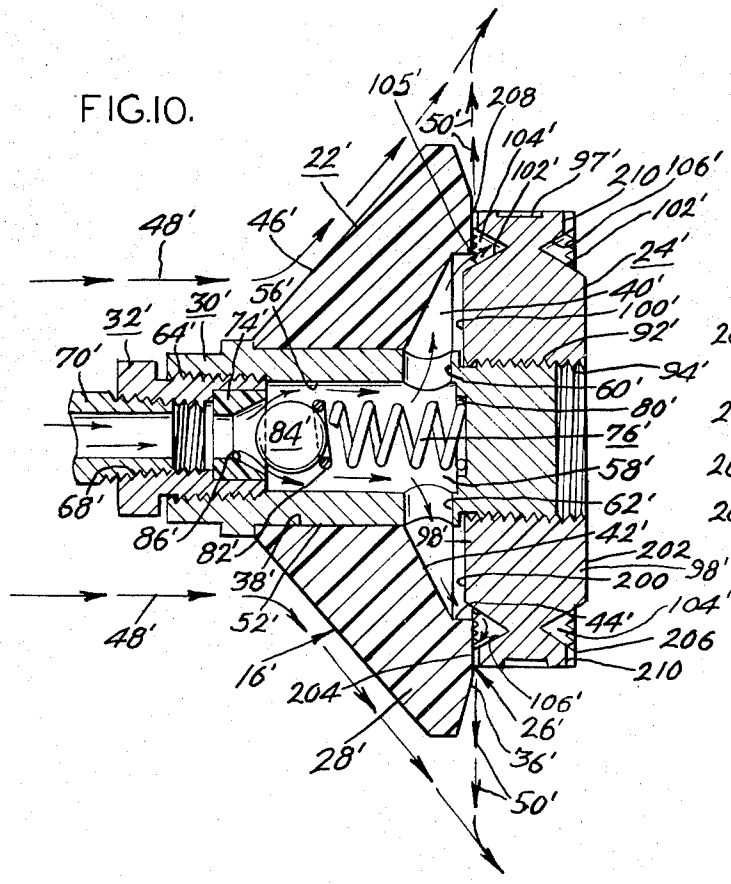
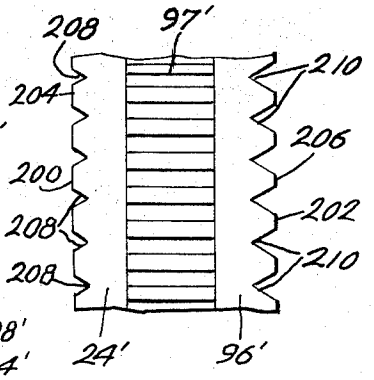


FIG.11.



SPRAY APPARATUS FOR SPRAYING HERBICIDES, INSECTICIDES AND THE LIKE

The present invention relates to a spray apparatus for spraying herbicides, insecticides and the like, and, more particularly, to a spray apparatus having structure for improved distirbution of the sprayed liquid and for permitting easy disassembly and assembly for cleaning without the use of tools.

In recent years there has been a considerable effort made to decrease the volume of liquids, such as fungicides, herbicides, insecticides and the like, applied to trees and field crops. When a large volume of liquid chemical is applied per acres, heavy tanks, pumps, motors and other equipment must be employed, as well as a large volume of chemical used. The weight of such equipment and chemical creates a substantial burden on the vehicle distributing the chemical. Because of the weight restrictions and carrying capacity of vehicles used in spraying crops, particularly aircraft, frequent returns by the aircraft for refueling and refilling of the chemical tanks is necessitated. Hence, low volume application of high concentrations of liquid chemicals has been increasingly employed to save time and the expense of high volume equipment and frequent returns by the aircraft for chemical and fuel.

With a high concentration of liquid chemical used in low volume application, such as from 4 ounces to 10 gallons of chemical per acre, it is important to provide a uniform distribution and very accurate metering of the chemical. The spray nozzles used in an attempt to provide an accurate and uniform distribution of the liquid chemicals have included mechanisms with moving parts, such as spinning discs and propellers. In these prior art arrangements, which have bearings, difficulty has been experienced with malfunction of the moving parts. Also, some prior art nozzles have small orifices through which the liquid chemical must pass and small particles of foreign matter frequently block the orifices. Still other prior art nozzles employ metering systems with diaphragms which rupture during repeated operation of the equipment.

All of the above prior art nozzle systems have employed generally from 20 to 50 nozzles on an airplane in the spraying operation to provide a uniform distribution over the swath of the airplane. A malfunction of any nozzle may interrupt the metering of the liquid chemical from the nozzle and disrupt the uniform distribution of the chemical, which may result in costly delays and operating expense to correct the malfunction. Hence, it is desirable to provide a spray apparatus having no rotating or moving parts in its system for distributing the chemical, and one which provides a uniform distribution of chemical over a wide area. It is also desirable to provide such a spray apparatus which not only avoids malfunction due to foreign matter that may pass through the system but permits easy disassembly and assembly for cleaning between applications.

In accordance with the present invention, a spray apparatus for spraying herbicides, insecticides and the like is provided comprising a diffuser housing having a liquid receiving passage at one end and a spray retainer member releasably supported at another end of the diffuser housing. A distribution channel receiving the liquid from the liquid receiving passage is formed between the diffuser housing and spray retainer member, and dispensing means for discharging liquid from the apparatus is provided by an annular plurality of discharge

openings between the diffuser housing and spray retainer member. The distribution channel directs liquid to the discharge openings to produce jets of liquid directed outwardly from the apparatus around the periphery thereof. According to another feature of the present invention the diffuser housing, which has a front end and a back end, has a peripheral surface in an air deflecting configuration for deflecting an air system outwardly around the back end of the diffuser body as the apparatus moves through air on a vehicle, such as an airplane. The jets of liquid which are discharged from the discharge openings are directed outwardly and transversely to the air stream. In this manner, a wide swath of distribution of liquid from each spray apparatus is provided by the deflected air stream which is combined with the discharged liquid chemical. Also, in this arrangement, the number of spray apparatus of the present invention needed for dispensing the liquid is decreased over the number of prior art spray nozzles normally employed.

In accordance with a further feature of the invention, the dispensing means for discharge of liquid from the apparatus comprises an annular flow regulating member supported between the diffuser housing and the spray retainer member. The flow regulating member has one side provided with a plurality of radially extending grooves uniformly spaced around the member to form the discharge openings. Further, the flow regulating member on the other side, which is opposite the one side having grooves, is provided with another plurality of radially extending grooves uniformly spaced around the flow regulating member to form another set of discharge openings. In this arrangement, the grooves on one side of the flow regulating member are of a different size from the grooves on the other side of the member to vary the volume of liquid flow through the grooves on each side of the member. Preferably, the flow regulating member is supported between the diffuser housing and spray retainer member such that only one set of grooves is effective to pass liquid when the apparatus is assembled. According to the invention, when the spray retainer member is released and removed, the flow regulating member may be removed and reversed in position to cause a different set of grooves to direct liquid from the apparatus. The set of grooves employed is determined by such factors as the liquid being sprayed and the coverage desired.

The distribution channel formed between the diffuser housing and flow regulating member directs the liquid to one of the sets of grooves in the flow regulating member. Furthermore, the distribution channel is preferably provided with a baffle surface to create turbulence in the liquid flow for more uniform distribution of the liquid directed to the grooves of the flow regulating member.

According to another embodiment for the dispensing means, the dispensing means may be provided by a plurality of radially extending grooves uniformly spaced around an annular surface on one side of the spray retainer member, the grooves communicating with the distribution channel to discharge liquid from the apparatus. Further, the volume of liquid sprayed from the apparatus in this arrangement may be changed by having the spray retainer member reversible in position and a different plurality of radially extending grooves uniformly spaced around each side of the spray retainer member.

It is preferred that the diffuser housing has a core member with a portion thereof extending outwardly at the back end of the diffuser housing and the spray retainer member is releasably attached to the core member such that the spray retainer member may be manually released and removed from the housing without the use of tools. In this manner, the apparatus may be easily disassembled for cleaning or reversal of the flow regulating member or spray retainer member and easily reassembled for use.

For a better understanding of these and other features and advantages of the present invention, reference is made to following description and accompanying drawings, in which:

FIG. 1 is a perspective view of an airplane spraying unit employing spray apparatus in accordance with the present invention;

FIG. 2 is a side elevational view of the spray apparatus of the invention and showing the aircraft feed line in section;

FIG. 3 is an end elevational view of the spray apparatus of FIG. 2;

FIG. 4 is an enlarged sectional view taken along line 4—4 of FIG. 2 and showing the flow of air around the outside of the apparatus and the flow of liquid through the internal distribution passage of the apparatus;

FIG. 5 is an end elevational view similar to FIG. 3 but with the spray retainer member removed and a portion of the flow regulating member broken away;

FIG. 6 is an enlarged exploded side elevational view of the spray apparatus of the invention with portions of parts of the apparatus broken away and in section;

FIG. 7 is a fragmentary enlargement of the edge portion of the flow regulating member;

FIG. 8 is a side elevational view of a spray apparatus embodying another form of the present invention and showing the aircraft feed line in section;

FIG. 9 is an end elevational view of the spray apparatus of FIG. 8;

FIG. 10 is an enlarged sectional view taken along line 10—10 of FIG. 8 and showing the flow of air around the outside of the apparatus and the flow of liquid through the internal distribution passage of the apparatus; and

FIG. 11 is a fragmentary enlargement of the edge portion of the spray retainer member.

Referring to FIG. 1, there is shown a perspective view of an airplane 10 equipped with a spray system generally designated 12 in accordance with the present invention. The spray system 12 includes a feed line 14 located below and behind each wing 18 of airplane 10 and supported from fuselage 20 and the ends of each wing 18. Feed line 14 supplies liquid chemical to be sprayed to the spray apparatus or housings 16 connected to the feed line. In the embodiment of FIG. 1, five spray apparatus or housings 16 are connected to feed line 14 under each wing and are generally uniformly spaced under the airplane, so that a total of ten spray apparatus are used to provide a uniform distribution of chemical over the swath of the airplane. The feed line 14 is supplied with liquid chemical from one or more reservoirs (not shown), which may be supported in fuselage 20 of airplane 10. The liquid chemicals are pumped from the reservoir into feed line 14 by suitable pumps (not shown), which may be located in fuselage 20 and operated at a desired pressure and application rate.

The details of the spray apparatus or housing 16 in accordance with the invention are shown in FIGS. 2–6. Referring specifically to FIGS. 2 and 4, the spray apparatus or housing 16 basically comprises a diffuser housing 22, a spray retainer member 24 and dispensing means generally designated 26 which discharges the liquid chemical from the apparatus. More particularly, the diffuser housing 22 comprises a diffuser body 28, a central core member 30 and a tubular conduit or fitting 32, as shown most clearly in FIGS. 2, 4 and 6. The diffuser body 28, which may be made of molded resinous material or plastic, has a front or forward end 34 in proceeding through the air and a back end 36 and has a central axial opening 38 therethrough. Diffuser body 28 at its back end 36 has an annular recess 40 defined by flat annular wall 42 and cylindrical wall 44, the recess 40 providing a portion of the distribution channel or passage for liquid passing through the apparatus, as will be explained more fully hereinafter.

The diffuser body has an annular peripheral surface 46 which is frustoconical in form and extends from front portion 34 outwardly to a back portion 36 of the diffuser body. The peripheral surface 46 is formed in an air deflecting configuration for deflecting air outwardly in a stream around the back of the diffuser body as the spray apparatus is moved through the air by the airplane, as shown by the arrows 48 representing the outwardly deflected air stream adjacent the peripheral surface 46 of diffuser body 28. More specifically, the frustoconical surface 46 diverges outwardly from a plane normal to the axis through the diffuser housing from front to back of the diffuser housing at a substantial angle between zero and ninety degrees, shown in FIG. 4 as approximately 35°. Expressed otherwise, the relationship of the frustoconical surface 46 to the axis of the diffuser housing is such that, if the frustoconical surface is extended to the axis, it would intersect the axis at a substantial angle between zero and ninety degrees, shown in FIG. 4 as approximately 55°. The angle in either case may vary greatly between zero and ninety degrees, as long as the surface 46 acts as an air deflector in deflecting air outwardly around the diffuser body. The liquid chemical which passes through the spray apparatus is directed outwardly and transversely to the air stream 48 after the air stream passes the back end of the diffuser body, as indicated by the arrows 50 representing the liquid passing through and discharged from the apparatus shown in FIG. 4, as will be explained more fully hereinafter.

The central core member 30, which may be made of brass, is cylindrical in form and has a reduced diameter portion 52 which is press fitted within the central opening 38 through diffuser body 28. The core member 30 has a shoulder 54 which abuts against the front end 34 of diffuser body 28. A portion 55 of core member 30 extends into recess 40 and a distance beyond the back end 36 of the diffuser body. Core member 30 provides the liquid receiving portion of the apparatus and, for this purpose, has an axial bore 56 extending from the front end of the core member to a position within recess 40 of the diffuser body 28, the bore 56 providing a distribution channel or passage 58. In order to permit the liquid chemical to be distributed from the distribution channel or passage 58 provided by bore 56, two radial ports 60 and 62, which are diametrically opposed, extend through the core member to communicate with recess 40 in diffuser body 28.

The core member 30 has an internally threaded portion 64 in the front end of its bore 56 to receive and mate with the externally threaded portion 66 of tubular conduit or fitting 32, as shown in FIGS. 4 and 6. The tubular fitting 32 provides an extension of and reduced diameter portion for core member 30. Tubular fitting 32 has an internally threaded portion 68 from the front end of its central opening which mates with the externally threaded end of conduit 70. The conduit 70 has its other end threaded into feed line 14. In this arrangement, liquid chemical from feed line 14 flows through conduit 70, into tubular fitting 32, and then into distribution passage 58 in core member 30.

In order to provide instant shut-off of the liquid flow through the spray apparatus, tubular fitting 32 at its back end has an increased diameter core 72 into which a valve seat 74 of resinous material is press fitted and stacked, as shown in FIGS. 4 and 6. A helical spring 76 is positioned in bore 56 of core member 30 and has one end 78 positioned in a recess 80 at the end of bore 56 in the core member. The other end 82 of spring 76 rests against ball 84 which is positioned in the tapering side 86 of valve seat 74. The ball 84 serves to provide instant cut-off when the fluid pressure is decreased below a predetermined level, as when the main shut-off valve or pump (not shown) controlling the liquid flow in feed line 14 is shut off by the operator to stop the spraying of liquid. During operation of the system in spraying, the liquid pressure works against a ball 84, to force it from tapering sides 86 of valve seat 74 against the bias of spring 76. While the spray operation continues, causing the ball to be unseated by the liquid pressure, the liquid can pass through the opening in valve seat 74 to distribution channel or passage 58 in core member 32, and, hence, through ports 60 and 62 into recess 40, as indicated by arrows 50 representing the flow of liquid during operation of the apparatus shown in FIG. 4.

The spray retainer member 24 is releasably attached to the back end of the diffuser housing to complete the distribution channel associated with recess 40 for liquid passing through the apparatus. The liquid is discharged from the apparatus by dispensing means 26, which includes an annular plurality of discharge openings between diffuser body 28 and spray retainer member 24. More specifically, spray retainer member 24 is generally in the form of a circular plate and may be made of stainless steel. The spray retainer member is attached to the diffuser housing 22 by means of core member 30. Particularly, the back portion 55 of core member 30 has an externally threaded portion 92 along its axial length, and spray retainer member 24 has an internally threaded central opening 94, which meshes with threaded portion 92 of the core member 30. An annular peripheral portion 96 of spray retainer member 24 has a knurled surface 97 to permit spray retainer member 24 to be manually threaded on and removed from the core member. In this arrangement, the spray retainer member may be easily removed and replaced without the use of tools.

As shown most clearly in FIGS. 4 and 6, annular spray retainer member or plate 24 has a reduced diameter axially extending boss 98, which has an annular flat surface 100 and a gradually outwardly sloping sidewall 102 extending into recess 104. When the spray retainer member is threaded on the core member 30 in assembled position, a portion of the boss 98 extends a distance into annular recess 40 formed in the back of the diffuser body 28. In this arrangement, an annular distribution channel or passage is provided by recess 40 between the surfaces of diffuser body 28 and spray retainer member 24. The outlet for liquid from recess 40, which will also be referred to as distribution channel or passage 40, is formed between sidewall 102 of boss 98 and outwardly extending annular lip 105 of diffuser body 28, the lip 105 having its inside diameter formed by sidewall 44 of recess 40. The outlet between the lip and boss is annular in form and communicates with recess 104, which provides a further portion of the distribution channel or passage for liquid passing through the apparatus. As can be seen in FIG. 4, lip 105 extends a distance into annular recess 104. Annular recess 104 is V-shaped in cross section, as shown in FIGS. 4 and 6, with one wall being formed by sidewall 102 of boss 98 and the other side by sidewall 106, which forms an angle of approximately 60° with wall 102. The angle between sidewall 102 and sidewall 106 may be varied over a wide range in accordance with the invention.

The dispensing means 26 for discharging the liquid from the apparatus includes an annular plurality of discharge openings or ports. The liquid which flows into recess or passage 104 then flows through an annular passage between lip 105 and sidewall 106 to the discharge openings provided by dispensing means 26. More specifically, the dispensing means in the embodiment of the invention shown in FIGS. 2–7 comprises an annular flow regulating member or washer 110. Flow regulating member 110, which may be made of stainless steel, is adapted to snugly receive lip 105 within its central opening and is supported by lip 105. When the flow regulating member 110 is positioned on lip 105, side 112 of the member rests against a rubber O-ring 114, which fits within an annular recess 116 in the back end 36 of diffuser body 28. The other side 118 of flow regulating member 110 abuts the surface 120 of spray retainer member 24, when the spray retainer member 24 is threaded in position on core member 30.

As shown most clearly in FIGS. 5, 6 and 7, the flow regulating member 110 on side 118 is provided with a plurality of radially extending grooves, each designated 121, uniformly spaced around side 118 of member 110 to form a set of discharge openings or ports, which direct the flow of liquid radially outwardly from the apparatus at a position along its axis directly behind the diffuser body 28. Also, on side 112 of flow regulating member 110, another plurality of radially extending grooves, each designated 123, is uniformly spaced around the side 112 to form a second set of discharge openings or ports for use in directing liquid radially outwardly from the apparatus. The set of grooves 123 in side 112 of the flow regulating member are of a different size from the grooves 121 on side 118 in order to vary the volume of liquid flow through the grooves on each side of the member. In FIG. 4, it can be seen that the flow regulating member 110 is supported on lip 105 such that only one set of the grooves is effective to pass liquid when the spray retainer member is in position on the core member, and in FIG. 4, set of grooves 121 in side 118 is arranged to permit discharge of liquid. However, as previously explained, the flow regulating member may be easily removed and reversed in position to present the other set of grooves 123 for providing a different volume of liquid to be directed outwardly from the apparatus.

A portion of the sets of grooves in the flow regulating member is most clearly shown in FIG. 7. As can be seen, the grooves 123 and 121 in sides 112 and 118, respectively, of flow regulating member 110 are V-shaped in end elevation, and the sides of each of the V-shaped grooves 121 and 123 form a 60 degree angle. In the embodiment of the invention shown in FIGS. 2–7, there are 96 grooves on side 112 and 96 grooves on side 118 of the flow regulating member. The depth of cut of the V-shaped grooves is preferably different for grooves 123 on side 112 from grooves 121 on side 118 to provide the different volumes of liquid flow through the two sets of grooves. On side 112 of flow regulating member 110, the grooves 123 may be one hundreth of an inch in depth and on side 118 the grooves 121 may be three hundreth of an inch in depth. For example, grooves 121 on side 118 facilitate the spraying of relatively large droplets as desired in spraying herbicides, and grooves 123 on side 112 of the flow regulating member facilitate the spraying of small droplets, as desired when spraying insecticides. In further illustration, when the apparatus is assembled for use with grooves 121, the liquid chemical is pumped at 55 pounds pressure, and the airplane speed is 100 miles per hour, ten spray apparatus of the present invention as shown in FIG. 1 will provide a spray coverage of 5 gallons per acre. Whereas, when the apparatus is assembled for use with the grooves 123, the liquid is pumped at 35 pounds pressure, and the airplane speed is 100 miles per hour, 10 spray apparatus of the invention will provide a spray coverage of 1 gallon per acre. Of course, depending on the particular type of chemical employed and the quality desired to be distributed, the flow regulating member may be provided with a fewer number of grooves on a particular side or with more grooves, or may be provided with grooves of a different depth than mentioned above. Also, it should be appreciated that the shape of the grooves may be changed or the angle of the V-shaped groove may be made larger or smaller. Basically, the coverage per acre is determined by such factors as the size of the grooves in the flow regulating member, the pressure at which the liquid is being pumped, and the speed of the vehicle carrying the apparatus.

In operation of the system shown in FIGS. 1–4, as the aircraft proceeds through air and the spray pumps pressurize feed line 14 with liquid chemical to be sprayed, the pressure of the liquid on ball 84 unseats the ball, as shown in FIG. 4, and permits passage of liquid into chemical or passage 58 in core member 30. The liquid in passage 58 is delivered to the annular channel or passage 40 through ports 60 and 62 in the core member. The liquid flowing in distribution channel 40 is diverted by wall 44 and passes between lip 105 and boss 98 into distribution or tubulence passage 104. The serpentine passage for liquid around lip 105 provides baffle surfaces and creates turbulence in the flow of the liquid, which provides a uniform distribution of the liquid. The liquid in passage 104 is directed angularly at the sidewalls of grooves 121 in flow regulating member 110 and then flows in grooves 121 between the flow regulating member and the spray retainer member to be discharged generally radially outwardly from the annular plurality of grooves 121 around the apparatus, as indicated by the liquid flow arrows 50 in FIG. 4. After the liquid is discharged from the apparatus in jets or streams 50, the liquid moves transversely into the deflected air stream 48 around the diffuser body This arrangement of movement of body. and liquid outwardly around the apparatus provides a wide pattern of spray eminating from each apparatus. By providing a wide spray pattern for each spary apparatus employed, the number of spray apparatus or nozzles needed for uniform distribution of liquid over the swath of the airplane is greatly reduced over the number normally employed with conventional prior art spray nozzles.

Moreover, since the spray apparatus employs no moving parts in the distribution system for the liquid chemical, malfunction of the apparatus is minimized. Furthermore, the spray apparatus of the present invention does not include any small nozzle passage or orifice through which all liquid must pass, and, therefore, foreign matter which might be in the liquid will not materially affect the operation of the apparatus. In addition, the present spray apparatus is adapted for easy and quick assembly and disassembly without the use of tools for cleaning and for reversing or changing the flow regulating member.

It should be appreciated that the spray apparatus may be embodied in a large variety of forms in accordance with the present invention. The distribution and dispensing arrangements for passage of liquid through the apparatus may be modified while still providing uniform distribution of liquid over a wide area from the spray apparatus of the invention. One such modification of the spray apparatus is shown in FIGS. 8–11. In this modification, parts similar to those in the apparatus of FIGS. 2–6 are identified by the same number designator with the addition of primes thereto. In the embodiment of FIGS. 8–11, the diffuser body 28′ has a blunt front end, the cylindrical front end 34 as shown in FIG. 4 being omitted, and the angle that the frustoconical surface 46′ makes with the axis of the diffuser housing is smaller in FIG. 10 than in FIG. 4, the angle in FIG. 10 being approximately 48°. Further, the diffuser body has been modified in regard to recess 40′, which provides a portion of the distribution channel or passage for liquid passing through the apparatus. Particularly, annular wall 42′ defining part of recess 40′ is frustoconical in form in FIG. 10 to slightly change the flow pattern in the distribution channel and to facilitate ease in manufacture of the diffuser body, for example, if the diffuser body is molded of a resinous material. The spray retainer member may also be made of a molded resinous material or may be made of stainless steel, navel brass or brass that is hard chrome plated.

The primary difference between the apparatus of FIGS. 2–6 and FIGS. 8–11 lies in the modification of the diffuser body 28′ and spray retainer member 24′ to facilitate omission of the flow regulating member 110 and O-ring 114 of FIGS. 2–6 in providing the dispensing means 26′ for discharging liquid from the apparatus. As shown in FIGS. 8–11, the spray retainer member 24′ has been made generally symmetrical with both sides 200 and 202 generally in the form of the front of the spray retainer member in FIG. 4 to provide the function of the spray retainer member in the embodiment shown in FIG. 4. Sides 200 and 202 of spray retainer member 24′ are each provided with boss 98′ having annular flat surface 100′ and gradually outwardly sloping sidewall 102′ extending into recess 104′. When spray retainer 24′ is threaded on core member 30′ in either orientation, the spray retainer member being reversible on the core member to have

either side 200 or 202 adjacent diffuser body 28', a portion of boss 98' extends a distance into recess 40' to complete the annular distribution passage between the diffuser body and spray retainer member.

The sets of discharge openings providing the dispensing means 26' in the embodiment in FIG. 10 are provided in annular surfaces 204 and 206 of sides 200 and 202, respectively, between recesses 104' and the periphery of the spray retainer member. More specifically, annular surface 204 on side 200 is provided with a plurality of radially extending grooves, each designated 208, uniformly spaced around surface 204 of member 24' to form a set of discharge openings or ports, which direct the flow of liquid radially outwardly from the apparatus at a position along its axis directly behind diffuser body 28'. Annular surface 206 on side 202 of spray retainer member 24' is provided with another plurality of radially extending grooves, each designated 210, uniformly spaced around surface 206 to form the second set of discharge openings or parts for use in directing liquid radially outwardly from the apparatus. As with the sets of grooves in the flow regulating member of FIG. 4, the sets of grooves 208 in surface 204 of the spray retainer member are of a different size from grooves 210 in surface 206 in order to vary the volume of liquid flow through the grooves on each side of the member. Referring to FIG. 10, the spray retainer member 24', when threaded on the core member 30' in the orientation shown, has annular surface 204 abutting against the flat back annular surface 36' of the diffuser body such that set of grooves 208 in surface 204 is effective to pass liquid. It is obvious that the spray retainer member 24' may be easily removed and reversed in position to present the other set of grooves 210 for dispensing a different volume of liquid outwardly from the apparatus.

As shown most clearly in FIG. 11, a portion of the sets of grooves in the spray retainer member 24' is represented in a fragmentary enlargement of the edge portion of the spray retainer member. The grooves 208 and 210 in surfaces 204 and 206, respectively, of member 24' are V-shaped in end elevation and the sides of each of the V-shaped grooves 208 and 210 form generally a 60° angle, as described in regard to the grooves in the flow regulating member shown in FIG. 4. Similarly to the arrangement of the flow regulating member in FIG. 4, there are 96 grooves in surface 204 and 96 grooves in surface 206 and the depth of the V-shaped grooves is preferably different from grooves 208 and 210 to provide the different volumes of liquid flow through the two sets of grooves. The depth of the two sets of grooves may be the same as the depth of the sets of grooves in the flow regulating member, as is indicated in FIG. 11. The smaller grooves 208 facilitate the spraying of samll droplets, as desired in spraying insecticides, and the larger grooves 210 facilitate the spraying of relatively large droplets, as desired in spraying herbicides. It is understood that the particular type of chemical employed and the quantity desired to be distributed will effect the choice of the number of grooves on a particular side and the shape and/or depth of the grooves desired.

The flow of liquid chemical through the spray apparatus in FIG. 10 is substantially the same as the flow of chemicals through the spray apparatus of FIG. 4, as indicated by the arrows 50' representing the liquid passing through and discharged from the apparatus shown in FIG. 10. Briefly, the liquid from the pressurized feed line 14', when the pumps (not shown) are operating, unseats the ball 84' and permits passage of liquid in channel or passage 58' of core member 30'. The liquid in passage 58' is delivered to annular channel or passage 40' through ports 60' and 62' in the core member. The liquid flowing in the distribution channel 40' is diverted by walls 42' and 44' and passes between lip 105' and boss 98' into distribution or turbulence passage 104'. The serpentine passage for liquid around lip 105' provides a baffle surface and creates tubulence in the flow of the liquid. The liquid in passage 104' is directed angularly at the rear surface 36' of the diffuser body and flows through grooves 208 between the diffuser body and spray retainer member to be discharged generally radially outwardly from the annular plurality of grooves 208 around the apparatus, as indicated by the liquid flow arrows 50'. The discharged liquid from the apparatus is directed traversely into the deflected air stream 48' around the diffuser body to provide a wide pattern of spray eminating from the apparatus.

While the present invention has been described with particular reference to a specific embodiment in the interest of complete definiteness, it will be obvious to those skilled in the art that it may be embodied in a large variety of forms diverse from the one specifically shown and described. For example, the feature of the reversible flow regulating member may be omitted. In this instance, the flow regulating member may be omitted and grooves provided in either face 120 of the spray retainer member or the back portion of the diffuser body. All such modifications within the scope and spirit of the claims are intended to be within the scope and spirit of the present invention.

I claim:

1. A spray apparatus comprising: a diffuser housing having a liquid receiving passage at one end, a spray retainer member releasably supported at another end of the diffuser housing, the diffuser housing and spray retainer member providing a distribution chamber receiving liquid from the liquid receiving passage, and dispensing means for discharge of liquid from the apparatus and including discharge openings, the distribution channel directing liquid to the discharge openings to produce jets of liquid directed outwardly from the apparatus, the dispensing means comprising an annular flow regulating member supported between the diffuser housing and spray retainer member, the flow regulating member having a plurality of radially extending grooves providing the discharge openings uniformly spaced around one side of the flow regulating member and having another plurality of radially extending grooves providing another set of the discharge openings uniformly spaced around another side opposite the one side of the flow regulating member, the set of grooves on the one side of the flow regulating member being of a different size from the set of grooves on the another side of the flow regulating member to vary the volume of liquid flow through the grooves on each side of the flow regulating member, the flow regulating member being supported between the diffuser housing and spray retainer member such that only one set of grooves is positioned to be effective to pass liquid, whereby when the spray retainer member is released and removed, the flow regulating member may be removed and reversed in position to cause a different set of grooves to direct liquid from the apparatus.

2. A spray apparatus comprising: a diffuser housing having a liquid receiving passage at one end, a spray retainer member releasably supported at another end of the diffuser housing, the diffuser housing and spray retainer member providing a distribution channel receiving liquid from the liquid receiving passage, and dispensing means for discharge of liquid from the apparatus and including discharge openings, the distribution channel directing liquid to the discharge opening to produce jets of liquid directed outwardly from the apparatus, the dispensing means including a plurality of radially extending grooves providing the discharge openings uniformly spaced around an annular surface on one side of the spray retainer member and including another plurality of radially extending grooves providing another set of the discharge openings uniformly spaced around an annular surface on the other side opposite the one side of the spray retainer member, the sets of grooves on the one side of the spray retainer member being of a different size from the set of grooves on the other side of the spray retainer member to vary the volume of liquid flow through the grooves on each side of the spray retainer member, the spray retainer member being supported with respect to the diffuser housing such that only one set of grooves is positioned to be effective to pass liquid, whereby the spray retainer member may be removed and reversed in position to cause a different set of grooves to direct liquid from the apparatus.

3. The spray apparatus of claim 2 in which the spray retainer member is supported adjacent the another end of the diffuser housing such that one of the annular surfaces having grooves of the spray retainer member abuts an annular surface of the diffuser housing.

4. A spray apparatus for spraying herbicides, insecticides and the like from a vehicle in movement through air, comprising: a diffuser housing having a front end and a back end, the diffuser housing having a liquid receiving passage in the front end and having a peripheral surface in an air deflecting configuration for deflecting an air stream outwardly around the back of the diffuser housing as the vehicle moves through the air, a spray retainer member releasably supported at the back end of the diffuser housing, the diffuser housing and spray retainer member forming a distribution channel receiving liquid from the liquid receiving passage, and dispensing means for discharge of liquid from the apparatus and including discharge openings, the distribution channel directing liquid to the discharge openings to produce uniform jets of liquid directed outwardly and transversely to the air stream, the dispensing means comprising an annular flow regulating member supported between the diffuser housing and spray retainer member, the flow regulating member having a plurality of radially extending grooves providing the discharge openings uniformly spaced around one side of the flow regulating member and having another plurality of radially extending grooves providing another set of the discharge openings uniformly spaced around another side opposite the one side of the flow regulating member, the set of grooves on the one side of the flow regulating member being of a different size from the set of grooves on the another side of the flow regulating member to vary the volume of liquid flow through the grooves on each side of the flow regulating member, the flow regulating member being supported between the diffuser housing and spray retainer member such that only one set of grooves is positioned to be effective to pass liquid, whereby when the spray retainer member is released and removed, the flow regulating member may be removed and reversed in position to cause a different set of grooves to direct liquid from the apparatus.

5. A spray apparatus for spraying herbicides, insecticides and the like from a vehicle in movement through air, comprising: a diffuser housing having a front end and a back end, the diffuser housing having a liquid receiving passage in the front end and having a peripheral surface in an air deflecting configuration for deflecting an air stream outwardly around the back of the diffuser housing as the vehicle moves through the air, and a spray retainer member releasably supported at the back end of the diffuser housing, the diffuser housing and spray retainer member forming a distribution channel receiving liquid from the liquid receiving passage, and dispensing means for discharge of liquid from the apparatus and including discharge openings, the distribution channel directing liquid to the discharge openings to produce uniform jets of liquid directed outwardly and transversely to the air stream, the dispensing means including a plurality of radially extending grooves providing the discharge openings uniformly spaced around an annular surface on one side of the spray retainer member and including another plurality of radially extending grooves providing another set of the discharge openings uniformly spaced around an annular surface on the other side opposite the one side of the spray retainer member, the sets of grooves on the one side of the spray retainer member being of a different size from the set of grooves on the other side of the spray retainer member to vary the volume of liquid flow through the grooves on each side of the spray retainer member, the spray retainer member being supported with respect to the diffuser housing such that only one set of grooves is positioned to be effective to pass liquid, whereby the spray retainer member may be removed and reversed in position to cause a different set of grooves to direct liquid from the apparatus.

6. A spray apparatus comprising: a diffuser housing having a liquid receiving passage and having a back portion, and a spray retainer member releasably supported at the back portion of the diffuser housing, the diffuser housing and spray retainer member providing a distribution channel receiving liquid from the liquid receiving passage, the spray retainer member having a plurality of grooves spaced around an annular surface on one side of the spray retainer member and having another plurality of grooves spaced around an annular surface on another side of the spray retainer member, the sets of grooves on the one side and the another side being of different size, the spray retainer member being supported such that only one set of grooves is positioned to be effective to discharge liquid received from the distribution channel, whereby the spray retainer member may be removed and reversed in position to cause the other set of grooves to direct liquid from the apparatus.

7. The spray apparatus of claim 6 in which the plurality of grooves of each set of grooves are provided by an annular array of radially extending grooves uniformly spaced around the annular surfaces on opposite sides of the spray retainer member, each set of grooves when in operative position directing jets of liquid generally radially outwardly from the apparatus.

8. The spray apparatus of claim 6 in which the apparatus is used for spraying liquid from a vehicle, and the diffuser housing has a peripheral surface in an air deflecting configuration for deflecting an air stream outwardly around the diffuser housing as a vehicle moves through the air, each set of grooves when in operative position directing liquid outwardly and transversely to the air stream.

9. The spray apparatus of claim 8 in which the air deflecting peripheral surface of the diffuser housing is frustoconical in form and diverging outwardly from a plane normal to an axia from front to back of the diffuser housing at a substantial angle between zero and 90° to the axis.

10. A spray apparatus comprising: a diffuser housing having a liquid receiving passage and having a back portion, a spray retainer member releasably supported at the back portion of the diffuser housing, and dispensing means between the diffuser housing and spray retainer member for discharge of liquid from the apparatus and receiving liquid from the liquid receiving passage, the dispensing means including a flow regulating member supported between the diffuser housing and spray retainer member, the flow regulating member having on one side a plurality of grooves spaced around an annular surface and having on another side another set of grooves spaced around an annular surface, the sets of grooves on the one side and the another side being of different size, the flow regulating member being supported such that only one set of grooves is positioned to be effective to discharge liquid received from the distribution channel, whereby when the spray retainer member is released and removed, the flow regulating member may be removed and reversed in position to cause the other set of grooves to direct liquid from the apparatus.

11. The spray apparatus of claim 10 in which the plurality of grooves of each set of grooves are provided by an annular array of radially extending grooves uniformly spaced around the annular surfaces on opposite sides of flow regulating member, each set of grooves when in operative position directing jets of liquid generally radially outwardly from the apparatus.

12. The spray apparatus of claim 10 in which the apparatus is used for spraying liquid from a vehicle, and the diffuser housing has a peripheral surface in an air deflecting configuration for deflecting an air stream outwardly around the diffuser housing as the vehicle moves through the air, each set of grooves when in operative position directing liquid out-wardly and transversely to the air stream.

13. The spray apparatus of claim 12 in which the air deflecting peripheral surface of the diffusers housing is frustoconical in form and diverging outwardly from a plane normal to an axis from front to back of the diffuser housing at a substantial angle between zero and 90° to the axis.

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