

Oct. 24, 1933.

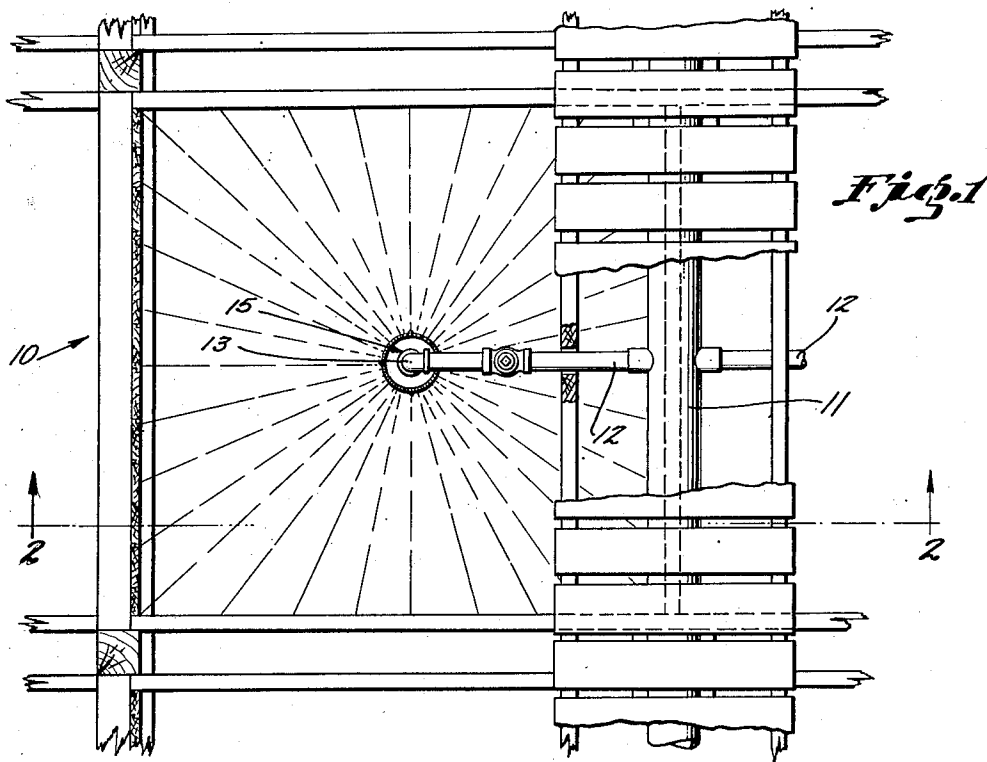
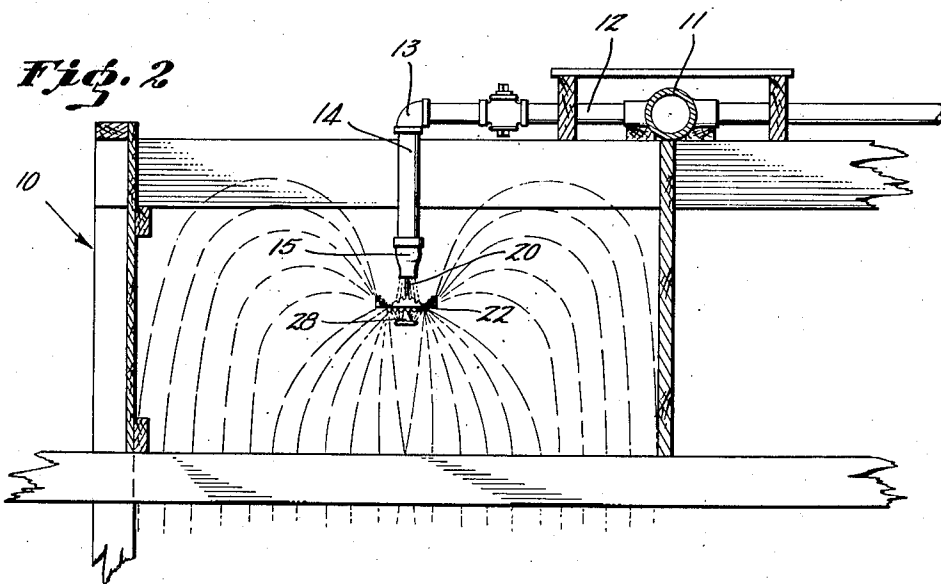
R. D. EVANS

1,931,689

SPRAY NOZZLE

Filed Feb. 4, 1931

4 Sheets-Sheet 1



INVENTOR

Robley Evans,

Oct. 24, 1933.

R. D. EVANS

1,931,689

SPRAY NOZZLE

Filed Feb. 4, 1931

4 Sheets-Sheet 2

Fig. 4

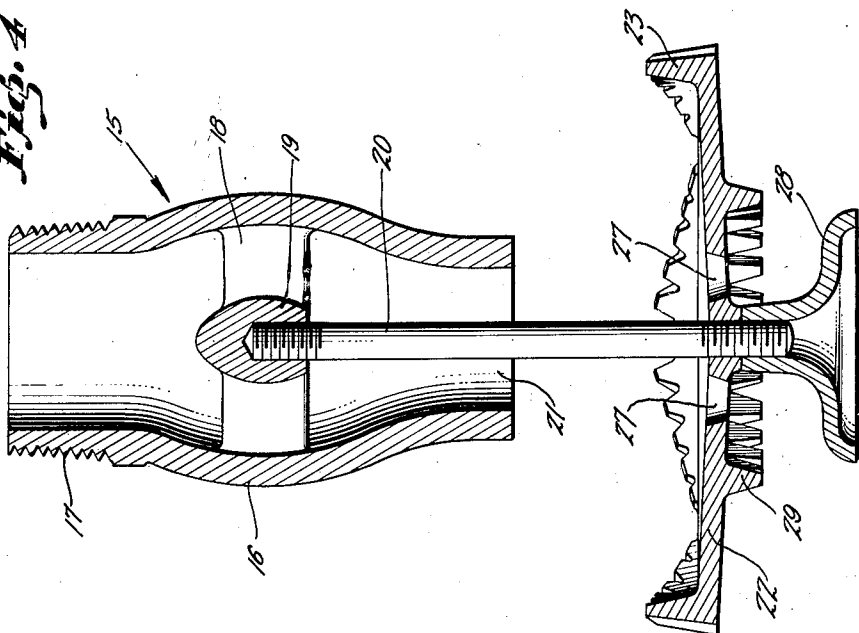
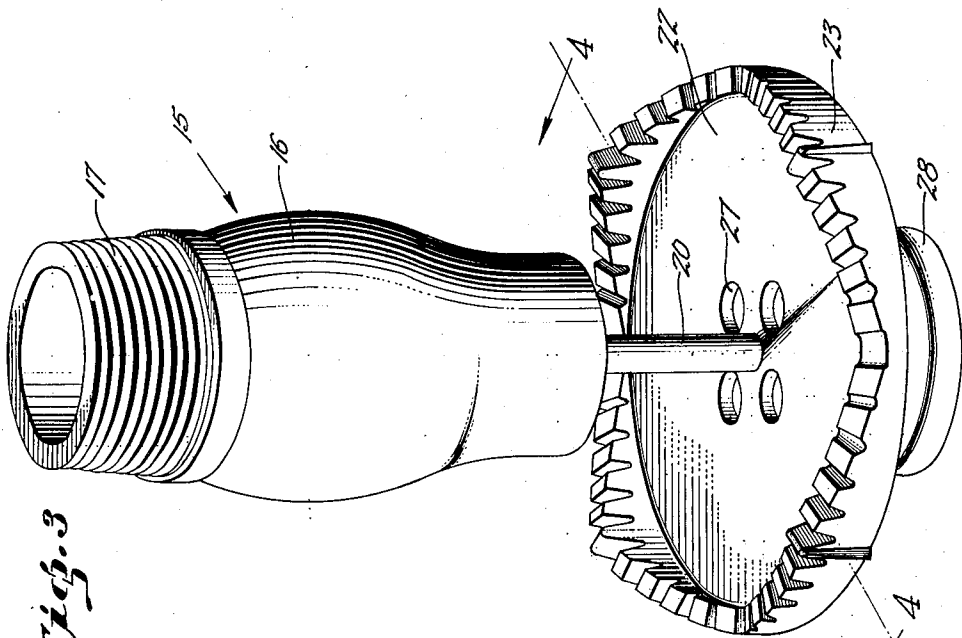


Fig. 3



INVENTOR

Robley D. Evans.

Oct. 24, 1933.

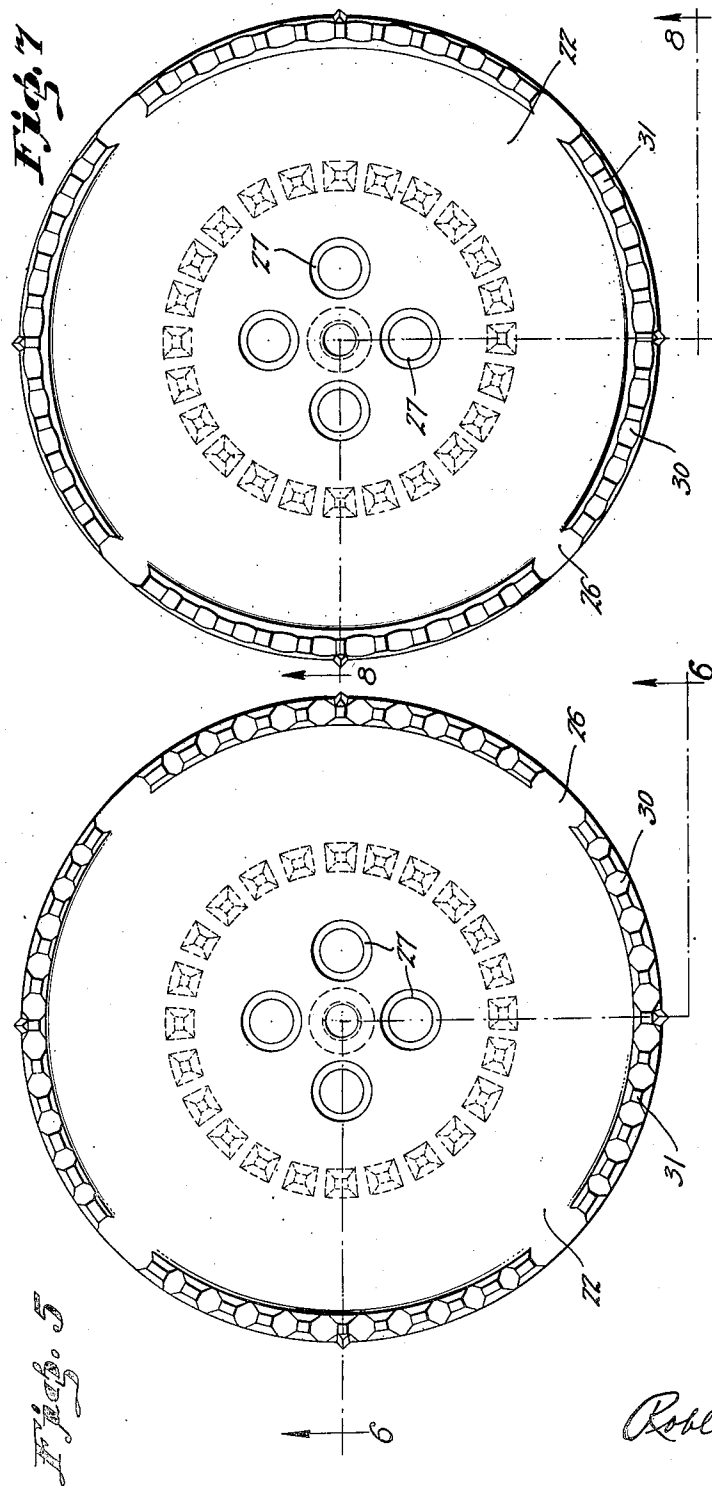
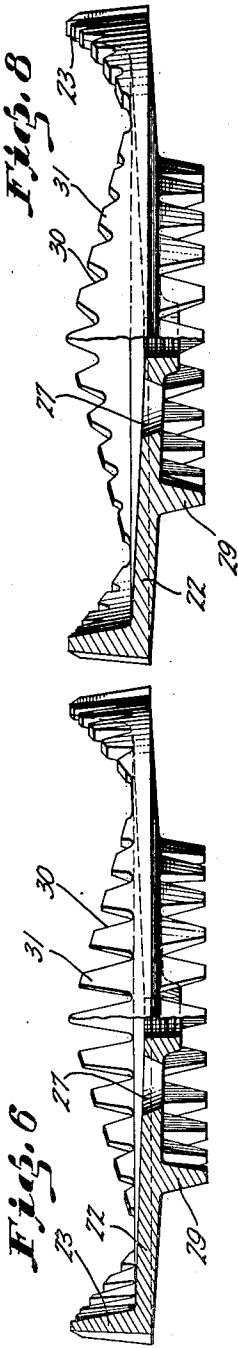
R. D. EVANS

1,931,689

SPRAY NOZZLE

Filed Feb. 4, 1931

4 Sheets-Sheet 3



INVENTOR

Robley D. Evans.

Oct. 24, 1933.

R. D. EVANS

1,931,689

SPRAY NOZZLE

Filed Feb. 4, 1931

4 Sheets-Sheet 4

Fig. 8

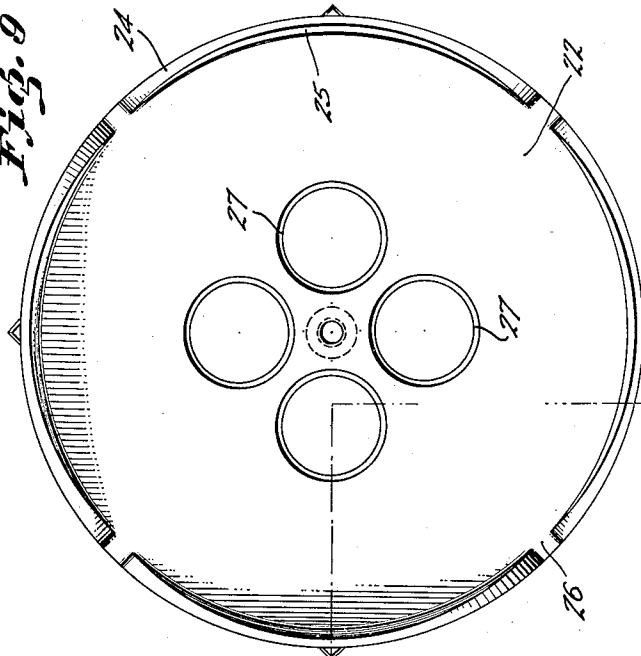


Fig. 10

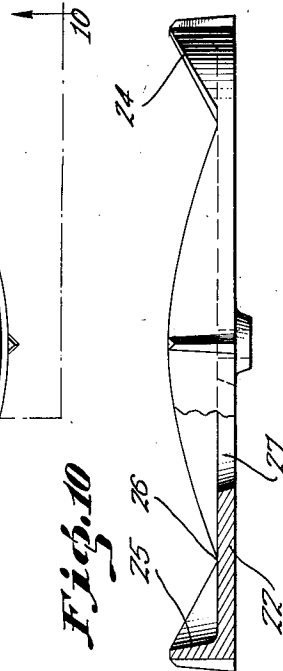


Fig. 11

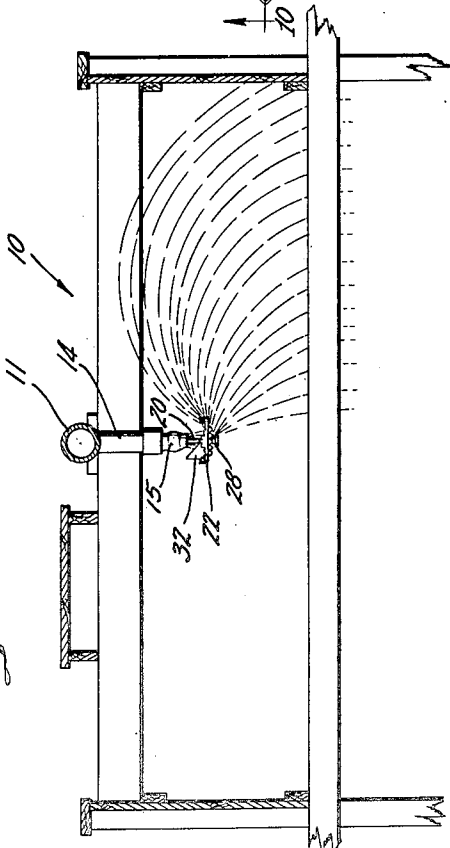
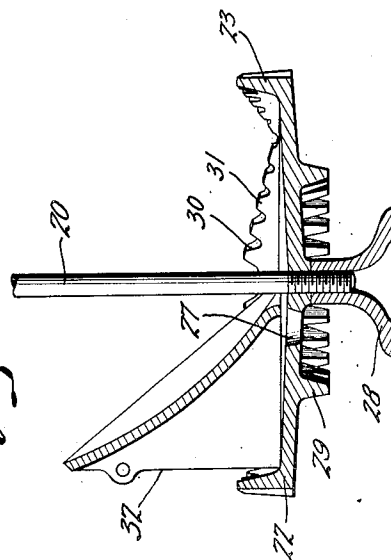


Fig. 12



INVENTOR

Robley D. Evans.

UNITED STATES PATENT OFFICE

1,931,689

SPRAY NOZZLE

Robley D. Evans, Alhambra, Calif., assignor to
C. F. Braun & Co., Inc., Alhambra, Calif.

Application February 4, 1931. Serial No. 513,326

11 Claims. (Cl. 299—18)

This invention relates to liquid distribution and particularly pertains to a spray nozzle.

In the operation of numerous mechanical structures and industrial plants it is necessary to distribute and spray a liquid over an area of given configuration and in a manner to insure that the area is uniformly wetted, or that the liquid will be uniformly aerated as it falls onto the specified area, such a structure being particularly adapted for use as a water distributing means in cooling towers of the atmospheric type.

It is the principal object of the present invention, therefore, to provide a spray nozzle through which a large volume of liquid may pass in uniformly unobstructed flow and by which nozzle the column of liquid may be broken up into a multiplicity of relatively small jets which are dispersed from the eduction end of the nozzle along varying angular paths of travel radially of the nozzle and along varying predetermined trajectories, all of which is brought about with the uniform distribution of water over the entire predetermined area and with a relatively low pressure loss due to friction.

The present invention contemplates the provision of a vertically disposed nozzle having a central passageway therethrough of relatively large area and of substantially uniform sectional area throughout its length, said passageway terminating in an eduction mouth from which a column of liquid may be projected at a predetermined hydrostatic pressure and in the path of which column is disposed a spray plate by which dispersion of the column is effected and a multiplicity of divergent jets of liquid created and directed along paths of travel to delineate an area of predetermined configuration and to uniformly wet this area.

The invention is illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a fragmentary view in plan showing the application of the present invention to a section of the cooling deck of an atmospheric water cooling tower.

Fig. 2 is a fragmentary view in side elevation showing the structure disclosed in Fig. 1.

Fig. 3 is an enlarged view in perspective showing one form of the nozzle with which the present invention is particularly concerned.

Fig. 4 is a view in central vertical section through the nozzle as seen on the line 4—4 of Fig. 3.

Fig. 5 is a view in plan showing one form of the present invention in which it is particularly adapted for small quantities of liquids and which

structure is characterized by the extension of the teeth gullets down to the disc.

Fig. 6 is a view in side elevation showing the spray plate of Fig. 5 with parts broken away to indicate sectional formation of the teeth.

Fig. 7 in a view in plan showing another form of the spray plate structure characterized by a relatively shallow uniform tooth gullet.

Fig. 8 is a view in side elevation showing the plate of Fig. 7 with parts broken away to indicate the formation of the teeth in section.

Fig. 9 is a view in plan showing a spray disc for large quantities of liquid and being characterized by the use of dispersion members devoid of teeth and whereby varying trajectories will be imparted to the liquid being thrown off therefrom.

Fig. 10 is a view in side elevation showing the structure of Fig. 9 with parts broken away to indicate the sectional formation of the dispersion plane.

Fig. 11 is a fragmentary view in elevation showing the use of a removable deflector to direct the liquid against wind pressure.

Fig. 12 is an enlarged view in vertical section showing the application of the removable deflectors to a spray plate.

Referring more particularly to the drawings 10 generally indicates a section of cooling deck of an atmospheric water cooling tower above which a water distributing pipe 11 is disposed and from which lateral pipes 12 extend. The outer ends of said pipes terminate in elbows 13 to which are connected downwardly extending vertical pipes 14 in the lower ends of which nozzle structures 15 are secured.

The present invention is particularly concerned with the nozzle structures and enlarged views of one of the units is indicated in Figs. 3 and 4 of the drawings. Referring to these figures it will be seen that a nozzle member 16 is provided, being of substantial cylindrical formation and of relatively large circular section. The upper end of the nozzle 16 is exteriorly threaded at 17 to receive a connection from the pipe 14. Cast integral with the nozzle and substantially midway the length thereof are radial arms 18 supporting a central boss 19. This boss receives the upper end of a stem 20 which extends downwardly and centrally of the nozzle and projects from the lower end thereof. Attention is directed to the fact that the circumscribing wall of the nozzle in the area occupied by the arms 18 and the boss 19 is enlarged, this enlargement being in proportion to the displacement area of the arms and the boss so that the column of liquid passing through the

nozzle may maintain its substantial uniformity and will not be undesirably disturbed or agitated when it is discharged from the eduction end of the nozzle.

5 The terminating end of the stem 20 occurs a predetermined distance below the eduction opening 21 of the nozzle and supports a spray plate 22. This plate is here shown as being in the form of a circular disc disposed concentrically of the longitudinal axis of the nozzle and in a plane at right angles thereto.

By reference to the drawings it will be seen that this disc will be disposed directly in the path of travel of the column of liquid projected from the nozzle and will act as a deflector to disperse the liquid radially of the axis of the column and thus cause it to tend to fall within the confines of a circle. It will be recognized that where a plurality of spray nozzles of common type and design is used to apply liquid to an area, rectangular or otherwise, that these nozzles will ordinarily function to apply water to a series of circular areas and that the liquid will not be universally distributed over the entire surface to be wetted since coincident overlapping areas will occur along the edges of the circles and an unwetted hypercycloidal area between the circular wetted areas, and it is the object of the present invention to provide means whereby the column of liquid may be dispersed in a manner to uniformly cover an area of predetermined size and configuration, and particularly areas of rectangular shape.

This is primarily accomplished in the present case by the provision of marginal dispersion flanges 23 which extend upwardly from the spray plate 22 and along quadrants of the plates. The dispersion flanges in their more simple form as shown in Figs. 9 and 10 have a solid-body and an arcuate upper edge 24 over which the liquid is projected after it strikes the plane obstructing face of the plate 22.

In this form of device as shown in Fig. 9 attention is directed to the fact that the inner face 25 against which the liquid initially impinges is of varying vertical angularity so that the jets of liquid dispersed over the lip 24 will be directed along a multiplicity of different radial paths of travel and so that trajectories of the jets will vary from relatively high short-range jets passing over the crown of the lip 24 to relatively low long-range jets passing directly from the plate 22 and through the opening 26, occurring between adjacent ends of the dispersion flanges 23.

It will be evident that there will be an area disposed beneath the spray plate 22 and sheltered thereby in which there would not be any spray of liquid. The configuration of this area would agree with the configuration of the entire area being sprayed and along the perimeter of which the jets of liquid projecting from over the edge of the disc would fall. In order to supply a uniform spray to this sheltered area, a plurality of openings 27 are formed through the disc and are disposed upon axial lines radial with the center of the quadrants subtended by the dispersion flanges 23 disposed beneath the spray plate 22 and in the path of travel of the relatively large jets of liquid flowing downwardly through the openings 27 is a subplate 28. This plate is substantially conical, having an outwardly flaring and curved face against which the columns of liquid from the openings 27 impinge and by which these columns are diverted outwardly and simultaneously dispersed. In order to increase the uniformity of

dispersion of this liquid it may be desirable to provide a serrated dispersion flange 29 beneath the spray plate 23 and preferably projecting downwardly from the under face thereof. The subplate 28 is secured to a threaded extension of the stem 20 as shown in Fig. 4.

As previously stated, the simplified form of the invention is shown in Figs. 9 and 10, for in this case the dispersion flanges 24 are smooth and are not serrated. This type of nozzle is particularly adapted for accommodating large volumes of liquid.

In the form of the invention shown in Figs. 7 and 8 the dispersion flanges 23 are indicated as being formed with a plurality of serrations 30. These serrations gradually increase in depth from the center of the flange outwardly and downwardly toward the point of convergence of the flange with the upper face of the spray plate 22.

In the form of the device shown in Figs. 5 and 6 the serrations 30 extend from the upper edge of the dispersion flanges 23 substantially to the upper face of the disc 22. This particular type of spray disc is desirable for use in cases where a relatively small volume flow of liquid is used.

In the form of the invention generally indicated in Fig. 12 of the drawings and the application of which is shown in Fig. 11, a deflector shield 32 is provided for the purpose of projecting the jets of liquid into the wind since it is evident that in cooling tower operation the air pressure on the windward side would tend to disturb the jets and to prevent them from forming and following the trajectories along which they had been calculated to travel, and which would be established and maintained under normal air conditions by the discs. When disturbing wind conditions are prevalent it is possible to place the deflector shields 32 upon the lee side of the nozzle thus diverting approximately one-half of the liquid from the lee side of the nozzle and into the wind upon the windward side of the nozzle. The deflector flanges are arcuate in horizontal section and are hyperbolic in vertical formation, the base of the structure resting upon the upper face of the spray disc 22 and the arcuate formation conforming to the dispersion flanges 23 thereon. A suitable means may be provided for detachably positioning the shield upon the disc.

In the operation of the structure with which the present invention is concerned, the nozzle is suitably connected with a delivery pipe 11 by the pipe 12 and a large volume of liquid in unrestricted flow is continuously fed directly through the nozzle under a predetermined hydrostatic head. Due to the fact that the mouth of the nozzle is spaced from the upper plane face of the spray disc 22 a vertical column of liquid will be projected downwardly from the mouth of the nozzle and caused to strike the obstructing spray disc with a predetermined force. Attention is directed to the fact that the openings 27 which are formed through the spray disc fall within the area represented by the circumference of the projected column of liquid so that the liquid which passes through the openings 27 will continue substantially under its original hydrostatic head and will impinge against the deflecting faces of the subplate 28 with substantially the same force as the remainder of the column of liquid strikes the obstructing plane face of the spray plate 22. The liquid diverted from its linear path of travel by the spray plate 22 will tend to move laterally of the plate, some portion of it splashing upwardly and falling off the sides

of the plate in a random fashion, the larger proportion of liquid moving radially of the plate to encounter the dispersion flanges 23.

In the form of invention shown in Figs. 9 and 10 where the dispersion flanges are arcuate in section, it will be evident that the liquid passing off from the spray plate will form substantially into four fan-shaped sheets of liquid which will tend to separate and break into a spray at the point where the force of the hydrostatic head is spent. This will be along a substantially straight line, the opposite ends of which will be established by the jets of liquid which have an opportunity to flow directly from the spray plate 22 and in substantially the plane thereof without deflection as they flow through the throats 26, occurring between contiguous ends of dispersion flanges.

The plane determined by the various trajectories may be inclined so that the pitch of the trajectories may be varied to agree with the shape of the surface area to be wetted.

It will, of course, be evident that a large volume of liquid will fall short of the outer limit as defined by the jets which pass upwardly over the lip of the dispersion flanges. This will insure that the confined area will be substantially uniformly sprinkled with the exception of the central sheltered area occurring beneath the spray plate 22 and a distance therebeyond. This area will be supplied with a uniform spray of liquid by the liquid which passes downwardly through the openings 27 and strikes the subplate 28. Attention is directed to the fact that there are as many openings 27 as there are dispersion flanges 23 and that due to this symmetrical subdivision of the liquid, the dispersion of the liquid from off the subplate will supplement the spray of liquid from off the sprinkler plate 22 to cause the entire predetermined rectilinear area to be uniformly sprinkled.

Under certain circumstances, such for example, as when apparatus is operated under a relatively small volume flow, or under a relatively small hydrostatic head it may be desirable to more thoroughly break up the sheet of liquid which would normally project upwardly and over the lip of the dispersion plate 22, shown in Figs. 9 and 10. This is done by forming a plurality of serrations along the margin of the dispersion flanges 23 so that the liquid may be impelled along a plurality of varying trajectories. The depth of the serrations may be varied, as calculations may determine, making it possible to insure that a liquid may be uniformly sprinkled over areas varying from rectangular to hyper-cycloidal.

It will thus be seen that the structure here disclosed is simple in construction and operation and that by proper design an area of any required shape may be uniformly sprinkled with the spray nozzle embodying the present invention.

While I have shown the invention as now known to me, it will be understood that various changes may be made in the combination, construction, and arrangement of parts by those skilled in the art without departing from the spirit of the invention as claimed.

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

1. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column

of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face of the disc whereby a liquid projected from the nozzle and striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges.

2. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face of the disc whereby a liquid projected from the nozzle and striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges, said arcuate flanges being outwardly beveled on their inner arcuate faces.

3. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face of the disc whereby a liquid projected from the nozzle and striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges, said arcuate flanges being serrated along their marginal edges.

4. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face

of the disc whereby a liquid projected from the nozzle and striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges, said arcuate flanges being serrated along their marginal edges, the serrations extending the depth of the flange throughout the lengths thereof.

5. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face of the disc whereby a liquid projected from the nozzle and striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges, said arcuate flanges being outwardly beveled on their inner arcuate faces, said arcuate flanges being serrated along their marginal edges.

6. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face of the disc whereby a liquid projected from the nozzle and striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges, the disc being formed with openings around its center and through which a proportion of the liquid of the column may pass, an obstructing deflector disposed beneath said disc and its openings to divert the liquid from its longitudinal path.

7. A nozzle for uniformly spraying non-circular areas which comprises a vertically disposed tubular nozzle having an outlet at its lower end, a circular disc disposed beneath said nozzle with its plane surface at right angles to the longitudinal axis of the nozzle and against which a column of liquid from the nozzle may project, and a plurality of arcuate flanges disposed in spaced relation to each other along the circumferential edge of said disc, and projecting at right angles to the aforementioned plane face of the disc, said arcuate flanges progressing in height from their opposite ends to their median line, the ends of contiguous flanges being spaced from each other and interrupted by the plane face of the disc whereby a liquid projected from the nozzle and

striking the disc will be divided into portions having relatively long flat trajectories and intermediate portions, the trajectories of which progressively shorten horizontally toward the median lines of the arcuate flanges, the disc being formed with openings around its center and through which a proportion of the liquid of the column may pass, an obstructing deflector disposed beneath said disc and its openings to divert the liquid from its longitudinal path, and an annular serrated flange projecting downwardly from the under face of the disc and adapted to being encountered by the liquid deflected from the deflector to disperse the liquid.

8. A nozzle for uniformly spraying a non-circular area which comprises a vertically disposed tubular nozzle of substantially uniform cross section opened at its lower end, a circular plate disposed beneath the opened lower end of the nozzle and lying in a plane at right angles to that of the nozzle, a plurality of arcuate flanges formed along the perimeter of said plate and projecting upwardly therefrom, said flanges being characterized by having an upper edge progressively increasing in height from the face of the plate to a median point, said edge being formed with a series of serrations gradually progressing in depth from the opposite ends of said flanges to the median point, the inner vertical surface of each of the flanges flaring outwardly at an angle greater than a right angle to the plane of the disc, and the opposite ends of said flanges being interrupted by the surface of the upper face of the disc, whereby a stream of liquid projected from the nozzle against the face of said disc will be dispersed in all directions therefrom, and along predetermined trajectories to spray a required area of non-circular form.

9. A nozzle for uniformly spraying a non-circular area which comprises a vertically disposed tubular nozzle of substantially uniform cross section opened at its lower end, a circular plate disposed beneath the opened lower end of the nozzle and lying in a plane at right angles to that of the nozzle, a plurality of arcuate flanges formed along the perimeter of said plate and projecting upwardly therefrom, said flanges being characterized by having an upper edge progressively increasing in height from the face of the plate to a median point, said edge being formed with a series of serrations gradually progressing in depth from the opposite ends of said flanges to the median point, the inner vertical surface of each of the flanges flaring outwardly at an angle greater than a right angle to the plane of the disc, and the opposite ends of said flanges being interrupted by the surface of the upper face of the disc, whereby a stream of liquid projected from the nozzle against the face of said disc will be dispersed in all directions therefrom, and along predetermined trajectories to spray a required area of non-circular form, openings through the disc, an obstructed deflector disposed beneath the disc and in the path of liquid passing through said openings whereby liquid will be deflected outwardly and upwardly and an annular downwardly extending fluted flange on the under face of the disc to be encountered by the deflected water and to insure that the central area of the surface to be sprayed will be uniformly wetted.

10. A nozzle for uniformly spraying a non-circular area which comprises a vertically disposed tube nozzle, having a liquid passageway therethrough of uniform sectional area, a spider formed across the passageway of said nozzle, a

<p>support rod carried by the spider and extending longitudinally and centrally through the mouth of the nozzle, a spray disc adjustably mounted upon the rod and support in a plane at right angles to the mouth of the nozzle, an obstructing deflector mounted upon the end of the rod beneath the spray disc, the perimeter of the upper face of the spray disc being divided into a plurality of segments, each bounded by a perpendicular flange progressing in height from the face of the spray disc to a median point and each flange being formed with uniformly spaced serrations which uniformly increase in depth from the ends of the flanges to their median points, the disc being spaced from the end of the passageway and being formed with openings through it which permit a portion of the liquid from the nozzle to pass through the disc and be dispersed by the obstructing deflector.</p>	<p>support rod carried by the spider and extending longitudinally and centrally through the mouth of the nozzle, a spray disc adjustably mounted upon the rod and support in a plane at right angles to the mouth of the nozzle, an obstructing deflector mounted upon the end of the rod beneath the spray disc, the perimeter of the upper face of the spray disc being divided into a plurality of segments each bounded by a perpendicular flange progressing in height from the face of the spray disc to a median point and each flange being formed with uniformly spaced serrations which uniformly increase in depth from the ends of the flanges to their median points, the disc being spaced from the end of the passageway and being formed with openings through it which permit a portion of the liquid from the nozzle to pass through the disc and be dispersed by the obstructing deflector, and a downwardly extending circumferential flange formed on the under face of the spray disc, said flange being fluted to disperse liquid which is deflected by the obstructing deflector.</p>	<p>80 85 90 95</p>
<p>11. A nozzle for uniformly spraying a non-circular area which comprises a vertically disposed tube nozzle, having a liquid passageway there-through of uniform sectional area, a spider formed across the passageway of said nozzle, a</p>	<p>ROBLEY D. EVANS.</p>	<p>100</p>
<p>30</p>		<p>105</p>
<p>35</p>		<p>110</p>
<p>40</p>		<p>115</p>
<p>45</p>		<p>120</p>
<p>50</p>		<p>125</p>
<p>55</p>		<p>130</p>
<p>60</p>		<p>135</p>
<p>65</p>		<p>140</p>
<p>70</p>		<p>145</p>
<p>75</p>		<p>150</p>