

[54] AGRICULTURAL SPRINKLER HEAD

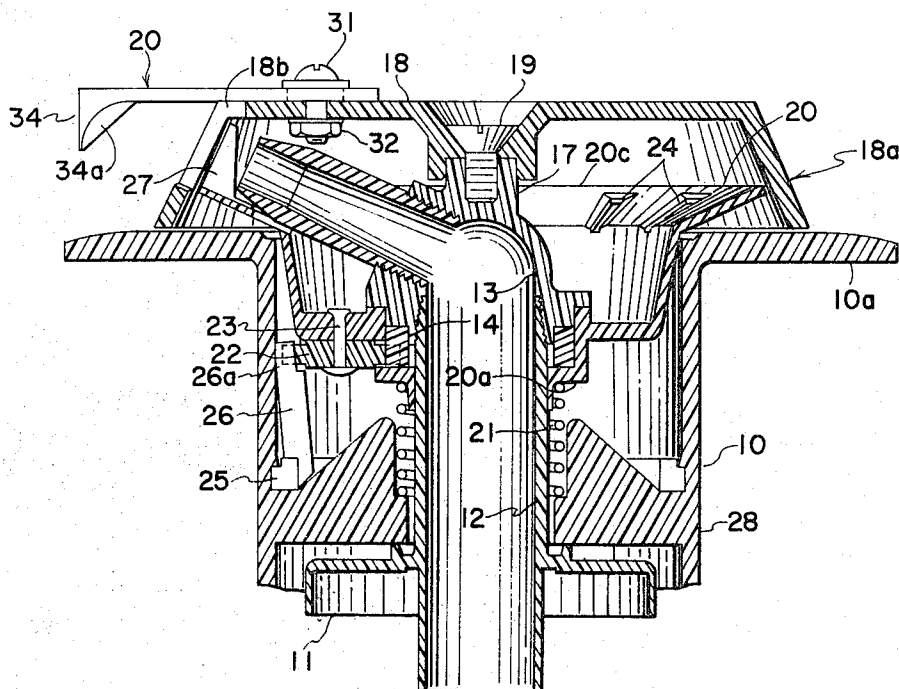
[75] Inventors: **Byron L. Ertsgaard; Edwin J. Hunter**, both of Riverside, Calif.[73] Assignee: **Toro Manufacturing Corporation**, South Minneapolis, Minn.[22] Filed: **June 24, 1971**[21] Appl. No.: **156,381**[52] U.S. Cl. **239/232**[51] Int. Cl. **B05b 3/08**[58] Field of Search.....239/225, 231, 233,
239/232, 236, 237[56] **References Cited****UNITED STATES PATENTS**

3,563,465	2/1971	Foreman	239/233 X
1,080,136	12/1913	Campbell	239/247 X
2,962,220	11/1960	Woods.....	239/231 X
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Primary Examiner—Allen N. Knowles*Attorney*—Vernon A. Johnson et al.[57] **ABSTRACT**

A sprinkler having a nozzle and a diffuser therefor which cooperate to provide a variable distribution of

water from the sprinkler head throughout the entire circumference thereof which accomplishes almost complete uniformity of distribution of the water within the maximum and minimum limits of projection of the water stream from the head. The nozzle is continuously driven in a circular direction and intermittently rotates simultaneously with a diffuser plate, the diffuser having diffuser vanes formed thereon which are intermittently interposed into the water stream from the nozzle to break up the pattern and the distribution thereof. The nozzle and diffuser plate travel together for one complete revolution, in fixed relationship to one another. Upon completion of each revolution, the nozzle disengages itself momentarily from the diffuser plate, and indexes itself relative to the diffuser plate a predetermined incremental distance, whereupon it re-engages and makes another complete revolution, so that the nozzle is constantly changing its relationship with respect to the diffuser plate, and the water dispersing or diffusing vanes provided thereon. The relative indexing of the nozzle and the diffuser plate is accomplished by a gear formed on the nozzle, and a pinion carried by the diffuser plate, which pinion engages the gear on the nozzle, and also engages each complete revolution, a stationary pin which is the equivalent of one tooth of an internal gear. When the pinion engages the pin, it causes the aforementioned disengagement of the diffuser and nozzle and indexing of the nozzle to the next diffuser station or vane.

25 Claims, 11 Drawing Figures

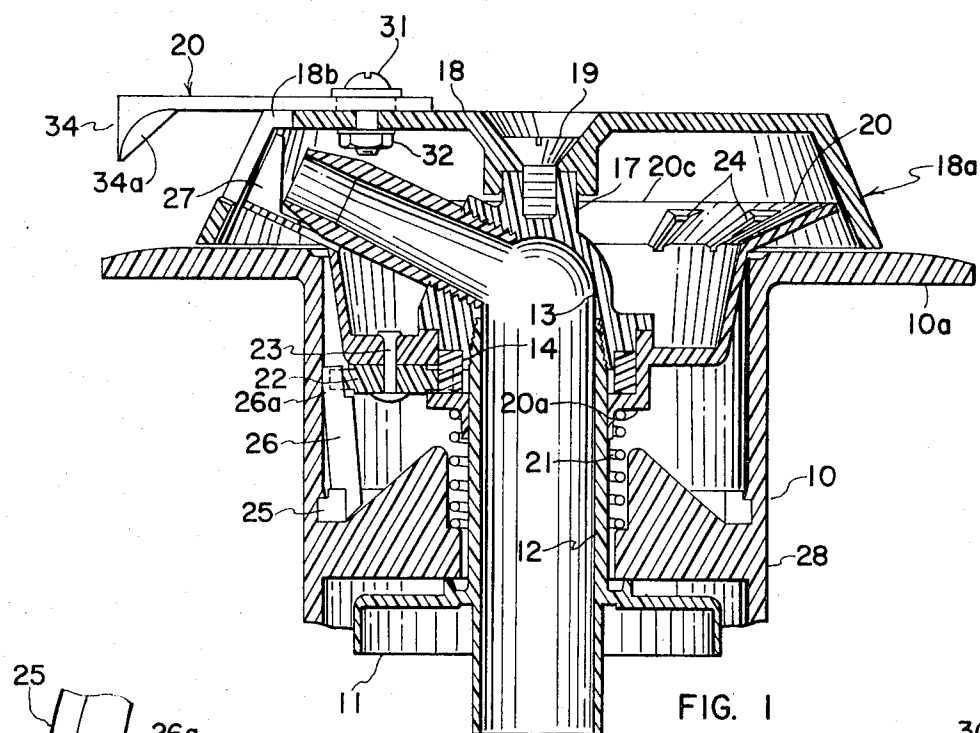


FIG. 1

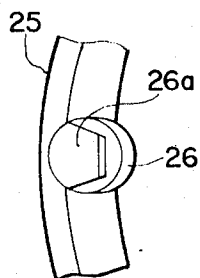


FIG. 7

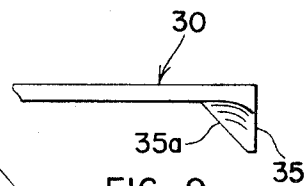


FIG. 9

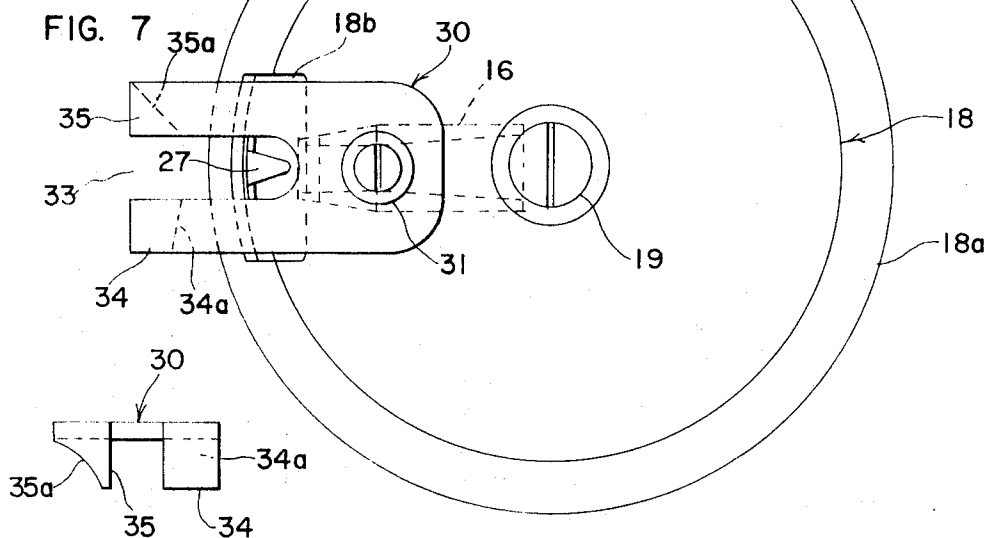


FIG. 2

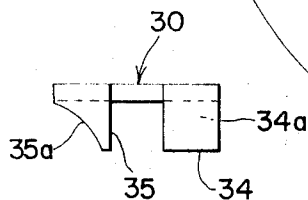


FIG. 10

INVENTORS
 BYRON L. ERTSGAARD
 EDWIN J. HUNTER
 BY THOMAS A. LENNON
 ATTORNEY

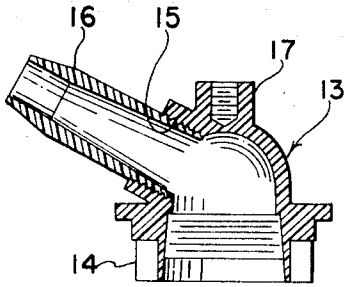


FIG. 3

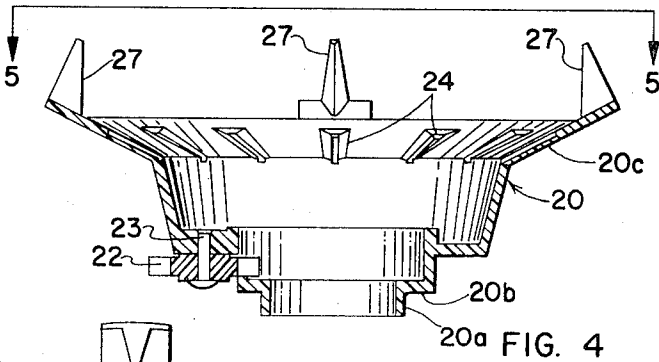


FIG. 4

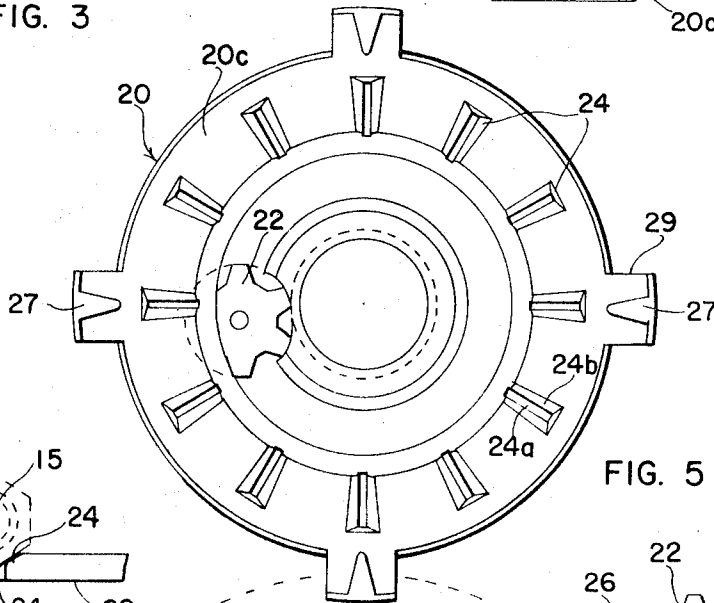


FIG. 5

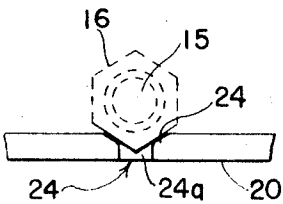


FIG. 8

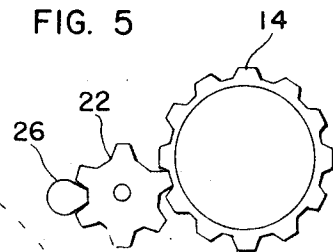


FIG. 11

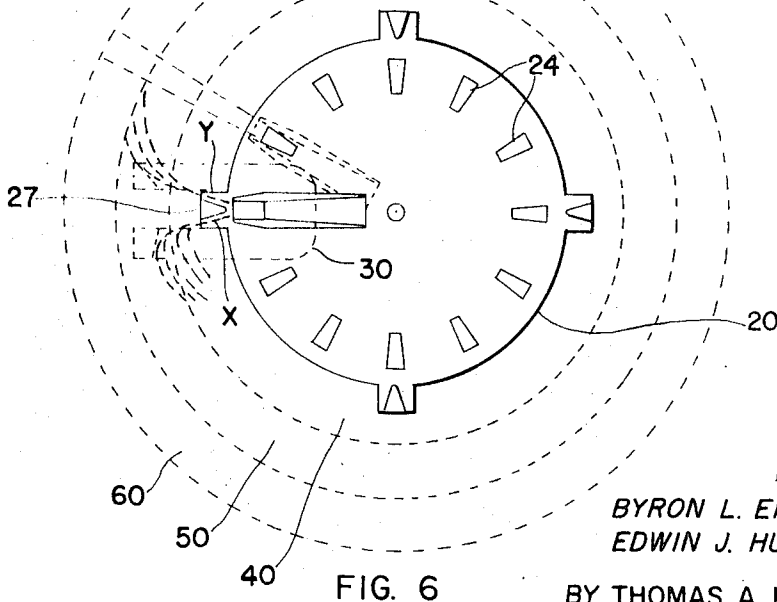


FIG. 6

INVENTORS
BYRON L. ERTSGAARD
EDWIN J. HUNTER

BY THOMAS A. LENNON
ATTORNEY

AGRICULTURAL SPRINKLER HEAD

In the sprinkler art, one of the constant problems facing the designers thereof is the ability to provide a sprinkler which can uniformly distribute the water in the area treated by the sprinkler.

Still another chronic design problem in sprinklers is the ability of the sprinkler to vary the pattern of distribution for a given application.

Still another design problem is to provide a sprinkler head which is capable of being quickly and easily modified or altered so as to be able to vary the pattern of uniformity of distribution or both.

The primary object of this invention is to provide a sprinkler head capable of accomplishing and solving all of the aforementioned problems in an efficient and simple manner and at a minimum of cost of construction.

These and other objects and advantages of the invention will be more fully understood from the following description made in connection with the accompanying drawings wherein like character references refer to the same parts throughout the several views, and in which:

FIG. 1 is a vertical center sectional view of one preferred embodiment of this invention;

FIG. 2 is a top plan view thereof;

FIG. 3 is a vertical sectional view of the nozzle base assembly;

FIG. 4 is a vertical sectional sub-assembly view of the diffuser plate with the pinion gear attached thereto;

FIG. 5 is a top plan view of FIG. 4;

FIG. 6 is a schematic view of the relative operation of the nozzle and diffuser plate and deflector and the patterns developed thereby;

FIG. 7 is a detail top view of the trip pin;

FIG. 8 is a cross-sectional view of a detent on an enlarged scale;

FIG. 9 is a side elevational view of a portion of the deflector as viewed from the side opposite to that seen in FIG. 1;

FIG. 10 is an end elevational view of the deflector as seen from the outer end thereof; and

FIG. 11 is a detail top plan view showing the relationship of the nozzle base gear, the pinion, and the trip pin.

Referring to the drawings, a stator body 10 is provided which is the exterior housing for the sprinkler head of this invention and would normally be imbedded in the ground with the flange 10a thereof being at or slightly below ground level. Mounted within the stator body 10 is a bull gear 11 which has an integral cylindrical riser 12 extending vertically upwardly therefrom, the upper outer end of said riser having pipe threads formed thereon for receiving and mounting the nozzle base assembly 13. The interior of the nozzle base assembly is interiorly threaded so as to threadedly engage the upper threaded portion of the riser of the bull gear so as to become operatively mounted thereon. The nozzle base also includes a ring gear 14 which is molded integrally with the nozzle base, and an internally threaded opening 15 in which a conventional nozzle 16 with a hexagonal shaped exterior is threadedly installed.

The top part of the nozzle base includes an upstanding interiorly threaded boss 17 to which the cover 18 is attached by means of a screw 19 causing the cover to rotate with the nozzle base. The cover has an annular

flange or skirt 18a, the lower marginal edge of which is in very close proximity to, but out of contact with, the flange 10a of the stator body in order to reduce the possibility of foreign matter entering the head. The cover is also provided with an opening 18b through which the water from the nozzle 16 is discharged.

Thus, as the sprinkler head has been described to this point, the bull gear 11 would continuously rotate and while continuously rotating would cause the nozzle base 13, nozzle 16, and cover 18 carried by the nozzle base to rotate simultaneously and continuously therewith, with the water rising upwardly through the riser 12 and being discharged through the nozzle base and nozzle itself through the opening 18b in the cover to the area surrounding the sprinkler heads so that, if nothing more were added to the sprinkler as described to this point, the water would be consistently distributed in a circle in the same pattern throughout, the distribution thereof being non-uniform from the head to the outer perimeter of the watered area with the heavier concentration of the water being towards the outer portion of the watered area.

To accomplish the desired periodic diffusion or breaking up of the stream of water so that the area closer to the sprinkler receives approximately an equal amount of water, a circular diffuser plate 20 is provided, which plate is coaxial with the riser portion 12 of the bull gear 11 and the nozzle base 13 and which is held in frictional engagement therewith by helical spring 21 which surround the riser. The diffuser plate is freely rotatable relative to the riser, and also the nozzle assembly, if not engaged therewith. Even if engaged therewith, it is movable relative to the nozzle assembly if subjected to a force sufficient to overcome the frictional resistance therebetween. The lower end of the spring rests on an annular shoulder 28a provided by internal stator body structure 28. The upper end of the spring encircles the hub 20a of the diffuser plate, and bears against the annular shoulder 20b thereof which extends laterally from the upper end of the hub 20a, the spring continuously biasing the diffuser plate upwardly into engagement with the nozzle base and the nozzle. The diffuser plate carries a pinion gear 22 engaging the gear 14 on the nozzle base. The diffuser plate is also provided with a series of detents 24, which are 12 in number in the illustrated embodiment, and which are circumferentially equally spaced. These detents receive and frictionally engage one of the corners of the nozzle exterior so that when so engaged, the rotation of the nozzle will cause simultaneous rotation of the diffuser plate, the nozzle driving the plate through its engagement therewith with the detents thereof.

However, a snap ring 25 is mounted on the interior of the wall of the stator body, which snap ring has a vertical pin 26 which has been molded to the snap ring which pin 26 is engaged once on each rotation by the pinion gear 22. The upper end 26a of the pin is shaped in the form of a gear tooth for proper cooperative engagement with the pinion. When the pinion gear engages the vertical pin 26, it causes the diffuser plate to shift its position slightly with respect to the nozzle and move the nozzle out of engagement with the detents 24 on the diffuser plate whereupon the nozzle is free to rotate momentarily relative to the diffuser plate until it engages the next detent in the series, whereupon the

nozzle and re-engaged diffuser plate will again simultaneously make a complete revolution until the pinion again engages the vertical pin, whereupon the process will be repeated of the nozzle becoming disengaged from the detent and quickly indexing itself to the next detent in the series.

At selected station on the diffuser plate, and in alignment with the detents, the diffuser plate is provided with diffuser vanes 27, of which, in the illustrated embodiment there are four located 90° apart. These diffuser vane are adapted to be interposed in the water stream from the nozzle, dividing the stream of water and reducing its range and causing the water to fall closer to the head. By varying the shape of the diffuser vanes and by varying the number of vanes, a nearly perfect distribution of water from the head to the outer periphery can be obtained.

The vanes 27 are mounted on generally rectangular projections 29 on the diffuser plate, which projections are merely extensions of the inclined annular lip portion 20c of the plate on which the detents are formed.

The vanes illustrated are triangular in shape when viewed from above, with one apex thereof directly pointing at the center of the nozzle mounted opposite said vane, so that the sides defining said apex diverge outwardly therefrom, splitting the stream of water issuing from the nozzle and causing same to fan out on a shorter radius than if the vane weren't there. It will be understood that a different number of vanes, and vanes having other shapes may also be used within the purview of this invention.

The detents 24, include an elongate recessed channel portion 24a which is rectangular in cross-section, with upwardly and outwardly inclined faces 24b extending from the upper edge of each side of said channel.

In some circumstances, it may be desirable to further diffuse the water to accomplish uniformity of distribution and prevent a dry area around the head. To assure diffusion of water on the area immediately surrounding the sprinkler, a deflector assembly 30 may be provided which is mounted on top of the cover 18 by means of a fastening means such as the bolt 31 and nut 32. The deflector 30 projects laterally out over the nozzle opening 15 to intercept some of the water from the nozzle 16. The deflector is provided with an elongate slot or opening 33 which permits the solid stream of water to pass therethrough when the nozzle is located at a station where there is no diffuser.

However, at those stations where a diffuser vane 27 is located, the water issuing from the nozzle 16 as previously described is divided into two streams x and y by the vane to sprinkle the water closer to the head. To further control the distribution of the water leaving the vanes, the deflector is provided with two different depending deflector bodies or portions 34 and 35, one on each leg thereof, which have water deflecting surfaces 34a and 35a respectively. Both deflecting surfaces 34a and 35a are concavities defining conical surfaces which are oriented differently to provide a different pattern of dispersion for each of the streams provided by the diffuser vanes 27. The conical deflector surface 34a on the left side of the deflector (as viewed from above) tends to intercept and deflect the left hand stream x from the vane downwardly and inwardly to disperse water in the inner annular area 40 around and im-

mediately adjacent the sprinkler as best seen in FIG. 6. The conical deflector surface 35a on the right side of the deflector (as viewed from above) intercepts the right hand stream y from the vane and deflects it downwardly and somewhat laterally to provide the intermediate annular pattern 50 between the inner pattern 60 provided by surface 34a and the furthestmost annular pattern 60 provided by the nozzle when the water is not diffused or deflected in any way after it leaves the nozzle.

In operation, the bull gear 11 can be driven by any suitable drive means (not shown) such for example as that disclosed in U.S. Pat. No. 3,107,056. As the bull gear is driven, the rotation thereof causes the riser 12 to rotate which in turn causes rotation of the nozzle base assembly 13 and the nozzle 16 attached thereto, and also the simultaneous rotation of the cover 18. As the aforementioned components rotate, water is passing through the riser and nozzle and being discharged therefrom through the opening 18b in the cover. The aforementioned water passing through the riser and nozzle is commonly the water used to operate or drive the drive means for the bull gear, said water passing through the riser after powering the drive mechanism.

The spring 21 continuously biases the diffuser plate 20 upwardly against the nozzle 16 which nozzle will normally be seated in one of the detents 24, except when traveling between detents. Because of the engagement of the nozzle with one of the detents, the diffuser plate rotates simultaneously with the nozzle in the same direction as the nozzle being rotated by the engagement with said nozzle.

As the nozzle and diffuser plate rotate, the gear 14 carried by the nozzle base and the pinion gear 22 simultaneously rotate in engagement with each other, but without any cooperative interaction therebetween.

However, when the nozzle and diffuser plate have traveled through one complete circle, that is, through 360°, the pinion 22 moves into engagement with the tooth portion 26a of the vertical trip pin 26, as perhaps best illustrated in FIG. 11. When the pinion engages the trip pin, (which is a stationary member) it causes the pinion to actuate or drive the nozzle base gear 14 thereby forcing the nozzle 16 out of engagement with whatever detent it had been engaged with and thereby causing the nozzle to index or travel to the next detent in the series whereupon the nozzle and diffuser plate are again cooperatively re-engaged and travel simultaneously through another 360° of movement, whereupon the trip pin is again engaged by the pinion and the aforementioned disengagement, indexing, and re-engagement are repeated.

During the times when the nozzle is seated in a detent where it does not have a diffuser vane 27 aligned therewith and opposed thereto, virtually all of the water issuing from the nozzle passes through the slot 33 of deflector 30 and the majority of said water is projected the furthestmost distance from the sprinkler and falls in the annular pattern 60 shown in FIG. 6. It will, of course, be understood however, that some of the water, even through not encountering diffuser vane or deflector surface will still drop in the areas 40 and 50.

When the nozzle is opposed by one of the vanes 27, the stream of water is divided into two sub-streams x

and y. The sub-stream x in turn encounters the conical deflecting surface 34a causing the majority of said stream to be deflected generally downwardly and rearwardly to develop the pattern 40. The sub-stream y encounters the conical deflecting surface 35a and is directed downwardly and somewhat laterally to a distance beyond that generally permitted by deflecting surface 34a to develop the sprinkling pattern 50.

Thus, it will be appreciated that through the frequent revolutions of the sprinkler, a uniform dispersion pattern of water is obtained around the sprinkler head.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of this invention.

What is claimed is:

1. A sprinkler comprising nozzle means, said nozzle means being designed to rotate about a fixed axis and to discharge a stream of liquid, diffuser means

said diffuser means and nozzle means being adapted for movement relative to each other whereby said diffuser means is intermittently interposed and removed from the path of said stream of liquid, said means being adapted to simultaneously travel a predetermined distance in the same direction with the diffuser means interposed in the path of said stream of liquid,

said means being further adapted to simultaneously travel of predetermined distance in the same direction with the diffuser means out of the path of said stream of liquid.

2. The sprinkler of claim 1, wherein said nozzle means moves in a circular path of travel relative to said diffuser means,

and wherein said diffuser means has at least one diffuser element arranged to be interposed in the path of the stream of liquid for a portion of the time said nozzle means travels in said circular path.

3. The sprinkler of claim 1, including cooperating gear means carried by said nozzle means and diffuser means,

and means for engaging one of said gear means to thereby effect relative movement between said nozzle means and said diffuser means.

4. The sprinkler of claim 1, including deflector means adapted to intercept at least some of the liquid disposed by said diffuser means and change the direction of travel thereof.

5. The sprinkler of claim 4, wherein said diffuser means divides

said stream of liquid into at least

two sub-streams, and

wherein said deflector means intercepts at least one of said sub-streams.

6. The sprinkler of claim 4, wherein

said diffuser means divides said stream of liquid into at least two sub-streams, and

wherein said deflector means intercepts both of said sub-streams and changes the direction of travel of each,

said deflector means causing a different pattern of distribution for one sub-stream than it does for the other sub-stream.

7. The sprinkler of claim 1, wherein said diffuser means divides said stream of liquid into two sub-streams.

8. The sprinkler of claim 1, wherein said diffuser means comprises an element including two intersecting surfaces, the juncture of which faces said nozzle means, with said surfaces diverging outwardly therefrom.

9. The sprinkler of claim 4, wherein said deflector means includes an opening to permit substantially uninterrupted passage of said stream of liquid where said diffuser means is not disposed in the path of travel of said stream.

10. The sprinkler of claim 1, wherein said diffuser means includes a plurality of diffusing elements, said elements being circumferentially spaced apart whereby the stream of liquid from the nozzle is not interfered with during its travel between said diffuser elements.

11. The sprinkler of claim 1, wherein said nozzle means and diffuser means are movable relative to each other, said diffuser means and nozzle means being adapted to adopt a plurality of operational positions relative to one another,

detent means adapted to releasably hold said diffuser means and nozzle means in each of said operational positions,

said diffuser means and nozzle means when in said operational positions being adapted to travel a predetermined distance simultaneously,

means for disengaging said diffuser means and nozzle means after they have completed their travel through said predetermined distance,

and means for effecting relative movement between said diffuser means and said nozzle means when they are so disengaged so as to bring them together at the next detent station in the series.

12. The sprinkler of claim 1, including a first disengaging element carried by one of said means, a fixed second disengaging element,

said disengaging elements being adapted to engage each other intermittently to effect said relative movement between said diffuser and nozzle means.

13. The sprinkler of claim 1, including gear means carried by said nozzle means,

pinion means carried by said diffuser means,

and stationary pin means adapted to intermittently engage said pinion means,

said pinion means and gear means being constantly engaged with each other,

said pinion when engaged by said pin means moving said diffuser means relative to said nozzle means.

14. The sprinkler of claim 1,

wherein said diffuser means and nozzle means are movable towards and away from each other,

and spring means continuously biasing said diffuser means and nozzle means towards one another.

15. The sprinkler of claim 1,

including structure supporting said diffuser means,

said structure including a series of detents for releasably holding said nozzle means,

at least one of said detents being capable of holding said nozzle means opposite said diffuser means, and

at least one of said detents being adapted to hold said nozzle means in a position where the diffuser means is not interposed in the path of said stream of liquid.

16. The sprinkler of claim 15, wherein said detents comprise recesses in said supporting structure and said nozzle means is adapted to be seated in said recesses, and means biasing said recesses and nozzle means into engagement with one another.

17. The sprinkler of claim 16, wherein said supporting structure includes an annular plate, said recesses being arranged in substantially equispace series about the circumference of said plate, said diffuser means comprising upstanding vanes mounted on said supporting structure in alignment with at least some of said recesses to intercept the stream of liquid from nozzles seated in said recesses.

18. The sprinkler of claim 17, wherein said biasing means engages said supporting structure and biases same towards and against said nozzle means.

19. The sprinkler of claim 1, including a first gear element carried by one of said means, a second gear element carried by the other of said means and stationary means engageable with one of said gear elements intermittently whereby the simultaneous engagement of said gear elements and said stationary means effects said relative movement between said diffuser means and nozzle means.

20. The sprinkler of claim 1, wherein said diffuser means has at least one diffuser element arranged to be interposed in the path of the stream of liquid for a portion of the time said nozzle means travels about said fixed axis, said element being adapted to divide said stream of liquid into two portions, deflector means supported by said nozzle means and rotatable therewith, said deflector means comprising two spaced apart arms, one of said arms being provided with a deflector element adapted to intercept and redirect one of said portions of said stream of liquid, the other arm having a second deflector element adapted to intercept and redirect the other of said portions of said stream of liquid, said deflector elements being adapted to redirect their respective portions of said stream of liquid at different angles, said space between said arms being of sufficient size and orientation with respect to said nozzle means as to permit substantially the entire stream of liquid from said nozzle means to pass through said space when said diffuser means is removed from the path of said stream of liquid.

21. The sprinkler of claim 1, wherein said diffuser means includes a plurality of diffusing elements, said elements being circumferentially spaced apart whereby the stream of liquid from the nozzle is not interfered with during its travel between said diffuser elements,

and wherein, said diffusing elements include two intersecting surfaces, the juncture of which faces said nozzle means with said surfaces diverging outwardly therefrom and adapted to divide the stream of liquid from said nozzle means into two portions, and including structure supporting said diffuser means, said structure includes a series of detents for releasably holding said nozzle means, said detents comprising recesses in said supporting structure in which recesses in said nozzle means is adapted to be selectively seated, and spring means biasing said supporting structure and nozzle means into releasable, frictional engagement with one another.

22. The sprinkler of claim 21, including gear means carried by said nozzle means, pinion means carried by said diffuser means, and stationary pin means adapted to intermittently engage said pinion means, said pinion means and gear means being constantly engaged with each other, said pinion when engaged by said pin means moving said diffuser means relative to said nozzle means.

23. A sprinkler comprising nozzle means rotatable about a fixed axis, diffuser means rotatable about said axis, first gear means connected with said nozzle means, second gear means connected with said diffuser means, said gear means being operatively engaged with each other, means for rotating said nozzle means and diffuser means about said axis, said gear means traveling with said nozzle means and diffuser means upon said rotation thereof, and stationary means for engaging at least one of said gear means whereupon said gear means co-act to cause relative rotational movement between said nozzle means and said diffuser means.

24. A sprinkler comprising nozzle means rotatable about a fixed axis, and deflector means rotatable simultaneously with said nozzle means, said deflector means including one opening to permit liquid from said nozzle to pass therethrough, said deflector means also including at least one surface capable of intercepting at least some of the liquid from said nozzle and changing the direction thereof, wherein said deflector means includes at least two surfaces capable of intercepting and changing the direction of liquid from said nozzle, wherein one of said surfaces is adapted to deflect the liquid in a direction different from that of said other surface, wherein both of said surfaces are concavities defining a conical surface.

25. A sprinkler comprising nozzle means rotatable about a fixed axis, and deflector means rotatable simultaneously with said nozzle means, said deflector means including one opening to permit liquid from said nozzle to pass therethrough, said deflector means also including at least one surface capable of intercepting at least some of the liquid from said nozzle and changing the direction thereof,

wherein said deflector means includes at least two
surfaces capable of intercepting and changing the
direction of liquid from said nozzle,
wherein said surfaces are disposed on opposite sides
of said opening.

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