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Troup

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[54] **CONSTRUCTION FOR REDUCING VORTEX SWIRL IN ROTARY WATER SPRINKLERS**

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[52] **U.S. Cl.** **239/230;** 239/233; 239/246; 239/262; 239/553.5; 239/DIG. 1

[51] **Int. Cl.**[2] **B05B 3/08**

[58] **Field of Search**..... 239/DIG. 1, 228, 230–233, 239/237, 246, 248, 251–255, 259, 261, 262, 264, 553–553.5, 590–590.5, 201–206

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[57] **ABSTRACT**

A rotary impact driven sprinkler of the type having a range nozzle for long distance water throw and a spreader nozzle for shorter distance throw and which includes an elbow having a converging passageway therethrough for reducing vortex swirl, and a bleed opening in the passageway for further reducing the amount of swirling water delivered to the range nozzle by bleeding the swirling water from the main flow and directing that water to supply the spreader nozzle.

10 Claims, 7 Drawing Figures

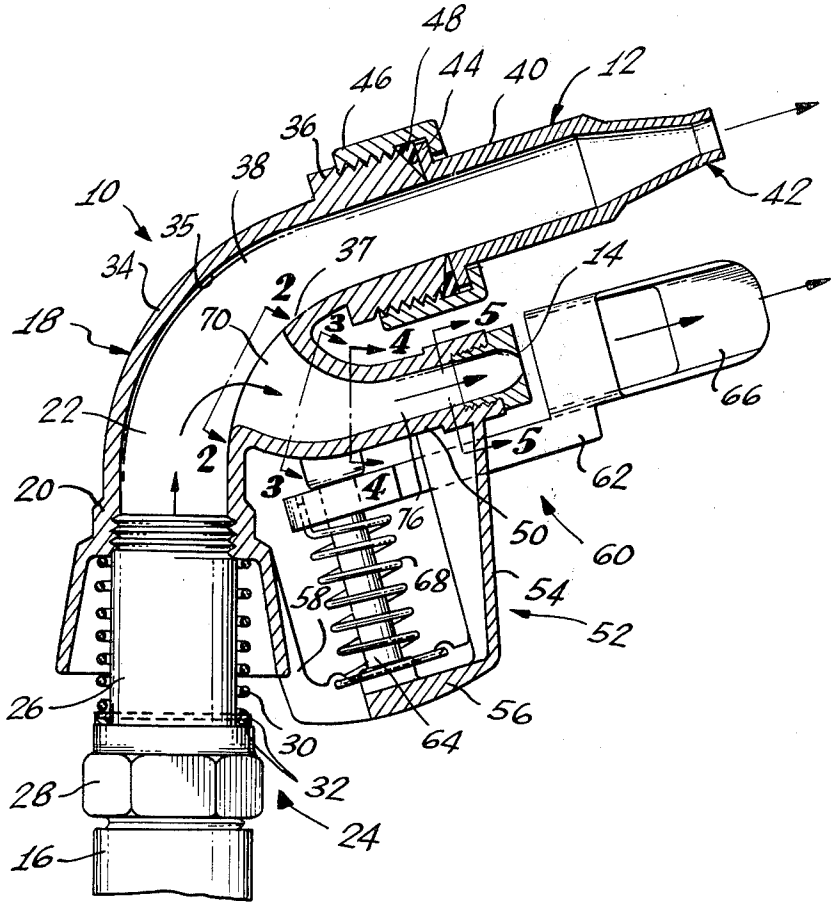


Fig. 1

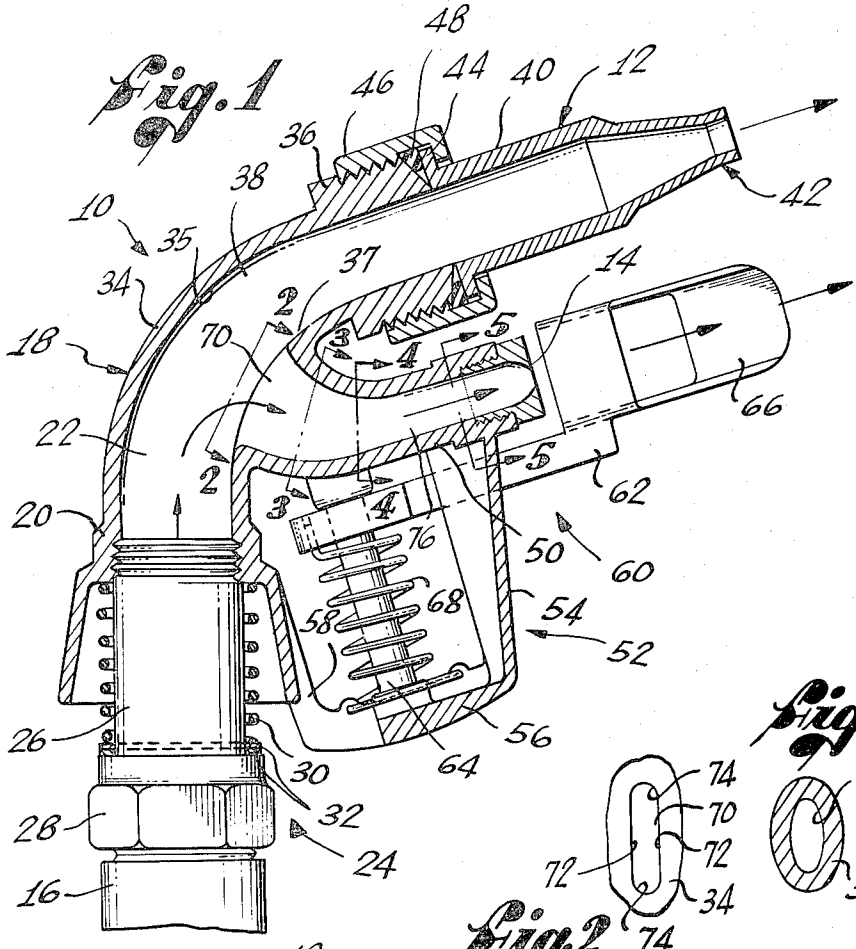


Fig. 3

Fig. 5

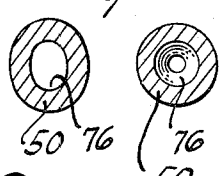
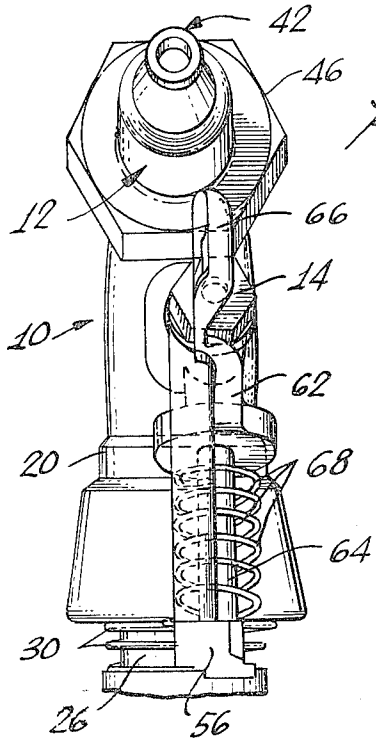


Fig. 2

Fig. 4

Fig. 6



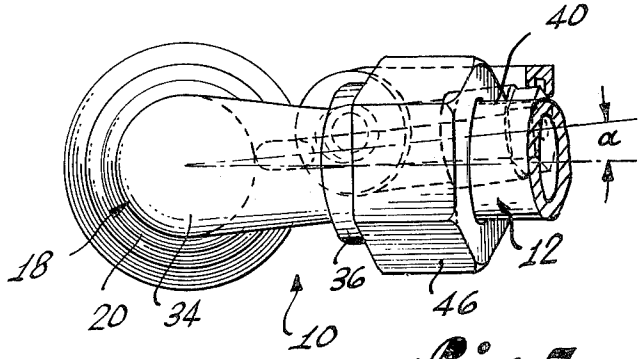


Fig. 7

CONSTRUCTION FOR REDUCING VORTEX SWIRL IN ROTARY WATER SPRINKLERS

BACKGROUND OF THE INVENTION

This invention relates to rotary water sprinklers for use in irrigation and more particularly to a new and improved rotary sprinkler of the type having a primary nozzle for relatively long distance water throw and a secondary nozzle for relatively short distance water throw.

There are numerous rotary sprinklers presently on the market which include a primary nozzle, often referred to as a "range nozzle," for providing the primary source of irrigating water, and a secondary nozzle, typically called a "spreader nozzle," which ejects a smaller water stream. Exemplary of these types of sprinklers are those manufactured and sold by Rain Bird Sprinkler Manufacturing Corp. of Glendora, Calif. under its designations 85E-TNT/95E-TNT (part circle sprinklers), and full circle sprinklers 80C and 80E Series as shown on pages 64 and 80, respectively, of the Rain Bird 1974 Irrigation Equipment Catalogue.

Such sprinklers are typically used in situations where relatively large areas are to be irrigated, the range nozzle functioning to eject its stream over a relatively great distance with its main fallout occuring well away from the sprinkler, and the spreader nozzle functioning to eject its stream over a shorter distance to produce relatively rapid fallout and fill in the area of low fallout created by the range nozzle. The range nozzle typically is disposed to traject its stream in a direction upwardly and laterally away from the sprinkler so that the water from the supply pipe which is usually vertically disposed must travel through a curved, generally elbow shaped path to the range nozzle.

It has been found that as the water travels through the elbow, vortex swirl is introduced into the water flowing to the range nozzle so that the water ejected from the range nozzle includes water particles which are traveling with a spiral motion in their direction of travel. This results in a substantial reduction in the distance of travel of the water stream from the range nozzle before fallout and a reduction in the area which can be effectively irrigated by the sprinkler.

To over come this problem, various attempts have been made at reducing the vortex swirl of the water ejected from the range nozzle. One of the most successful solutions has been to form anti swirl vanes inside the sprinkler downstream from the elbow and upstream from the range nozzle and which attempt to align the water particles into a straight line flow condition prepatory to being ejected from the range nozzle.

While the provision of straightening vanes has increased the effective distance of water throw from the range nozzle, such vanes have also introduced several additional problems and have not fully solved the underlying problem. For example, the provision of vanes adds additional material and labor costs to the construction of such sprinklers, and the vanes tend to provide a flow restriction which may result in clogging of the sprinkler after prolonged use and the build up of dirt and particulate matter around the vanes.

Thus, it is apparent that there exists a need for a new and improved sprinkler of the type referred to above which is simple and inexpensive in construction, and which will increase the effective distance of water throw from the range nozzle yet be trouble free in use.

SUMMARY OF THE INVENTION

This invention provides a sprinkler construction which substantially reduces the amount of vortex swirl of the water flowing through an elbow to a range nozzle and which significantly increases the effective area irrigated over similar types of prior art sprinklers. Moreover, the sprinkler construction of the present invention is relatively inexpensive to manufacture, is trouble free and reliable in use, and attains its improved result without requiring anti swirl vanes or the like.

More specifically, the flow passage through the elbow leading to the range nozzle is formed as a uniformly converging passageway of circular cross-section and which accelerates the flow in the lonitudinal direction of travel to reduce the amount of energy that is available for producing vortex swirl. The passageway also includes a lateral bleed opening which is positioned to effectively bleed swirling water particles from the flow to the range nozzle and to channel the swirling water to a spreader nozzle.

The passageway through the elbow is defined by a rear wall having an outer radius of curvature and a forward wall having an inner radius of curvature, and the bleed opening is formed as a slot through the forward wall. The spreader nozzle is attached to the end of a tubular projection extending laterally from the elbow below the range nozzle and in general alignment therewith, and has an internal conduit communicating with the bleed opening. With this construction, a substantial portion of the water swirl that is produced during flow through the elbow is channeled out of the main flow and directed to the spreader nozzle.

Although the formation of vortex swirl may not be entirely eliminated by the converging passageway through the elbow, it will be appreciated that not only is the amount of swirl reduced appreciably, but the bleed opening cooperates to channel off much of the swirl that is developed during travel through the elbow thereby to increase the distance of water throw from the range nozzle. Further, it should be appreciated that the construction of the sprinkler is relatively simple, easy to manufacture and free of clogging problems of prior art sprinklers.

Many other features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the drawings which disclose, by way of example, the principles of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view with portions shown in perspective, of a rotary, impact driven sprinkler embodying the principles of the invention and which includes a range nozzle and a spreader nozzle;

FIG. 2 is a fragmentary perspective view taken substantially in the direction of line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken substantially along the line 3—3 of FIG. 1;

FIG. 4 is another sectional view and taken substantially along line 4—4 of FIG. 1;

FIG. 5 is a further sectional view and taken substantially along line 5—5 of FIG. 1;

FIG. 6 is a fragmentary front perspective view of the sprinkler of FIG. 1; and

FIG. 7 is a fragmentary top plan view of the sprinkler of FIG. 1.

DETAILED DESCRIPTION

As shown in the exemplary drawings, the present invention is embodied in a new and improved rotary water sprinkler **10** of the type having a primary or range nozzle **12** for ejecting a stream of water over a relatively long distance, and a secondary or spreader nozzle **14** for ejecting a water stream over a shorter distance. In this instance, the sprinkler **10** is coupled to a generally vertical water supply pipe **16** which provides pressurized water to the sprinkler, and is mounted for full circle rotation in one direction about the pipe. In this connection, it should be appreciated that although the sprinkler **10** is illustrated as a full circle type sprinkler, the sprinkler can be adapted for part circle operation by providing a suitable reversing mechanism of conventional design.

Referring primarily to FIGS. **1** and **6**, the sprinkler **10** includes a body **18**, herein formed from a metal casting, having a lower portion **20** defining an internal, generally vertical water inlet passage **22** which communicates with the supply pipe **16** through a conventional rotary coupling **24** comprising a tubular spindle **26** journaled within a sleeve **28** threaded to the pipe, and a bearing spring **30** compressed between the body and a pair of bearing rings **32** disposed around the spindle above the sleeve. A curved central portion or elbow **34** of the body **18** projects upwardly and laterally from the lower portion **20** and terminates in an upper tubular portion **36** to which the range nozzle **12** is coupled. The range nozzle **12** communicates with the vertical inlet passage **26** through a curved central flow passage **38**, within the elbow **34** and which if cut longitudinally along the centerline as seen in FIG. **1** is defined by a rear wall **35** having an outer radius of curvature and a forward wall **37** having an inner radius of curvature. The elbow **34**, is formed so that water ejected from the range nozzle **12** travels in an upwardly and laterally directed path from the sprinkler **10**.

While the range nozzle **12** can take various forms, herein the nozzle comprises a tube of circular cross-section having an elongated cylindrical section **40** which projects outwardly from the body **18** and converges uniformly to an outlet section **42**. Inwardly, the cylindrical section **40** terminates in an enlarged peripheral flange **44** which is clamped to the upper end portion **36** of the body **18** by an oppositely flanged collar **46** threaded to the body. An O-ring seal **48** disposed between the outer end of the body **18** and the inner surface of the flange **44** forms a liquid seal between the range nozzle **12** and the body to prevent water leakage.

For reasons that will become more apparent hereinafter, the spreader nozzle **14** is coupled to the outer end of a tubular projection **50** which extends outwardly from the elbow **34** and located below the range nozzle **12** in general alignment therewith. Depending below the tubular projection **50** is an open sided, generally U-shaped frame or cage **52** comprising a front post **54** projecting downwardly from the tubular projection, a base plate **56** projecting rearwardly from the lower end of the post, and a rear strut **58** attached to the rear end of the base and to the lower portion **20** of the body.

For driving the sprinkler **10** in a rotary direction about the supply pipe **16**, an impact drive assembly **60** of generally conventional design is supported by the cage **52** of the body **18** below the range nozzle **12**. Herein, the impact drive assembly **60** is operated by the water stream ejected from the spreader nozzle **14** and produces incremental rotation of the sprinkler **10** in a clockwise direction about the supply pipe **16** as viewed in FIGS. **1** and **7**.

As illustrated in FIGS. **1** and **6**, the impact drive assembly **60** comprises an impact arm **62** mounted adjacent one end, the left end in FIG. **1**, for rotation on a journal pin **64** supported between the tubular projection **50** and the base **56** of the cage **52**, and carries a drive spoon or vane **66** at its opposite end which is designed to be aligned with the spreader nozzle **14** so that the water stream from the spreader nozzle can impinge on the vane. A torsion spring **68** connected at its lower end to the base **56** and at its upper end to the impact arm **62** normally biases the vane **66** into the path of the water stream from the spreader nozzle **14** and operates in a conventional manner to pull the vane back into the stream from the spreader nozzle when the vane has been deflected out of the stream by the stream pressure, thereby causing the impact arm to strike the forward post **54** of the cage **52** and impart an incremental rotation to the sprinkler **10**.

In accordance with the present invention, the central flow passage **38** and the tubular projection **50** cooperate to effectively reduce swirling motion of water flowing through the elbow **34** to the range nozzle **12** and significantly increase the distance of throw of the water stream ejected by the range nozzle to enlarge the size of the area irrigated by the sprinkler **10**. Further, the sprinkler **10** of this invention is relatively inexpensive to manufacture, is trouble free and reliable in use, and does not require any vanes or the like in the water passages to obtain its improved result.

Toward the foregoing ends, the central flow passage **38** is formed as a uniformly and upwardly converging passageway of circular cross-section and which includes a lateral bleed opening **70** positioned in such a manner to effectively bleed swirling water particles from the central flow passage and supply pressurized water through the tubular projection **50** to the spreader nozzle **14**. It has been found that by forming the central passage **38** as a uniformly converging passageway, the water flowing through the central passage is accelerated in the longitudinal direction of flow, and a substantial reduction in the amount of vortex swirl produced in the water flowing through the elbow **34** is achieved. Moreover, by appropriately locating the bleed opening **70** to the spreader nozzle **14**, a substantial portion of the water swirl that is developed during flow through the elbow **34** can be channeled out of the main flow and directed to the spreader nozzle.

Referring primarily to FIG. **1**, as water passes through the elbow **34**, vortex swirl is introduced due to the longer distance water particles near the rear wall **35** must travel as compared with water particles traveling near the forward wall **37**. The vortex swirl induced into the flow tends to take the form of eddy currents traveling from the centerline of the elbow **34** upwardly toward the rear wall **35**, then laterally around the periphery and downwardly toward the forward wall **37**, and then back in an upwardly direction toward the centerline as FIG. **1** is viewed.

By accelerating the flow in the direction of the centerline of the elbow **34**, a substantial reduction in vortex swirl is achieved due to an increase in the amount of energy required to accelerate the flow in the direction of the centerline and a consequential reduction in the amount of energy available for vortex flow. Thus, the formation of vortex swirl is inhibited substantially by

the converging nature of the central flow passage **38.**

Additionally, the bleed opening **70** is formed in the forward wall **37** so that a substantial portion of the vortex swirl that is produced during travel through the elbow **34** will be directed to the spreader nozzle **14** rather than rejoining the main flow to the range nozzle **12.** As best seen in FIGS. **1** and **2,** the bleed opening **70** is formed as a slot through the forward wall **37** and which has parallel sides **72** elongated in the longitudinal direction and connected by rounded ends **74.**

Water bled from the main flow in the central passage **38** through the bleed opening **70** is directed to the spreader nozzle **14** through a conduit **76** defined within the tubular projection **50.** As shown in FIGS. **3** through **5,** the conduit **76** has a substantially constant cross-sectional area although the shape continuously and uniformly changes from an elliptical configuration (FIG. **2**) adjacent the bleed opening **70** to a circular configuration (FIG. **5**) adjacent the outer end of the tubular projection to which the spreader nozzle **14** is attached, herein by a threaded connection **78.**

Referring to FIGS. **6** and **7,** it will be noted that the tubular projection **70** is obliquely disposed to project outwardly from the elbow **34** at a small lateral angle with respect to the range nozzle **12** so that the water stream from the spreader nozzle **14** will be ejected somewhat laterally and not be directly below that ejected by the range nozzle. It has been found that if the stream from the spreader nozzle **14** were directed below that of the range nozzle **12,** water from the spreader nozzle would tend to be sucked into the range nozzle stream and disrupt the fallout pattern. By laterally offsetting the direction of the stream from the spreader nozzle **14,** the water particles in the stream from the spreader nozzle will not be sucked into the stream from the range nozzle **12.**

In comparative tests between a sprinkler constructed in accordance with the present invention and a conventional sprinkler of the same size and general type and which included anti swirl internal vanes, it was found that about a 15 percent increase in the effective distance of water throw under substantially the same conditions was achieved with the sprinkler employing the principles of the present invention. Thus, it should be apparent that the present invention substantially enhances the effective watering area of a sprinkler having a range nozzle and a spreader nozzle, even one employing anti swirl vanes upstream from the range nozzle.

While a particular form of the invention has been illustrated and discribed, it should be apparent that various modifications and variations therein can be made without departing from the spirit and scope of the invention.

I claim:

1. In a rotary water sprinkler of the type including a body having a lower portion defining an inlet water passage for receiving water from a supply pipe, a curved central portion extending upwardly and laterally from the lower portion and within which is a curved central flow passage defined by a rear wall having an outer radius of curvature and a forward wall having an inner radius of curvature, and an upper portion extending from the central portion, a range nozzle attached to the upper portion of the body for ejecting a stream of water over a relatively long distance, and a spreader nozzle attached to the central portion of the body for ejecting a stream of water over a shorter distance, the improvement comprising:

forming said central flow passage as a uniformly and upwardly converging passageway of substantially circular cross section whereby water flowing through said passage is accelerated in the longitudinal direction of flow; and

providing a bleed opening through said forward wall below said range nozzle and positioned to bleed swirling water particles from the flow through said central flow passage and to channel said swirling water particles to said spreader nozzle whereby the amount of swirling water in the stream ejected through said range nozzle is substantially reduced.

2. The improvement as defined in claim **1** in which said bleed opening comprises an elongated slot through said forward wall.

3. The improvement as defined in claim **1** wherein said spreader nozzle is positioned below said range nozzle and in general alignment therewith, and said bleed opening comprises an elongated slot through said forward wall and through which water is supplied to said spreader nozzle.

4. The improvement as defined in claim **3** wherein said body includes a tubular projection extending from said central portion and defining therein a flow conduit from said slot, said spreader nozzle being attached to the end of said projection remote from said slot.

5. The improvement as defined in claim **4** wherein said projection extends obliquely from said central portion relative to said range nozzle, and said body further includes a frame and an impact drive assembly supported by said frame, said impact drive assembly including an impact arm having a drive spoon attached at one end and disposed to be normally aligned in the path of the stream ejected by said spreader nozzle whereby said sprinkler is driven by the stream from said spreader nozzle.

6. In a rotary water sprinkler of the type including a body having a lower portion defining an inlet water passage for receiving water from a supply pipe, a curved central portion extending upwardly and laterally from the lower portion and within which is a curved central flow passage defined by a rear wall having an outer radius of curvature and a forward wall having an inner radius of curvature, a range nozzle attached to and projecting from the upper end of the central portion for ejecting a stream of water over a relatively long distance, and a spreader nozzle attached to the body for ejecting a stream of water over a shorter distance, the improvement comprising:

forming said central flow passage as a uniformly and upwardly converging passageway of substantially circular cross-section whereby water flowing through said passage is accelerated in the longitudinal direction of flow;

and providing a bleed opening through said forward wall below said range nozzle, said bleed opening comprising a slot having substantially parallel sides elongated in the longitudinal direction of travel of water through said central flow passage, and positioned to bleed swirling water particles from the flow through said central flow passage and to channel said swirling water particles to said spreader nozzle thereby to reduce the amount of swirling water ejected by the range nozzle and increase substantially the distance of throw of water ejected through the range nozzle.

7. The improvement as defined in claim **6** including a tubular projection extending from said forward wall

and defining therein a flow conduit, said bleed opening communicating with said passage through said conduit, and said spreader nozzle being attached to the outer end of said projection.

8. The improvement as defined in claim **7** wherein said tubular projection extends below said range nozzle in general alignment therewith.

9. The improvement as defined in claim **7** wherein said sprinkler includes an impact drive assembly attached to said body for providing incremental rotation of said sprinkler.

10. The improvement as defined in claim **9** wherein said drive assembly includes an impact arm pivotally attached to said body and carrying a drive spoon at one end, said drive spoon being disposed to normally lie in the path of the stream ejected by said spreader nozzle whereby said sprinkler is driven by the stream from said spreader nozzle.

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