United States Patent

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[73] Assignee **Rain Bird Sprinkler Mfg. Corp.**
Glendora, Calif.

[54] **DRIVE MECHANISM FOR LARGE VOLUME ROTARY SPRINKLERS**
6 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** **239/233**
[51] **Int. Cl.** **B05b 3/08**
[50] **Field of Search** 239/233

[56] **References Cited**

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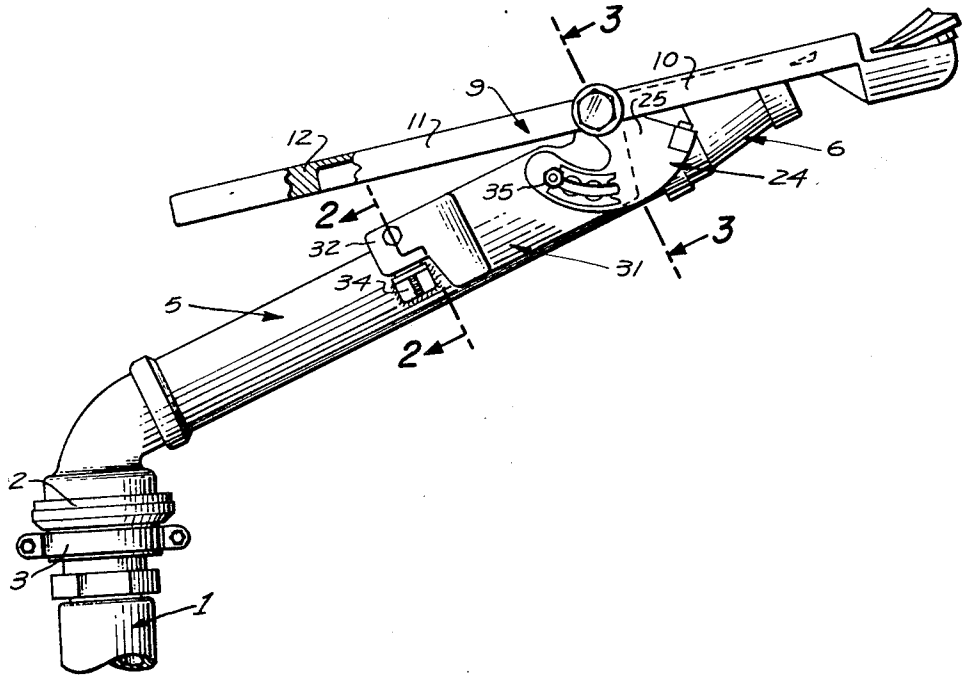
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ABSTRACT: A drive mechanism for large volume rotary sprinklers having an upwardly sloping barrel rotatable about a vertical axis and terminating in a nozzle. An arm is supported intermediate its ends from the barrel for oscillation about a horizontal axis alongside the barrel. One end of the arm extends beyond the nozzle and is provided with a vane and a deflector spoon which move periodically into the water stream issuing from the nozzle to disrupt the stream and produce reaction forces which cause oscillation of the arm as well as rotation of the barrel, and the remaining end of the arm carries a counterbalance. A snubbing structure is journaled about the same axis as the arm and includes an adjustably connected snubber lever and counterbalance weight, the snubber lever being engaged after a preselected free travel of the arm, to lift the counterbalance weight.



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2 Sheets-Sheet 1

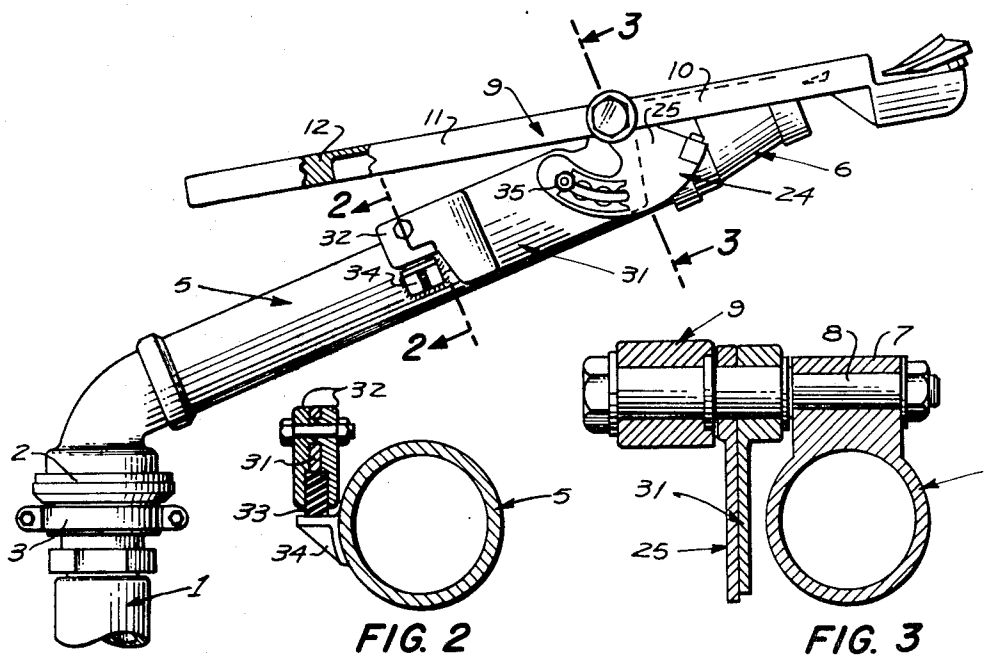


FIG. 1

FIG. 2

FIG. 3

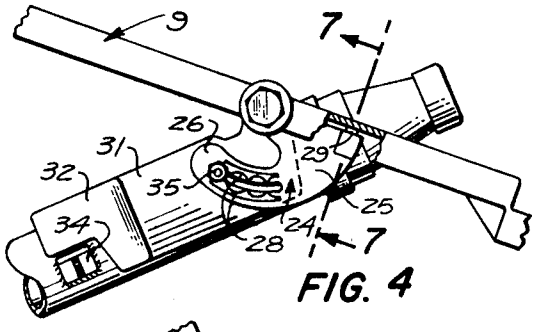


FIG. 4

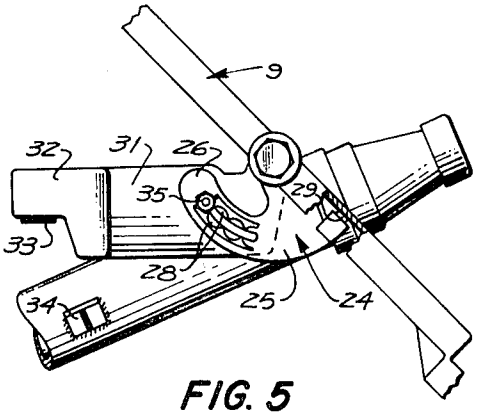


FIG. 5

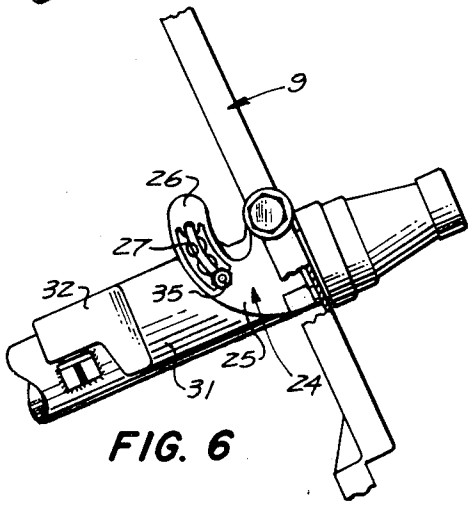


FIG. 6

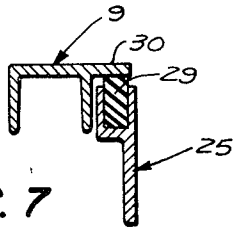


FIG. 7

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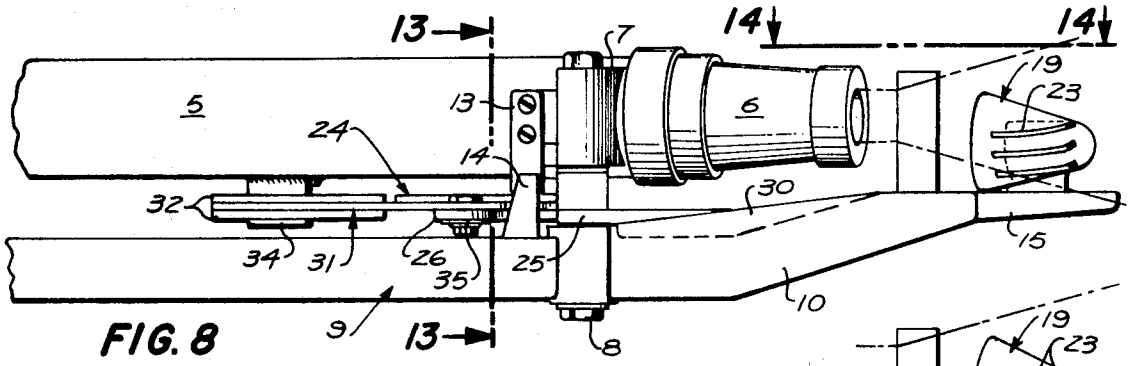


FIG. 8

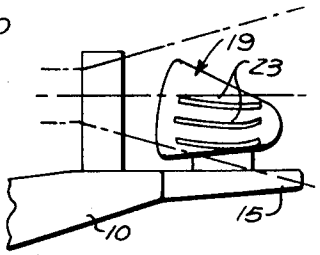


FIG. 9

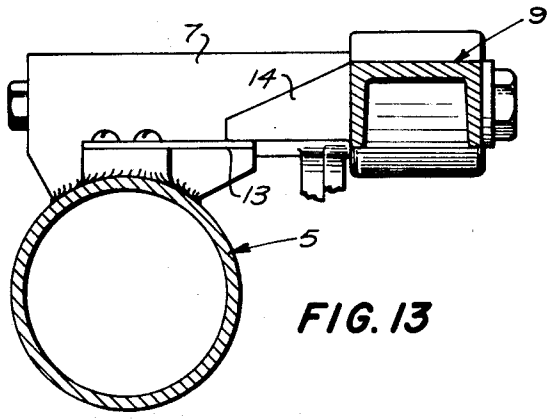


FIG. 13

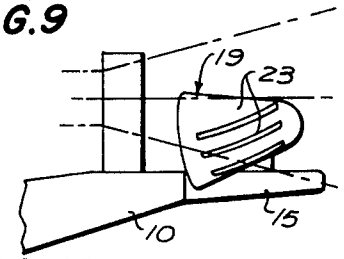


FIG. 10

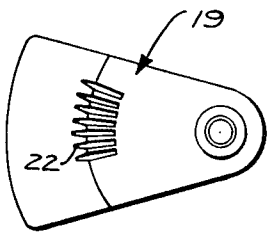


FIG. 11

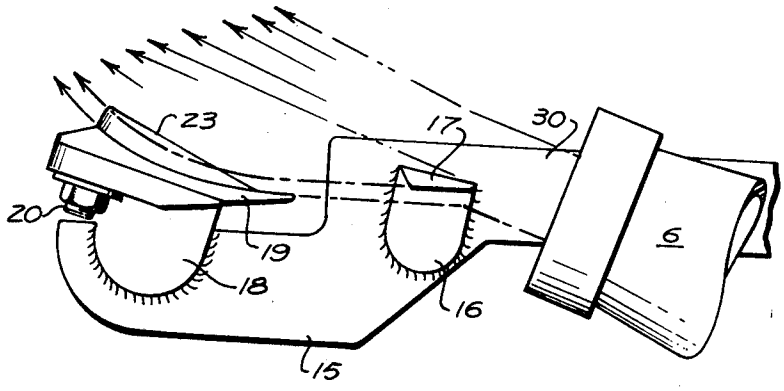


FIG. 14

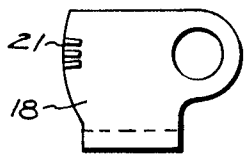


FIG. 12

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DRIVE MECHANISM FOR LARGE VOLUME ROTARY SPRINKLERS

BACKGROUND OF THE INVENTION

This invention is primarily directed to, but not limited to, large volume sprinklers used for commercial irrigation; that is, to sprinklers which operate on pressures ranging from 60 to 130 pounds per square inch, having orifice diameters ranging from three-fourths to 2 inches in diameter, and discharging water in the amount ranging from 100 to 1,500 gallons per minute. The crops irrigated by sprinklers of this type, include citrus trees, sugar cane, pineapple, tobacco, field corn, vegetables, bananas, grasses and cotton, to list representative crops.

While, in the past, oscillating arms equipped with deflectors which periodically engage the water stream have been used, it has been impractical to provide in a single sprinkler a range of adjustment which would meet all irrigation requirements. Often one adjustment would be in derogation of another adustment.

SUMMARY OF THE INVENTION

The present invention is summarized in the following objects:

First, to provide a drive mechanism for large volume rotary sprinklers wherein adjustment is accomplished by varying the excursion of an oscillating arm and varying the rotational force exerted on the sprinkler, each adjustment having minimal effect on the other adjustment and being capable of being made without shutting off the water so that such adjustments may be made in the field and the effect of each adjustment noted.

Second, to provide a drive mechanism for rotary sprinklers which incorporates a novel reaction means movable into the water stream to cause the sprinkler to turn by increments and which may be readily adjusted to increase or decrease the increments of movement thereby to increase or decrease the speed of rotation of the sprinkler.

Third, to provide a drive mechanism for rotary sprinklers which incorporates a novel means for controlling the arc through which the oscillating arm moves; that is, the arm may be caused to move through a small arc, and hence with a greater number of strokes per unit of time, or to move through a greater arc with correspondingly fewer strokes per unit of time; such adjustment also causing corresponding increase or decrease of disturbance to the water stream so that irrigation adjacent the sprinkler and the intermediate area between the sprinkler and the maximum range of the water stream tends to receive its proportion of water irrespective of change in the rate of rotation.

Fourth, to provide a control means as indicated in the preceding object which includes an adjustable snubber lever structure which is engageable after different preselected arcs of travel of the oscillating arm.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a rotary sprinkler with the drive mechanism mounted thereon, the drive mechanism being shown in its "at rest" position when the sprinkler is not in operation.

FIG. 2 is an enlarged transverse sectional view, taken through 2–2 of FIG. 1.

FIG. 3 is an enlarged fragmentary sectional view, taken through 3–3 of FIG. 1.

FIG. 4 is a fragmentary side view of the sprinkler and drive mechanism with the oscillating arm adjusted for minimum stroke of the drive mechanism shown in initial engagement with the snubbing mechanism.

FIG. 5 is a fragmentary side view, similar to FIG. 4, showing the snubbing mechanism raised by the oscillating arm.

FIG. 6 is another similar fragmentary side view, showing the oscillating arm adjusted for maximum stroke before engaging the snubbing mechanism.

FIG. 7 is an enlarged fragmentary sectional view, taken through 7–7 of FIG. 4.

FIG. 8 is an enlarged fragmentary plan view of the rotary sprinkler and drive mechanism and illustrating a deflector spoon shown in an intermediate position.

FIG. 9 is a fragmentary plan view, showing the deflector spoon and adjacent portions of the drive mechanism with the deflector spoon shown in a minimum lateral deflecting position.

FIG. 10 is a view similar to FIG. 9, but showing the deflector spoon in a position for maximum lateral deflection.

FIG. 11 is a further enlarged bottom view of the deflector spoon.

FIG. 12 is a further enlarged top view of the bracket which supports the deflector spoon.

FIG. 13 is an enlarged fragmentary transverse sectional view, taken essentially through 13–13 of FIG. 8, showing the mutually engaging stops which support the drive mechanism when the sprinkler is not in use.

FIG. 14 is an enlarged fragmentary side view, taken from 14–14 of FIG. 8.

A typical sprinkler for which the drive mechanism is adapted is supported on a riser 1, by means of a journal structure 2, which usually includes a friction brake 3. The journal structure is attached to an elbow 4, which in turn supports a discharge tube 5 directed upwardly and laterally, and terminating in a nozzle 6.

Secured to the upper side of the discharge tube 5 adjacent the nozzle 6 is a mounting pad 7, having a horizontal transverse bore which receives a shaft 8. The shaft 8 journals an oscillating arm 9, which includes a forward portion 10 and a rearward portion 11. The rearward portion 11 incorporates a weight 12 so that the forward portion 10 tends to swing upwardly. A stop spring 13 and a stop lug 14, extending respectively from the mounting pad 7 and the oscillating arm 9, limit the upward movement of the forward portion 10, as indicated in FIG. 13.

The forward portion 10 is provided with a downwardly offset extremity 15 which projects beyond the nozzle 6. Between the offset extremity and the nozzle, the forward portion of the oscillating arm supports a bracket 16. The bracket 16 may be welded to the arm or may be suitably attached by fastening means. The bracket is provided with an integral horizontally extending vane 17, which is adapted to intersect a stream of water issuing from the nozzle. The vane is wedge shaped with an apex margin directed toward the nozzle 6, and the angular position of the vane 17 is such that the vane deflects a portion of the water downwardly or in angular relation to the main stream of the water.

Welded or otherwise secured to the offset extremity 15 is a second bracket 18, including a horizontally extending support on which is mounted a deflector spoon 19. The deflector spoon is secured to the bracket 18 by a bolt 20, having an axis essentially perpendicular to the axis of the shaft 8 which constitutes the axis of rotation of the oscillating arm 9. The bracket 18 and the deflector spoon 19 are provided with mating teeth 21 and 22, as shown in FIGS. 11 and 12, which are arranged to position the deflector spoon in the positions shown in FIGS. 8, 9 and 10, as well as intermediate positions.

The deflector spoon is provided with a relatively sharp leading edge disposed slightly below the plane defined by the under side of the vane 17, as shown in FIG. 14, so that the slice of water diverted by the vane 17 is directed on top of the deflector spoon 19. The deflector spoon 19 curves upwardly from its leading edge so as to deflect the water upwardly to produce a downward force on the deflector spoon. It should be noted that when the slice of water deflected by the vane 17 passes over the deflector spoon, the downward force on the spoon is in excess of the upward force applied to the vane so that there remains a resulting force which drives the deflector spoon and forward portion 10 of the oscillating arm downwardly toward the positions shown in FIGS. 4, 5 and 6.

The upper surface of the deflector spoon 19 is provided with at least one and preferably three deflector ribs 23 which are curved laterally in such a manner that when the spoon receives the water diverted by the vane 17 the water is

deflected laterally as well as upwardly so that a side thrust is imparted to the oscillating arm 9. Such side thrust causes the discharge tube 5 to move about the vertical axis formed by the journal structure 2. By rotating the deflector spoon about the axis of the mounting bolt 20, the amount of lateral thrust and therefore rotation of the oscillating arm 9 about the vertical axis of the journal structure, may be varied.

Mounted on the transverse shaft 8, between the oscillating arm 9 and the mounting pad 7, is a snubber structure 24, which includes a first lever 25 depending from the shaft 8, and provided with an arcuate portion 26, having an arcuate slot 27 bordered by opposed sets of retainer bosses 28. One arcuate extremity of the first lever 25 is provided with a socket which receives a stop or snubbing pad 29 positioned for engagement by a web 30 forming a part of the oscillating arm 9.

The snubber structure 24 includes a second lever 31, also journaled on the shaft 8 and normally extending parallel with the discharge tube 5 at one side thereof. The extremity of the second lever is provided with weight plates 32 at opposite sides which clamp a yieldable stop pad 33, which normally rests on a bracket 34 welded to the side of the discharge tube 5, as shown in FIGS. 1, 4, 5, 6 and 8.

The first arm or lever 25 and the second lever 31 are joined by a bolt and nut 35. The bolt extending through the slot 27 and the nut or the head of the bolt being received within opposed retainer bosses 28 so that the angular relation of the levers 25 and 31 may be adjusted.

Operation of the drive mechanism is as follows:

When the sprinkler is shutoff, the weight 12 provided in the rearward portion 11 of the oscillating arm 9 causes the stop spring 13 and stop lug 14 to engage so as to locate the vane 17 and the deflector spoon 19 in position to be engaged by water when the sprinkler is activated. Such engagement produces an upward reaction force on the vane 17 due to the slice of water diverted downwardly with respect to the axis of the water stream. However, an instant later, impingement of the diverted slice of water on the the upwardly curving upper surface of the deflector spoon 19 produces a greater reaction force downward causing the oscillating arm 9 to turn in a clockwise direction, as viewed in FIGS. 1, 4, 5 and 6. Only a small portion of the total water stream need impinge upon the vane 17 and deflector spoon 19 in order to effect the oscillation of the arm 9.

If the amount of free movement of the oscillating arm before mutual engagement of the stop pad 29 and web 30 is minimal, as indicated in FIGS. 1 and 4, the oscillating arm oscillates rapidly even though the second or weight lever 31 may be raised, as indicated in FIG. 5. If the levers 25 and 31 are adjusted so as to provide maximum travel of the arm 9 before mutual engagement of the pad 29 and web 30, the rate of oscillation is correspondingly slower. Thus, without change in the adjustment of the deflector spoon, but with relative adjustment of the levers 25 and 31, the oscillations of the arm 9 may be caused to vary between a predetermined fast speed and a predetermined slow speed.

Rotation of the deflector spoon 19 about the mounting bolt 20, and the corresponding change in the angular relation of the deflector ribs 23 to the direction of flow of water from the nozzle, produces a corresponding change in the resulting side thrust. As a consequence, the discharge tube 5 may turn in small increments or in large increments.

It should be noted that if the sprinkler water stream is small or water pressure low, the vane and deflector spoon rise high into the water stream before receiving that amount of energy required to overcome arm momentum and to reverse arm oscillation direction. If the water stream is large or the pressure high, the vane and deflector spoon do not rise as high into the water stream in order to receive a reversing amount of energy. Thus, a smaller percentage of total energy is utilized to effect oscillation of the arm when the stream is large or the pressure high than is the case with a small stream or low water pressure.

Long, slow arm strokes tend to give higher deflector spoon momentum, forcing the deflector spoon higher into the water stream and remains there longer so that the rotational increment is greater, although there are fewer increments per minute. Short, fast arm strokes result in less deflector spoon momentum and less penetration of the water stream with reduced rotational increment of force, although there are more increments per minute. The results tend to equalize sprinkler rotation speeds regardless of arm stroke, pressure and stream diameter, thereby delegating to the deflector spoon and its rotational adjustment the primary control of rotational drive.

High breakup of the water stream reduces the area covered; however, the water velocity on contact with the plants is less so that this condition is best suited for tender plants. Minimal disturbance enables the sprinkler to cover a maximum area and is permitted for more hardy crops and orchards. Often sprinklers adjusted for maximum coverage and mounted on vehicles and moved continuously across the field while in operation.

It should be noted that the rotation of the sprinkler is also influenced by the brake 3. In practice, however, it has been found that the adjustments afforded by the snubber structure 24 and by the deflector spoon are such that the friction brake need only be lightly applied, primarily to minimize change in rotational rate if the riser is not vertical. Also, a traveling sprinkler which is movable on rolling terrain may require use of the brake.

It should also be noted that the sprinkler is fully adjustable in the field; adjustments can be readily done by holding the oscillating arm 9 out of the water stream so that it is not necessary to shutoff the sprinkler. Still further, the force exerted by the deflector spoon 19 in a direction to cause oscillation of the arm 9 is not changed appreciably with rotation of the spoon to control the side thrust. As a consequence, the effect of each adjustment of the spoon or the snubber structure may be noted so that each adjustment may be treated individually; that is, one adjustment does not adversely affect the other adjustment.

It should be noted that the spring stop 13 and lug stop 14 are, normally, only engaged when the sprinkler is not in operation. However, should they engage when the sprinkler is in operation, the spring yields to reduce the impact shock.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the details of the constructions set forth, but instead, the invention embraces such changes, modifications and equivalents of the various parts and their relationships as come within the purview of the appended claims.

I claim:

1. A drive mechanism for sprinklers having a rotatable structure including a discharge tube terminating in a nozzle mounted for rotation about an essentially vertical axis, said drive mechanism comprising:

a. an oscillating arm supported from said rotatable structure for movement about a horizontal axis; a first end of said arm extending beyond said nozzle; said arm including biasing means tending to cause the first end to move upwardly alongside a water stream issuing from said nozzle;

b. a mounting means carried by said first end;

c. a deflector spoon adapted to be received on said mounting means and including an upwardly directed surface tending when moved upwardly into said stream, by said oscillating arm, to deflect the arm downwardly in opposition to said biasing means thereby to cause said arm to oscillate, and at least one deflector rib carried thereby for movement into said water stream, thereby to apply a turning force to said rotatable structure;

d. fastening means for adjusting the deflector spoon about an axis perpendicular to the axis of said arm to change the angular relation of said rib with respect to said water stream thereby to change the turning force tending to rotate the sprinkler; and

e. a snubbing means pivotally mounted on said rotatable structure for movement about a horizontal axis, said snubbing means being engageable by said oscillating arm as said first end moves downwardly from said stream a preselected distance to increase the force required to effect further movement of said oscillating arm.

2. A drive mechanism, as defined in claim 1, wherein:

a. said snubbing means includes a first and a second lever journaled about a common axis, said levers being relatively adjustable arcuately, the first lever having means for engagement by said oscillating arm, said second lever including a second biasing means tending to rotate said deflector spoon into said water stream; and

b. a stop is carried by said rotatable structure and supports said second lever until engagement of said oscillating arm with said first lever.

3. A drive mechanism for rotary sprinklers having a rotatable structure including an upwardly sloping discharge tube terminating in a nozzle mounted for rotation about an essentially vertical axis, said drive mechanism comprising:

a. an oscillating arm supported intermediate its ends from said rotatable structure on at least one side thereof for movement about a horizontal axis; a first end of said arm extending beyond said nozzle; a second end of said arm including a first biasing means tending to cause the first end to move upwardly alongside a stream issuing from said nozzle;

b. a snubbing means including a first and second lever journaled about a horizontal axis, said second lever including a second biasing means supplementing said first biasing means;

c. means for rigidly connecting said levers in selected angular relations;

d. means extending from said rotatable structure for supporting said second lever;

e. means on said oscillating arm and said first lever mutually engageable to raise said second lever from said support after said oscillating arm has travelled selected distances determined by said connecting means; and

f. deflector means carried by the first and of said oscillating arm and periodically movable into the path of said stream of water to cause oscillation of said arm.

4. A drive mechanism, as defined in claim 3, wherein said deflector means comprises:

a. a vane for deflecting a portion of the water stream; and

b. a deflector spoon having an upwardly directed surface disposed in angular relation to the water stream issuing from said vane to produce a net force causing downward movement of the first end of said arm thereby to cause engagement of said mutually engageable means and raising of said second lever from said supporting means.

5. A drive mechanism, as defined in claim 4, wherein: said deflector spoon is provided with at least one rib extending in angular relation to said water stream to produce a rotational thrust to said discharge tube.

6. A drive mechanism, as defined in claim 5, wherein: said deflector spoon is rotatably adjustable about an axis perpendicular to the axis of rotation of said oscillating arm thereby to change the rotational thrust applied to said discharge tube.