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Perry et al.

[11] **3,785,565**

[45] **Jan. 15, 1974**

[54] **ROTARY SPRINKLER HEAD**

[75] Inventors: **Leonard T. Perry**, Midway City; **Donald T. Costner**, Downey; **Edward F. Noggle**, Tustin, all of Calif.

[73] Assignee: **Wet Manufacturing Co.**, Orange, Calif.

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[52] **U.S. Cl.** **239/206**, 239/242

[51] **Int. Cl.** **B05b 3/16**

[58] **Field of Search** 239/206, 240, 242

[56] **References Cited**

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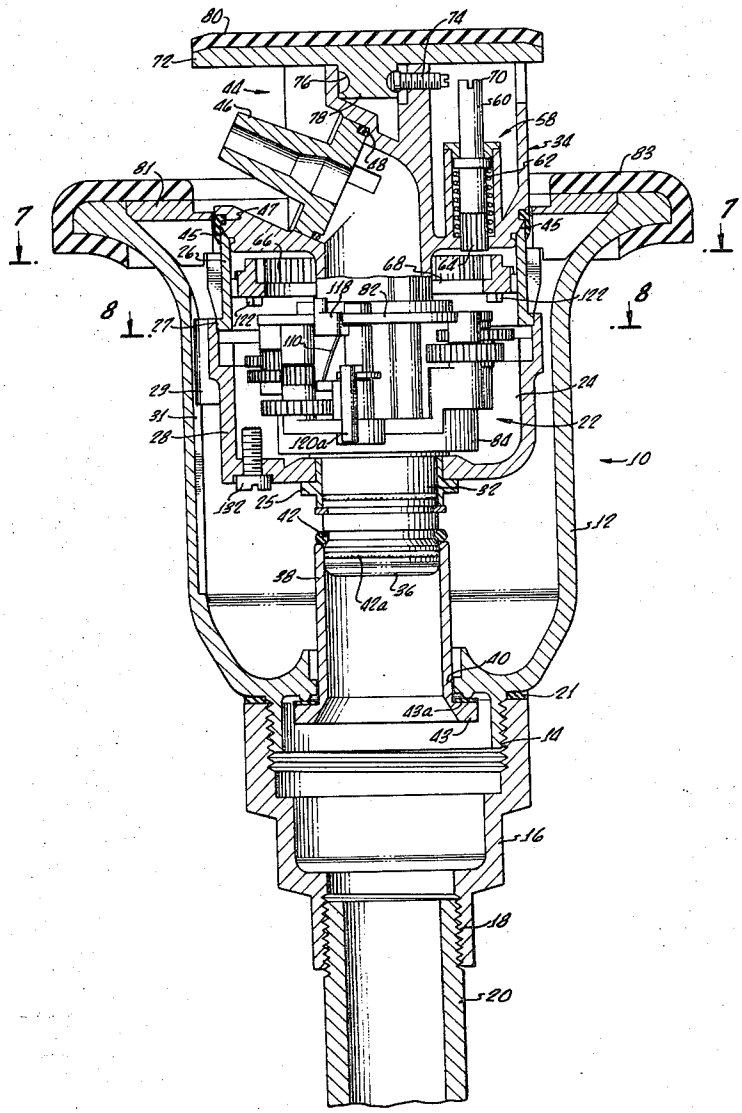
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Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Andres Kashnikow
Attorney—Allan R. Fowler et al.

[57] **ABSTRACT**

A pop-up, gear driven, rotary sprinkler head in which the arc of spray coverage may be precisely adjusted while the sprinkler head is inoperative by counting clicks of a detent and in which the drive reversal means for the nozzle is a cam actuated deflector which directs water from a single orifice in either of two directions to reversably drive the gear train.

19 Claims, 8 Drawing Figures



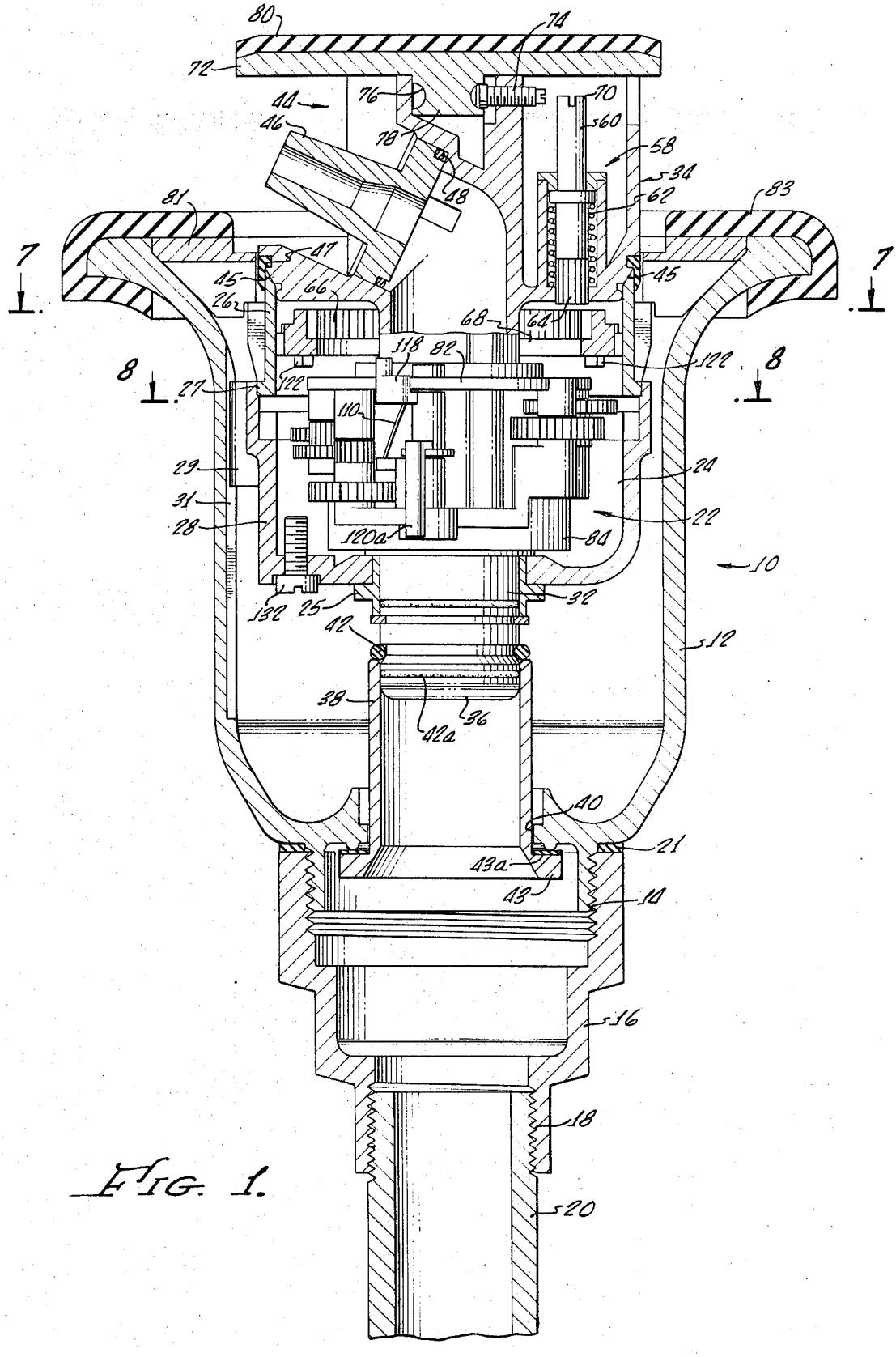
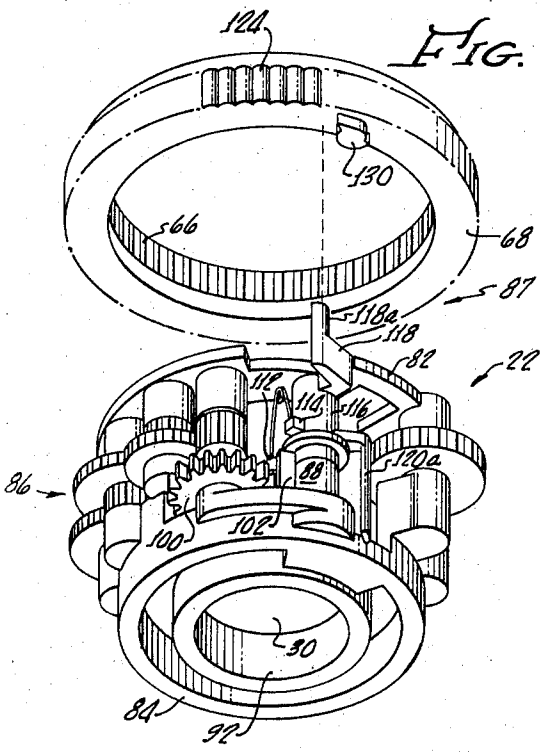

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64
118
82
102
8
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27
122
110
29
24
31
22
28
120a
84
10
132
25
32
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12
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42a
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43a
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FIG. 1.

FIG. 2.



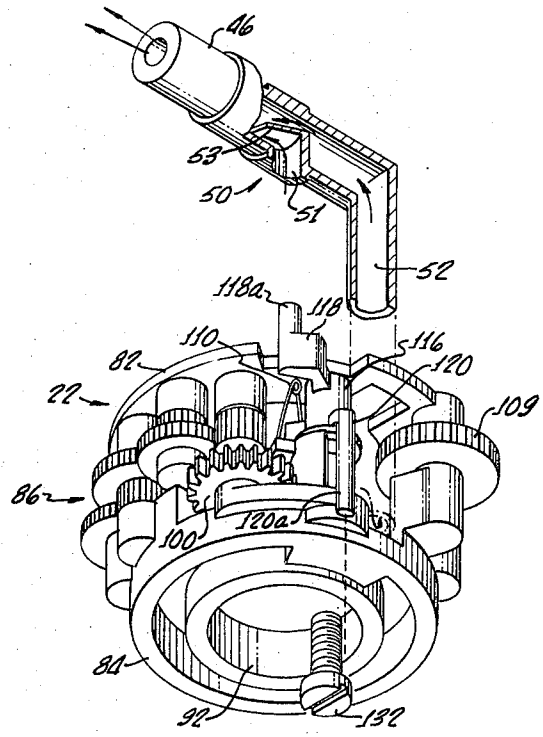


FIG. 3.

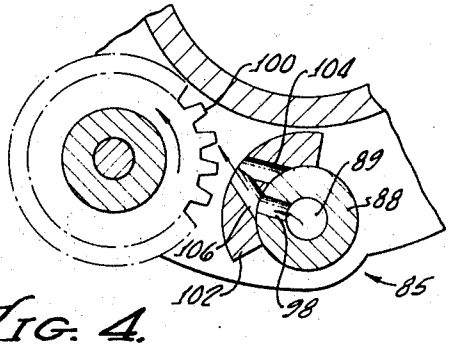


FIG. 4.

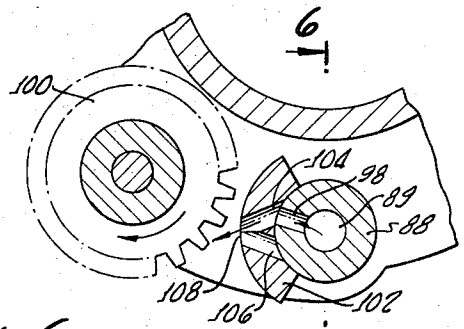


FIG. 5.

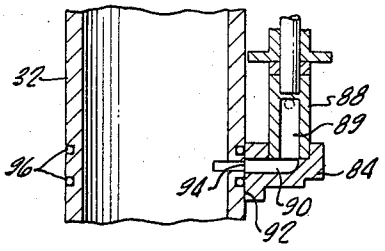


FIG. 6.

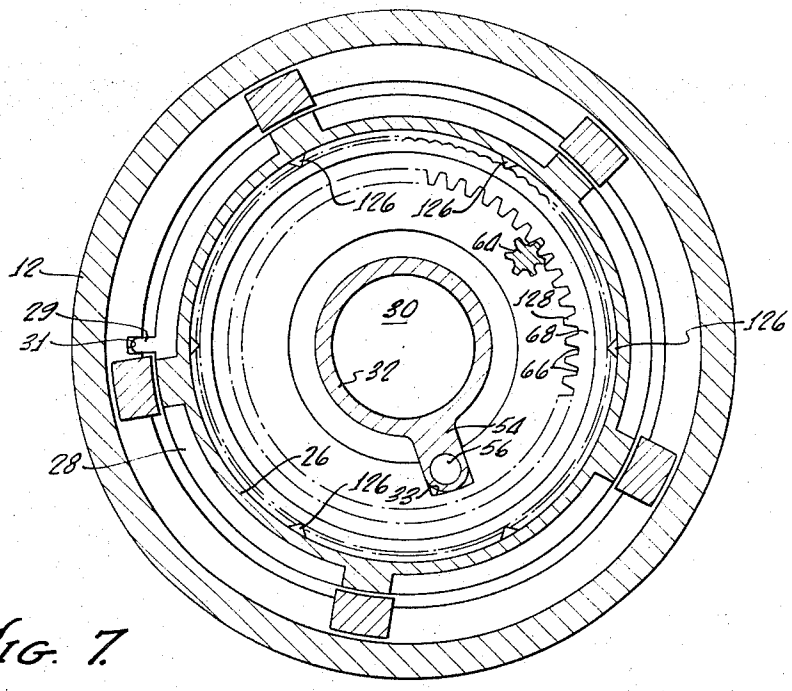

12
29
31
28
126
126
60
128
68
66
126
30
32
54
56
26
126
33

FIG. 7.

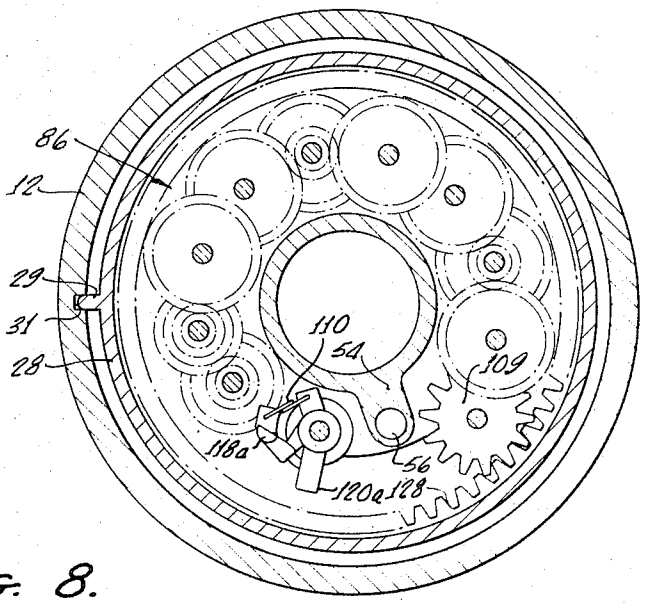

86
12
29
31
28
110
54
109
118a
56
120a
128

FIG. 8.

ROTARY SPRINKLER HEAD

BACKGROUND OF THE INVENTION

The present invention relates to pop-up rotary sprinkler heads which are gear driven and in which the main flow of water bypasses the gear train. The sprinkler heads are fitted onto underground water pipes, and, when not operating, the tops of the sprinkler heads lie flush with the ground. The heads return to this position from the popped up position automatically when the water supply is discontinued.

It is desirable, in designing sprinklers of this type, to allow for adjustment of the arc of water coverage by operators in the field because it is impossible to anticipate all the situations which may arise by providing one permanent setting at the factory. Also, it is highly desirable that a sprinkler of the indicated type be provided which will allow an operator to change the sprinkler coverage adjustment while the sprinkler is inoperative, i.e., while it is not rotating and spraying.

A second problem involved with field adjustment of the coverage is that of precision. Although there are prior art devices which allow a field operator to adjust the coverage, generally these prior devices do not enable the operator to make a truly precise adjustment. For example, when an operator is surveying a field which is receiving improper coverage, it is relatively easy for him to approximate by eye the angle by which the spray arc should either be increased or deceased. But if the adjustment itself does not allow him to use this information, but instead forces the operator to depend entirely on "feel" when manipulating an unprecise adjustment mechanism, it becomes very difficult to obtain the exact correction needed. And when the operator is getting doused all the while he is attempting to adjust the sprinkler, as is the case with some prior devices, the problem is aggravated still more.

It is well known in the art to which this invention relates that the supply water from which the rotary power is derived is often full of dirt and other forms of debris. While it is relatively easy to keep the nozzle clean and the main stream unimpeded, it is a much more difficult task to ensure that the water which is diverted from the main flow into the transmission means does not bring into the gear train a sufficient amount of debris to stop the sprinkler from functioning properly. It therefore follows that the probability of the transmission means remaining unclogged decreases in direct proportion to the amount of water diverted thereto from the main flow.

Another problem encountered in the prior art relates to the ease with which vandals may change the sprinkler adjustment by tampering with it. This is a particularly important problem when viewed in light of the fact that a typical playground might employ several hundred of the sprinklers of the type under consideration. An operator simply does nto have time to be constantly adjusting many of the sprinklers of which he has charge. Thus it can be seen that prior art sprinklers which allow the arc adjustment to be made by the mere insertion of, for example, a finger or a common screwdriver, are particularly susceptible to such time-wasting vandalism.

Still further problems are involved in the design of the transmission means, and in particular, in the design of the actual drive mechanism whereby the momentum of the water is converted to rotary motion by spraying

a concentrated stream, or jet, of water onto a bladed impeller. It has been observed that some prior art devices have their effectiveness reduced because prior design considerations result in water velocity being lost by requiring that the impeller be placed a substantial distance from the source of the water jet. The prior art affords examples of another type of design failure which can be equally undesirable. Impellers are often made in the form of bladed "propellers" having a very few, widely spaced, flat blades of considerable length. It happens with such an arrangement that there can occur a "neutral" position of the impeller when water pressure is initially supplied to the sprinkler, such that the impeller does not turn in either direction. This comes of the water jet striking the impeller so that the vector forces in the two rotational directions are balanced. A neutral, or non-rotating, situation then obtains, which an operator must expend time correcting.

SUMMARY OF THE INVENTION

It is the purpose of the present rotary sprinkler head to eliminate the difficulties set out above in such ways as will be apparent upon achievement of an understanding of the physical structure of the preferred embodiment.

A nozzle housing assembly, which includes a nozzle housing and a dependent hollow shaft, is slidably retained within a basically cylindrical outer body. The dependent hollow shaft is provided with a longitudinal rib which engages a keyway in the transmission means when the shaft is inserted in a hole provided therein. The shaft is supplied with water under pressure through engagement with a standard pipe.

The transmission means are disposed about the shaft such that any rotary motion imparted to the transmission means will necessarily be imparted also to the shaft and to the nozzle housing assembly, because of the engagement of the shaft rib with the keyway in the transmission means. The transmission means comprise in part a post and deflector arrangement which is used to direct a jet of water at an impeller gear. The impeller gear drives the remaining gears of a gear train, and thereby imparts rotation to a drive gear. The drive gear engages gear teeth in a stationary member of the device, and thus causes the nozzle housing assembly to revolve in the body about a vertical axis.

Reversal means are also provided as part of the transmission means. The reversal means comprise principally the post and deflector arrangement, switching means, and cam means, all of which will be explained in greater detail. The post and reflector arrangement comprises a vertical, cylindrical post through which water is diverted from the main flow and about which post the deflector may be partially rotated. The deflector abuts the post, and it may be switched selectively between two discrete positions in response to the cam means.

The cam means are comprised in part of two discrete cams, one positioned for insertion with a first L-shaped arm attached rigidly to the switching means; and the other one positioned for interaction with a second L-shaped arm also attached rigidly to the switching means. When the sprinkler head is operating, the first L-shaped arm will eventually be brought by the rotation of the head into abutment with the first cam, causing the deflector to switch to its second position, which

in turn causes the sprinkler to begin rotating in the opposite direction. The second L-shaped arm will after a short time be brought into abutment with the second cam, causing the deflector to switch to its original position, which causes the sprinkler to reverse itself to again rotate in original direction. The sequence repeats itself as long as the water is supplied to the sprinkler. However, it is also possible to achieve 360° coverage in a manner which will be described.

Arc adjustment means are also contemplated by the present invention. An adjustment ring is provided which is supported on the inner periphery of the body, below the nozzle housing, which ring is provided with scalloped serrations on its outer edge for detent interaction with detent lugs situated suitably on the inside of the body. The angular position between each detent position is precisely a selected angle, exactly four degrees in the preferred embodiment. The first cam, mentioned above, is disposed on the under surface of the ring.

The inside surface of the adjustment ring is provided with gear teeth. These teeth may selectively interact with teeth provided on a spring-loaded plunger —disposed in the nozzle housing— when the plunger is actuated with a specially provided wrench. Once the respective sets of teeth are engaged, the adjustment ring may be rotated with respect to the body by turning the plunger with the wrench. When the ring is rotated in this manner the angle between the two cams is changed. It is this angle between cams which is determinative of the arc of coverage of the sprinkler head, as may be ascertained more clearly by reference to the following detailed description. Also, as suggested above, the sprinkler head may be adjusted to obtain 360 degree coverage by removing the second cam from the arcuate path of traverse of the second L-shaped arm of the switching means.

DESCRIPTION OF THE DRAWINGS

The various novel attributes of the preferred embodiment of the present invention may be more clearly understood if the detailed description is read in conjunction with an examination of the attached drawings, in which:

FIG. 1 is a partially cut-away, sectional elevation of the rotary sprinkler head in popped-up position;

FIG. 2 is an exploded perspective view of portions of the transmission and cam means;

FIG. 3 is also an exploded perspective showing the transmission means, other portions of the cam means, and portions of the nozzle structure;

FIG. 4 is a sectional plan view of the novel drive means of the present invention in one of its two discrete positions;

FIG. 5 is a sectional plan view of the novel drive means in the other of its two discrete positions;

FIG. 6 is a sectional elevation of the shaft and the post, taken along line 6—6 of FIG. 5;

FIG. 7 is a sectional elevation detailing elements of the arc adjustment means, taken along line 7—7 of FIG. 1; and

FIG. 8 is a sectional elevation taken along lines 8—8 of FIG. 1, depicting the drive means and switching means of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a sectional view of a rotary sprinkler head **10** shown in the popped up, or elevated, position. A generally cylindrical body **12**, preferably formed of plastic, is provided with threads at **14** which are suitable to engage the coacting threads of a pipe adapter **16.** The pipe adapter **16** is shown threadedly connected at **18** to a vertical water pipe **20** from which water may be supplied to the sprinkler head **10** under pressure. Shown at **21** is a sealing gasket.

Interior to the body **12** are transmission means **22.** The transmission means **22** are rotatably disposed within an aperture **24** formed by the mutual interconnection of upper and lower transmission covers **26** and **28,** respectively. The upper transmission cover **26** is of a generally hollow cylindrical shape; while the lower transmission cover **28** is of a generally upward-opening cup-like shape. The two transmission covers are held together by means of a friction fit (seen best in FIG. 7) wherein lugs **27** formed integrally with the upper transmission cover **26** engage suitable receptacles on the lower transmission cover **28,** so as to provide a water tight fit. The manner in which the transmission means **22** are retained within the transmission covers will become apparent from the description below. The lower transmission cover **28** is secured against rotation with respect to the body **12** by the engagement of a lug **29** on the lower transmission cover **28** with a suitable keyway **31** on the inner surface of the body **12.** A vertical cylindrical through-aperture **30** in communication with a keyway **33** (best FIGS. **2** and **7**) is provided in the transmission means **22** and upper and lower transmission covers **26** and **28** suitable to slidably receive a generally cylindrical, hollow shaft **32** which has an integrally formed rib **54** disposed longitudinally thereof suitable to slidably engage the keyway **33.** The shaft **32** is preferably formed integrally with and dependent from the bottom of a nozzle housing assembly **34,** of which it comprises one of the elements.

The shaft **32** is disposed within the aperture **30** such that the lower end **36** thereof depends below the bottom of the lower transmission cover **28.** A cylindrical bushing **25** is disposed about the shaft **32** within the opening **30** through the lower transmission cover **28.** A flow tube **38** is attached to the bottom end **36** of the shaft **32,** and the flow tube **38** slidably engages the bottom of the body **12** through a circular hole at **40** therein. The shaft **32** is attached to the flow tube **38** by a press fit. Sealing about the shaft **32** is accomplished as with O-rings **42** and **42***a*. Sealing about the hole **40** is accomplished through the abutment of a circular ridge **43** with a gasket **43***a*.

The nozzle housing assembly **34** will now be described, with reference primarily to FIG. **1.** The nozzle housing assembly **34** comprises the shaft **32** and a generally cylindrical nozzle housing **44** with such internal supporting structure as is necessary to retain the elements to be described. The periphery of the bottom surface of the housing **44** is beveled as at **45** so as to rotatably seat on a corresponding beveled lip of the upper transmission housing **26.** A sand seal **47** is provided around this beveled lip. When water is supplied to the sprinkler head **10,** the nozzle housing assembly **44,** the shaft **32,** the transmission means **22,** the upper and lower transmission covers **26** and **28,** and the flow tube

38, while maintaining their mutual spatial relationships, all pop up from ground level to the position shown in FIG. 1. The flow tube 38 is of such length that the integrity of the water flow from the pipe 20 is maintained even in this elevated, or popped up, position.

A nozzle 46 is releasably retained in the housing 44 so that the internal passage thereof is in fluid communication with the internal passage of the shaft 32. The nozzle 46 is secured in position with any convenient means as are known in the art, such as screws (not shown), and sealing is accomplished by utilizing an O-ring 48.

The nozzle 46 is also provided with a venturi structure as shown at 50 in FIG. 3. Water flows up through passage 30, enters the venturi at 51 and flows past the constriction 53 and through the nozzle 46. The tube 52 is in fluid communication with the interior 24 of the transmission housing by way of the vertical rib 54 having an internal tubular passage 56 in communication with the tube 52. The rib 54 is fixedly mounted on the outer periphery of the shaft 32, as discussed previously. The rib 54 and its internal passage 56 may be seen in cross-section in FIGS. 7 and 8. The venturi thus causes a suction to be created in the tube 52 to remove water from the interior of the transmission housing.

Also retained in the housing 44 are elements of arc adjusting means 58, which in the preferred embodiment comprise a reciprocable plunger 60 biased upward by a compression spring 62. Gear teeth 64 are provided on the lower portion of the plunger 60 for selective engagement with the teeth 66 on an adjustment ring 68 to be described below. The plunger 60 may be depressed and turned about its longitudinal axis with the aid of a special wrench (not shown) which may be applied to the top surface 70 of the plunger 60.

The nozzle housing assembly 34 also comprises a freely rotatable top 72 which abuts the top cylindrical surface of the housing 44. A set screw 74 selectively engages circular groove 76 in dependent lug 78 of the top 72 so as to releasably retain the top element 72 in a freely rotatable manner. A protective cap 80 rests on the top element 72. An annular flange 81 is removably disposed flush with the top of the body 12 (and the cap 80 when the sprinkler is in the unelevated position) so as to protect the sprinkler 10 against the incursion of debris from the surrounding soil. The flange 81 is held in place by any convenient means. A flange cap 83, formed of more flexible material, is provided to further ensure the continued cleanliness of the sprinkler head 10.

The details of the transmission means 22 will now be discussed. The transmission means 22 are comprised of top and bottom frame members 82 and 84, respectively, which are rigidly connected so as to support below-described drive means 85, gear means 86, and reversal means 87.

The drive means 85 are comprised principally of the following elements. A hollow vertical post 88 is rigidly affixed between the upper and lower frame members 84 and 85 such that an inner passage 89 of the post 88 is in fluid communication with a passage 90 through the lower frame member 84. The passage 90 at its other terminus (on the inner surface 92 of the lower frame member 84—see FIG. 6) is in fluid communication with the inner passage of the shaft 32 through an opening 94. A filter not shown, is provided inside the shaft 32. O-rings 96 may be used to provide an effective seal.

Although the main flow of water in the rotary sprinkler head 10 is through the shaft 32 and the nozzle 46, a small amount of this flow is diverted into the interconnecting passages 90 and 89 because of the pressure under which the water is provided. Referring to FIG. 5, a circular hole 98 in the side of the post 88 opens in the general direction of an impeller gear 100 of gear means 86. The impeller gear comprises, in the preferred embodiment, a spur gear 100 having a substantial number of short, closely spaced teeth. It is contemplated that the number of teeth should be significantly greater than four; in the preferred embodiment approximately 20 teeth are provided. It is further contemplated that the diameter of the root circle of the spur gear 100 be much greater than the depth of the individual teeth. (The root circle is the circle along which the bases of the teeth lie.)

Interposed between the impeller gear 100 and the post 88 is a deflector 102 having two circular holes 104 and 106 therethrough that may be selectively brought into communication with the hole 98 in the post 88. The deflector 102 and the post 88 are mutually slidably engaged so that the deflector 102 may be rotated about the vertical longitudinal axis of the post 88, thus accomplishing the selective communication of the hole 98 with the respective holes 104 and 106. The holes 104 and 106 have a common opening 108 and are so formed as to provide a precisely focused stream, or jet, of water. They are aligned so that water flowing out the hole 104 when it is aligned with the hole 98 will cause the impeller gear 100 to rotate in a clockwise direction (as pictured in FIG. 5); and water flowing out the hole 106 when it is aligned with the hole 98 will cause the impeller gear 100 to rotate in a counterclockwise direction (as shown in FIG. 4).

The reasons for the above-described configuration of the impeller gear 100 may now be explained. The spur gear 100 is of course rotated in the well known manner whereby a water jet imparts a continual series of moments by impinging on the operative surfaces of the individual teeth, the operative surfaces being here defined as the sides of the teeth that would mesh with other gear teeth were the spur gear 100 to be engaged directly with another gear. It is one purpose of the present invention to ensure that in a sprinkler head of the type under consideration the impeller gear 100 never assumes a neutral position. Provision of a spur gear 100 with the particular configuration described accomplishes this objective by ensuring that whenever the water jet impinges on the operative surfaces of the teeth of the spur gear 100 a moment sufficient to rotate the spur gear 100 is thereby created. By providing that the spur gear 100 has a substantial number of short, closely spaced teeth it is possible to place the spur gear 100 sufficiently close to the deflector 102 that the water jet will not traverse a distance sufficient to lose more than a negligible proportion of its velocity and focus. The optimum energy transfer between the water jet and the impeller gear 100 is thereby effected.

The rotation of the impeller gear 100 is imparted to the reduction gear means 86, which is comprised of a gear train, which gear train terminates in the drive gear 109. The drive gear 109 is at all times disposed in engaging contact with gear teeth 128 which are provided around the entire inner periphery of the lower transmission cover 28. Because of the engagement of the rib 54 with the keyway 33 in the transmission means 22,

the rotary motion generated by the water striking the impeller gear **100** causes the transmission means **22** and the nozzle housing assembly **34** to rotate about a vertical axis longitudinal of the body **12.** The body **12** and the upper and lower transmission covers **26** and **28** do not rotate, however, because of the engagement of the lug **29** and the keyway **31.** The overall gear reduction from rotation of impeller gear **100** to rotation of the nozzle assembly is about 3,600:1 in the preferred embodiment.

The reversal means **87** will be described at this time. As discussed previously, the deflector **102** may be rotated about the circumference of the post **88** between two discrete positions by switching means **110** comprising, in the preferred embodiment, overcenter spring means of the the well-known type. Referring to FIGS. **2, 3** and **8,** one end **112** of the spring means **110** is attached to the deflector **102.** The other end **114** is attached to a collar **116** about an upper portion of the post **88** and which may be selectively rotated about an axis collinear with that of the post **88.** L-shaped arms **118** and **120** are rigidly affixed to the collar **116** such that the short portions of the arms are horizontal and the long portions of the arms are vertical. The vertical member **118***a* of the arm **118** extends somewhat above the top of the top frame member **82.** Contrariwise, the vertical member **120***a* of the arm **120** extends in a downward pointing manner to the approximate level of the bottom frame member **84.** The selective abutment of the members **118***a* and **120***a* with cam means, to be described below, results in the deflector **102** being selectively rotated about the post **88** so as to bring one or the other of the holes **104** and **106** into alignment with the hole **98,** the over-center spring causing the deflector to snap from one position to the other.

Shown in FIGS. **1** and **2** is the adjustment ring **68,** which has a dependent cam **130** on its underside disposed so as intermittently to abut the member **118***a* when the transmission **22** is operating. Rotation of the transmission means **22** will cause the member **118***a* to trigger the spring means **110,** thus causing the deflector **102** to move from the position shown in FIG. **4** to that of FIG. **5.**

As shown in FIGS. **1** and **3,** the reversal means additionally includes another cam in the form of a screw **132,** threadedly engaged in the bottom of the lower transmission cover **28.** The screw **132** is disposed so as to abut intermittently the member **120***a* when the transmission has rotated a suitable arcuate distance from the cam **130** of the ring **68.** With the member **118***a* in the position shown in FIG. **3,** the transmission **22** will rotate in a clockwise direction until the member **120***a* abuts the screw **132.** The rotational force will cause the spring means **110** to trigger the deflector **102** —this time in the opposite direction.

The adjustment ring **68** is supported by lugs **122** spaced around the inner periphery of the upper transmission cover **26.** The circumference of the ring **68** is provided with scalloped serrations **124** suitable to engage triangular detent bearings **126** which are provided at intervals around the inner periphery of the upper transmission cover **26.** The angular difference between each succeeding detent position of the ring **68** is precisely known, and is equal to four degrees in the preferred embodiment.

As shown in FIG. **7,** the ring **68** also has, on its inner surface, gear teeth **128** suitable to engage the teeth **64** provided on the above-mentioned plunger **60** when the plunger **60** is depressed by an operator. The detent action of detent bearings **126** in serrations **124** is sufficiently firm that the ring **68** will be releasably retained in each detent position firmly enough that rotation to the next detent position is readily perceptible.

Portions of the arc adjusting means **58** were discussed earlier in conjunction with the nozzle housing **44.** The remaining elements of the means **58** will now be described. The teeth **64** on the bottom of the plunger **60** will be brought into engagement with the teeth on the ring **68** when the plunger **60** is depressed. The same wrench (not shown) used to depress the plunger **60** may then be used to rotate it about its longitudinal axis. This causes the ring **68** to rotate with respect to the upper transmission cover **26,** one detent stop at a time. The sprinkler head **10** need not be operating at the time the arc adjustment is made. This should be apparent if the interaction of the cam **130** with the member **118***a* is considered. Each detent "click" indicates a four degree change in arc. Thus, for example, by referring to FIG. **2** it can be seen that turning the ring **68** in a counterclockwise direction will allow the sprinkler to spray a wider arc, as the cam will not trigger the deflector **102** until a greater angle from the screw **132** has been traversed.

The operation of the sprinkler head **10** will be described. An operator first supplies water to the sprinkler head **10** via the pipe **20.** The water pressure immediately causes the nozzle housing **44** to pop up to spraying position (as shown in FIG. **1**) along with the transmission means **22** and it s associated mechanical assemblies. A small portion of the water flowing into the sprinkler head **10** is diverted by the opening **94** in the shaft **32** into the transmission means **22,** where it is sprayed in the form of a water jet against the spur gear **100.**

The rotary motion thus imparted to the spur gear **100** results in the rotation of the drive gear **109.** The interaction of the drive gear **109** with the teeth **126** on the lower transmission cover **28** causes the rotation of the entire gear train **86** about the longitudinal axis of the shaft **32** since the lower transmission cover **28** is held stationary. The shaft **32** and the housing **44** are also rotated due to the engagement of the rib **54** in the keyway **33** of the top and bottom transmission frame members **82** and **84.** The nozzle **46** will thus rotate in a first direction until one of the L-shaped arms, say **118,** is actuated by the cam **130.** This will cause reversal means to switch, resulting in the rotation of the nozzle **46** in a second direction until the L-shaped arm **120** is actuated by the screw cam **132,** at which time the direction of rotation will again be reversed.

Now assume, for example, that an operator, on observing the sprinkler head **10** spraying a given sector of lawn, estimates that complete coverage of the sector dictates a change in the spray arc of about 40°. To effect the adjustment, the operator first turns off the water to the sprinkler. He then removes the top **72** and cap **80** after loosening the set screw **74.** Next he engages the plunger **60** with a specially provided wrench. The plunger **60** is depressed and rotated against the gear teeth **128** of the adjustment ring **68** until 10 detent clicks have been perceived. Rotating the ring **68** causes the dependent cam **130** to be moved such that its angular relation to the screw cam **132** is altered. This angular relationship is determinative of the arc of coverage.

The ten detent clicks provide 10 × 4 equals 40° change in spray arc.

The preferred embodiment of the sprinkler head **10** may also be adjusted to provide 360° coverage. This is accomplished by backing off the screw **132** enough that the L-shaped arm **120** will never contact it as the nozzle **46** is rotating. The nozzle **46** will thus be rotated continuously in the same direction.

What is claimed is:

1. In a pop up, gear driven, rotary sprinkler head, apparatus for adjusting the arc of water spray coverage, comprising:

a. a first cam;

b. a second cam arcuately spaced apart from said first cam;

c. means responsive to the included angle between said first and second cams for reversing the direction of rotation of said sprinkler head; and

d. means for adjusting said included angle between said first and second cams while said sprinkler is inoperative.

2. In a pop up, gear driven, rotary sprinkler head, apparatus for adjusting the arc of water spray coverage comprising:

a. a sprinkler body;

b. means on said sprinkler body for limiting the arc of rotation of the sprinkler head in one direction and for reversing said rotation;

c. an arc adjustment ring having means thereon for limiting the arc of rotation of the sprinkler head in the opposite direction and for reversing said rotation;

d. means on said sprinkler body and said adjustment ring relasably holding said adjustment ring against rotation relative to said body; and

e. manually operable means to rotate said adjustment ring relative to said body against said releasably holding means so as to allow adjustment of said spray arc while said sprinkler head is inoperative.

3. The apparatus as set forth in claim **2** in which said releasably holding means are detent means including uniformly spaced serrations each of such depth that a readily perceptible detent stop is provided at each of said detent positions.

4. The apparatus defined in claim **2** in which said releasably holding means comprise:

a. detent lugs rigidly retained on said sprinkler body; and

b. detent serrations on the outer periphery of said arc adjustment ring for detent interaction with said detent lugs on said sprinkler body.

5. The apparatus defined in claim **2** wherein:

a. said arc adjustment ring has gear teeth on the periphery thereof; and

b. said manually operable means comprises a rotatable gear in engagement with said gear teeth of the adjustment ring.

6. The apparatus defined in claim **2** in which said rotatable gear is disposed on a reciprocable plunger such that said gear may be moved into selective engagement with said gear teeth on said arc adjustment ring.

7. The apparatus as defined in claim **2** in which said detent means comprise equal, precisely spaced serrations so as to be readily perceptible by an operator when said adjustment ring is rotated relative to said body, so as to provide an exact indication of the angle through which said adjustment ring is rotated.

8. In a pop up, rotary sprinkler head wherein the rotary motion is derived from a gear train, apparatus for providing a water jet to energize said gear train, comprising:

a. water conduit means having a first opening in fluid communication with a portion of the water supplied to said sprinkler head, and a second opening on the side of said water conduit means so as to provide a transverse stream of water; and

b. a deflector movable with respect to said transverse stream of water from said second opening so as to provide a focused jet of water directed selectively in either of two directions when water is supplied to said sprinkler head to selectively drive the gear train in either of two opposite directions.

9. The apparatus defined in claim **8** in which said water conduit means is a cylindrical post and said deflector abuts said post along a portion of the length of said post and is selectively rotatable about the longitudinal axis of said post to first and second discrete positions, said deflector being provided with first and second transverse holes therethrough, such that said first hole of said deflector is brought into communication with said second opening in said post when said deflector is in said first discrete position, and said second hole of said deflector is brought into communication with said second opening in said post when said deflector is in said second discrete position, said first and second holes of said deflector being adapted to provide a focused jet of water directed selectively in either of two directions when water is supplied to said sprinkler head.

10. In a pop up, rotary sprinkler head in which the rotary motion of a nozzle relative to the stationary sprinkler body is derived from a gear train, apparatus for converting linear motion of the supply water to rotary motion of said gear train, comprising:

a. a cylindrical post having a hollow central passage, said passage having a first opening in fluid communication with a portion of the water supplied to said sprinkler head, and a second opening on the circumference of said post so as may provide a transverse stream of water;

b. a deflector abutting said post along a portion of the length of said post and selectively rotatable about the longitudinal axis of said post to first and second discrete positions, said deflector being provided with first and second transverse holes therethrough, such that said first hole of said deflector is brought into communication with said second opening in said post when said deflector is in said first discrete position, and said second hole of said deflector is brought into communication with said second opening in said post when said deflector is in said second discrete position, said first and second holes of said deflector being adapted to provide a focused jet of water directed selectively in either of two directions when water is supplied to said sprinkler head; and

c. an impeller gear having teeth in engagement with a gear of said gear train, and which impeller gear is disposed immediately adjacent said deflector so that said teeth are in suitable position so that said jet of water emanating from said deflector will cause said impeller gear to rotate in a first direction

about its axis when said first hole of said deflector is in communication with said second opening of said post, and said impeller gear will rotate in a second direction about its axis when said second hole of said deflector is in communication with said second opening of said post, so as to impart rotary motion to said gear train in either of two directions selected.

11. The apparatus as set forth in claim **10,** in which said impeller gear comprises a spur gear having a substantial number of short, closely spaced teeth so as to place optimally close to said deflector holes the operative surfaces of said gear teeth upon which the water jet impinges, in order to obtain the optimum energy transfer from said water jet to said spur gear and thence to said gear train.

12. The apparatus as set forth in claim **10** in which said impeller gear comprises a spur gear having a substantial number of short, closely spaced teeth and a root circle diameter much greater than the depth of said gear teeth, so as to ensure that whenever said water jet impinges on the operative surfaces of said teeth a rotating moment is always created about said axis of said spur gear.

13. The apparatus as set forth in claim **10** additionally comprising means for switching said deflector between said first and second discrete positions.

14. The apparatus as set forth in claim **13** in which said switching means comprise:

a. first cam means on said body of said sprinkler head;

b. second cam means arcuately adjustable relative to said first cam means; and

c. spring means responsive to said cam means disposed on said post and deflector so as to cause said deflector to snap between said first and second discrete positions so as to render the included angle between said first and second cam means determinative of the arc sprayed by said nozzle.

15. In a pop up, gear driven, rotary sprinkler head, apparatus for converting the linear motion of the flow of supply water to the rotary motion of the nozzle of said sprinkler head, comprising:

a. a cylindrical post having a hollow central passage, said passage having a first opening in fluid communication with a portion of the water supplied to said sprinkler head, and a second opening on the circumference of said post so as may provide a transverse stream of water;

b. a deflector which abuts said post along a portion of the length of said post and is selectively rotatable about the longitudinal axis of said post to first and second discrete positions, and which deflector is provided with first and second horizontal holes therethrough, such that said first hole of said deflector is brought into communication with said second opening in said post when said deflector is in said first discrete position, and said second hole of said deflector is brought into communication with said second opening in said post when said deflector is in said second discrete position, said first and second holes of said deflector being adapted to provide a focused jet of water directed selectively in either of two directions when water is supplied to said sprinkler head;

c. gear means comprised of a train of gears disposed rotatably between top and bottom frame members suitable for impinging interaction with said jet of water so that said individual gears of said train rotate when said jet of water impinges thereon;

d. means for imparting the rotation of said individual gears to said top and bottom frame members of said gear means so as to cause said gear means to rotate about a vertical axis; and

e. means secured to said gear means to impart said rotation of said gear means to said nozzle of said sprinkler head.

16. The apparatus as set forth in claim **15,** in which said gear means comprised of a train of gears further comprise an impeller gear in engagement with said gear train, which impeller gear is disposed suitably to be impinged by said water jet in such a manner that said impeller gear is caused to rotate so as to cause the rotation of said individual gears of said gear train.

17. The apparatus as set forth in claim **16** in which said impeller gear comprises a spur gear.

18. The apparatus as set forth in claim **15,** and further including means for alternately reversing the direction of rotation of said nozzle of said rotary sprinkler head comprising:

a. means for switching said deflector alternately between said two respective discrete positions; and

b. means for camming said switching means so as to cause said switching means to switch said deflector between said two respective discrete positions, said camming means being responsive to the angular position of said nozzle.

19. The apparatus as set forth in claim **18,** in which said means for switching said deflector alternately between said two respective discrete positions comprise:

a. a collar disposed about a portion of said post such that said collar may be rotated about said longitudinal axis of said post selectively to two discrete positions corresponding respectively to the two discrete positions of said deflector;

b. a first L-shaped arm having the shorter portion thereof rigidly affixed to said collar such that the longer portion thereof extends in a first direction parallel to said post, so as to be actuated by said camming means;

c. a second L-shaped arm having the shorter portion thereof rigidly affixed to said collar such that the longer portion thereof extends in a second direction parallel to said post, so as to be selectively actuated by said camming means; and

d. spring means of the over center type having two ends and being attached at one end to said deflector and at the other end to said collar, so as to cause said deflector to rotate very rapidly from said first discrete position to said second discrete position when said first L-shaped arm is actuated, and to cause said deflector to rotate from said second discrete position to said first discrete position when said second L-shaped arm is actuated.

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