United States Patent

Hart et al.

[15] **3,677,472**

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[54] ROTARY SPRINKLER

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[52] **U.S. Cl.**.....**239/230**, 239/241, 277/95

[51] **Int. Cl.**.....**B05b 3/04**

[58] **Field of Search**.....239/206, 204, 205, 240, 241, 239/259, 261, 230, 237; 287/87, 90 R; 277/95, 212 FB

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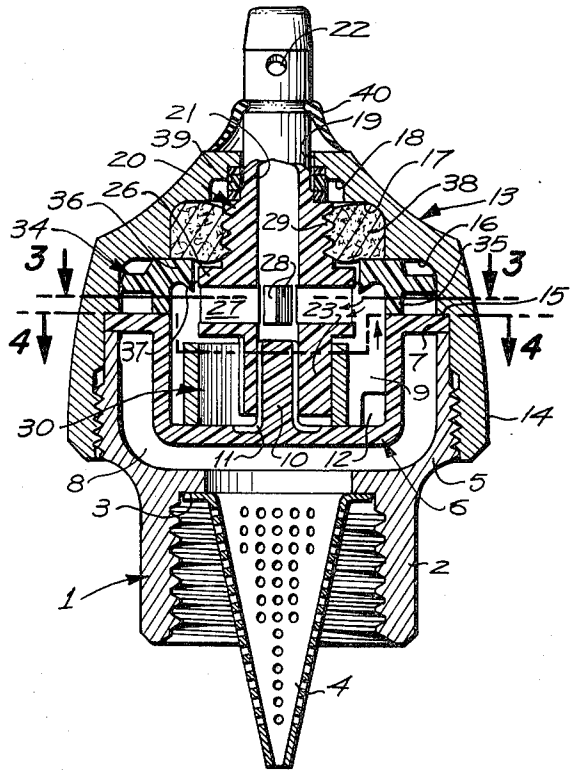
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[57] **ABSTRACT**

A rotary sprinkler including a tubular rotor having impact lobes and a surrounding impact ring, contained in a motor chamber into which water is admitted in a manner to produce a swirling action thereby to cause rotation of the impact ring. The lower end of the rotor fits an upstanding journal pin provided with grooves permitting the flushing of particles carried in the water. A thrust bearing is provided at the upper portion of the rotor and a labyrinth packing aided by a deflector ring prevents entrance of particles into the bearing. Water exits from the motor chamber above the motor and below the deflector ring through passageways which tend to neutralize the swirling movement of the water.

8 Claims, 5 Drawing Figures



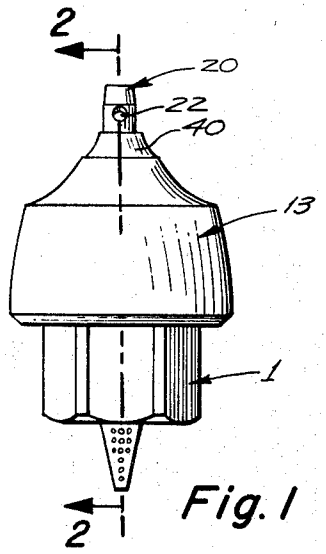


Fig. 1

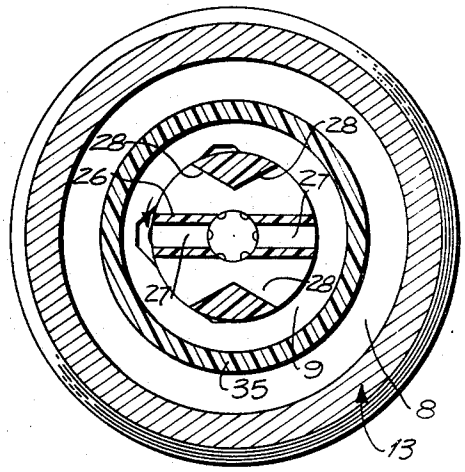


Fig. 3

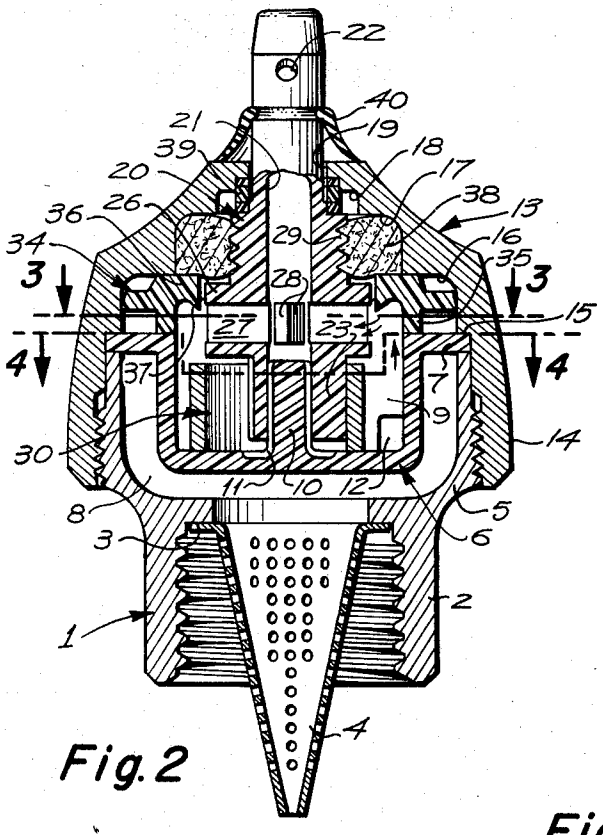


Fig. 2

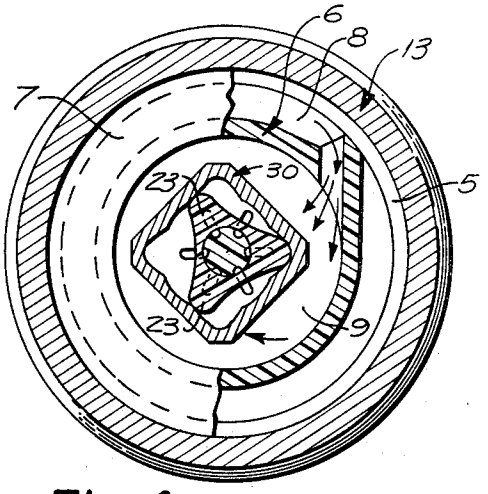


Fig. 4

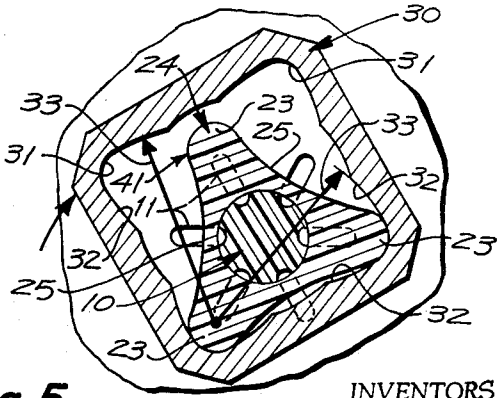


Fig. 5

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ROTARY SPRINKLER

BACKGROUND OF THE INVENTION

A growing trend in regard to rotatable sprinklers, is to eliminate the external drive means which has been in common use for many years in favor of an internal drive. Typical of such sprinklers is the sprinkler disclosed in U.S. Pat. No. 3,315,898, as well as in copending applications, Ser. No. 809,190, filed Mar. 21, 1969 now U.S. Pat. No. 3,580,506 and Ser. No. 810,132 filed Mar. 25, 1969 now U.S. Pat. No. 3,580,508.

One of the primary problems inherent in all rotary sprinklers stems from the fact that the water usually contains particulate matter which may wedge between moving parts of the sprinkler bearings, or the sprinkler may be splattered with mud or otherwise exposed to dirt from an external source. Should the sprinkler stall or fail to turn when water is supplied, serious soil erosion may occur.

SUMMARY OF THE INVENTION

The present invention is directed to a rotary sprinkler, which is summarized in the following objects:

First, to provide a rotary sprinkler which, in relation to its water output, may be made quite compact without sacrifice of starting and operating torque while effecting slow rotational speed.

Second, to provide a rotary sprinkler which incorporates a novel means for passing particulate matter through the sprinkler, and includes a thrust bearing protected by a novel water lubricated barrier as well as a diverter means which minimizes exposure of the barrier to contaminants.

Third, to provide a rotary sprinkler which incorporates an improved water motor utilizing a rotor having impact receiving lobes surrounded by an impact ring, and providing for swirling flow of water externally of the impact ring, the main portion of water after applying its motivating force flowing into the rotor bore above the motor and through passages in the rotor which counteract the swirling movement of the water and tend to convert some of the swirling force to a torsional force aiding the action of the motor.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the rotary sprinkler.

FIG. 2 is an enlarged longitudinal sectional view thereof, taken through 2—2 of FIG. 1.

FIG. 3 is a transverse sectional view, taken through 3—3 of FIG. 2.

FIG. 4 is another transverse sectional view, taken through 4—4 of FIG. 2.

FIG. 5 is a further enlarged fragmentary sectional view, corresponding to FIG. 4, but showing only the central portion of the rotary sprinkler, and particularly the impact receiving lobes and the impact ring.

The rotary sprinkler includes a lower housing 1, having an internally screwthreaded stem 2 for connection to a riser pipe, not shown, forming a part of an irrigation system. Clamped between the riser pipe and an internal shoulder 3 is a strainer cone 4. Above the stem 2, the lower housing is radially enlarged to form an upper externally screwthreaded cup 5. The cup 5 receives a motor shell 6, which is also cup shaped and provided with a flange 7, which rests on the upper edge of the lower housing 1. The walls of the motor shell are spaced from the upper portion of the lower housing to form a cup shaped inlet chamber 8, communicating with the inlet stem 2.

The motor shell 6 forms a cylindrical motor chamber 9, and the bottom wall of the motor shell is provided with an upwardly extending journal pin 10, having longitudinal channels 11. The channels extend radially from the base of the journal pin in the lower wall of the motor shell 6. The side walls of the motor shell are provided adjacent its bottom wall with a tangential inlet port 12.

The lower housing 1 is joined to a complementary upper housing 13, having an internally screwthreaded lower portion 14 which engages the screwthreads of the cup 5. The upper housing 13 is provided with an internal shoulder 15, which clamps the flange 7 of the motor shell 6. Immediately above the flange 7, the upper housing forms a diverter ring cavity 16, and above the cavity 16 there is formed a contaminant barrier cavity 17 of smaller diameter. Continuing upwardly within the upper housing is a thrust bearing cavity 18, and finally, a relatively short bore 19.

A rotor 20 extends from the motor chamber 9 through the upper housing 13 and is provided with a bore 21, closed at its upper end except for one or more lateral and upwardly directed discharge orifices 22. The lower portion of the rotor within the motor chamber 9 is provided with a set of impact receiving lobes 23. In the construction illustrated, three such lobes are provided, each lobe has a semicylindrical apex 24 and the sides of the rotor between the lobes are concave, as indicated by 25.

Above the lobes 23, the rotor is radially enlarged, as indicated by 26, and the enlarged portion thus formed is provided with opposed radial slits 27, bordered on opposite sides by opposed V-slots 28 which are essentially tangential to the bore 21. Above the enlarged portion 26, the rotor is reduced in diameter and provided with annular grooves and ribs 29.

An impact ring 30 surrounds the impact receiving lobes 23. The impact ring has one more side than the number of lobes and hence, in the drawing illustrated, is square in plan. The impact ring is provided with semicylindrical corners 31, spaced so as to receive a pair of lobes 23. The lateral margins of the semicylindrical corners merge into arcuate extensions 32, having a radius equal to the distance between the center of one semicylindrical corner and an arc tangential to the adjacent corners, as indicated by the arrows 33 in FIG. 5 of the drawings.

Fitted in the diverter ring cavity 16 is a diverter ring 34, having a vertical portion 35 which forms an extension of the cylindrical side wall of the motor shell 6. At its upper end, the diverter ring forms an inturned flange 36 underlying the contaminant barrier cavity 17. The underside of the flange 36 forms an annular diverter lip 37 located slightly below the upper extremities of the slits 27 and V-slots 28 formed in the enlarged portion 26. The flange 36 clears the enlarged portion to provide restricted communication with the contaminant barrier cavity 17. The cavity 17 receives a contaminant barrier ring 38 formed of felted material. Tests have indicated that a felt formed of Dacron conforms readily to the annular grooves and ribs 29, has low friction characteristics and is effective in preventing the upward movement of particles or other contaminants in the water. A set of thrust bearing rings 39 is contained in the thrust bearing cavity 18 and bear against opposing shoulders formed by the upper portion of the upper housing 13, and the upper portion of the rotor having the grooves and ribs 29. The thrust bearing rings may include a pair of Acrylonitrile rings separated by a polytetrafluoroethylene ring. A thrust bearing of this type has extremely low friction and wear characteristics if it is maintained free of solid contaminants. It is for this reason that the contaminant barrier ring 38 is provided.

In order to prevent the entrance of contaminants from the outside of the sprinkler, the protruding portion of the rotor is provided with a flexible shield 40 formed of a suitable elastomer and having a downwardly flaring skirt which bears against the upper surface of the upper housing. This shield further acts as a spring to lift the rotor, keeping the thrust bearing rings in mutual contact.

Operation of the rotary sprinkler is as follows:

The journal pin 10 provides the main support for the rotor 20, although the contaminant barrier ring 38 serves to a minor extent as a bearing. In the construction shown, a single tangential inlet port 12 supplies the motor chamber with water which serves as a motive fluid. The water swirls or rotates at relatively high velocity, causing the impact ring to rotate about the lobes 23 in the manner to cause successive impacts against the lobes so that the rotor 20 is caused to turn in small successive

increments. It would seem that the water contained within the impact ring and surrounding the lobes would interfere with the impact action between the impact ring and the lobes, particularly in view of the fact that the clearance between the impact ring and the bottom of the motor chamber and the enlarged portion **26** is minimal. However, such is not the case. This may be due to the fact that the swirling water may tend to produce a negative pressure within the impact ring so as to produce a cavitation effect; that is, sufficient air or vapor is present within the ring so that the inertia of entrapped water is minimal.

The fact that the effect of water within the impact ring **30** has minimal damping effect is further indicated by the fact that the lobes **23** and the impact ring may be relatively dimensioned to intermesh and that the lobes may have a minimal clearance relation with the arcuate portions **32**. As a consequence, the radial point at which the impact force is applied is at the greatest possible distance from the center. Considering FIG. **5**, the lobe defined by the apex of the two arrows **33** forms a pivotal point for the impact ring **30** so that the next corner thereof, clockwise, will impact the succeeding lobe at approximately the point indicated by **41** in FIG. **5**. Erratic movement of the impact ring is virtually eliminated with the result that a more efficient transfer of force is directed against the impact lobes.

A minimal amount of the swirling water enters the bore of the rotor through the channels **11** provided in the journal pin **10**. The size of the channels is such that only enough water to lubricate the bearing surfaces and to wash particulate matter from the motor chamber into the rotor bore is permitted. The main portion of the water is deflected by the diverter lip **37** into the radially outer intake ends of the slits **27** and slots **28**. The arrangement of the passageways thus formed is such as to counteract the swirling motion of the water as it leaves the motor chamber and to apply to some extent a torsion force on the rotor, however, not to the extent as to interfere with the intermittent motion function of the impact ring.

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.

We claim:

1. A rotary sprinkler, comprising:

a. a rotor having a bore terminating in a discharge orifice and including a set of impact receiving lobes adjacent its lower end, and an enlarged portion above the lobes having laterally directed flow passages communicating with the rotor bore;

b. means for rotatably mounting the rotor;

c. means defining a motor chamber containing the lobes and enlarged portion and forming a surrounding annular chamber having at least one water inlet port positioned to cause the water to rotate about the periphery of the chamber and move spirally upward for discharge through the flow passages;

d. and an impact ring surrounding the lobes between the bottom of the chamber and the enlarged portion and exposed to the rotating water to cause multiple impacts against the lobes thereby to cause slow rotation of the rotor, the rotor forming a barrier confining the major portion of the water to the region between the rotor and the surrounding wall of the annular chamber.

2. A rotary sprinkler, as defined in claim **1**, wherein:

a. the rotor mounting means includes a journal pin projecting upwardly from the bottom of the motor chamber.

3. A rotary sprinkler, as defined in claim **1**, wherein:

a. the rotor mounting means includes a journal pin projecting upwardly from the bottom of the motor chamber, a thrust bearing for the rotor above the motor chamber, and a porous barrier member surrounding the rotor between the thrust bearing and the motor chamber;

b. and a deflector at the upper end of the motor chamber for directing water into the flow passages.

4. A rotary sprinkler, comprising:

a. complementary housing members forming an inlet port and an inlet chamber;

b. means secured between the housing members and disposed within the inlet chamber to form a motor chamber having at least one inlet opening communicating with the inlet chamber and positioned to cause swirling motion of water in the peripheral portion of the motor chamber;

c. a rotor mounted for rotation within the housing members and including a bore terminating at its upper end in a discharge orifice, a set of impact receiving lobes adjacent its lower end within the motor chamber, and a radially enlarged portion above the lobes having swirl counteracting passages communicating between the motor chamber and the bore of the rotor to effect discharge of water from the motor chamber;

d. and an impact ring surrounding the impact receiving lobes and exposed to the swirling water thereby to effect multiple impacts on the lobes.

5. A rotary sprinkler, as defined in claim **4**, wherein:

a. said motor chamber forming means includes a journal pin extending upwardly into the rotor bore, the journal pin and adjacent wall portion of the motor chamber having flow channels communicating between the motor chamber and the rotor bore to lubricate the pin and effect discharge of particulate matter.

6. A water motor for rotary sprinklers, comprising:

a. a rotor having a set of symmetrically disposed impact lobes;

b. and an impact ring having one more side than the number of impact lobes on the rotor and journal corners between each side;

c. the distance between adjacent lobes of the rotor and between adjacent journal corners of the impact ring being essentially the same to permit limited pivotal movement of the impact ring about each lobe in succession;

d. the interior wall of the impact ring at both sides of each corner forming an arc tangent to the journal corner and having a center of curvature coinciding with the pivotal centers of the adjacent journal corners whereby the lobes and journal corners intermesh to provide uniform impact forces by the impact ring on the lobes;

e. means defining a motor chamber surrounding the impact ring, and having a water inlet disposed to produce rotary movement of water around the impact ring thereby to induce rotary motion of the impact ring.

7. A water motor, as defined in claim **6**, wherein:

a. means is provided for discharge of water from a region of the motor chamber axially beyond the impact ring.

8. A rotary sprinkler, as defined in claim **1**, wherein:

a. the rotor mounting means includes a journal pin projecting upwardly from the bottom of the motor chamber, the pin having grooves to receive a portion of the water for lubrication and flushing of particulate matter.

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