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FLUID SPRINKLER

Filed April 8, 1963

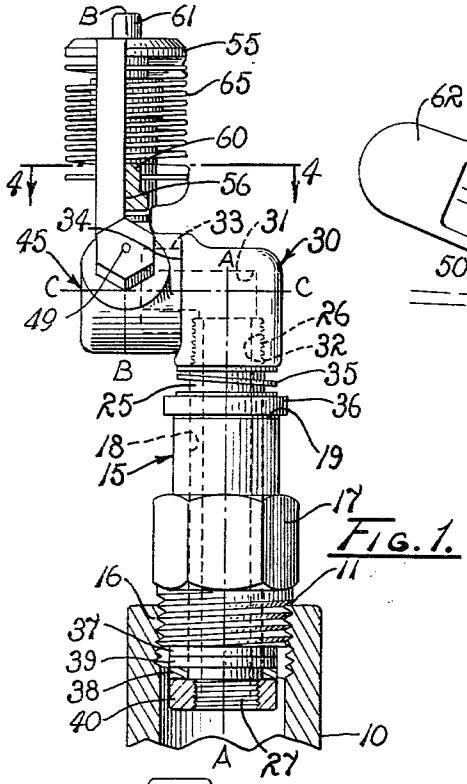


FIG. 1.

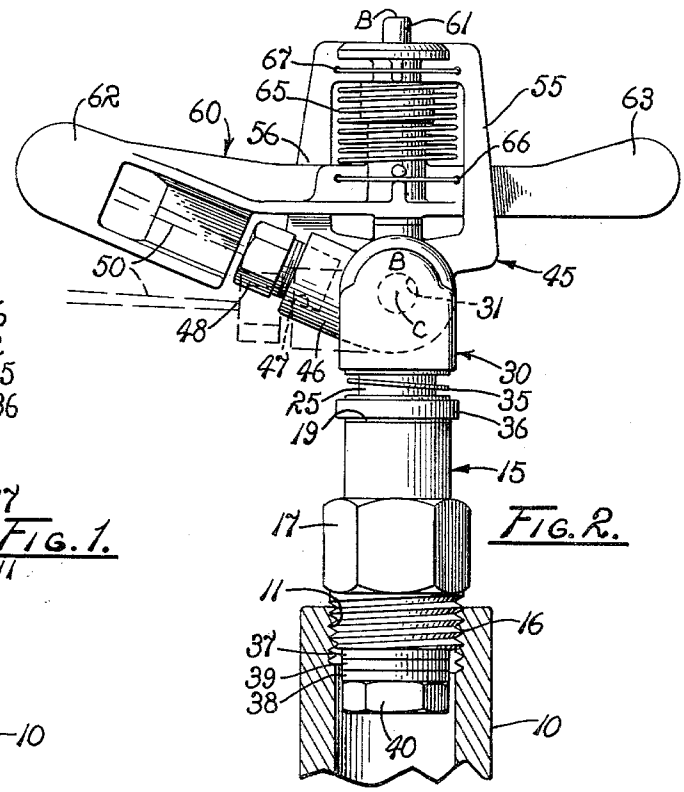


FIG. 2.

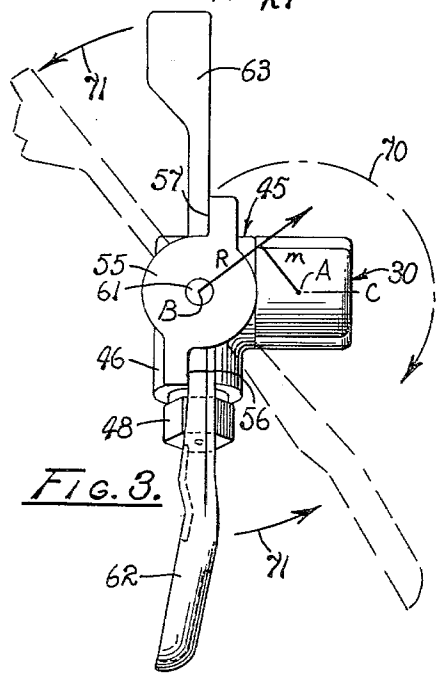


FIG. 3.

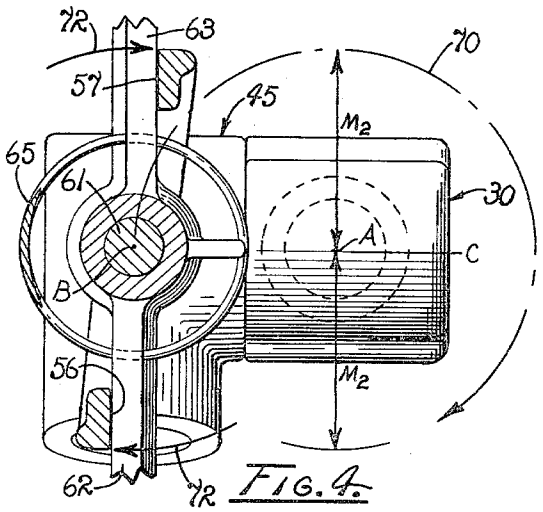


FIG. 4.

HOWARD M. CROW
INVENTOR

Huebner & Worrel
ATTORNEYS

United States Patent Office

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FLUID SPRINKLER

Howard M. Crow, P.O. Box 880, Lindsay, Calif.

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The present invention relates to a fluid sprinkler and more particularly to a rotary sprinkler of the impulse-type wherein rotation is effected by intermittent energy pulses transmitted by an oscillating arm.

Previously known impulse-type rotary sprinklers normally employ a spring-biased impulse arm mounted for oscillatory movement about an axis which is substantially coincident with the axis of rotation provided for the sprinkler. In such sprinklers, a nozzle is normally disposed to direct a jet of discharge fluid in a generally radial direction to impinge upon one end of the impulse arm. Water deflecting means are carried by such end of the arm to deflect the discharge jet in such a manner that the reaction force therefrom causes rotation of the arm in a direction opposite from the direction of desired rotation. The energy of the moving arm is stored in a biasing spring interconnecting the sprinkler and the arm. Upon the return of the energy to the arm, an anvil integral with the sprinkler is struck thereby transmitting the energy to the sprinkler and causing rotation in the desired direction. The amount of energy so transferred is usually of a value sufficient to cause rotation through only a small arc of movement. Since the oscillation of the arm is relatively rapid, the sprinkler is rotated through successive increments of stepped progression.

It will be appreciated that the sealing means employed in such sprinklers also imposes a predetermined frictional drag or resistance to rotation of the sprinkler. This frictional resistance is not altogether undesirable in that the absence thereof would prevent the sprinkler from operating, since the sprinkler would be rotated in a direction opposite from that desired during the period of energy transfer from the impulse arm to the spring. Accordingly, the magnitude of such frictional resistance must be selected to accommodate the energy available from the jet of discharge fluid, the mass of the particular impulse arm, and the rate and total energy capacity of the biasing spring.

During continued operation of such impulse-type sprinklers, particularly in arid climates wherein sprinklers are employed for irrigation purposes, mineral deposits, principally calcium carbonate, frequently increase the frictional resistance to rotation. In such a case, an accumulation of such minerals reduces the range of movement effected by each energy pulse of the arm and materially changes the rate of water deposition.

Under certain circumstances, fine particles of relatively hard mineral crystals, such as silica, mica, and the like, become embedded in the seal means and materially alter the net coefficient of friction between abutting elments of such seal means. A typical deleterious effect caused by such crystals is a reduction in the frictional resistance below a value required to prevent rotation in a direction opposite from that desired during energy transfer from the impulse arm to the biasing spring. Consequently, the sprinkler is alternately rotated in one direction during movement of the impulse arm and in an opposite direction when the impulse arm strikes the anvil. As a result, the sprinkler oscillates with random and unpredictable results in water distribution.

In addition to the above shortcomings, previously known impact-type sprinklers have been unable to provide a flexibility in adjusting the radius of distribution. Consequently, they have been unable to be adapted most effectively to various environments in which they are to

be installed and wherein the radius of distribution must be selectively adjusted to suit such environment.

Accordingly, it is an object of the present invention to provide an improved rotary fluid sprinkler of the impulse-type with a means for readily adjusting the radius of fluid distribution.

Another object is to provide such a sprinkler with a positive acting means to insure continued rotation in a desired direction.

Another object of the invention is to provide a fluid sprinkler of the rotary impulse-type having an impulse arm and biasing spring with a means of utilizing the reaction force resulting from the transfer of energy from the arm to the spring thereby to prevent or control rotation of the sprinkler in a direction opposite from that desired.

A further object of the invention is to provide in an impulse-type sprinkler an improved means for mounting the sprinkler on a fixed fluid inlet.

These, together with other objects, will become more fully apparent upon reference to the following description and accompanying drawing.

In the drawing:

FIG. 1 is a view in front elevation showing an impulse-type sprinkler embodying the principles of the present invention.

FIG. 2 is a view in side elevation of the sprinkler of FIG. 1.

FIG. 3 is a top plan view of the sprinkler of FIG. 1 and showing in dashed lines the impulse arm moved to a position resulting in the storing of energy in the biasing spring of the sprinkler.

FIG. 4 is a somewhat enlarged, fragmentary view in horizontal section taken on line 4—4 of FIG. 1 and showing the impulse arm in an energy transferring position to cause rotation of the sprinkler.

Referring more particularly to FIGS. 1 and 2, an inlet riser is fragmentarily shown at 10 and is normally fixed in a substantially vertical position in the ground which is to be irrigated. Frequently, a plurality of such risers are installed at selected intervals of spacing and connected to a common source of fluid under pressure, not shown, which in the case of agricultural irrigation, is a suitable source of irrigating water. The riser 10 terminates in an upper threaded end 11 to provide a mounting base for the sprinkler subsequently to be described.

The sprinkler includes an annular bearing member 15 having a lower threaded end 16 adapted for screw-threaded connection to the upper end 11 of the riser 10. When so connected, the bearing member 15 provides a substantially vertical first axis of rotation indicated at A—A. The bearing member includes an integral nut 17 to facilitate connection to the riser, and is also provided with an axial bore 18. The bore 18 also defines a cylindrical bearing surface generated about the axis A—A. The bearing member terminates in an upper annular shoulder 19.

A tubular fluid conducting member 25 is rotatably received within the bore 18 and is adapted for rotation about the axis A—A and relative to the bearing member 15. The tubular member 25 terminates in upper and lower threaded ends 26 and 27, respectively. The upper end 26 is screw-threadably rigidly connected to a mounting member 30. A fluid conducting passageway 31 is provided in the mounting member and leads from a lower threaded opening 32 to an upper outlet end 33, circumscribed by an annular shoulder 34.

To perform the function of providing a fluid seal between the bearing member 15 and the tubular fluid conducting member 25, as well as providing the deisred frictional resistance of relative rotation therebetween, a spring

35 circumscribing the tubular member 25 is disposed in abutting relationship with the lower threaded end 32 of the mounting member 30. A seal washer 36 is interposed the spring 35 and the upper shoulder 19 of the bearing member 15. Two relatively soft washers 37 and 38 are disposed in sandwiching relationship to a relatively hard washer 39, and all are mounted in circumscribing relationship to the lower threaded end 27 of the tubular member 25. In a commercial embodiment of the sprinkler, the seal washers 37 and 38 are fabricated from a relatively soft elastomeric material, such as rubber or the like, while the washer 39 is formed of an inert chemical material, relatively harder than the washers 37 and 38. An example of a suitable material for the washer 39 is polymerized tetrafluorethylene, which has excellent wearing characteristics, particularly for use in sprinkler distributing irrigation waters bearing abrasive mineral particles. A nut 40 is screw-threadably mounted on the lower end 27 and axially positioned sufficiently to compress the spring 35 to result in a desired pre-load on the washers 37, 38, and 39. The desired pre-load is selected to insure a satisfactory seal between the bearing member 15 and the fluid conducting member 18, while also providing a predetermined frictional resistance to relative rotation therebetween.

A housing 45 is provided with an axially projecting sleeve 46 adapted to receive the upper outlet end 33 of the mounting member 30. The relative dimensions of the outlet end 33 and the sleeve 46 are such as to result in a cooperating frictional sealing engagement between these members. The sleeve 46 is moved axially a sufficient distance during assembly to abut the shoulder 34. The housing 45 is provided with an internal chamber 47 in communication with the passageway 31 and leading to a nozzle 48 screw-threadably mounted in the housing. The nozzle is mounted in the housing so that a discharge orifice 49 is disposed in a position to direct a jet of fluid 50 discharged therefrom in a direction substantially tangential with respect to a circle having its center at the axis A—A. By reference to FIG. 2, it will be observed that the orifice 49 discharges the jet in an angularly elevated trajectory, the angle of such elevation being selectively adjustable by reason of the connection between the sleeve 46 and the end 33 of the mounting member 30.

An anvil 55 is integrally joined to the housing and provides a pair of opposite contact areas 56 and 57 which are in substantial coplanar relation. An impulse arm 60 is rotatably mounted on a pivot pin 61 rigidly secured to the housing. The arm is adapted for rotational movement about an axis of rotation B—B afforded by the pin 61. A water deflector 62 is carried at one end of the arm and a counterweight 63 is provided on the opposite end.

A torsion spring 65 circumscribes the pivot pin 61 and serves as an energy storing and transferring medium during oscillation of the impulse arm 60. To perform this function, one end 66 of the spring is anchored to the arm 60 and an opposite end 67 is anchored to the anvil 55, which in turn is integrally mounted on the housing 45.

Operation

The operation of the described embodiment of the subject invention is believed to be readily apparent and is briefly summarized at this point. Assuming first that the bearing member 15 has been connected to the riser 10, which in turn is in communication with a suitable source of irrigating water, irrigating water under pressure is delivered through the fluid conducting member 18 and admitted to the chamber 47 of the housing 45. Consequently, a jet of discharge fluid 50 is directed from the orifice 49. The angle of elevation of the discharge jet is readily varied by rotation of the housing 45 about the axis C—C afforded by the sleeve 46 and the upper outlet end 33 of the mounting member 30.

By reference to FIGS. 3 and 4, it will be observed that the discharge jet is directed in a tangential direction relative to a circle having its center at the first axis, A—A.

The reaction force of such discharge jet is available to urge the sprinkler in a direction of rotation indicated by the arrow 70, which is clockwise as viewed in the drawings. As viewed in FIGS. 3 and 4, the desired direction of rotation is that indicated by the arrow 70. Accordingly, due to the reaction force of the discharge jet, a source of energy is at all times available to urge the sprinkler in the direction of desired rotation. Consequently, in the event of an accumulation of mineral deposits, such as calcium carbonate, which would tend to increase the frictional resistance or total frictional drag, the reaction force of the discharge jet assists the impulse arm in rotating the sprinkler.

The jet of discharge fluid 50 issuing from the orifice 49 is adapted to strike the water deflector 62 when the impulse arm is in the position shown in solid lines in FIG. 3. A portion of the kinetic energy of the water is consequently transferred to the impulse arm to cause rotation thereof in a direction indicated by the arrows 71, which is opposite to the predetermined direction indicated by the arrow 70. During such rotation, the impulse arm moves to an approximate position indicated by the dashed lines in FIG. 3, and during such movement transfers the kinetic energy to the biasing spring 65. During such energy transfer in conventional, previously known sprinklers of the impulse-type, a torque force is exerted on the sprinkler urging the sprinkler in a direction opposite to that of the desired direction, indicated by the arrow 70. Consequently, when small mineral particles become embedded in the washers 37 and 38 and the total frictional resistance to rotation between the bearing member 15 and the tubular fluid conducting member 18 is reduced below a value equal to such torque force, the sprinkler is rotated in such an opposite direction. However, with a sprinkler incorporating the principles of the present invention, the reaction force incident to the transfer of energy from the impulse arm to the spring 65 has a line of action in the general direction indicated by the letter R. It will be appreciated that such line of action varies slightly throughout the total range of movement of the impulse arm as it moves toward the position shown in dashed lines, however, the arrow R is indicative of the general direction of the line of action of such reaction force. Accordingly, the reaction force is provided with a moment arm, indicated at M to exert a torque force relative to the axis of rotation A—A. Therefore, it is to be noted that a torque force is available at all times to urge the sprinkler in a direction of desired rotation during movement of the impulse arm in an opposite direction. Stated differently, during wind up of the biasing spring 65, as energy is transferred thereto, the reaction force of said spring wind up and impulse arm movement urges the sprinkler in the desired direction of rotation, rather than urging it in an opposite direction, as in the case of previously known sprinklers. Consequently, the housing components, including the impulse arm, can be fabricated from lighter weight materials and the pre-load on the seal washers selected at a low value to provide optimum sealing characteristics, rather than tightened to such a degree to give a high value of frictional resistance required in such previously known sprinklers.

As soon as the angular momentum of the impulse arm has decreased to a value equal to the effective force then exerted by the spring, the direction of rotation of the impulse arm is reversed and the kinetic energy again returned to the arm. Upon reaching the limit of movement in a direction indicated by the arrow 72, the opposite ends of the arm substantially simultaneously strikes the contact areas 56 and 57 of the anvil 55. Upon such striking, the kinetic energy of the arm is consequently transferred to the anvil. At the moment of such striking, the line of action of the forces acting upon the anvil is substantially tangential with respect to a circle having its center at the pivot axis B—B as well as tangential to

a circle having its center at the axis of rotation A—A. By reference to FIG. 4, it will be observed that the respective force acting on each of the contact areas 56 and 57 is provided with a moment arm of substantially equal length and indicated by the reference character m_2. Consequently, the energy transferred to the anvil 55 exerts a torque force on the housing relative to the axis A—A to cause rotation thereabout and in the direction indicated by the arrow 70.

The present invention provides an improved sprinkler of the impulse-type which can be readily adjusted to provide a radius of distribution suited for each installation. In addition, the invention provides a sprinkler which can be fabricated of low-cost lightweight materials requiring a minimum of seal washer pre-load and thereby extending the useful life of the sprinkler, while insuring positive rotation in the desired direction at all times throughout extended periods of unattended operation.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An impulse-type sprinkler adapted to be mounted on a fixed fluid inlet member comprising bearing means rigidly secured to the inlet member and defining a predetermined first axis of rotation; a fluid conducting member mounted for rotation about said axis and relative to the bearing; seal means interposed said bearing means and said fluid conducting member including force means to exert a load on said seal means thereby to impose a predetermined frictional drag resisting relative rotation of said fluid conducting member and said bearing means; a housing providing a fluid chamber and including an impulse arm rotatably mounted on the housing for oscillation about a second axis, an anvil member providing two substantially coplanar contact areas in diametrically opposed relationship relative to said second axis and adapted to be struck substantially simultaneously by said arm during oscillation thereof, a biasing spring mounted on the housing and urging the arm into contact with said areas of the anvil, and a fluid discharge nozzle in communication with said chamber and oriented relative to the arm to discharge fluid in a direction to strike the arm and cause rotational movement thereof away from the contact areas thereby to store energy in said biasing means; fluid conducting mounting means securing the housing to said fluid conducting member in fluid communication therewith and disposing said second axis in a plane substantially parallel to but eccentrically of said first axis while disposing said discharge nozzle to effect fluid discharge in a tangential direction relative to a circle having its center at said first axis; and adjustment means carried by said mounting means to permit adjustable movement of the housing about a third axis normal to said first axis so that selective elevation is permitted of said discharge nozzle and the jet of fluid discharged therefrom thereby determining the radius of fluid distribution of said discharge fluid.

2. In an impulse-type water sprinkler adapted to be mounted on a fixed water inlet and having bearing means rigidly secured to the inlet and defining a predetermined first axis of rotation, and a fluid conducting member mounted for rotation about said axis and relative to the bearing, the combination of seal means interposed said bearing means and said fluid conducting member including force means to exert a load on said seal means thereby to impose a predetermined frictional drag resisting relative rotation of said fluid conducting member and said bearing means; a housing providing a fluid chamber; a pivot post rigidly secured to the housing and providing a second axis of rotation disposed in a plane substantially parallel to said first axis; an impulse arm pivotally mounted on said post for oscillatory movement about said second axis; an anvil rigidly secured to the housing and providing a contact area adapted to be struck by said arm during oscillations thereof; a torsion spring circumscribing said pivot post and having opposite ends operatively connected respectively to said arm and said housing and arranged to be torsionally stressed upon movement of a first end of the arm in a direction toward said first axis; nozzle means carried by the housing in fluid communication with said chamber and having a discharge orifice tangentially arranged relative to said first axis; water deflecting means carried by said impulse arm adjacent to said first end and disposed in the fluid discharged from said nozzle when the arm is in contact with said anvil so that movement of said first end of the arm toward said first axis is effected by water striking said deflecting means; and fluid conducting mounting means securing the housing to said fluid conducting member in fluid communication therewith and disposing said second axis in a plane substantially parallel to but eccentrically of said first axis while disposing said discharge nozzle to effect fluid discharge in a tangent direction relative to a circle having its center at said first axis.

3. The water sprinkler of claim 2 wherein adjustment means are carried by said fluid conducting mounting means to permit adjustable movement of the housing about a third axis normal to said first axis so that selective elevation is permitted of said discharge nozzle and the jet of water discharged therefrom and thereby determining the radius of water distribution of said discharged water.

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EVERETT W. KIRBY, *Primary Examiner.*

RAPHAEL M. LUPO, *Examiner.*