

[54] **DEVICE FOR DISTRIBUTING IRRIGATION WATER**

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[51] Int. Cl. **B05b 3/02**

[58] Field of Search **239/97, 98, DIG. 1, 230, 239/231**

[56] **References Cited**

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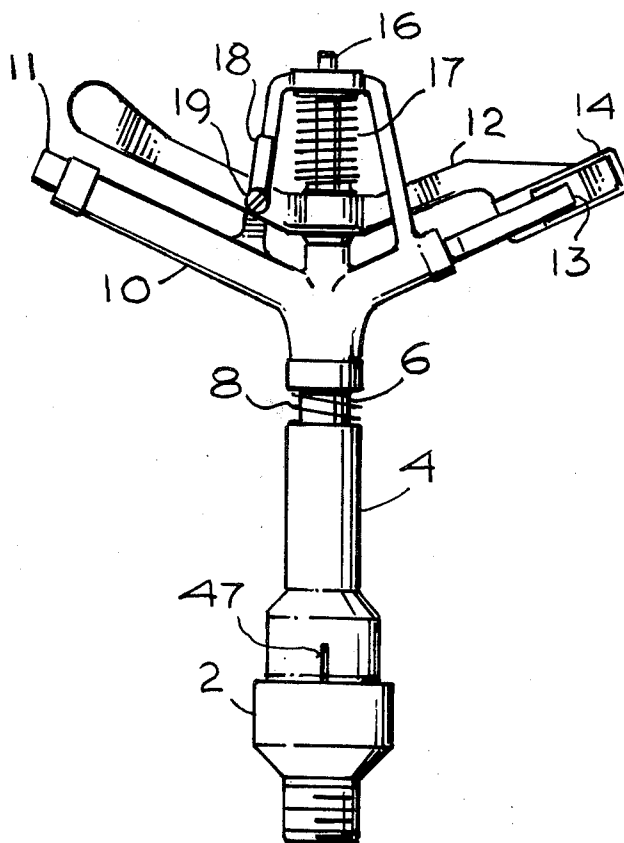
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[57] **ABSTRACT**

A device for distributing irrigation water over an arbitrarily shaped surface is provided with a rotating sprinkler head and a hollow cylindrical shaft for conveying water under pressure into the head. The flow of water into the hollow bore of the shaft is restricted by a port plate inset into the lower end thereof. The port plate is provided with at least two passages, a central port aligned with the axis of rotation of the sprinkler shaft and another radially offset therefrom. An orifice plate keyed to the shaft housing is pressed against the port plate by means of a coil spring. The orifice plate is pierced by a central orifice — aligned with the central port of the port plate — and one or more orifices radially and angularly displaced from the central one and from each other — in radial alignment with the radially offset port. As the sprinkler head rotates with its shaft, the quantity of water, and the radial reach of that water, are varied depending upon the mutual overlap between the radially offset orifices and ports. A square irrigation pattern may be achieved with four offset orifices equispaced on the orifice plate.

6 Claims, 11 Drawing Figures



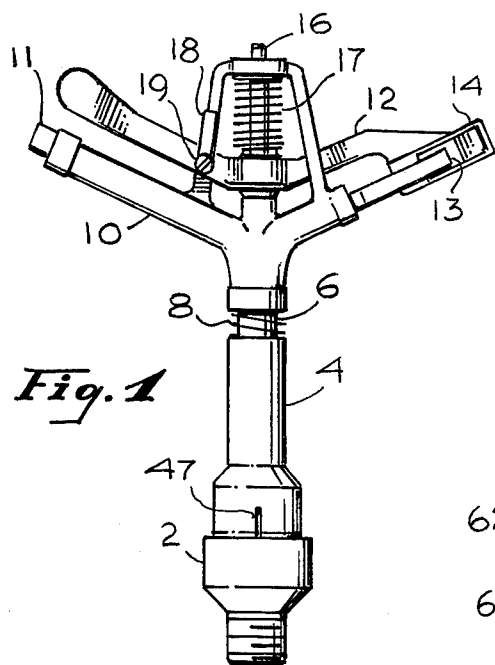


Fig. 1

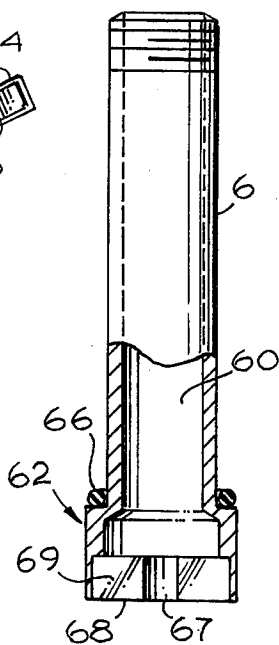


Fig. 4

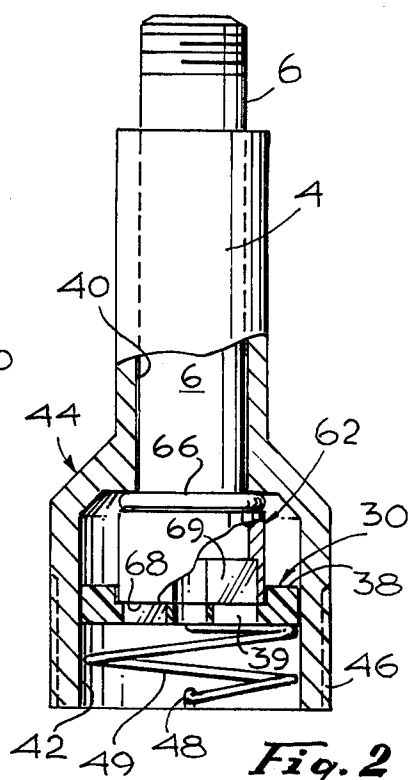


Fig. 2

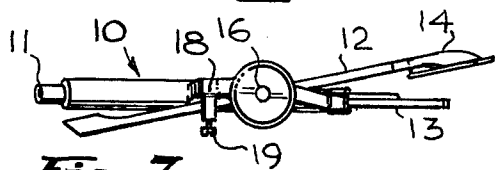


Fig. 7

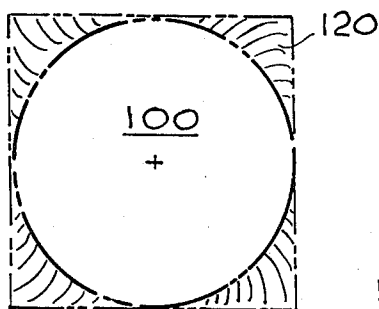


Fig. 8

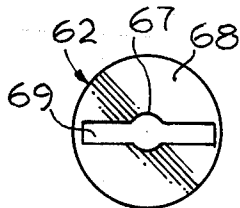


Fig. 5

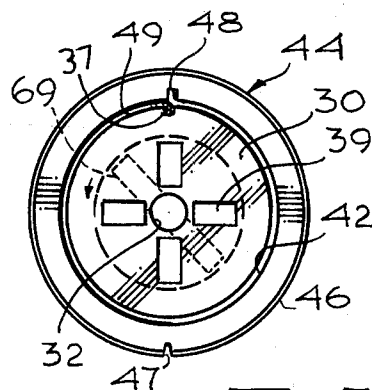


Fig. 3

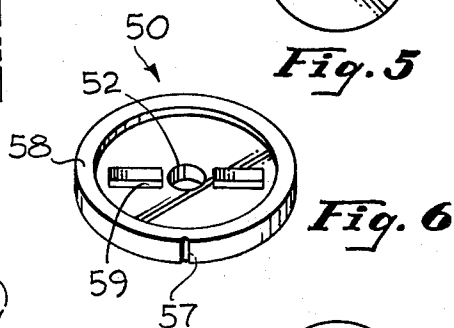


Fig. 6

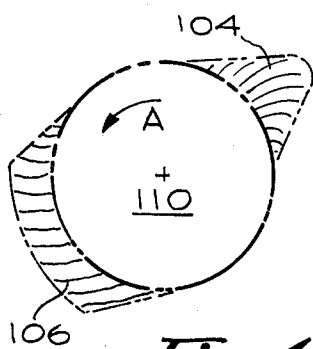


Fig. 11

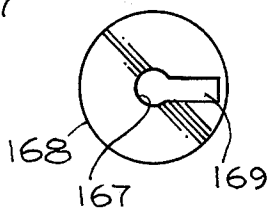


Fig. 9

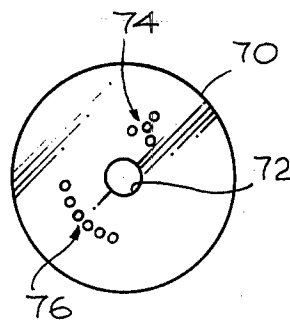


Fig. 10

DEVICE FOR DISTRIBUTING IRRIGATION WATER

BACKGROUND OF THE INVENTION

This invention relates to devices for distributing irrigation water to fields and lawns. It relates, more particularly, to such devices equipped with rotating sprinkler heads.

It is known in the prior art to provide a water distributing device based on a rotary sprinkler head whose rotation is derived from the internal energy of the pressurized water passing therethrough. Most of these devices of the prior art are restricted, inherently, to a distribution pattern corresponding to a circle whose center is the location of the sprinkler head and whose radius corresponds to the reach of the jet, or jets, issuing from its orifices.

There have also been proposed variations on these devices which would permit the shape of the irrigated area to be varied from a circular one, typically to a square or rectangle.

Such devices have not met with commercial success due to their poor performance, high cost, unreliable operation, or a combination of such factors.

Accordingly, it is the primary object of the instant invention to teach the construction of a rotating irrigating device with an arbitrary pattern of water distribution.

It is another object of the invention to provide in such a device constructional features leading to reliable operation, ease of maintenance and economy of manufacture.

It is yet another object of the invention to provide an irrigation-water distributing device in which the pattern of water distribution is simply and readily altered by the substitution of a different, replaceable orifice plate.

SUMMARY OF THE INVENTION

To attain the enumerated objects of the invention, there is provided a device for the distribution of irrigation water which comprises a body for the support of a vertical shaft, a sprinkler head affixed to the shaft and means for deriving rotational motion of the sprinkler head from the internal energy of the irrigation water passing through it.

Such drive means preferentially include a water-deflecting vane affixed to a vane-arm elastically pivoted in the sprinkler head and means for limiting the travel of the vane-arm to a given arcuate distance.

The sprinkler head is provided with a primary orifice and a secondary orifice, with the secondary orifice so aligned that the water-jet issuing from it intercepts the deflecting vane and initiates rotary motion of the vane-arm relative to the sprinkler head. The unbalanced torques resulting from the intermittent action of the secondary water jet on the vane and from the elastic restraint of the vane-arm propel the sprinkler head into unidirectional rotary motion about its shaft.

Water is conveyed through a hollow bore in the shaft to the internal passages of the sprinkler head and, thence, to the primary and secondary orifices.

Water is admitted into the shaft bore through a port plate rigidly affixed to the base thereof, and the port plate is provided with a central port and at least one radially offset port.

An orifice plate is keyed to the body and pressed against the face of the port plate by a spring. The orifice plate is provided with a central orifice and one, or more, radially offset orifices in locations corresponding to the aforementioned ports in the port plate.

The rotational motion of the sprinkler head, and of the shaft, sweeps the port plate across the face of the orifice plate and varies to the coincident water passage area as a function of the angular position of the sprinkler head.

By varying the size, shape, number and angular location of the orifices in the orifice plate, the irrigation pattern of the sprinkler may be adjusted to any arbitrary shape.

The central orifice, aligned with the central port, provides irrigation water to a base area circular in outline; the radially offset orifices irrigate additional surfaces outside the base circle.

For example, a square irrigation pattern may be achieved by providing four orifices, substantially rectangular in shape, along two orthogonal diameters of the orifice plate.

The metering assembly of the invention, comprising the port and orifice plates, may be also applied to any other type of rotating sprinkler supplied through a hollow shaft with irrigation water and rotating with a substantially constant angular velocity about its vertical axis.

Other features, advantages and constructional details of the irrigation water distributing device of the invention will become apparent from the detailed description of the preferred embodiment, below.

DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the invention is described with reference to the accompanying drawings, in which:

FIG. 1 is a side view of a device for the distribution of irrigation water;

FIG. 2 is a partial, vertical section through the body and shaft of the embodiment of FIG. 1;

FIG. 3 is a base view of the assembly of FIG. 2;

FIG. 4 is a partial, vertical section through the shaft and port plate of the preferred embodiment;

FIG. 5 is a base view of the assembly of FIG. 4;

FIG. 6 is a perspective view of an orifice plate used with the preferred embodiment, adapted to control water distribution over a substantially elliptical surface;

FIG. 7 is a top view of the embodiment of FIG. 1;

FIG. 8 is a map of the surface irrigated by the assembly of FIGS. 2 and 3;

FIG. 9 is a base view of a shaft and port plate, adapted to the irrigation of surfaces lacking an axis of symmetry;

FIG. 10 is a plan view of an orifice plate, adapted for use with the port plate of FIG. 9; and

FIG. 11 is a map of the surface irrigated by the combination of the orifice plate of FIG. 10 and port plate of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The irrigation-water distributing device of the invention is shown in FIG. 1, embodied in an impact driven lawn sprinkler with a rotating head 10, a shaft 6 and body 4. The body 4 is a cylindrical column with a smooth central bore 40 in which the shaft 6 is rotatably

disposed. The lower end of the body expands into a housing 44 provided with external pipe threads 46 for engaging the mating internal threads of an adaptor 2 wherethrough the device may be connected to a water conduit.

The upper end of shaft 6 and an internal bore of the head 10 are also threaded to form a mating assembly; a spring 8 is slipped over the shaft, prior to engagement with the head 10, and provides an elastic bearing support between the latter and the upper surface of body 4.

The rotating head 10 has opposing, bifurcated water passages, terminating in orifices 11 and 13, respectively. The axes of these orifices are aimed at about 30° above the horizon and water entering the internal passages of the head through bore 60 of the shaft 6 is distributed through these orifices to the ground to be irrigated.

The rotational motion of the head 10 is derived from the momentum of the water jet issuing from the secondary orifice 13 through its interaction with a vane 14 mounted on an arm 12. The vane-arm 12 is elastically pivoted in the head 10, on a pin 16 coaxial with the shaft 6. The torsionally elastic support is provided by a coil spring 17 anchored to the head at one end and to vane-arm 12 at the other.

The rotating head, with its primary orifice 11 and secondary orifice 13, and the vane-arm 12 and its associated parts are similar to the conventional impact-driven sprinklers of the prior art and normally employed in sprinklers whose irrigation pattern is a perfect circle, delimited by the radius to which water is delivered from the primary orifice. The rate of rotation is set by the size of the secondary orifice 13 and the stiffness of spring 17. Sprinklers of this type are, for example, sold under the registered trademark "Rainbird".

The rotating assembly of the embodiment of FIG. 1 is modified in one important respect — compared to the constructions of the prior art — to adapt it for use with the irrigation device of the invention. This modification will be described below, with reference to FIG. 7.

The internal construction of the metering assembly of the invention is shown in the partly sectional illustration of FIG. 2. The body 4 accommodates the shaft 6 and allows for the free rotation of that part. The shaft 6 has an enlarged lower portion 62 in which water admitting ports are provided in a rigidly affixed port plate 68. These ports communicate with a bore 60 passing through the length of the shaft and convey water there-through into the sprinkler head 10.

The housing 44 has an internal bore 42 which is larger in diameter than the enlarged shaft-end 62 and into which an orifice plate 30 is keyed by means of a coil spring 49. One end of the spring 49 is engaged in a pocket 48 in the inner periphery of the bore 42, and the other end engages a notch 37 in the perimeter of the orifice plate 30. The orifice plate has a raised rim 38 which slips over the shaft-end 62 and assures radial alignment between these parts. The spring 49 prevents the orifice plate from rotating with respect to the housing 44 and, simultaneously, presses the plate 30 upwardly into intimate contact with face of the shaft-end 62. An external groove 47, cut into the threads 46 of the housing 44, is exactly opposite the notch 37 and provides the installer or operator with a reference mark for the alignment of the irrigation pattern.

The orifice plate 30 is pierced by rectangular passages 39, four in number, radiating from a central, circular orifice 32. In the shaft-end 62 the port plate 68 is also pierced by a central port 67 and two rectangular ports 69 along a diameter passing through the center of the shaft 6. The ports 67 and 69, and the orifices 32 and 39 are coincident every quarter revolution in the rotational travel of the shaft 6 relative to the housing 44 and, therefore, the orifice plate 30.

The variation in the coincident flow passage area from a minimum — corresponding to the cylindrical path through orifice 32 and port 67 — to a maximum — when two orifices 39 are in alignment with the ports 69 — at four equispaced angular positions of the shaft 6 and of head 10, results in a square irrigation pattern.

This effect is shown in FIG. 8, a planar map of an irrigated surface, wherein a central, circular area 100 denotes the surface that would be reached by the water issuing from orifices 11 and 13 as a result of liquid flow through the central orifice 32 and port 67.

As the sprinkler head sweeps through its rotary path toward a typical corner 120 of the irrigated surface, one pair of orifices 39 comes into coincidence — partial at first — with the rectangular ports 69. With the increased flow area available, the hydraulic resistance in the circuit between the irrigation pump, or municipal water supply pipe, and orifices 11 and 13 is reduced and, consequently, the flow of water through the system increased.

This effect is due to a higher pressure level inside the sprinkler head 10 and the result is not only a larger flow but also a larger radius of reach of the streams leaving the discharge orifices. The orifices 39 and ports 69 are so sized, in relation to the orifices 11 and 13, that the resultant increase in the radius corresponds to the diagonal dimension of a square tangent to the circle 100.

By these means a simple and reliable mechanism is provided for the supply of an even flow of irrigation water to a substantially square surface.

In FIG. 3, a base view of the assembly of FIG. 2, the orifice plate 30 is clearly visible, along with retainer spring 49 and the broken outline of the port 69, shown at an angle of approximately 45° from the principal axis of symmetry, corresponding to the angular position of groove 47.

FIG. 4 is a partial section, in side elevation, of the shaft 6 and illustrates the construction of the enlarged shaft-end 62 and of the port plate 68, secured therein. A seal ring 66 is also shown; it prevents the leakage of water around the outer periphery of the shaft 6 to the atmosphere. The installed position of the seal 66 is shown in FIG. 2.

FIG. 5 is a base view of the shaft-end 62 and of the port plate 68 with ports 67 and 69.

FIG. 6 is a perspective view of an orifice plate 50, corresponding in all external dimensions of the plate 30 of FIG. 2, with which it is interchangeable. The orifice plate 50 is provided with a raised perimeter 58, a spring-retaining notch 57, a central orifice 52 and two rectangular orifices 59 aligned with a diameter of the plate.

With the orifice plate 50 replacing the plate 30, the irrigation pattern is changed from a square to a substantially elliptical area with its major axis parallel to the diameter defined by the orifices 59.

FIG. 7 is a plan view of the sprinkler head 10 and the components associated therewith for propelling the

sprinkler in a substantially uniform rotational motion on its shaft 6. The rotational speed is a function of the momentum transferred to the vane-arm 12 by the deflection of the water stream issuing from orifice 13 by the vane 14, affixed to the vane arm. Since the variable water passage created by the tranverse of the port plate over the face of the orifice plate results in a variable velocity of the stream, it is necessary to prevent rotational variations in speed resulting therefrom. The device of the invention accomplishes this end by providing a stop, in the form of a set-screw 19 engaged in a yoke 18, to limit the arcuate travel of the vane-arm and, thereby, the momentum transfer to the sprinkler head 10. The set-screw provides a variable stop and may be also used to adjust the magnitude of the rotational speed of the head.

FIG. 9 is an end view, corresponding to the illustration of FIG. 5, of a port plate 168 inset into shaft-end 62. The plate 168 is provided with a central port 167 and a single radial port 169. The plate 168 is adapted to be used with mating orifice plates to irrigate a surface lacking an axis of symmetry. An orifice plate 70, meeting the above definition, is shown in FIG. 10; it is provided with a central orifice 72, a group of adjacent orifice bores 74, and another group of bores 76.

The combination of the orifice and port plates shown in FIGS. 9 and 10 is adapted to irrigate a surface whose map is shown in FIG. 11. A central, circular area 110 is served by the combination of port 67 with orifice 72; side lobes 104 and 106 in the irrigated surface correspond to the increased water delivery permitted by the passage of orifice groups 74 and 76, respectively, over the port 169 as the sprinkler head rotates in the direction defined by arrow 'A'.

It will be clear to one skilled in the art of constructing irrigating apparatus that by a judicious combination of orifice and port patterns, any arbitrary shape of sprinkling pattern may be obtained by the device of the invention. The only limitation on the use of such an irrigation device lies in the radial throw capacity of the orifices 11 and 13, and is set by the available pressure-head of water delivered to the chamber 42.

Changes in the outline of the irrigated surface may be expeditiously achieved by replacing the orifice plate with another part having the same external dimensions but a different pattern of flow passages machined into its metering surface. Due to the inherent simplicity of the construction, such a change may be undertaken in a few minutes, using only hand tools commonly available in every household or farm.

This and other advantages of the invention may also be enhanced by minor changes and rearrangements of the mechanical parts of the irrigating device; such changes shall not be construed as deviating from the disclosure herein, which is limited in scope only by the appended claims.

What is claimed is:

1. A device for distributing irrigation water, comprising:
 - a body;

a hollow, tubular shaft, rotatably disposed in a vertical bearing passing through said body, and provided with a basal surface orthogonal to the rotational axis thereof;

seal means between said body and said shaft;

a sprinkler head affixed to the upper end of said shaft;

a primary orifice piercing said sprinkler head, in communication with the hollow bore of said shaft and substantially radially aligned with said rotational axis;

a secondary orifice piercing said sprinkler head opposite said primary orifice, in communication with said hollow bore;

vane means, resiliently pivoted in said sprinkler head and adapted to deflect the water jet issuing from said secondary orifice;

stop means, affixed in said sprinkler head, for adjustably limiting angular travel of said vane means under influence of said water jet issuing from the secondary orifice;

port means, piercing said basal surface of said shaft and communicating with the internal bore thereof, including a circular port centered on the rotational axis of the shaft and at least one other port radially disposed from said circular port;

an orifice plate, facing said basal surface, pierced by a central orifice aligned with the rotational axis of said shaft, and at least one other orifice radially spaced from said central orifice, adapted for periodic alignment with said radially disposed port;

spring means, urging said orifice plate into sliding contact with said basal surface; and

key means, for preventing rotational displacement of said orifice plate with respect to said body.

2. The device of claim 1, wherein said basal surface covers a radially enlarged portion of said shaft.

3. The device of claim 1, wherein said port means include two radially disposed ports, aligned on a diameter passing through said rotational axis.

4. The device of claim 1, wherein said vane means comprise:

a pivot pin, affixed in said sprinkler head in substantial coincidence with said rotational axis;

a vane arm, pivotably engaged on said pivot pin;

a vane, affixed to said vane arm; and

a torsion spring coaxial with said pivot pin and engaged in said vane arm and said sprinkler head at either end.

5. The device of claim 4, wherein said stop means include a yoke, affixed to said sprinkler head and encompassing arcuate path of said vane arm; and

a set-screw threaded into said yoke, aligned to intercept angular travel of said vane arm.

6. The device of claim 3, adapted to irrigate a substantially square surface, wherein said orifice plate is provided with four angularly equispaced orifices radially spaced from said central orifice.

* * * * *