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SPRINKLER

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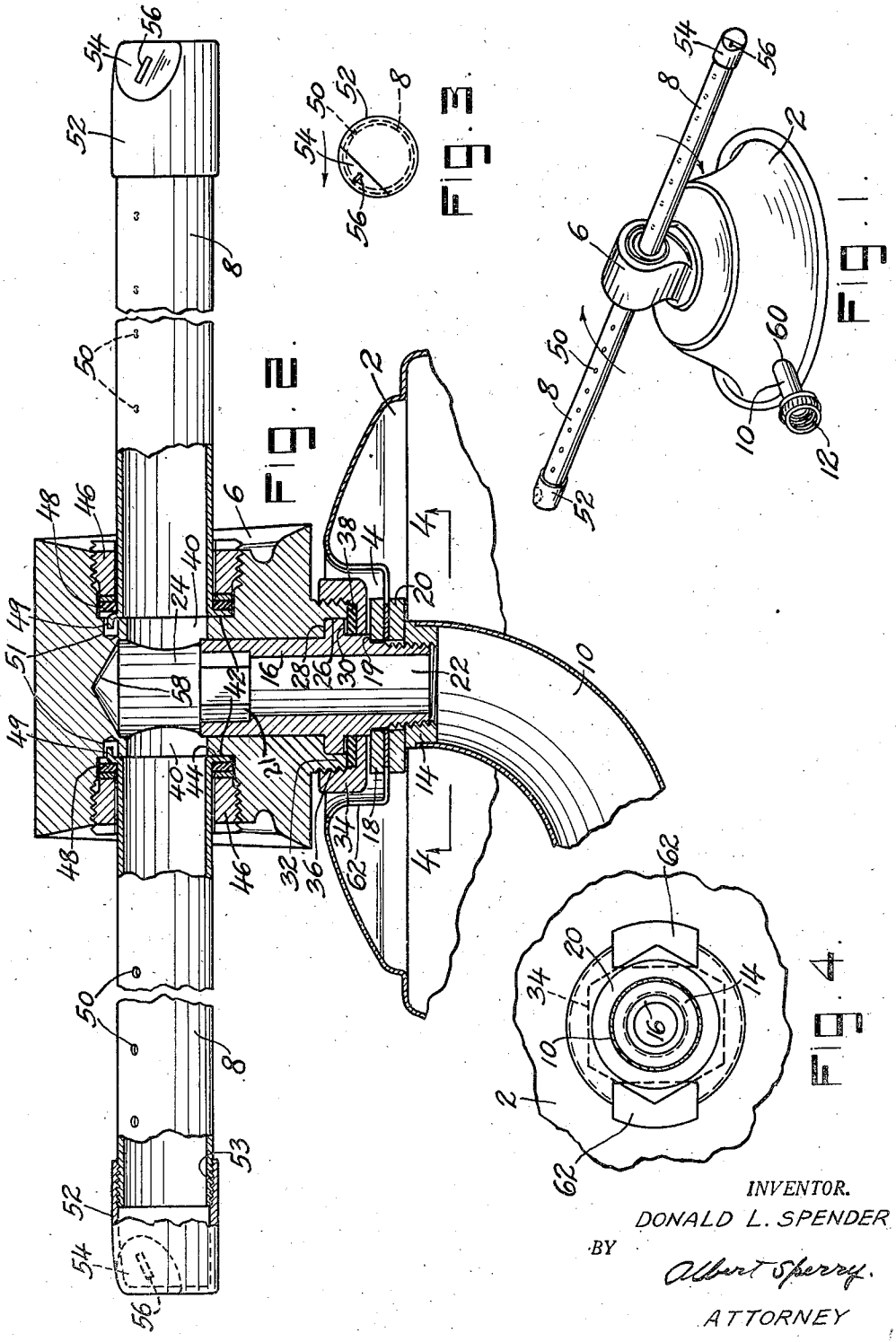


FIG. 2

FIG. 3

FIG. 1

FIG. 4

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SPRINKLER

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This invention relates to sprinklers and particularly to rotary sprinklers of the type commonly used for watering lawns and gardens.

Sprinklers of this character have frequently been constructed with perforated tubular arms or other elements which are caused to rotate by the reaction force of the liquid issuing from the openings or perforations in the arms so that the liquid is projected outward and distributed over a wide area by centrifugal force. However, the speed of rotation of such arms or elements varies considerably upon variation in pressure of the water supplied thereto and as a result the centrifugal force applied to water issuing from the sprinkler differs greatly. Thus, for example, when a sprinkler is used for watering a lawn and is connected by hose to the water system of a dwelling, it will operate irregularly and rotate at different speeds when water is drawn from other outlets in the system for domestic purposes. Under such cimcumstances the rotating elements move only slowly or may even cease to rotate altogether when the water pressure is decreased, whereas they rotate rapidly and distribute water over a wide area when the water pressure is increased. This irregularity in operation results in unequal distribution of the water so that the area adjacent the sprinkler may receive too much water while areas remote from the sprinkler are insufficiently watered.

In accordance with the present invention a rotary sprinkler is provided which rotates at substantially constant speed independently of the water pressure above a predetermined minimum starting pressure. As a result the centrifugal force with which the water is thrown outward remains substantially constant and the operation affords greater uniformity of liquid distribution within the area sprinkled. Moreover, the varying distance which the water is projected due to changes in the water pressure, and with a constant speed of rotation of the sprinkler head, may be used to control and vary the area to which water is supplied.

These results are preferably attained by providing a rotating element with means responsive to the pressure of water supplied to the sprinkler for controlling the speed of rotation of the rotating element. In the construction hereinafter described and illustrated in the drawing, such control is maintained by variation in the friction between relatively rotating members and by maintaining a predetermined relationship of position and size of the outlet openings through which the liquid is discharged from the sprinkler head.

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One of the objects of the invention is to provide a novel type of sprinkler embodying elements rotatable at a substantially constant speed under varying liquid pressures.

Another object of the invention is to provide a rotary sprinkler with pressure responsive means controlling the speed of rotation thereof.

A further object of the invention is to provide a rotary sprinkler having relatively rotating members with means for varying the frictional contact between elements of the construction upon variation in the pressure of liquid supplied to the sprinkler.

Another object of the invention is to insure substantial uniformity in the operation of water sprinklers with variation in pressure of the water supplied thereto.

Another object of the invention is to provide a rotary sprinkler by which the area sprinkled can be controlled effectively with manual changes in the water pressure.

These and other objects and features of the invention will appear from the following description thereof in which reference is made to the figures of the accompanying drawing.

In the drawing:

Fig. 1 is a perspective of a typical water sprinkler embodying the present invention,

Fig. 2 is a vertical sectional view through the principal parts of the water sprinkler illustrated in Fig. 1,

Fig. 3 is an end view of one of the arms of the water sprinkler illustrated in Fig. 1, and

Fig. 4 is a view partly in section taken on the line 4—4 of Fig. 2.

In that form of the invention shown in the drawing, the sprinkler has a base 2 which may be formed of a metal stamping and of suitable design to render the construction attractive in appearance. The upper central portion of the base 2 is recessed at 4 to receive and house the lower portion of the rotary head 6 of the sprinkler. Arms 8 are carried by the head 6 and extend radially therefrom while liquid is supplied to the head and arms by a pipe 10 provided with a suitable coupling 12 for connecting the sprinkler to a hose or other source of liquid supply.

The pipe 10 is fixedly secured in place with respect to the base 2 by means of an internally threaded ring 14 secured to the interior of the pipe 10 adjacent the upper end thereof and engaging external threads on a central tubular spindle 16. The spindle in turn is secured to the base 2 by a washer 18 located in the recess 4 and engaged by the shoulder 19 on the spindle 16. A

washer 20 is located beneath the bottom of the recess 4 in the base 2 and is engaged by the upper face of the ring 14 on pipe 10 to cooperate with washer 18 in clamping the spindle to the base when the spindle is threaded into the ring 14. The upper end of the spindle is recessed at 21 to receive a wrench for rotating the spindle relative to the ring 14 so as to tighten the parts and clamp them securely together.

The stationary spindle 16 has a central opening 22 therethrough for the passage of water from the pipe 10 to the cavity 24 located centrally within the rotary head 6. The outer surface of the spindle 16 is generally cylindrical in shape and serves as a bearing about which the head may rotate. An annular rib or collar 26 projects outward from the stationary spindle 16 and presents a flat, annular, upwardly facing supporting surface 28 and a flat, annular downwardly facing braking surface 30. The rotary head 6 is formed with a downwardly projecting boss 32 surrounding the spindle 16 and has a complementary supporting surface engageable with the supporting surface 28 on the collar 26 acting as a bearing when the head is in a state of rest or is idling after the water pressure has been shut off to the sprinkler. A retaining nut 34 rotatable with the head 6 engages threads 36 on the exterior of the boss 32 of the rotary head and is centrally recessed to receive a friction element 38 which engages the downwardly facing braking surface 30 on the collar 26 of the spindle 16.

The rotary head 6 carries the radially extending tubular arms 8, two of which are shown, and each of which communicates with the central cavity 24 in the head through the passages 40. The arms are secured in place on the head, by suitable means, and as shown are provided on their inner ends with flanges 42 which seat in the bottom of the outwardly facing recesses 44 on opposite sides of the head. These recesses are threaded internally to receive externally threaded retaining rings 46 which engage suitable packing rings 48 and serve to secure the arms in place. A lug 49 struck from the flange 42 is positioned in a corresponding recess 51 in the bottom of the recess 44 to locate sprinkler openings 50 in the arms in a predetermined inclined position.

The sprinkler openings 50 in each arm 8 are spaced apart along the length of the arm and are inclined with respect to a vertical plane passing through the arm. Water issuing from the openings 50 therefore imparts a reaction force to the arms and head and this reaction force has a horizontally directed component which tends to rotate the arms in a direction opposite to that in which the openings 50 are inclined. Each of the arms 8 also is threaded on its outer end to receive a nozzle 52 formed with an angularly disposed surface 54 having an elongated discharge opening 56 therein. The nozzle is adjustable with respect to the arm so that it can be turned to position the opening 56 at any desired angle with respect to the vertical plane passing through the arm, but its position can be fixed by soldering or otherwise securing the nozzle in place when the desired angle of inclination for the opening 56 has been established. Water issuing from the opening 56 also imparts a reaction force to the arm and head, and this force also has a horizontally directed component which tends to rotate the arm in a direction opposite to that in which the opening 56 is inclined.

In practice it is desirable to position the openings 50 and 56 so that they are inclined toward

opposite sides of the vertical plane passing through the arm 8. Therefore, the horizontally directed components of the reaction forces are generally opposed to each other, but the magnitude of these components differs and is dependent upon the size and inclination of the openings. The resultant driving force and the torque available for rotating the head and arms is the algebraic sum of the horizontally directed components of the reaction forces exerted on the arms by liquid issuing from the openings 50 and 56. It is generally preferable to proportion and position the openings 50 and 56 so that the reaction force of the liquid issuing from the openings 50 exceeds that of the liquid issuing from the elongated opening 56 in the nozzle 52 on the end of the arm. The arm 8 then will rotate in a direction such that the openings 50 are inclined rearwardly while the opening 56 is inclined in the direction of rotation.

The arms and head tend to rotate more rapidly when the pressure of the water supplied to the sprinkler increases due to the increase in the reaction forces applied to the arms by the water issuing from the openings 50 and 56. However, the speed of rotation of the arms and head of devices embodying the present invention is maintained substantially constant even though the pressure of water supplied to the sprinkler may vary considerably. This result is attained by adjustment in the position of the nozzle 52 to effect a variation in the angle of inclination of the opening 56 in the nozzle. The adjustment made in any case will depend upon the size and character of the braking element 38 and the braking surface 30, and therefore it is generally necessary to determine the proper angle of inclination for maintaining uniform rotation of the head for each design of sprinkler or for each group of sprinklers produced.

The action of the elements in maintaining the speed of rotation constant will be apparent from the following description of the operation of the device illustrated and described.

In operating the device water or liquid passing through the pipe 10 and spindle 16 flows freely into the cavity 24 in the head 6 and passes directly to the arms 8 so that it will issue from the openings 50 and 56. The pressure of the liquid against the surface 53 at the top of the cavity 24 tends to raise the head upward on the spindle 16. However, such upward movement of the head causes the retaining nut 34 carried by the head to force the friction element 38 upward against the downwardly facing braking surface 30 on the collar 26 of the spindle 16. The friction element 38 therefore tends to retard rotation of the head, and the force with which the friction element 38 is urged against the braking surface 30 will depend upon the pressure of the water supplied to the sprinkler and urging the head 6 upward on the spindle 16. As the water pressure increases the force applied to the friction element and braking surface is also increased, overcoming the increased reaction force tending to rotate the head. The friction element also serves to prevent leakage between the head and spindle and as the water pressure increases the sealing pressure increases preventing leakage between the relatively moving parts.

The pressure of the water on surface 53 of head 6 which tends to raise the head on spindle 16 and tends to increase the braking effect of the friction element and braking surface, is opposed and to some extent balanced by the vertically and

downwardly directed components of the reaction forces applied to the arms and tending to urge the arms and head downward as the water issues from the openings 50 and 56. Therefore by suitably positioning or adjusting the angles of inclination of the openings 50 and 56, the magnitude of the downwardly directed reaction forces may be varied and a balanced relation may be produced which will insure a uniform speed of rotation of the arms and head over a wide range of water pressures. In practice it is preferable to effect this adjustment by varying the position of a single element, and this is accomplished by changing the position of the opening 56 through rotation of the nozzle 52 on the threads 53 at the ends of the arms 8. The position established will depend upon the size and character of the braking element 38 and the braking surface 30, and will be different with each design or group of sprinklers produced. It is therefore desirable to adjust each springler or group of sprinklers independently and when the angle of inclination of the opening 56 for any sprinkler has been determined the nozzle should then be soldered or otherwise secured fixedly in place.

In a typical construction wherein the sprinkler head is provided with two arms extending diametrically from opposite sides of the head 8, openings 50 are spaced one inch apart along the arms and inclined at an angle of 45° from a vertical plane passing through the arms. The projected area of the surface 58 at the top of the cavity 24 was 0.306 square inch, the area of the braking surface 30 engaged by the friction element was 0.275 square inch, and the friction element 38 consisted of a graphite containing resinous washer. The nozzle 52 was adjusted so that the opening 56 was inclined on the opposite side of the vertical plane passing through the arms from the openings 50 and was positioned at an angle of approximately 45°. When this sprinkler is subjected to a water pressure of 10 lbs. per square inch, the total upwardly directed force exerted on the surface 58 is 3.06 lbs., thus the braking pressure exerted on the friction element 38 is about 11 lbs. per square inch. However, the braking force on the friction element is reduced by the downwardly directed weight of the head and arms which is a constant factor and by the opposing downwardly directed components of the reaction forces of the water issuing from the openings 50 and 56 which is a variable force depending upon the pressure of the liquid supplied to the head. The amount of these opposing downwardly directed forces cannot be readily calculated and is dependent upon the adjustment of the inclination of the opening 56 in the nozzle. When the water pressure is increased to 50 lbs. per square inch, the total upwardly directed force exerted on the surface 58 of the head is 15.3 lbs., and the frictional element is subjected to a pressure of 55 lbs. per square inch. In the construction described this would be more than sufficient to overcome the reaction forces tending to increase the speed of rotation of the sprinkler arms and head, but it is opposed by the correspondingly increased downwardly directed vertical components of the reaction forces of the water issuing from the openings 50 and 56, and as a result the arms and head rotate at substantially the same speed under 50 lbs. water pressure as they do when the water is supplied to the sprinkler at a pressure of only 10 lbs.

Due to the number of variables involved in every design of sprinkler including the size,

number and inclination of the openings 50 and 56, the size and character of the braking surface and braking elements which may be used, it is not possible to establish any fixed rule which will apply to any and all constructions and designs of sprinklers embodying the present invention. Nevertheless, it has been found that the best results are attained when the ratio of the area of the surface 58 in the head to the braking surface 30 on the spindle is approximately equal or in the neighborhood of 1.1 to 1.0. Similar ratios can be readily determined for other constructions, designs and arrangements of the arms and discharge openings by simple experiments and calculations, or the ratio suggested may be maintained and adjustment to insure uniformity of rotation can be effected entirely through variation in the angle of inclination of the openings in the arms and nozzle.

At the same time the size of the area throughout which water is distributed can be varied manually since the distance which the water issuing from the outlets of a uniformly rotating sprinkler is projected from the sprinkler varies only with the pressure to which it is subjected. This may be regulated by means of a conventional faucet or valve. Furthermore, by forming the opening 56 in the nozzle 52 so that it is elongated and moves forward in the direction of rotation, the water issues in the form of a fan-like spray and is thus broken up. The area supplied with water therefore can be controlled much more accurately and the water distributed much more uniformly than has been possible heretofore.

In assembling the elements of the sprinkler described the pipe 10 is inserted through an opening 60 in the base 2 and the end thereof which carries ring 14 is positioned adjacent the recessed central portion 4 of the base. Washer 20 is placed between the recessed portion 4 and the ring 14 on pipe 10 while washer 18 and retaining nut 34 with its friction element 38 are placed in the recessed portion 4. Spindle 16 is then passed through the nut 34 and washers 18 and 20 on opposite sides of the bottom of recess 4 as a preliminary assembly and then the threaded end of the spindle 16 is threaded into the ring 14 by means of a wrench inserted into wrench socket 21 at the upper end of the spindle. When suitably tightened the shoulder 19 on the spindle engages washer 18 and serves to clamp the washer 20 against the bottom of the recess in the base so that the spindle, washers and pipe are all secured firmly in place. The rotary head carrying the arms 8 is then slipped over the spindle so that the threads 36 on the boss 32 are engaged with the inwardly facing threads on the recessed retaining nut 34. The retaining nut is then held stationary by means of a wrench inserted through the openings 62 in the recessed portion 4 of the base (Fig. 4) and the head and arms are rotated to thread the retaining nut onto boss 32 and thus complete the assembly of the device.

Rotary sprinklers embodying the present invention may be constructed in various sizes, types and styles and can be produced to rotate at constant speed and to afford uniformity of distribution of liquid throughout a predetermined area without departing from the spirit and scope of the invention. In view thereof the embodiment of the invention herein described and shown in the drawing should be understood as illustrative only and is not intended to limit the scope of the invention.

I claim:

1. A sprinkler comprising a base having a stationary vertical stem with a water supply passage therethrough, a head rotatably mounted on said stem and having a crosswise extending sprinkler arm provided with a passage communicating with said supply passage, said arm having inclined water outlet openings arranged so that jets of water issuing therefrom will cause said arm to rotate in one direction and other outlet openings for issuing jets of water in a direction to oppose such rotation, said head having a substantial downwardly facing area subjected to water pressure, and a friction washer between a downwardly facing surface on the stem and an upwardly facing surface on the head and serving as a brake to resist rotation of the head, the braking effect of said friction washer when acted upon by the differential lifting force of the water pressure on the head and the downward reaction of water issuing from said jets increasing with an increase in water pressure substantially as much as the increase in the rotating torque caused by the differential action of said jets to provide substantially uniform speed of rotation with various water pressures.

2. A sprinkler comprising a base with a vertically extending stationary member thereon formed with a liquid supply passage therethrough, a head rotatably mounted on said stationary member and having a cavity therein communicating with said passage, said stationary member having a downwardly facing annular braking surface and said head having a complementary upwardly facing annular surface thereon located opposite said braking surface, a friction member located between said braking surface and said annular surface and engageable therewith on upward movement of said head to seal the space between said surfaces and to retard rotation of said head, said head having a pair of oppositely extending tubular arms communicating with said cavity and each provided on its outer end with a closure means, said arms having liquid discharge openings therein inclined with respect to a vertical plane passing through said arms and cooperating to cause said head to rotate in a predetermined direction on discharge of liquid therefrom, said closure means having discharge openings therein inclined opposite to the discharge openings in the arms to which they are applied and cooperating with said braking and complementary surfaces to maintain a substantially constant speed of rotation of said head under different pressures of liquid said supplied to said sprinkler.

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