

Filed Feb. 29, 1960

SPRINKLER OSCILLATING MECHANISM

3 Sheets-Sheet 1

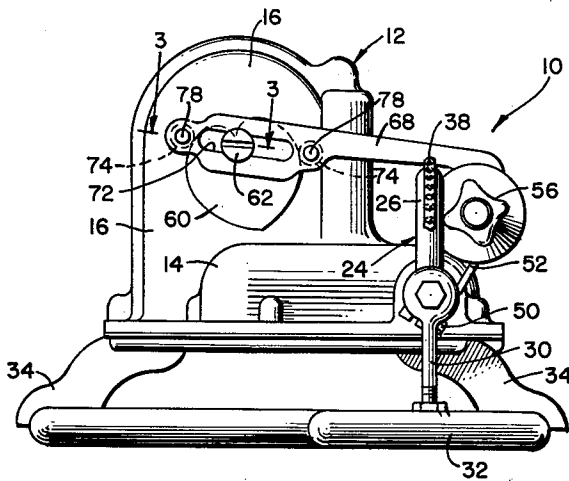


Fig. 1

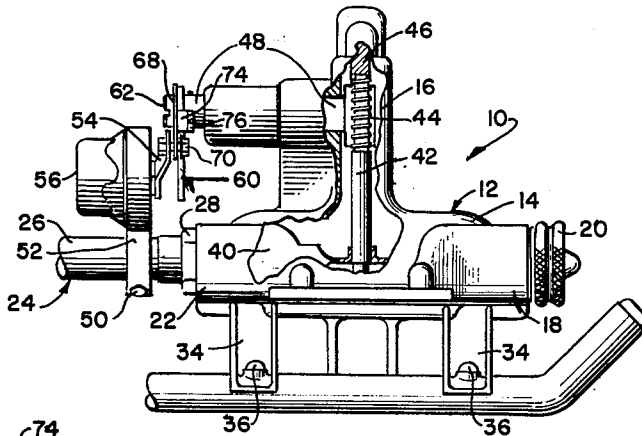


Fig. 2

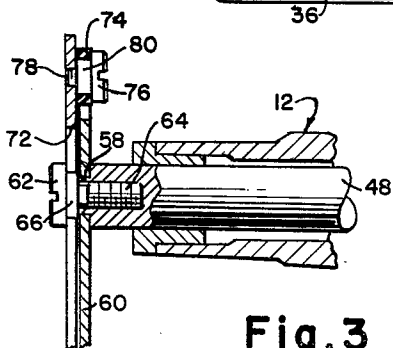


Fig.3

INVENTOR

WALTER W. BALLARD

BY *Lushman, Parley & Lushman*
ATTORNEYS

Nov. 13, 1962

W. W. BALLARD

3,063,646

SPRINKLER OSCILLATING MECHANISM

Filed Feb. 29, 1960

3 Sheets-Sheet 2

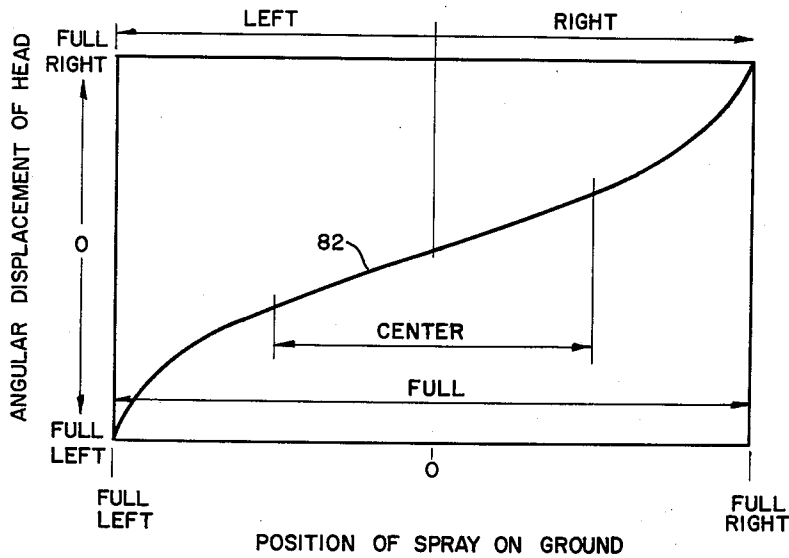


Fig. 4

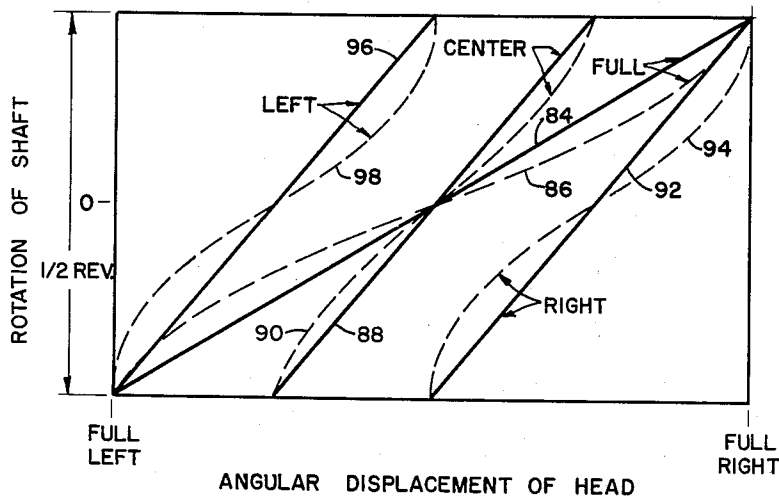


Fig. 5

INVENTOR

WALTER W. BALLARD

BY *Lushman, Darby & Lushman*
ATTORNEYS

Nov. 13, 1962

W. W. BALLARD

3,063,646

SPRINKLER OSCILLATING MECHANISM

Filed Feb. 29, 1960

3 Sheets-Sheet 3

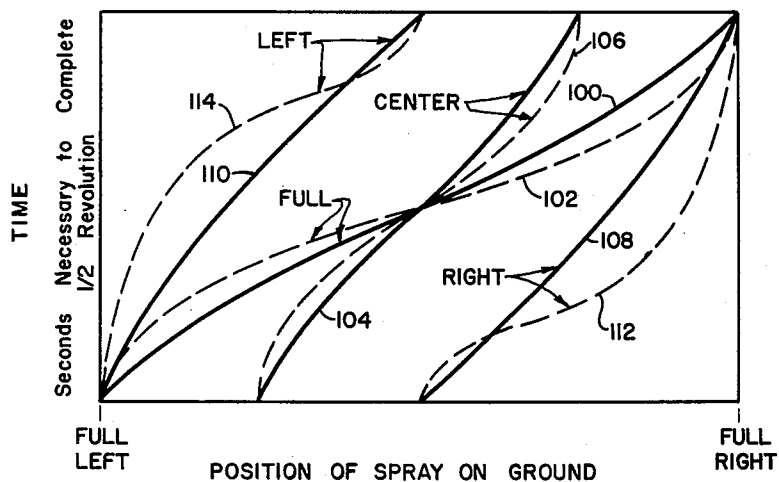


Fig. 6

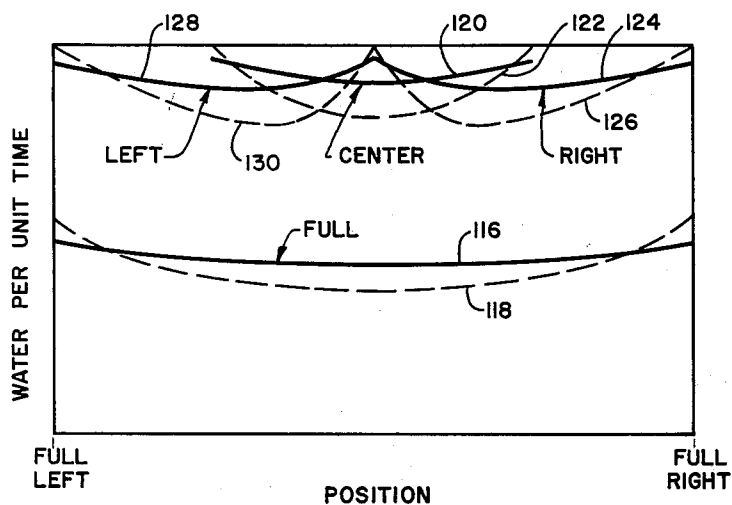


Fig. 7

INVENTOR

WALTER W. BALLARD

BY *Cushman, Darby & Cushman*

ATTORNEYS

1

3,063,646

SPRINKLER OSCILLATING MECHANISM

Walter W. Ballard, Peoria, Ill., assignor to L. R. Nelson
Mfg. Co., Inc., Peoria, Ill., a corporation of Illinois

Filed Feb. 29, 1960, Ser. No. 11,633

5 Claims. (Cl. 239-242)

This invention relates to water sprinklers and more particularly to improvements in water sprinklers of the wave type.

Wave type sprinklers have become quite popular, particularly for use in sprinkling lawns. In general, the wave type sprinklers which are commercially available provide an arcuate-shaped tubular spray head having a series of spaced nozzles or orifices provided thereon. This head is oscillated by suitable mechanism actuated by the pressure of the water being sprayed. While the commercial wave type sprinklers have proven satisfactory, one of the big disadvantages of these sprinklers is that the water distribution pattern is somewhat unequal. This unequal water distribution results from the fact that the sprinkler head is pivotally oscillated by a crank and connecting link which imparts a simple harmonic motion to the oscillatory head. Thus, in operation, considerably more water is distributed at the ends of the pattern than in the middle portion thereof.

An object of the present invention is to provide a sprinkler of the type described having improved means for effecting oscillatory pivotal movement of the sprinkler head at a substantially constant rate of angular movement so as to materially improve the water distribution pattern of the sprinkler.

Another object of the present invention is the provision of a simple but effective cam and cam follower construction between the output shaft of a sprinkler of the type described and the spray head of the same, which cam and cam follower means is operable to effect a substantially constant angular movement of the sprinkler head in response to the rotational movement of the output shaft.

Still another object of the present invention is the provision of a sprinkler of the type described embodying an improved cam and cam follower motion transmitting means which is simple in construction, efficient in operation and economical to manufacture and maintain.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompanying drawings wherein an illustrative embodiment is shown.

In the drawings:

FIGURE 1 is a side elevational view of a sprinkler embodying the principles of the present invention;

FIGURE 2 is a fragmentary front elevational view of the sprinkler with certain parts broken away for purposes of clearer illustration;

FIGURE 3 is an enlarged fragmentary cross-sectional view taken along the line 3-3 of FIGURE 1;

FIGURE 4 is a graph illustrating the relationship between the angular position of the sprinkler head and the distribution of the spray on the ground, the graph indicating the four positions of adjustment of the sprinkler head;

FIGURE 5 is a graph illustrating the relationship of the output shaft of the sprinkler and the angular displacement of the sprinkler head for each of the four adjustments of the sprinkler head, the graph indicating a comparison between the cam and cam follower motion transmitting means of the present invention and conventional crank and connecting link motion transmitting mechanism of the prior art structures;

FIGURE 6 is graph similar to FIGURE 5, illustrating

2

the relationship between the rotational movement of the output shaft and the distribution of the spray on the ground; and

FIGURE 7 is a graph similar to FIGURES 5 and 6 illustrating the relationship between the amount of water distributed and its distribution on the ground.

Referring now more particularly to FIGURES 1-3 of the drawings, there is shown therein a sprinkler, generally indicated at 10, embodying the principles of the present invention. The sprinkler comprises a frame, generally indicated at 12, which provides an impeller housing 14 and a gear housing 16 communicating therewith. The impeller housing 14 is provided with an inlet 18 having a conventional hose fitting 20 mounted therein for connection with a conventional garden hose or the like. The impeller housing 14 is also provided with an outlet 22 which communicates with a sprinkler head, generally indicated at 24.

The sprinkler head 24 preferably comprises a tube 26 having one end journaled in the impeller housing outlet 22, as by a rotary fitting 28. The opposite end of the tube 26 is pivotally supported by an eye bolt 30 fixed in upwardly extending relation to the outer end of a bent tube 32 defining ground engaging runners of the sprinkler. As best shown in FIGURE 2, the bent tube 32 extends beneath the frame 12 and is rigidly secured to legs 34 depending therefrom, as by bolts 36. As best shown in FIGURE 1, the central portion of the tube 26 is formed into an upwardly arcuate configuration and is provided with a series of longitudinally spaced spray orifices or nozzles 38.

The sprinkler head 24 is pivotally oscillated to distribute water to the ground by suitable motion transmitting means actuatable in response to the pressure of the water being sprayed. To this end an impeller 40 is mounted within the impeller housing 14 for rotation in response to the passage of water under pressure through the impeller housing from the inlet 18 to the outlet 22 thereof. Fixed to the impeller 40 and extending upwardly therefrom into the gear housing 16 is a shaft 42 having worm gear teeth 44 formed on the upper end thereof. Disposed in meshing engagement with the worm gear teeth 44 is a pinion 46 which is mounted within the gear housing 16 by means of a shaft 48. As best shown in FIGURE 2, one end of the shaft 48 is disposed within the gear housing 16 and has the pinion 46 suitably fixed thereto. The opposite end of the shaft 48 extends outwardly of the frame 12.

Fixed to the end of the sprinkler head tube 24 adjacent the fitting 28, as by a bolted split sleeve 50, is an arm 52. Rotatably mounted on the outer end of the arm 52 is an adjustment arm 54, the latter being movable into four positions of adjustment, as by a knob 56, to change the spray pattern of the sprinkler head. In general, the four patterns of water distribution provided by the adjusting knob 46 are full, center, left and right as shown on the knob. In order to obtain full distribution, the arm 54 is moved into a position of general alignment with the arm 52, with the outer end of the arm extending toward the sprinkler head tube 26. Center distribution is obtained by moving the arm 54 into a substantially diametrically opposed position from that which obtains full distribution. Right and left patterns of distribution are obtained by disposing the arm 54 at substantial right angles to the arm 52 extending to the left and right, as shown in FIGURE 1, respectively. It will be understood that suitable means (not shown) may be provided between the knob 56 and the arm 52 for retaining the arm 54 in any one of its four positions of adjustment (see, for example, Pat. No. 2,921,474).

In accordance with the principles of the present inven-

tion, motion transmitting means is connected between the outer end of the shaft 48 and the arm 54 for effecting a substantially constant angular movement of the sprinkler head 24 in response to the rotational movement of the shaft 48. To this end, the outer extremity of the shaft 48 is provided with an angular projection 58, as for example, a projection of square cross-sectional configuration. The projection 58 engages within a corresponding angular opening formed in a symmetrical heart-shaped cam plate 60. The cam plate 60 is retained on the extremity of the shaft 48 by means of a headed bolt 62 having an inner shank end portion 64 threadedly engaged within the end of the shaft 48 and an enlarged outer shank end portion 66 providing a smooth cylindrical surface.

Extending between the shaft 48 and the arm 54 is a connecting link 68, one end of which is pivotally connected to the outer end of the arm 54, as by a pin 70. The opposite end of the connecting link 68 is provided with a longitudinally extending elongated slot 72 which receives the cylindrical end portion 66 of the bolt 62. As best shown in FIGURE 3, the head of the bolt 62 engages the outer surface of the connecting link and prevents the same from moving off of the cylindrical shank portion 66.

Suitably mounted on the connecting link 68 adjacent the ends of the slot 72 is a pair of cam follower elements in the form of rollers 74. As best shown in FIGURE 3, each cam roller is mounted on the connecting link by means of a headed bolt 76 having an outer end shank portion 78 threadedly engaged within the connecting link and an enlarged inner shank end portion 80 providing a smooth cylindrical periphery for rotatably receiving the associated roller 74. Preferably, the roller 74 is made of nylon, although any suitable material may be employed.

As best shown in FIGURE 1, the cam 60 is of symmetrical heart-shaped configuration and the rollers 74 engage the periphery of the cam at substantially diametrically opposed positions with respect to its axis of rotation. As shown, the periphery of the cam is formed so as to effect a substantially constant displacement of the connecting link for each increment of shaft rotation. Thus, a constant angular displacement of the sprinkler head 24 is effected in response to the rotation of the shaft 48.

In operation, it will be understood that the fitting 20 is connected to one end of a garden hose, the opposite end of which is connected to a source of water under pressure. The water under pressure entering the inlet 18 imparts a rotary movement to the impeller 40 as it passes through the impeller housing 14 and then out through the outlet 22 into the sprinkler head tube 24, from which it passes through the nozzles 38 in a series of jet streams. Rotation of the impeller will, in turn, rotate the worm gear teeth 44 which in turn imparts a rotary movement to the pinion 46 and shaft 48. As indicated above, the rotary movement of the shaft 48 will impart a substantially constant angular movement to the sprinkler head tube 26. The particular range of oscillatory pivotal movement imparted to the sprinkler head is determined by the position of adjustment of the arm 54.

Referring now more particularly to FIGURE 4 of the drawings, there is shown therein a graph which illustrates a curve 82 such as would be obtained by plotting the angular displacement of the sprinkler head against the position at which the jet streams will strike the ground. It will be noted that this curve constitutes a portion of a sine wave since a given angular displacement of the sprinkler head near a central vertical position will result in covering a greater ground increment than the same increment of angular displacement will cover when the sprinkler head is at either of its extreme nearly horizontal positions.

FIGURE 4 illustrates the curve obtained when the adjusting arm 54 is disposed in its full position and the portions of this curve which are applicable when the adjusting arm is disposed in its center, left and right positions are also indicated.

FIGURE 5 illustrates the curves obtained by plotting the rotation of the shaft against the angular displacement of the head for each of the adjusted positions of the sprinkler. It will be noted that when the arm 54 is in its full position a substantially straight line curve 84 is obtained which extends from the full left position of the sprinkler head to the full right position thereof. Superimposed upon the curve 84 is a dotted line curve 86 which illustrates simple harmonic motion relationship between a rotating output shaft and the angular movement of the sprinkler head such as is provided by conventional sprinklers embodying a crank and connecting rod. It will be noted that this same comparison is also evident from the straight line curve 88 obtained by the present arrangement and the sine curve 90 obtained by the conventional arrangement when the arm 54 is disposed in its center position. Similar curves 92 and 94, and 96 and 98 are shown for the right and left positions of the adjusting arm 54 respectively.

FIGURE 6 shows a graph which is obtained by adding the effects of the graphs shown in FIGURES 4 and 5. In FIGURE 6 curves are obtained by plotting the time necessary to complete a half revolution of the output shaft against the position of the jet streams on the ground. It will be noted that when the adjusting arm 54 is disposed in its full position, a shallow sine wave curve 100 shown in full lines in FIGURE 6 is obtained by the arrangement of the present invention. The curve 100 shows that while a constant angular displacement of the sprinkler head is imparted by the cam and cam follower means arrangement in response to the rotation of the output shaft, the actual distribution of the jet streams on the ground varies due to the effect illustrated in FIGURE 4. It will be noted, however, that this uneven effect is multiplied when the head is moved angularly by a simple harmonic motion as with a conventional arrangement. Under these circumstances, a sharp sine wave curve 102 is obtained, as shown in dotted lines in FIGURE 6. This same comparison is also apparent when the adjusting arm 54 is disposed in its center position. Thus, with the present arrangement a shallow sine wave curve 104 is obtained as shown in solid lines in FIGURE 6. The conventional arrangement provides a rather steep sine wave curve 106, such as shown in dotted lines in FIGURE 6.

It will be noted that when the adjusting arm 54 is moved to its right or left position of adjustment the cycle of angular movement of the sprinkler head is imposed on only one half of the full cycle of ground spray as shown in FIGURE 4. Thus, with the present arrangement substantially shallow curves 108 and 110 are obtained which correspond generally to the corresponding half of the sine wave shown in FIGURE 4. However, where a conventional simple harmonic motion is imposed on the left and right hand half of the curve shown in FIGURE 4, there results an extreme condition as illustrated in dotted lines at 112 and 114. Thus, in the left position the effect of the simple harmonic motion is to increase the inequality of water distribution when the sprinkler head is at its full left position and to somewhat compensate for it as it approaches the center position. Of course, the opposite is true when the arm 54 is disposed in its right position.

It can be seen that by integrating the curves shown in FIGURE 6 by plotting the slope of the curve the amount of water sprayed per unit time on any given ground position can be obtained. The curves thus obtained are shown in FIGURE 7 and it will be noted that since the curve 100 of FIGURE 6 more nearly approaches a straight line, the distribution curve illus-

trated at 116 in FIGURE 7 when the adjusting arm 54 is in its full line position is more nearly horizontal than the corresponding dotted line curve 118 obtained with the use of a conventional sprinkler. This same comparison is also evident when the sprinkler head is oscillated in its center position cycle shown by solid line curve 120 and dotted line curve 122. The distribution curve of the present arrangement when the adjusting arm is disposed in its right position is illustrated by the solid line curve 124 and the comparable curve obtained by the conventional sprinkler is shown in lines at 126. The left position of adjustment curves are illustrated in solid lines at 128 and in dotted lines at 130 respectively.

It can be seen that by utilizing the present cam and cam follower motion transmitting means a more equal distribution of water on the ground is obtained than with the use of conventional sprinkler apparatus. The cam 60 as shown is designed to give a substantially constant angular movement to the sprinkler head in response to the rotation of the shaft 48. This design is preferred, since it tends to level out all of the distribution curves for all of the various positions of adjustment of the adjusting arm 54. The cam could be designed to impart a greater angular displacement of the sprinkler head as it moves through its mid-position than at its ends, so that more nearly straight line curves would be obtained in FIGURE 6 when the sprinkler is in its full and center positions. In other words, the cam could be shaped to offset the sine curve of FIGURE 4. However, it will be noted that in the left and right positions, such a cam would not result in curves which are more nearly straight than the curves 108 and 110 shown in FIGURE 6. Consequently, a constant angular movement cam design as shown is preferred because the mid-position of the sprinkler head constitutes the end of its oscillation.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of this invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. In a sprinkler of the type including a frame having an impeller housing provided with an inlet for connection to a source of water under pressure and an outlet, an impeller mounted in said housing for rotation in response to the passage of water under pressure through said housing from said inlet to said outlet, spray nozzle means pivotally mounted on said frame and connected with said impeller housing outlet, a shaft journaled in said frame and extending outwardly therefrom, means within said frame drivingly connecting said shaft with said impeller whereby rotation of the latter will effect rotation of said shaft, and motion transmitting means operatively connected between the outwardly extending end of said shaft and said spray nozzle means for effecting oscillatory pivotal movement of said spray nozzle means in response to the rotation of said shaft, the improvement which comprises said motion transmitting means including a connecting link having one end pivotally connected with said spray nozzle means in spaced relation to the pivotal axis thereof, the opposite end of said link having a longitudinally extending slot formed therein, guide means on the outer extremity of said shaft engaging within said slot, a symmetrical heart-shaped cam plate fixed to the outer end of said shaft adjacent said guide means, and a pair of rollers carried by said link adjacent the ends of said slots engaging the periphery of said cam plate at substantially diametrically opposed positions thereon, said cam plate being shaped to effect a substantially constant angu-

lar movement of said spray nozzle means in response to the rotation of said shaft.

2. In a sprinkler comprising a frame defining an impeller housing and a gear housing communicating therewith, said impeller housing having an inlet for connection to a source of water under pressure and an outlet, ground engaging runner means fixed to said frame beneath said housing and extending outwardly therefrom, an impeller mounted in said impeller housing for rotation in response to the passage of water under pressure through said impeller housing from said inlet to said outlet, an arcuate tube having its ends mounted respectively on said frame and the outwardly extending end of said runner means for pivotal movement about a substantially horizontal axis, the end of said tube connected with said frame being open and communicating with said impeller housing outlet, the opposite end of said tube being closed, said tube having a plurality of spray orifices formed therein in spaced relation between the ends thereof, a shaft journaled in said frame about an axis substantially parallel to the pivotal axis of said tube and having one end extending within said gear housing and an opposite end extending outwardly of said frame, gear means within said gear housing drivingly connected between said impeller and said one shaft end to effect rotation of said shaft in response to rotation of said impeller, an arm pivotally connected with said tube for movement about an axis parallel with the pivotal axis of said tube into different positions of angular adjustment with respect to the latter, and a connecting link pivoted to said arm in spaced relation to its pivotal axis, the improvement comprising cam means and cooperative cam follower means between the outwardly extending end of said shaft and the opposite end of said link, said link including an elongated longitudinal slot at its end opposite said pivot connection and operatively connected to said cam means providing both longitudinal reciprocating and pivotal movement thereof to provide a substantially constant angular movement of said tube in response to the rotation of said shaft.

3. A sprinkler as defined in claim 2 wherein said cam and cam follower means comprises a symmetrical heart-shaped cam fixed to the outwardly extending end portion of said shaft, a guide element on the extremity of said outwardly extending shaft end, the said link slot receiving said guide element, and a pair of cam follower elements carried by said link adjacent the ends of said slot engaging the periphery of said heart-shaped cam at substantially diametrically opposed positions thereon.

4. A sprinkler as defined in claim 3 wherein said guide element comprises a bolt having a head and a shank extending therefrom, the outer end portion of said shank being threadedly engaged within said shaft, the portion of said shank adjacent said head providing a smooth cylindrical periphery engaged within said slot.

5. A sprinkler as defined in claim 3 wherein each of said cam follower elements comprises a bolt having a head and a shank extending therefrom, the outer end of each shank being threadedly engaged within said link, the portion of each shank adjacent the associated head providing a smooth cylindrical periphery, and a roller mounted on each cylindrical shank portion engaging the periphery of said cam.

References Cited in the file of this patent

UNITED STATES PATENTS

774,496	Rivett	Nov. 8, 1904
2,006,498	Dassett	July 2, 1935
2,034,404	Lubberhuizen et al.	Mar. 17, 1936
2,921,474	Ballard	Jan. 19, 1960

FOREIGN PATENTS

602,019	Germany	Aug. 29, 1934
763,655	Germany	Feb. 28, 1955