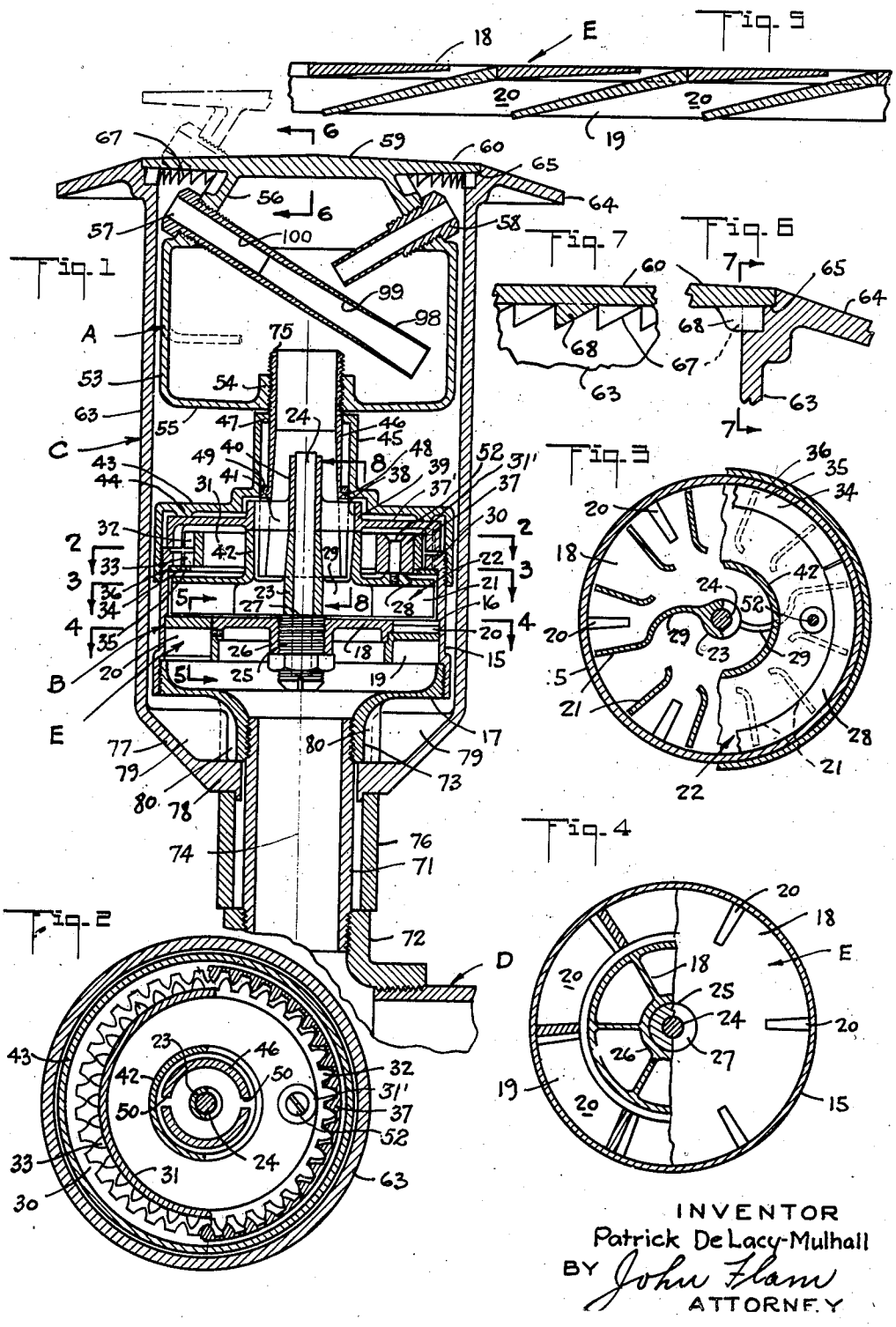
Aug. 26, 1941 P. DE LACY-MULHALL 2,253,979

SPRINKLER HEAD

Filed April 19, 1938 2 Sheets-Sheet 1



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SPRINKLER HEAD

Filed April 19, 1938 2 Sheets-Sheet 2

Fig. 9

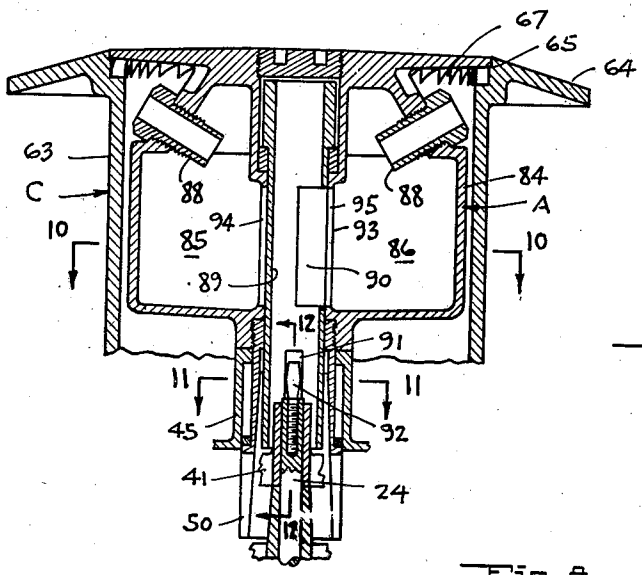


Fig. 11

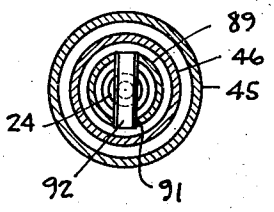


Fig 12

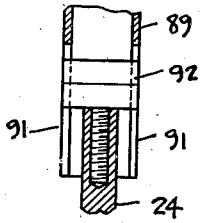


Fig. 8

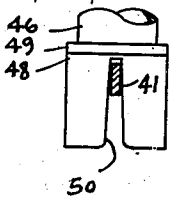


Fig. 10

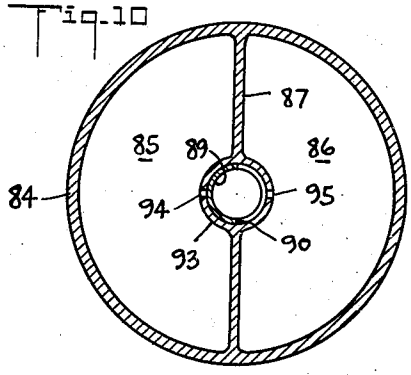


Fig. 13

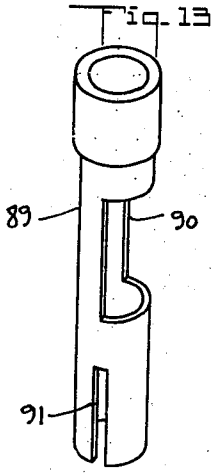
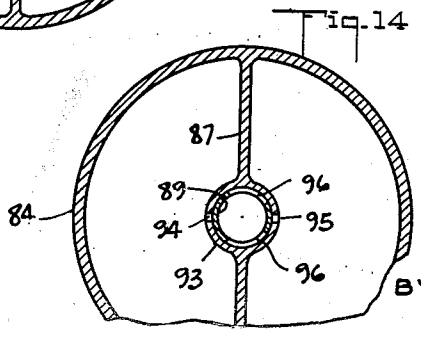


Fig. 14



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Patented Aug. 26, 1941 2,253,979

UNITED STATES PATENT OFFICE

2,253,979

SPRINKLER HEAD

Patrick De Lacy-Mulhall, Los Angeles, Calif., assignor to Katherine De Lacy-Mulhall, widow of Patrick De Lacy-Mulhall, deceased, by court order and decree

Application April 19, 1938, Serial No. 202,854

14 Claims. (Cl. 299—67)

This invention relates to a sprinkler head, and more particularly to one that is adapted to be used for irrigation purposes, as for agricultural purposes, parks, golf courses, etc.

In a prior application filed in the name of Patrick De Lacy-Mulhall, on November 3, 1934, for System for irrigation, under Serial No. 751,402, there is described a head of this general character. The present invention is an improvement over that described in said prior application.

In said prior application, a head is provided which is adapted to be rotated by the flow of water under pressure, which emerges in a trajectory from one or more nozzles connected with the head. It is an object of this invention to provide a simple and efficient drive means for the head, operated by the flowing water.

It is another object of this invention to provide a rotary sprinkler head operative only over a fraction of each revolution of the head. Such an arrangement may be advantageous where the head is near a wall or a road, which it is not desired to wet. This effect is obtained in the present instance by a simple valve mechanism.

The trajectory of the water stream, as in the prior application, may be extended by virtue of the proper choice of area of the channels through which the water flows as it passes into the nozzles.

The head as described herein is capable of being elevated during its period of activity. This elevation is accomplished by the water pressure. It is another object of this invention to provide a "pop-up" structure for the head that causes the trajectories of the water stream readily to clear the walls of the recess in which the head may rest in retracted position; and yet, when the period of activity terminates, the head forms no obstructions to the passage of vehicles or for pedestrians.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a central vertical section through a complete sprinkler;

Figs. 2, 3 and 4 are cross sections as seen on correspondingly numbered planes of Fig. 1, the outer cage or housing being omitted from the latter two figures;

Fig. 5 is a developed section on an enlarged scale as seen on the surface of a cylinder 5—5 of Fig. 1;

Fig. 6 is a detail section as seen on plane 6—6 of Fig. 1;

Fig. 7 is a section as seen on plane 7—7 of Fig. 6;

Fig. 8 is a detail section as seen on plane 8—8 of Fig. 1;

Fig. 9 is a fragmentary section, similar to Fig. 1, but showing a modified form of sprinkler;

Fig. 10 is a cross section as seen on plane 10—10 of Fig. 9;

Figs. 11 and 12 are detail sections as seen on correspondingly numbered planes of Fig. 9;

Fig. 13 is an isometric view of a detail of the structure of Fig. 9; and

Fig. 14 is a cross section similar to Fig. 10, but showing a further modification of the sprinkler.

Referring to the form of the invention shown in Figs. 1 to 8, the sprinkler may be conveniently described as including the rotary and axially movable head A, a motor B connected to the head, and adapted to rotate the head, and a housing or cage C which encloses the head as well as the motor. The cage is placed in the ground with its upper end at or about the surface of the ground, and the motor B as well as the housing C are both attached to and supported by the water supply pipe D. The arrangement is such that when the head A is resting within the housing C, it is held against rotation, but when water under pressure is admitted to the sprinkler, the head A is projected from the housing sufficiently to allow the streams from the sprinkler nozzles to clear the side of the housing C, and is also released so as to be rotated by the motor B. When the flow of water is checked, the head A returns to its original position within the housing C and is again held against rotation.

Since the water which is discharged from the head A must first pass through the motor B to rotate the head, it is evident that the smaller the amount of velocity and pressure which the water must give up to drive the motor, the greater will be the velocity and pressure effective at the sprinkler nozzles. Thus a motor of high efficiency and a driving connection between the

motor and head which has a low friction loss, are both desirable.

The driving connection includes a novel arrangement of gearing, permitting a large ratio of reduction between the motor B and the head A, and having at the same time a minimum number of moving parts, thereby assuring a low friction loss. A motor of high efficiency is provided by providing a novel form of Venturi nozzle in connection with a bucket wheel.

The non-rotary nozzle structure E (Figs. 1, 4 and 5) is of substantially circular form, substantially coaxial with the upright supply conduit 71 that is connected to the supply pipe D. The nozzle structure is firmly supported in the motor casing 15 by being clamped against a shoulder 16 therein by the lower flange member 17 of the casing. The nozzle structure E is formed of upper and lower members 18 and 19 respectively, defining in this instance six nozzle openings 20, each having an axis oblique to the top surface of the nozzle structure, and directing fluid in a tangential direction. By making the nozzle structure in two parts, it is possible to use castings for the parts, since the parts necessary to form the nozzle openings 20 can then be readily cast without cores. The upper part 18 is shown in this instance as relatively shallower than the lower part 19. Further, it is possible to install upper and lower members 18 and 19 of different proportions, whereby larger or smaller nozzles 20, or a number of such nozzles other than that shown, may be readily provided to suit any of various sized discharge nozzles which it may be desired to use in the head. Thus the sprinkler can be used with all ranges of water distribution.

Water entering the bottom of casing 15 will be constrained to pass upwardly through nozzle structure E and emerge from openings 20 adjacent the periphery of the structure, where it acts against blades 21 (Figs. 1 and 3) of a bucket wheel 22 to cause the latter to rotate. The bucket wheel 22 has an integral hub 23 rotatably mounted on a vertical stub shaft 24. This shaft is suitably secured in a member 25 which is threaded supported in hub 26 formed in the upper nozzle plate 18. The upper surface 27 of member 25 is arranged to support the bucket wheel 22 by means of hub 23, whereby the paddles 21 are maintained out of contact with the surface of plate 18. By vertical adjustment of member 25, the bucket wheel 22 may be so positioned with respect to the nozzle plate 18 and nozzles 20 as to obtain optimum motor efficiency.

Bucket wheel 22 has an upper annular web or flange 28 to which the blades 21 are attached. Some of the blades may be extended inwardly, as at 29, and joined to hub 23 to form spokes for the wheel structure. Web 28 has an upwardly extending annular flange 42 spaced from the hub and forming an axial discharge passage for the water as it leaves the blades. The bucket wheel 22 fits the inside of casing 15 with a very small clearance. Thus there is no tendency for water to escape around the periphery of the wheel upwardly into the gears. Instead, the water is all directed to the central discharge opening or flange 42.

Wheel 22 is arranged to rotate the sprinkler head A at slow speed through reduction gearing of improved and simplified form. Thus a stationary internal gear 30 is provided near the upper end of casing 15 and may be integral therewith as shown. A floating ring gear 31 having upper and lower rows of axially spaced teeth forming gear members 32 and 33 respectively, is supported with its lower gear member 33 alined with gear 30 by means of an annular shoulder 34 in casing 15. For convenience in manufacture, this shoulder may be formed of a split ring 35 sprung into a recess 36 in the casing. Gear member 33 of ring 31 is sufficiently less in diameter than gear 30, so that when the teeth of these gears are meshed at one point, they are disengaged at a point diametrically opposite. Gear 33 has a slightly different number of teeth than gear 30; accordingly successive teeth of gear 33 are caused to progressively engage the teeth of gear 30. Gear 31 will be rotated about its axis, the direction and amount of this rotation depending on the relative number of teeth in the ring gear 31 and the stationary gear 30.

The successive engagement of gear teeth is accomplished by imparting a rolling motion to gear 31 relative to gear 30. This can be conveniently done by means of an eccentrically mounted roller 31' (Fig. 2) carried on web 28 of the bucket wheel 22 by a screw 52 and contacting the inner cylindrical surface of gear 31. Rotation of the bucket wheel 22 is such as to carry the roller in a counter clockwise direction as indicated by the adjacent arrow. If the gear member 33 has for example one less tooth than gear 30, then ring 31 will have a progressive movement about the axis in the same direction as the bucket wheel and at greatly reduced speed.

To transmit this motion to the sprinkler head A and also to provide further reduction in the speed, an internal gear 37 is supported for rotation on shaft 24 and in engagement with the upper gear 32 of ring gear 31. This pair of gears is arranged to permit relative rolling motion between them, the same as in the lower pair of gears. By appropriate choice of the number of teeth in the gear 37, the eccentric motion of gear 31 about the axis may be caused to impart a rotation of gear 37 about its supporting shaft 24, in the same direction and at a reduced speed. Ring gear 37 has a web or flange 37' with a large central opening 38 surrounded by a flange 39, and a hub 40 joined to flange 39 by a pair of oppositely extending spokes 41 (Fig. 8), which form the driving connection to the head A.

Gear 37 is supported by its hub 40 resting on hub 23 of the bucket wheel, as well as by flange 39 resting on flange 42 of the bucket wheel. Casing 15 has an upper closure member 43 which may be conveniently attached to the casing by screw threads and has an annular pad 44 which engages the upper side of gear 37 so as to maintain it against accidental upward displacement. Cover 43 has a central tubular extension 45 within which a depending tubular extension 46 from the head A is free to move. Shoulders 47 and 48 respectively on the extensions cooperate to limit upward movement of the head. A packing ring 49, which may be of copper or brass, between the extensions, serves to prevent leakage.

The lower portion of tube 46 is slotted as at 50 (Fig. 8) to receive the spokes 41. Thus rotation of gear 37 is effective to rotate the tube 46 with head A, but these are at the same time free to move axially. Flanges 42 and 39, together with tube 46, define an axially extending passageway through the reduction gearing for the water from the motor to the bowl carrying the discharge nozzles.

The sprinkler head includes a cylindrical member or bowl 53 threadedly secured to the upper

part of tube 46 by a central hub 54 on its bottom wall 55. The upper part of the bowl has a frustoconical portion 56 of reduced diameter, in the walls of which are disposed the oppositely directed nozzles 57 and 58. The top of the bowl is closed by a flat head 59, which may be integral with the rest of the bowl and has a flat annular extension 60.

The pressure of the water effective in bowl 53 acts on the bottom of cover 59 to raise the bowl until ring 49 engages flange 47.

Since the sprinkler is intended to be placed if desired in the ground with the top of the head approximately on a level with the surface thereof, it is necessary that some means be provided to keep the soil from hindering the movements of the head. Accordingly a soil cage or housing C is provided which includes a cylindrical portion 63 within which the sprinkler head A and the motor casing are enclosed. The top of this housing has a sloping flange 64 surrounding it, and an internal ledge 65 upon which the outer edge of the extension is adapted to rest. Thus, when the sprinkler is not operating and the head is in its retracted position, the housing C is entirely closed against ingress of dirt and the like. Further, the head A is supported by the housing entirely free of the motor, so that the weight of a heavy object, such as a tractor passing over the sprinkler, will not injure it.

To guard against possible rotation of the head A by the passage of a tractor over it, or from any other undesired cause, with consequent damage to the gearing, means are provided to restrain the head against rotation when in its retracted position. Thus, a plurality of teeth 67 are formed in housing 63, adjacent ledge 65, adapted to be engaged by a tooth 68 formed on the annular flange 60 of the head 53. Since the head A might stop rotating with tooth 68 midway between adjacent teeth 67, which would prevent the head sinking to its fully retracted position, the teeth are inclined downwardly in the direction of rotation of the head. Thus, if when the head comes down, tooth 68 strikes the top of one of the teeth 67, the inclined surfaces will cause the upper tooth to slide relative to the lower tooth, turning the head slightly further in its usual direction of rotation, until the teeth are fully engaged, as shown in Fig. 7. Further rotation in the normal direction will be prevented by the engagement of the abrupt faces of the teeth. Rotation in the opposite direction is opposed by the inclined engaging faces of the tooth. Any tendency to rotate the bowl so as to move the abrupt faces of the teeth apart, would produce a tendency to lift the head. But any object resting on the bowl and tending to cause such rotation would impose sufficient weight to prevent such lifting of the bowl.

The sprinkler is connected to the water supply pipe D by means of the short nipple 71, which threadedly engages a T or other suitable fitting 72 in the supply line. The other end of nipple 71 is threaded into an extension 73 formed on the lower cover 17 of motor casing 15.

A brief study of Fig. 1 will show that careful provision has been made to assure an unhindered flow of water through the sprinkler by arranging everything coaxial with respect to a common axis 74. Thus the water entering through nipple 71 is spread out and passed through nozzles 20 and bucket wheel 22. It is then brought together again and passed through the tubular extension on the bucket wheel, thence through tube 46 into bowl 53. One of the nozzles, as 57, has an extension 98 within the head reaching substantially across the bowl 53. This, together with the extension 75 of tube 46 within the bowl, effectively prevents "short circuiting" of the water flow to either of the nozzles and enhances the velocity of the water leaving the nozzles in accordance with Bernauli's theorem, as discussed in the above identified prior application.

It will be noted that extension 98 of nozzle 57 has a tapered bore 99 merging at its smaller end into a straight portion 100, which forms the discharge. The length of the straight portion is a substantial portion of the length of the tapered portion, by which means the spray is maintained in a solid beam for a greater distance from the head than would otherwise be the case.

A convenient way of supporting the housing C with respect to the sprinkler is by means of a spacer 76, which may be a short piece of pipe, resting on T 72. The lower end of the housing C is tapered inwardly at 77 to a collar 78 of reduced diameter which closely fits nipple 71 and is clamped between hub 73 and spacer 76. The housing 63 has a pair of inwardly extending lugs 79 adjacent the collar 78, which are adapted to engage projections 80 formed on the outside of hub 73 of cover 17. The engagement of these lugs and projections makes it possible to turn cover 17, together with all its attached parts, by turning housing C. Thus, by turning housing C in a direction to tighten cover 17 on nipple 71, has also the result of clamping collar 78 more tightly between spacer 76 and hub 73. Turning housing C in the opposite direction loosens cover 17 on the nipple 71 and will enable its removal therefrom, as well as from the housing, and removal of the housing.

The sprinkler just described irrigates the entire area of a circle described by the streams from the nozzles as the head rotates. It may often be desirable to irrigate only a portion of the circle, as for instance when the sprinkler is located adjacent a road or walk, or near the property line. Or it may be desirable to have certain parts of the circle receive no water. This may be readily accomplished by providing a valve structure arranged to admit water to the discharge nozzles only when they are in position to reach the desired area, the valve structure being operated by the rotation of the sprinkler head. Figs. 9 to 14 illustrate a modification of the sprinkler incorporating such a valve.

Referring to Fig. 9, this shows the upper part of a sprinkler having a head A arranged to be rotated and moved axially, as by the aid of mechanism such as shown in Fig. 1. Housing C also includes means to restrain the head against rotation when in its retracted position. In this form, however, the head proper or bowl 84 is divided into two sections 85, 86 as by a transverse wall 87 (Fig. 10). Each of the bowl sections has a discharge nozzle 88, and means are provided such that when the rotation of the bowl brings either nozzle in position to irrigate the desired area, water will be admitted to it until it passes from this area. Thus, a valve tube 89 having a cut-out portion 90, corresponding in angular extent and position with the desired portion of the area to be watered, is mounted axially of bowl 84, being maintained against rotation by slots 91 engaging a T headed key 92 threadedly secured in the upper end of stub shaft 24. Bowl 84 has a central hub 93 embracing the valve tube 89 and provided with ports 94, 95. The nozzles

88, as well as ports 94, are all located on a common diameter of the bowl. As long as one of the ports 94 or 95 is passing the cut away part 90 of tube 89, water from the tube will be admitted into the associated section 85 or 86 of the bowl, and thence discharged through the nozzle 88 of that section. As soon as rotation of the bowl carries the port 94 past opening 90, flow of water will cease.

Figs. 9, 10 and 13 show the valve arrangement for a sprinkler to water one-half of a circle, or a "half turn sprinkler." Thus, opening 90 is approximately 180° in extent. Water is flowing into section 86 through port 95, but no water is flowing into section 85, since port 94 is passing over the wall of tube 89. With the parts in the positions illustrated, the right hand nozzle 88, discharging from section 86, has already watered about half or 90° of the desired area, and the rotation of the head will permit this watering to continue for another ninety degrees, when port 95 will pass out of communication with tube 89. At this point, however, port 94 will pass onto opening 90 and admit water into section 85, which will be discharged through its nozzle 88. This condition will prevail for a half turn of the bowl, when the communication to section 85 will be interrupted, and communication to section 86 will be re-established.

The area which is watered may be made of any desired angular extent other than 180° by the simple expedient of making opening 90 of a corresponding angular width. Or by making a number of openings 96 corresponding to opening 90, as shown in Fig. 14, it is possible to provide irrigation for a number of sectors, separated by areas which are not watered.

What is claimed is:

1. In a sprinkler structure, a housing, a rotatable and axially movable head in the housing, and means including teeth respectively carried by the housing and the head and adapted to interengage when the head is lowered to restrain rotation of the head, said means serving to impart limited rotational movement to the head as the head approaches its lowermost position.

2. In a sprinkler structure, a housing, a head in the housing, said housing and said head forming relatively rotatable as well as relatively axially movable members, and interengaging means between the housing and the head for restraining rotation of the head except while the head is raised axially, said interengaging means including a ratchet formed on one of said members and means on the other of said members for cooperating with the ratchet.

3. In a sprinkler structure, a housing, a rotatable and axially movable head in the housing, and means restraining rotation of the head except while the head is raised axially with respect to the housing, said means including a pair of inclined surfaces, respectively on the housing and the head, adapted to interengage as the head is lowered and impart limited rotational movement to the head, the inclination of said surfaces being such that said rotational movement is in the direction of the normal rotation of the head.

4. In a sprinkler structure, a hollow housing, and a rotatable sprinkler head in the housing and adapted to be placed in communication with a conduit, said housing having a lower extension surrounding the conduit, said housing being adapted to enclose a hydraulic motor for rotating the head, said motor having a casing connected to the conduit, said casing serving to secure said lower extension in position about the conduit.

5. In a sprinkler structure, a hollow housing, and a rotatable sprinkler head in the housing and adapted to be placed in communication with a conduit, said housing having a lower extension surrounding the conduit, said housing being adapted to enclose a hydraulic motor for rotating the head, said motor having a casing detachably connected to the conduit, said casing when connected to the conduit serving to restrain the housing with respect to the conduit.

6. In apparatus of the character described, a rotary sprinkler head, a hydraulic motor for rotating said head, and reduction gearing connecting the motor and the head, comprising a floating ring gear, an internal gear operatively connected to the head and in driving relation to the ring gear, and means mounted eccentrically with respect to the axis of the motor, for causing the ring gear to engage the internal gear neighboring said means.

7. In apparatus of the character described, a rotary sprinkler head, a hydraulic motor, including a casing for rotating said head, and reduction gearing connecting the motor and the head, comprising a floating ring gear, an internal gear in driving relation to the ring gear, and operatively connected to the head, a stationary internal gear secured to the casing and also in driving relation to the ring gear, and an eccentric pin device carried by the motor for urging the ring gear into engagement with both internal gears.

8. In a rotary sprinkler structure, a hollow head having a central hub and a partition wall connected to the hub for forming a plurality of chambers in the head, nozzle structures respectively in communication with the chambers, and a non-rotary hollow member telescoping in the hub, and adapted to be in communication with a source of liquid supply, said hub and member being provided with ports to cause liquid to flow into the head between definite relative angular positions of the head and said hollow member.

9. In a sprinkler structure, an axially movable and rotatable head having one or more discharge nozzle openings, means for controlling the flow of liquid into the head, comprising a non-rotary hollow member, and a member telescoping with the non-rotary member and joined to the head to rotate with respect to the non-rotary member, there being passages formed in the said members adapted to aline for the passage of liquid therethrough during at least a part of a revolution of the head, and means whereby the pressure of the liquid in the non-rotary member is effective to move the head axially.

10. In a rotary sprinkler structure including an axially movable and rotatable head having one or more discharge nozzle openings, comprising a non-rotatable tube telescoped within a member joined to the head to rotate therewith, there being ports formed in the member and the tube adapted to be alined for the passage of liquid therethrough during at least a part of a revolution of the head, means whereby the pressure of the liquid in said tube is effective to move the head axially and a connection between the head and the tube to prevent relative axial movement.

11. In a device of the character described, a rotatable sprinkler head having a central hub and an axial tubular extension forming an inlet for the head, said head having a partition wall con-

nected to the hub for forming a plurality of chambers in the head, a non-rotary hollow member telescoping in the hub and said extension, a water wheel connected to said extension and discharging into the extension and said hollow member, said hub and member being provided with ports to cause liquid to flow into the head between definite relative angular positions of the head and the hollow member.

12. In a device of the character described, a rotatable and axially movable sprinkler head having a central hub and an axial tubular extension forming an inlet for the head, said head having a partition wall connected to the hub for forming a plurality of chambers in the head, a non-rotary hollow member telescoping in the hub and secured against axial motion relative thereto, and adapted to form an inlet from the extension into the head, said hub and member being provided with ports to cause liquid to flow into the head between definite relative angular positions of the head and the hollow member, and a closure for the member whereby pressure of liquid in the member is effective to move the head axially.

13. In a device of the character described, a rotatable and axially movable sprinkler head having a central hub and an axial tubular extension forming an inlet for the head, said head having a partition wall connected to the hub for forming a plurality of chambers in the head, a non-rotary hollow member telescoping in the hub and cooperating therewith to form a valve controlling the flow of liquid to said chambers, and means whereby the pressure of liquid in said member is effective to move the head axially independently of the flow of liquid to said chambers.

14. In apparatus of the character described, a hydraulic motor including a bucket wheel and a nozzle structure having means forming a nozzle adapted to discharge into said bucket wheel as well as means for rotatably supporting said bucket wheel adjacent the nozzle, said supporting means being axially adjustable with respect to the nozzle structure, whereby the spacing between the bucket wheel and the nozzle may be varied.

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