Sept. 22, 1964 J. R. SKIDGEL 3,149,784

LONG-RANGE ROTARY WATER SPRINKLER

Filed June 15, 1962 3 Sheets-Sheet 1

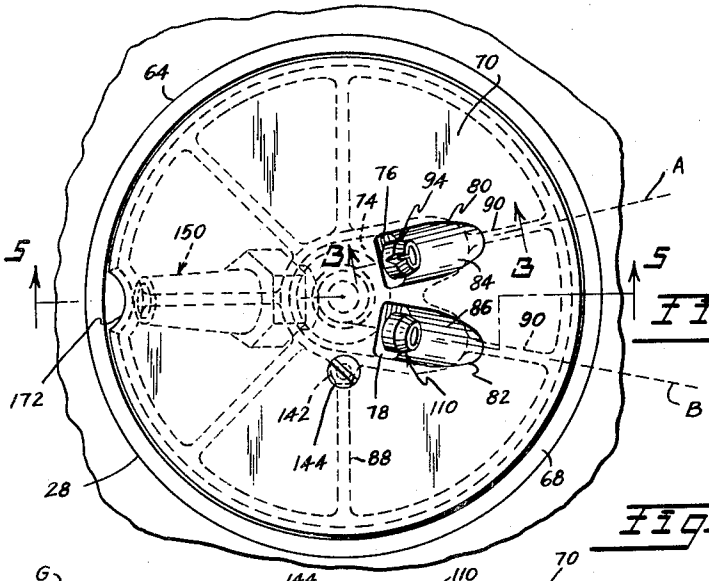


Fig. 1.

Fig. 2.

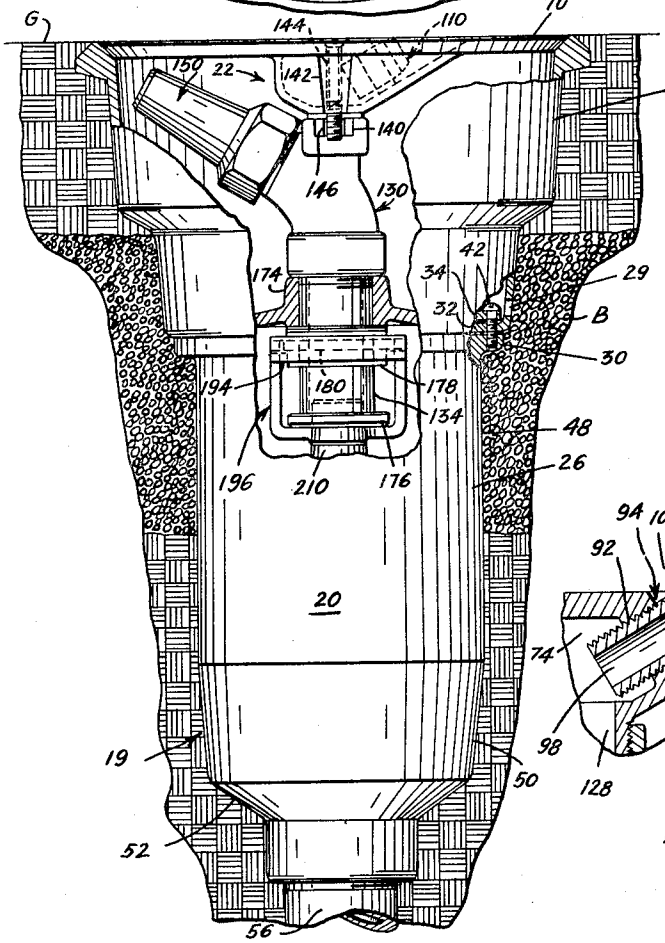


Fig. 4.

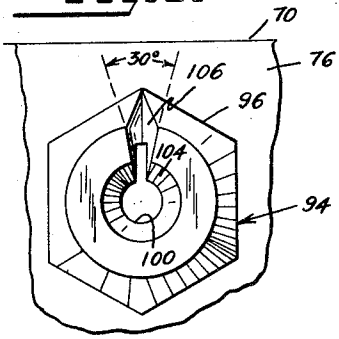
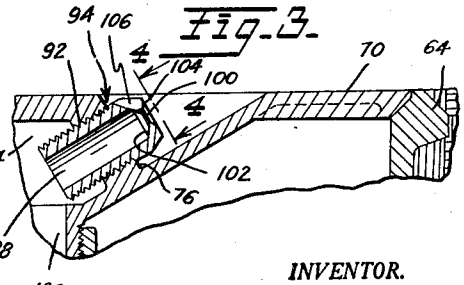


Fig. 3.



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LONG-RANGE ROTARY WATER SPRINKLER

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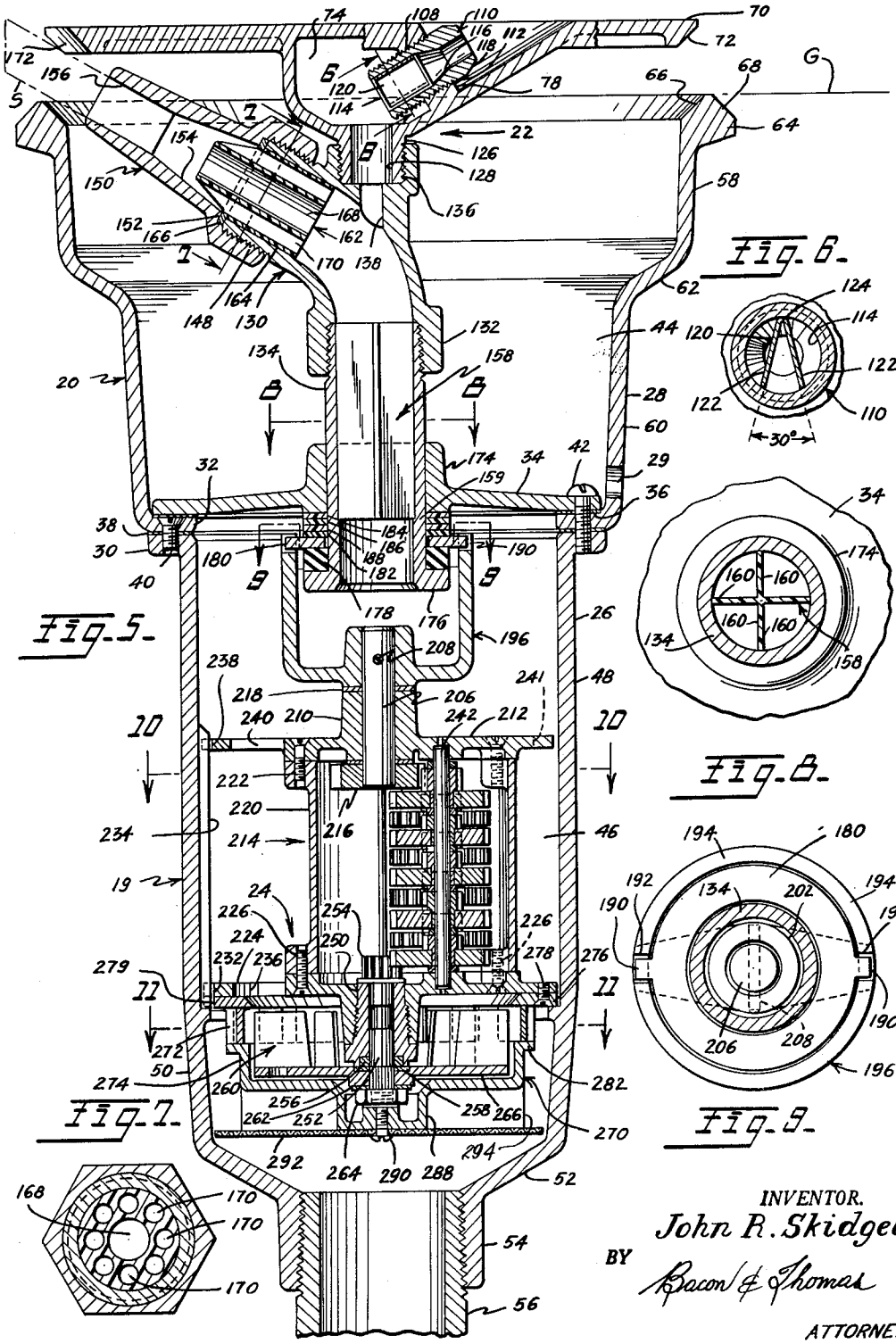

Fig. 5.

Fig. 7.

Fig. 6.

Fig. 8.

Fig. 9.

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LONG-RANGE ROTARY WATER SPRINKLER

Filed June 15, 1962 3 Sheets-Sheet 3

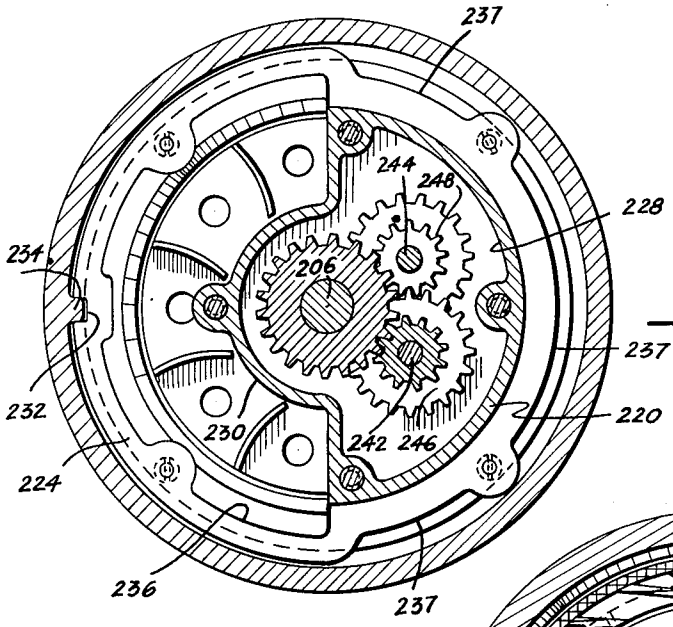


Fig. 10.

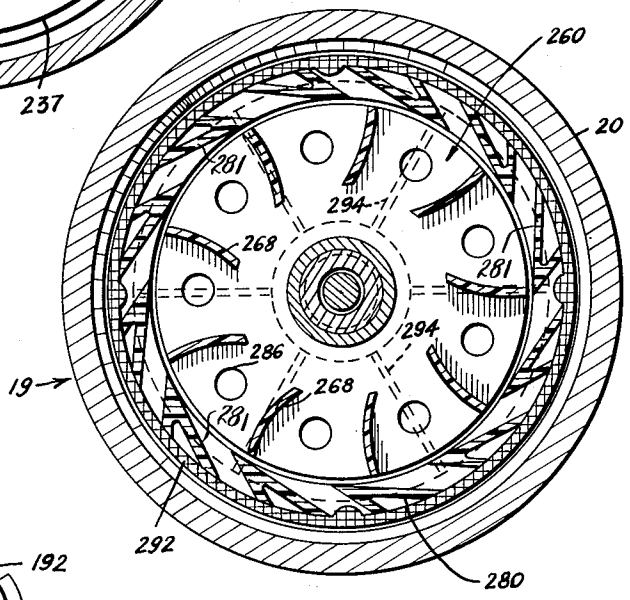
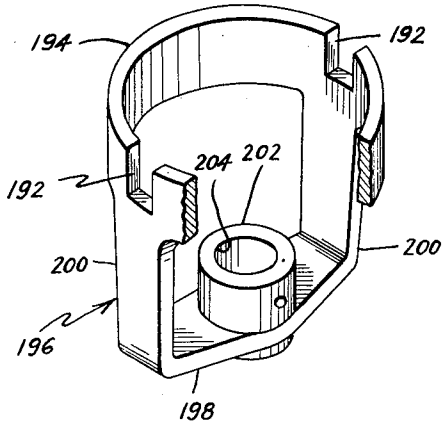


Fig. 11.

Fig. 12.



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LONG-RANGE ROTARY WATER SPRINKLER

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Filed June 15, 1962, Ser. No. 202,815
17 Claims. (Cl. 239—206)

The present invention relates to rotary water sprinklers and in particular to a long-range rotary sprinkler structure designed to irrigate a maximum area for a given nozzle orifice diameter and available water pressure.

More specifically, the present rotary sprinkler is of the type that is buried underground, and includes a cover for closing the upper end of the sprinkler housing, the cover having assembled therewith a plurality of nozzles for respectively irrigating areas of different annular radii concentric with the axis of the sprinkler. To this end, the present structure includes a cover and sprinkler head assembly comprising a long-range nozzle for irrigating the outermost annular area to be watered, a medium-range or intermediate-range nozzle for irrigating an intermediate annular area, and a short-range nozzle for irrigating the area between the sprinkler head and said intermediate annular area.

The present rotary sprinkler is designed so that when not in use the cover is in a lowered position and closes the upper end of the sprinkler housing, lying substantially flush with the ground. On the other hand, when the sprinkler device is placed in use, the cover and nozzle assembly are automatically raised above ground level so that the long range nozzle, which is disposed below the cover, is elevated to a position above the rim of the sprinkler housing. When the sprinkler operation is discontinued, the cover and nozzle assembly descend by gravity to closed position.

The present sprinkler construction also includes a hydraulically operated turbine structure that is rotated at the desired speed by the water flowing through the sprinkler housing. A gear-reduction unit is driven by the turbine and, in turn, rotates the cover and sprinkler head assembly through a friction clutch. In this connection, the friction drive means between the gear-reduction unit and the sprinkler head assembly is such that when the cover is in its lowered position and a lawn mower or other wheel passes over the cover and causes the same to rotate slightly, no damage can be done to any part of the nozzle assembly or drive mechanism therefor.

A very important feature of the present sprinkler unit is that it includes water turbulence-arrestors for reducing eddying of the water as it flows through the device and for straightening and compacting the flow to cause rather stiff streams to discharge from the nozzles and thereby greatly increase the effective watering range. Thus, in watering large areas, such as golf courses, the increased range of the present sprinkler units makes it possible to use about forty percent fewer units than heretofore for any given area to be watered. While the turbulence-arresting means is associated with nozzles embodied in an underground sprinkler, it will be understood that the principles involved are applicable to all types of sprinkler nozzles.

Accordingly, the principal object of the present invention is to provide a rotary type of lawn sprinkler having a greater range for a given nozzle discharge orifice diameter than prior sprinklers of the same size.

Another object is to provide turbulence-arresting means for use in a rotary lawn sprinkler in conjunction with the nozzle means thereof for extending the discharge range of the sprinkler.

A further object is to provide automatic drive means for a rotary sprinkler that will be substantially unaffected by wind conditions and will effect rotation of the sprinkler head at a uniform rate; instead of with a jerky motion, to thereby effect substantially uniform watering of the area covered by the sprinkler.

A still further object is to provide a rotary sprinkler incorporating means for stiffening the stream discharging therefrom so that wind will have much less effect on the maximum range of the sprinkler.

Another object is to provide turbulence-arresting means for use in a sprinkler nozzle to increase the effective range of the nozzle, without increasing the length of the nozzle as was heretofore required.

Still another object is to provide a long range sprinkler unit wherein the housing diameter is maintained relatively small compared to that of prior devices of comparable capacity.

Still another object is to provide a water sprinkler that will irrigate a maximum area so that a minimum number of sprinkler units is required to water a given area.

A still further object is to provide a rotary sprinkler that will not be damaged in the event that the sprinkler cover is engaged by a lawn mower wheel or the like and is rotated by such wheel.

Other objects and advantages of the invention will be apperent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a plan view of a long range rotary water sprinkler device embodying the principles of the present invention;

FIG. 2 is a side elevational view with a part of the main housing broken away and with the cover plate in its lowered or in the inactive position of the nozzles;

FIG. 3 is an enlarged fragmentary vertical sectional view through the short range nozzle taken on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged fragmentary elevational view showing the discharge end of the short range nozzle as viewed on the line 4—4 of FIG. 3;

FIG. 5 is an enlarged vertical sectional view through the entire sprinkler device taken on the line 5—5 of FIG. 1, and showing the sprinkler head cover plate in its raised, or in the active position of the nozzles;

FIG. 6 is an enlarged fragmentary transverse sectional view through the intermediate nozzle taken on the line 6—6 of FIG. 5, and showing the turbulence-arrester that is mounted in the inlet end of said nozzle;

FIG. 7 is an enlarged transverse sectional view taken on the line 7—7 of FIG. 5 illustrating the different form of turbulence-arrester at the inlet of the long range nozzle;

FIG. 8 is an enlarged transverse sectional view taken on the line 8—8 of FIG. 5 showing the turbulence-arrester that is employed in the main stem of the sprinkler for straightening and dividing the water stream just prior to its entry into the nozzle assembly;

FIG. 9 is an enlarged sectional view taken on the line 9—9 of FIG. 8 showing certain details of the drive coupling disposed between the drive mechanism and the nozzle assembly;

FIG. 10 is an enlarged sectional view taken on the line 10—10 of FIG. 5 through the reduction gear drive of the nozzle assembly;

FIG. 11 is an enlarged horizontal sectional view taken on line 11—11 of FIG. 5 through the water-driven turbine for driving the reduction gear; and

FIG. 12 is an enlarged perspective view, partly in section of the yoke of the drive coupling that is disposed between the reduction gear and the nozzle assembly.

Referring to FIGS. 1, 2 and 5 of the drawings, the rotary water sprinkler unit is generally identified by the numeral 19 and comprises essentially a housing 20, an axially movable and rotatable sprinkler head assembly 22 and

hydraulically actuated drive means 24 for rotating the sprinkler head assembly 22.

In normal use, the housing 20 is buried below the surface of the ground G, as illustrated in FIG. 2, with the upper edge of the housing section 20 substantially flush with the ground. The housing 20 includes a tubular lower section 26 and an enlarged upper section 28. The lower section 26 has an outwardly extending flange 30 at its upper end, and the upper section 28 has an inwardly extending flange 32, with the two flanges disposed coaxially. A dividing wall or partition 34 is located above the flange 32.

A gasket 36 is disposed between the wall 34 and flange 32, and a gasket 38 is disposed between the two flanges 30 and 32. Two circumferentially spaced screws 40 secure the housing sections 26 and 28 together, and eight relatively longer screws 42 extend through the wall 34 and flange 32 of the upper housing section and into threaded openings in the finage 30 of the lower housing section and mount the wall 34 in the housing 20. The wall 34 divides the housing 20 into an upper compartment 44 and a lower compartment 46, and the gaskets 36 and 38 form a seal to prevent leakage at the junctures of the wall and housing sections.

The lower housing section 26 includes a truly cylindrical portion 48, a slightly tapered portion 50, a generally conical portion 52, and a cylindrical inlet portion 54. The inlet portion 54 is internally threaded and has a water supply pipe 56 connected therewith. The side wall of the upper housing section 28 includes offset, upwardly flared wall portions 58 and 60 connected by an inclined portion 62, and terminates at its upper end in a reinforcing flange 64. The chamber 44 is thus enlarged at its upper end to accommodate the sprinkler head assembly 22 when in its lowered position shown in FIG. 2. The upper edge of the housing section is chamfered both internally and externally on an angle of about 45°, as indicated at 66 and 68 in FIG. 5. In one embodiment of the invention the flange 64 has a maximum diameter of about 8 inches.

The nozzle assembly 22 includes a cover plate 70 having a chamfered peripheral edge 72 that seats tightly on the chamfered edge 66 of the housing 20. The plate 70 has a flat top surface (FIG. 5) and is circular (FIG. 1). A chamber 74 is formed at the lower side of the plate 70 and is defined in part by flat, inclined wall portions 76 and 78 disposed on lines A and B that are parallel with radial lines (not shown) about 10° to each side of a diametrical line disposed midway between the lines A and B. The walls 76 and 78 form the end walls of cavities 80 and 82, respectively, disposed below the top surface of the cover plate 70 and defined by arcuate bottom walls 84 and 86, respectively, disposed on an angle of about 30° relative to the plane of the cover plate 70. The walls 76 and 78 are also disposed on an angle of about 30° to the axis of the cover plate, and thus are perpendicular to the walls 84 and 86. The cover plate is reinforced by radial webs 88 extending from the wall of the chamber 74 to the rim of said cover plate, and by ribs 90 extending from the inclined bottom walls 80 and 82 to said rim.

Referring to FIGS. 3 and 4, the wall 76 has a threaded opening 92 in which a short-range nozzle 94 is mounted. The outer end of the nozzle 94 is hexagon shaped to provide socket wrench-engaging surfaces 96. The nozzle 94 has a counterbore 98 extending inwardly from its inner end, and in one operative example of the invention an orifice 100 of .125" diameter is provided at the outer or discharge end of the nozzle. The body of the nozzle is chamfered on an angle of 45° on both sides of the nozzle orifice 100, as indicated at 102 and 104. The nozzle 94 also has a slot 106, the bottom of which is inclined on an angle of about 30° to the axis of the nozzle, and which has side walls that diverge on an angle of about 30°, as is best shown in FIG. 4. The purpose of the slot 106 is to cause the nozzle to immediately break up part of the stream discharging therethrough so that a generally fan-shaped spray is formed, for watering the ground area closest to the sprinkler unit.

Referring now to FIG. 5, the inclined wall 78 has a threaded opening 108 in which a medium range nozzle 110 is mounted. This nozzle is also hexagonal shaped at its outer end 112 and has a counterbore 114 extending axially from its inner end. The counterbore 114 includes a portion 116 that converges outwardly on an angle of about 38° and merges into an orifice 118 of uniform diameter, which in one operative embodiment of the invention is .219" in diameter.

The medium-range nozzle 110 is provided with a water turbulence-arrester 120 disposed within the cylindrical portion of the counterbore 114. The arrester 120 is preferably formed of sheet metal, such as brass, and is bent into a general V-shape with legs 122 diverging at an angle of about 30°. The juncture 124 of the legs 122 is rounded on a small radius to avoid a sharp break.

The purpose of the turbulence-arrester 120 is to eliminate any eddying and turbulence in the flowing water as it enters the nozzle 110, so that a stiff and compact stream discharges from the nozzle orifice 118, without any substantial breaking up of the stream until it reaches a point that slightly overlaps with the maximum radius of the stream discharging from the short-range nozzle 94.

It will be noted that the ends of the nozzles 94 and 110 are beveled on an angle of about 30° relative to the axis of said nozzles, so that the nozzles do not project above the plane of the top surface of the cover plate 70. This avoids damage that might occur to the nozzles if they projected above the plate 70, and the wheel of a vehicle ran over the cover plate.

The cover plate 70 has a threaded boss 126 depending axially from the walls forming the chamber 74. The boss 126 contains a passageway 128 that communicates with the chamber 74. A 60° elbow 130 has the inlet 132 thereof internally threaded and mounted upon a tubular stem 134. An internally threaded recess 136 is axially aligned with the inlet 132 and stem 134 and has the boss 126 mounted therein, whereby to support the cover plate 70 on the elbow 130. An axial passageway 138 in the elbow 130 communicates with the passageway 128 in the boss 126 to deliver water under pressure to the cover chamber 74.

Referring to FIGS. 1 and 2, the elbow 130 has a laterally extending boss 140 in the region of the recess 136, and the cover plate 70 has a boss 142 that projects from the side wall of the chamber 74. A bolt 144 extends through an opening in the boss 142 having threads at its lower end, and into a plain opening 146 in the boss 140 and secures the cover plate 70 in predetermined registration with the elbow 130.

Referring to FIG. 5, the outlet end of the elbow 130 has external threads 148 upon which a long-range nozzle 150 is mounted. The nozzle 150 has a shoulder 152 and a tapered bore 154 extending outwardly from said shoulder. The walls of the counterbore 154 having an included angle of about 18°. The counterbore 154 merges into an orifice 156, which is of uniform diameter and in one operative embodiment is .500" in diameter.

The stem 134 contains a water turbulence-arrester 158, which is preferably made of polyvinyl chloride and is generally X-shaped in transverse cross-section, providing four wings or partitions 160, as is best illustrated in FIG. 8. The arrester 158 engages a slight shoulder 159 in the stem 134 and has a tight fit in said stem. It serves to divide the water stream flowing through the stem 134 into four separate streams, thereby removing any turbulence that existed in the stream at the time that it entered said stem.

Further removal of turbulence and straightening of the discharging stream is effected by a water turbulence-arrester 162 mounted in the discharge end of the elbow

130, or at the inlet end of the long-range nozzle 150. The arrester 162 is preferably made of a known hard plastic material such as "Delrin," or of any other suitable material, and includes a cylindrical portion 164 that has a close fit in the elbow 130, and terminates at its outer end in a flange 166 that is engaged by the shoulder 154 of the nozzle 150, which holds the arrester 162 in place.

The outer end of the arrester 162 is conical shaped on an angle experimentally determined as 31° 30′ for most effective action with the counterbore 154. A passage 168 extends axially through the arrester 162 and is surrounded by eight equally spaced, relatively smaller passages 170. In one operative embodiment of the invention, the passage 168 is .375″ in diameter and the passages 170 are each .188″ in diameter. The total cross-sectional area of the passages 168 and 170 is substantially greater than the cross-sectional area of the nozzle orifice 156. Hence, the stream discharged through the nozzle 150 is greatly compacted during its flow between the turbulence-arrester 162 and the nozzle orifice 156, so that a very rigid or stiff stream leaves the long-range nozzle 150. In this connection, the axial passage 168 and the surrounding passages 170 supplement the action of the arrester 158 in straightening and stiffening the stream for discharge through the orifice 156. The long-range nozzle 150 is designed so that the stream discharged therefrom does not start to break up until after it has traveled a substantial distance from the sprinkler unit, and the innermost portion of the breaking stream is approximately at the maximum range of the medium-range nozzle 110, as will be explained more fully hereinafter.

The cover plate 70 has an arcuate notch 172 in its periphery on a radial line disposed in the same vertical plane as the axis of the long-range nozzle 150. The notch 172 provides clearance for the stream discharging from the nozzle 150 above the rim of the housing 20, as will be readily understood from FIG. 5. The provision of the notch 172 makes it possible to locate the cover plate 70 closer to the nozzle 150 than would be the case if the notch were omitted.

The stem 134 is rotatably mounted in a boss 174 disposed centrally of the dividing wall 34. The lower end of the stem 134 projects into the lower compartment 46 and carries a flange 176. A friction washer 178 has one side thereof engaged with the flange 176 and its other side in contact with a drive coupling plate 180, which is free to rotate relative to the stem 134. A stem seal washer 182 is disposed above the plate 180 and a similar washer 184 is disposed adjacent the lower face of the boss 174. Thrust washers 186 and 188 are disposed between the seal washers 182 and 184. The thrust washers 186 and 188 are preferably made of a self-lubricating or slippery material so that one washer can be freely rotated with respect to the other. The friction washer 178 is preferably made of rubber, the stem seal washers 182 and 184 are preferably made of "Durabla," and the thrust washers 186 and 188 are preferably made of the plastic "Delrin," although it will be understood that the several washers may be made of any other suitable known materials.

The drive coupling plate 182, FIG. 9, is in the form of an annulus having diametrically projecting ears 190. The ears 190 extend into notches 192 formed in a ring portion 194 at the upper end of a driving yoke 196 best shown in FIG. 12. The yoke 196 includes a generally U-shaped portion 198, the vertical legs 200 of which are connected with the ring portion 194 and disposed directly below the notches 192. The U-shaped portion 198 carries a boss 202 having an opening 204 to receive a shaft 206, FIG. 5. The drive yoke 196 is secured to the shaft 206 by a pin 208. This shaft is rotatably mounted in a boss 210 projecting upwardly from a cover 212 of a reduction gear unit generally identified by the numeral 214. A driven gear 216 is secured to the lower end of the shaft 206. A thrust washer 218, made of brass or other suitable material, is disposed between the boss 210 and the drive yoke 196.

The gear reduction unit 214, FIG. 5, comprises a housing 220 that is secured to the cover 212 by screws 222. A bottom plate 224 is secured to the lower end of the housing 220 by similar screws 226. The housing 220, the cover 212 and the bottom plate 224 are preferably made of brass or other material that will resist corrosion. The housing 220 has the cross-sectional configuration best shown in FIG. 10, from which it will be noted that said housing comprises two semi-circular side wall portions 228 and 230 disposed upon opposite sides of a diametrical plane passing through the axis of the shaft 206. The bottom plate 224 has the configuration shown in FIG. 10, wherefrom it will be noted that a notch 232 is formed in the edge of said bottom plate and receives a key 234 projecting inwardly from the side wall of the cylindrical portion 48 of the housing section 26. The bottom plate 224 has an opening 236 of the general configuration of an arcuate segment. It also has peripheral recesses 237 providing passageways for water flow past the gear reduction unit 214.

The top plate 212 has a similar notch 238, FIG. 5, to receive the key 234 and also has a similar segment-shaped passageway 240 and marginal recesses. The purpose of the longitudinal key 234 and the notches 232 and 238, is to prevent the reduction gear unit 214 from rotating relative to the housing section 26, while permitting slight vertical movement of said unit relative to said housing.

The top plate 212 and bottom plate 224 have aligned recesses to receive vertical shafts 242 and 244, FIG. 10. One set of gear and pinion assemblies 246 is rotatably mounted upon the shaft 242 and a similar set of gear and pinion assemblies 248 is rotatably mounted upon the shaft 244, the pinions of the set 246 meshing with the gears of set 248, and vice versa. The uppermost pinion of the gear set 246 meshes with the gear 216 on the output shaft 206 of the gear reduction unit 214, as is shown in FIG. 5.

The bottom plate 224, FIG. 5, has a depending boss provided with an axial opening in which an externally threaded bearing 250 is mounted. An impeller-driven shaft 252 is rotatably mounted in the bearing 250 and carries a pinion 254 at its upper end that meshes with the lowermost gear of the gear assembly 246. The impeller shaft 252 thus serves as an input shaft, and the pinion 254 as a drive gear for the gear reduction unit 214.

The bearing 250 is recessed at its lower end to receive a felt washer 256. This end of the bearing is also engaged by a stainless steel thrust washer 258 mounted in a recess formed in an impeller wheel 260. The impeller wheel 260 is mounted upon a lower knurled end of the impeller shaft 252 and is retained upon said shaft by a washer 262 and a nut 264 threaded upon the lower extremity of said shaft.

The impeller wheel 260 includes a circular or disc portion 266 having a series of nine vanes 268 projecting upwardly therefrom. The vanes 268 are arcuate and slightly off radial. The outer edges of the vanes 268 are truly vertical, whereas the inner edges are inclined on an angle of about 3° from the vertical and conform generally with the taper of the boss depending from the bottom plate 224.

The impeller wheel 260 is preferably made of a hard plastic material known as "Cycolac," black, but may be made of any other suitable known material. The impeller 260 is contained within a turbine or diffuser housing generally identified by the numeral 270, comprising a top section 272 and a bottom section 274. The top section 272 has an annular portion 276, FIG. 5, at its upper end which is secured by screws 278 to the bottom plate 224. The opening in the portion 276 is larger in diameter than the impeller 260, which can readily pass therethrough. A notch 279 is formed in the outer

edge of the portion 276 and engages the key 234 to prevent relative rotation of the turbine with respect to the housing section 26.

A series of 12 vanes 280, FIG. 11, having a generally V-shaped configuration, as shown in FIG. 11, project downwardly from the portion 276 and provide generally tangential slots or passageways 281 for the entry of water under pressure into the upper half of the turbine housing. A flange 282 is formed at the upper edge of the lower housing section 274 and the lower face of the respective vanes 280 is adhesively bonded to said flange to hold the housing sections 272 and 274 together. The impeller 260 has openings 286 disposed between adjacent vanes 268, whereby the hydraulic pressure on opposite sides of disc portion 266 are balanced and thus reduce axial thrust on the impeller.

The lower housing section 274 has a depending cup-like formation 288, FIG. 5, which receives the lower end of the drive shaft 252 and nut 264. A screw 290 is mounted in the portion 288 and secures a screen 292 to the lower end of the turbine unit 270. A series of radial ribs 294, FIGS. 5 and 11, project downwardly from the lower housing section 274 and outwardly from the formation 288 and provide circumferentially spaced supports for the screen 292, to prevent it from being deformed. The screen 292 is of such diameter that it has a close fit with the tapered portion 50 of the main housing section 26, and serves to prevent foreign matter of a size larger that can be passed through the sprinkler heads, from entering the housing section 26.

The main housing section 26 has an inwardly projecting flange 294 located at about the juncture of the cylindrical portion 48 and the tapered portion 50 of said main housing section. The flange 294, may be engaged by the portion 276 of the turbine housing 272 and serve as a support for said turbine and gear reduction assembly 214. At the same time, the foregoing arrangement provides for slight axial movement of the entire driving mechanism of the assembly in response to pressure and water flow through the housing.

The general operation of the sprinkler unit described above is as follows: Water under pressure from the supply pipe 56 passes through the strainer 292 and around the turbine assembly 270 up to the distributing vanes 280. The water then flows through the slots 281 between the vanes 280 and impinges against the impeller vanes 268 to effect high speed rotation of the impeller 260 and shaft 252. Rotation of the impeller 260 thus imparts a drive to the yoke element 196 through the gear reduction unit 214, as will be readily understood. Meanwhile, water that has reacted against the impeller vanes 268 passes through the opening 236 in the bottom plate 224, upwardly around the gear housing 220 and through the opening 240 in the top plate 212. It will be understood that some water flows between the outer edges of the top and bottom plates 224 and 212 and the housing 26 in view of the clearance provided between these plates and the interior of said housing by the recesses 237 and 241.

The turbine assembly 270 provides an effective drive for the sprinkler head assembly and thus eliminates the need for a swirl nozzle commonly employed with other sprinkler devices.

The pressure of the water in the chamber 46 acts upon the flange 176 at the lower end of the stem 134 and against the lower end of the turbine housing and tends to force the yoke 196, said stem, and the sprinkler head assembly 22 associated therewith, upwardly from the position shown in FIG. 2, to that shown in FIG. 5. In other words, it automatically raises the sprinker head assembly from the inactive position shown in FIG. 2 to the active sprinkling position shown in FIG. 5.

Upon axial movement of the stem 134, the flange 176 exerts pressure upon the friction washer 178 to forcefully engage it with the coupling plate 180, whereby the yoke 196 is then enabled to impart rotation to the stem 134 and the nozzle assembly connected therewith. Thus, the friction washer 178 transmits power from the yoke 196 to the stem 134 through the driven coupling element 180 and friction washer 178. The drive thus effected through the hydraulic pressure of the water flowing through the unit is quite smooth so that all jerky motion of the nozzle assembly is avoided. The smooth rotation insures that the nozzles of the sprinkler assembly will discharge water as evenly as possible. The hydraulic drive and the smooth operation of the device also minimize wear on the parts of the sprinkler drive mechanism. The discharge of the long-range nozzle 150 in a direction opposite to that of the short-range nozzle 94 and the medium-range nozzle 110 balances side thrust and thus further reduces wear.

When the long-range nozzle 150 has a discharge orifice of ½" diameter, it is preferable that the sprinkler unit be operated with a water pressure of about 80 pounds per square inch, and that in the event that a 7/16" diameter long-range nozzle be used, that the pressure be not less than 60 pounds per square inch. With a pressure of about 80 pounds per square inch, the maximum diameter of the throw of the long-range nozzle 150 is about 190 feet, with a flow rate of about 65 gallons per minute; whereas with a 7/16" nozzle and a pressure of about 60 pounds per square inch, the maximum diameter of throw of the long-range nozzle will be about 160 feet with a flow rate of about 55 gallons per minute. The size of the orifices of the short-range and intermediate-range nozzles may be the same for both ½" and 7/16" long-range nozzles and correspond to that described hereinabove.

Tests have shown that with a water pressure of about 80 pounds per square inch, the longe-rang nozzle 150 with a ½ inch orifice will water an annular area having a radius of 25 to 95 feet, the medium-range nozzle 110 will water an annular area having a radius of about 10 to 30 feet, and the short-range nozzle 94 will water an area having a radius up to 15 feet, with the stream discharging from the nozzle watering an area of about 10 to 15 feet, and the fan spray watering the area from the sprinkler unit up to the 10 feet radius.

Water pressures substantially below 80 pounds per square inch do not provide optimum results with a ½" long-range nozzle. On the other hand, pressures above 80 pounds per square inch will increase the effective range of the unit, for example a pressure of about 135 pounds per square inch will increase the maximum radius of the long-range nozzle to about 116 feet.

The great effective range of the nozzles described above is attained through the use of the turbulence-arresting means in the main stem 134, in the long-range nozzle 150, and in the medium-range nozzle 110. The importance of the arresters 158, 120 and 162 is self-evident from the fact that when they are removed from the stem and nozzles, the diameter of coverage is reduced by about 50 percent. One or more of the arresters may be omitted with the consequent impairment of the range of the unit, hence, all should be used.

The sprinkler head assembly disclosed is very compact and the sprinker housing itself is of a practical and economically feasible size. Moreover, the sprinkling pattern from the unit has a low silhouette so that wind cannot substantially affect the streams discharging from the nozzles nor alter the speed of rotation of the sprinkler head.

It will also be noted that restriction of the flow of water through the sprinkler housing assembly is minimized. The passageways around the gear housing and other components provide a minimum pressure drop which enhances the range of the sprinker. The axial movement of the turbine assembly and gear box in the lower housing section 26 is restricted by the yoke 196 engaging the driven coupling plate 180. This restriction

and longitudinal movement and the design features of the turbine end of the gear box prevents any great quantity of water from by-passing the impeller 260. Thus, the power and efficiency of the sprinkler are further enhanced. It will also be apparent that ready access to the gear unit and turbine assembly may be attained by removing the screw 144, raising the cover plate 70, and holding the long-range nozzle 150 while unscrewing the cover plate 70 from the elbow 130. With the removal of the cover plate 70, ready access is had to the screws 42 which can be taken out to permit removal of the wall 34 and enable the entire assembly of the gear reduction unit and turbine to be lifted out of the housing for ready replacement or repair or cleaning of the screen 292.

It will be understood that the sprinkler unit is preferably installed with due provision for drainage of the upper housing section 28. To this end a drain opening 29 is provided in the lower portion of the housing section 28 adjacent the wall 34. Hence, any leakage, sprayed water, or rain water that finds its way into the housing section 28 can readily drain therefrom through the opening 29. Drainage is further facilitated by providing a bed of coarse gravel B, FIG. 2, in the region of the drain opening 29.

It will be readily apparent that various changes may be made in the design and arrangement of the components of the present sprinkler unit without departing from the principles of the invention or the scope of the annexed claims.

I claim:

1. A rotary water sprinkler, comprising: a housing having an inlet for water under pressure; a cover plate on said housing; nozzle means associated with said cover plate and including a nozzle element disposed below said cover plate, and additional nozzle means disposed in a cavity formed in the upper outer surface of said cover plate; means including a hollow stem communicating with said nozzle means and supporting said cover plate for rotary movement relative to said housing; water turbulence-arresting means within said housing for straightening the water stream in advance of said nozzle means to increase the range of said nozzle means; and means in said housing connected with said stem for rotating said stem.

2. A rotary water sprinkler as defined in claim 1, in which the water-turbulence-arresting means is positioned in the tubular stem.

3. A rotary water sprinkler as defined in claim 1, in which the water turbulence-arresting means is located in the entrance of at least one of the nozzle elements.

4. A rotary water sprinkler as defined in claim 1, in which the water turbulence-arresting means is located in the entrance of at least one of the nozzle elements, and in which water turbulence-arresting means is also located in the tubular stem.

5. A rotary water sprinkler, comprising: a generally upright housing having an inlet for water under pressure at its lower end; a cover plate at the upper end of said housing; means including a hollow stem supporting said cover for rotary and axial movement relative to said housing; nozzle means located below said cover plate and communicating with said hollow stem; nozzle means carried by said cover plate communicating with said hollow stem and arranged to discharge a stream of water above said cover plate; water turbulence-arresting means disposed within said stem for straightening the water stream in advance of discharge from said nozzle; and means in said housing actuatable by the pressure and flow of water through said housing for rotating said stem, and for effecting axial movement of said stem to raise said nozzle means to discharge a stream of water above the upper end of said housing.

6. A rotary water sprinkler, comprising: a housing having an inlet for water under pressure at one end thereof; a cover plate for said housing at the other end of said housing; nozzle means carried by said cover plate arranged to discharge water above said cover plate; means including a hollow stem communicating with said nozzle means and supporting said cover plate for rotary and axial movement relative to said housing; an additional nozzle located below said cover plate and communicating with said hollow stem; water turbulence-arresting means for straightening the water stream in advance of both the nozzle means carried by said cover plate and said additional nozzle; means for effecting axial movement of said stem to raise said additional nozzle to enable the same to discharge a stream of water above said other end of said housing; and means in said housing connected with said stem for rotating said stem.

7. A rotary water sprinkler, comprising: a housing; a wall in said housing dividing said housing into upper and lower compartments, said lower compartment having an inlet for water under pressure; sprinkler nozzle means in said upper compartment; a tubular stem communicating with said nozzle means rotatably mounted in said dividing wall, said tubular stem having a portion extending into and communicating with said lower compartment; drive means for said stem disposed in said lower compartment; means including a friction clutch connected with said stem and with said drive means for rotating said stem; and means for effecting axial movement of said stem relative to said dividing wall in response to water pressure in said lower compartment.

8. A rotary water sprinkler as defined in claim 7, wherein the drive means includes a turbine mechanism and a gear reduction mechanism that are joined together and are movable slightly relative to the housing, and wherein means is provided for preventing said turbine mechanism and said gear reduction mechanism from rotating relative to said housing.

9. In a rotary water sprinkler, a housing having an inlet for water under pressure; a hollow upright stem rotatably supported in said housing; an elbow fitting mounted upon the upper end of said stem, said elbow having a passageway including an inlet portion axially aligned with said stem and an outlet portion disposed at an angle to said stem; a long-range nozzle connected with the outlet portion of said elbow; a water turbulence-arrester mounted at the inlet end of said long-range nozzle, a cover plate for said housing mounted upon said elbow and having a chamber communicating with said passageway in said elbow, said cover plate having angularly disposed wall means defining a portion of said chamber and cavities disposed outwardly thereof, said angularly disposed wall means having a pair of apertures disposed below the top surface of said cover plate and opening into said cavities; a pair of nozzles mounted in said apertures with their discharge end located in said cavities and disposed below the top surface of said plate, one of said pair of nozzles being a short-range nozzle and having a slit at its orifice to form a fan spray and stream and the other of said pair of nozzles being a medium-range nozzle and having a V-shaped water turbulence-arrester at its inlet end; and means in said housing for effecting rotation of said stem.

10. A sprinkler head assembly for a rotary water sprinkler, comprising: a substantially circular plate having a closed chamber at one side thereof defined in part by a depending wall portion having two openings extending therethrough and leading to cavities in the top side of said plate, said openings being disposed to one side of a first diametrical line through said plate and upon one side of a second diametrical line disposed at right angles to said first diametrical line; a short-range nozzle and a medium-range nozzle mounted in said openings; and turbulence-arresting means mounted in said medium-range nozzle adjacent the entrance end thereof, said chamber having an inlet for admitting water thereinto.

11. A sprinkler head assembly as defined in claim 10 including an elbow for supplying water to said nozzles, said elbow having an extension in axial alignment with

its inlet end, said extension communicating with the chamber of said plate; a long-range nozzle connected with the other end of said elbow and arranged to discharge water past the edge of said plate; and a tubular stem connected with said inlet end of said elbow for rotatably mounting said sprinkler head assembly in a supporting member.

12. A sprinkler head assembly as defined in claim 11, wherein water turbulence-arresting means is disposed in said stem.

13. In a water sprinkler, a sprinkler head assembly comprising: a substantially circular plate; a short-range nozzle; a medium-range nozzle; a long-range nozzle, said plate having depending wall means provided with a pair of adjacent, outwardly diverging openings that are also inclined toward the plane of said plate and open into cavities in the top side of said plate, said openings being disposed on opposite sides of a first diametrical line through said plate and also being located to one side of a second diametrical line at right angles to said first diametrical line, said short-range and medium-range nozzles respectively being mounted in one of said openings; means including said depending wall means providing a chamber at one side of said plate communicating with said openings; and an elbow connected with said plate and having a passageway aligned with its inlet and communicating with said chamber, said elbow having a laterally extending outlet opening inclined toward the plane of said plate, said long-range nozzle being mounted in said outlet opening, said long-range nozzle having its axis disposed in the plane of said first diametrical line and being located to the other side of said second diametrical line.

14. A rotary water sprinkler, comprising: a housing having an inlet for water under pressure; a sprinkler head assembly at one end of said housing including a substantially circular cover plate for said housing, said sprinkler head assembly including a short-range nozzle, a medium-range nozzle and a long-range nozzle, said cover plate having depending wall means provided with a pair of adjacent, outwardly diverging openings that are also inclined upwardly relative to the plane of said cover plate and open into cavities in the top side of said plate, said openings being disposed on opposite sides of a first diametrical line through said cover plate and also being located to one side of a second diametrical line at right angles to said first diametrical line, said short-range and medium-range nozzles respectively being mounted in one of said openings; means including said depending wall means providing a chamber below said cover plate communicating with said openings; an elbow connected with said cover plate and having a passageway aligned with its inlet and communicating with said chamber, said elbow having a laterally extending outlet opening inclined upwardly and outwardly relative to said cover plate, said long-range nozzle being mounted in said outlet opening for discharging a stream of water between said housing and said cover plate, said long-range nozzle having its axis disposed in the plane of said first diametrical line and being located to the other side of said second diametrical line; a tubular stem connected with the inlet of said elbow and through which water under pressure may flow to all of said nozzles; turbulence-arresting means in said tubular stem and in said medium-range and long-range nozzles, respectively, for stabilizing water stream flow therethrough and extending the range of all of the nozzles of said sprinkler head assembly; means in said housing supporting said stem for axial and rotary movement relative to said housing and means in said housing for effecting axial and rotary movement of said stem including drive means comprising a turbine driven by the flow of water through said housing and a gear reduction unit disposed between said turbine and said stem.

15. In a water sprinkler, a sprinkler head assembly comprising: a substantially circular plate, said plate having means associated therewith provided with a pair of adjacent openings that are outwardly and upwardly inclined relative to the plane of said plate, said openings being disposed on opposite sides of a first diametrical line through said plate and also being located to one side of a second diametrical line disposed at right angles to said first diametrical line; a short range nozzle mounted in one opening of said pair of openings, a medium range nozzle mounted in the other opening of said pair of openings, said means associated with said plate providing a chamber in communication with said openings, said means associated with said plate also providing an opening disposed in the same plane as said first diametrical line and extending outwardly and upwardly relative to the plane of said plate; and a long range nozzle in said last-mentioned opening, whereby said long range nozzle has its axis disposed in the plane of said first diametrical line, and is located on the opposite side of said second diametrical line from that on which said short range and medium range nozzles are located.

16. In a rotary water sprinkler, a housing having an inlet for water under pressure; a hollow upright stem rotatably supported in said housing; an elbow fitting mounted upon the upper end of said stem, said elbow having a passageway axially aligned with said stem; a long-range nozzle connected with said elbow; a water turbulence-arrester mounted at the inlet end of said long-range nozzle; a cover plate for said housing mounted upon said elbow and having a chamber communicating with said passageway in said elbow, said cover plate having angularly disposed wall means defining a portion of said chamber and a cavity disposed outwardly thereof, said angularly disposed wall means having an aperture disposed below the top surface of said cover plate and opening into said cavity; a nozzle mounted in said aperture with its discharge end located in said cavity and disposed below the top surface of said plate; and means in said housing for effecting rotation of said stem.

17. In a rotary water sprinkler, a housing having an inlet for water under pressure; a hollow upright stem rotatably supported in said housing; an elbow fitting mounted upon the upper end of said stem, said elbow having a passageway axially aligned with said stem; a long-range nozzle connected with said elbow; a water turbulence-arrester mounted at the inlet end of said long-range nozzle; a cover plate for said housing mounted upon said elbow and having a chamber communicating with said passageway in said elbow, said cover plate having angularly disposed wall means defining a portion of said chamber and cavities disposed outwardly thereof, said angularly disposed wall means having a pair of apertures disposed below the top surface of said cover plate and opening into said cavities; a pair of nozzles mounted in said apertures with their discharge end located in said cavities and disposed below the top surface of said plate; and means in said housing for effecting rotation of said stem.

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