

July 25, 1961

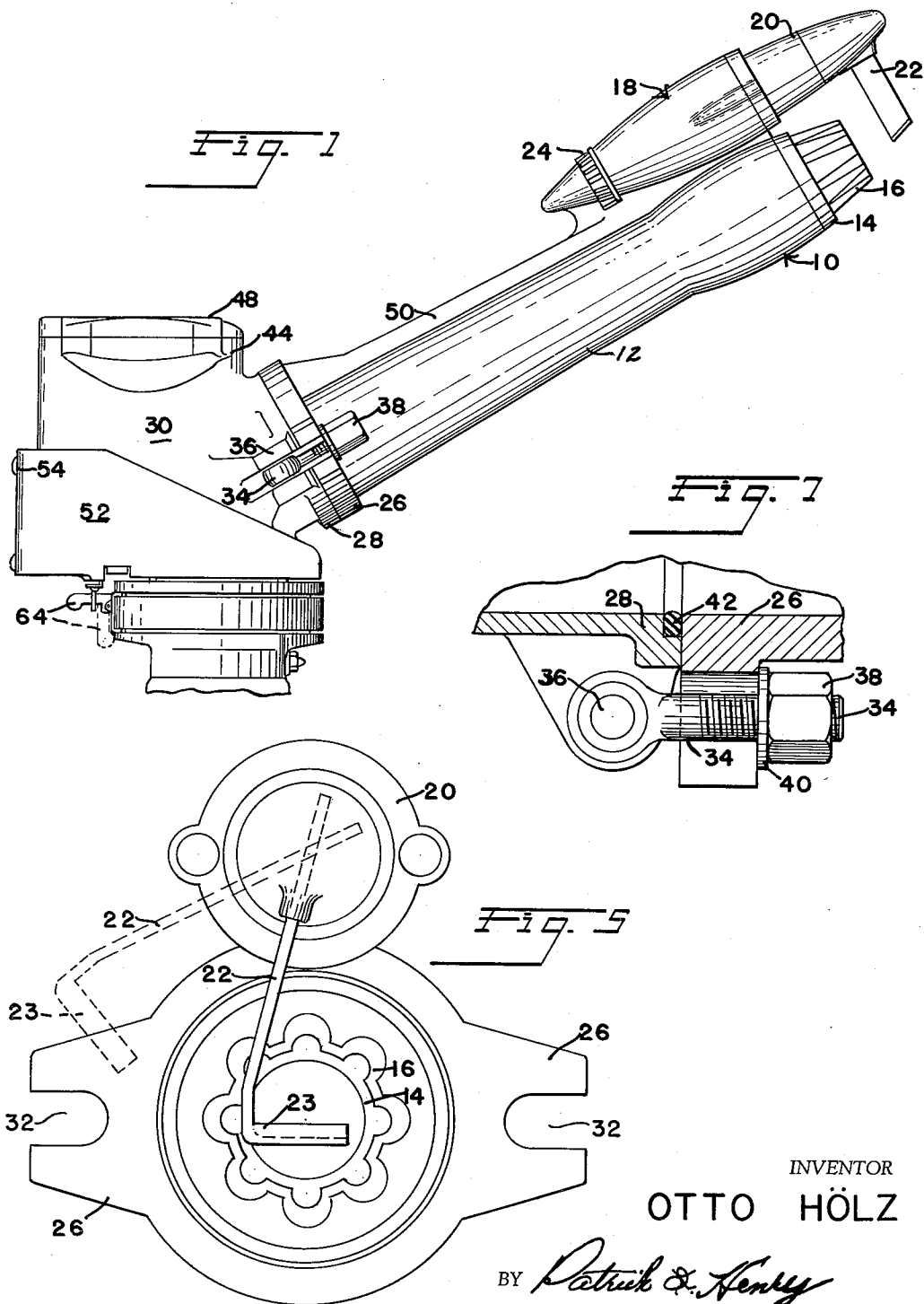
O. HÖLZ

2,993,649

VACUUM OPERATED LIQUID SPRINKLERS

Filed Dec. 12, 1958

3 Sheets-Sheet 1



INVENTOR

OTTO HÖLZ

BY

Patrick & Kenney

ATTORNEY

July 25, 1961

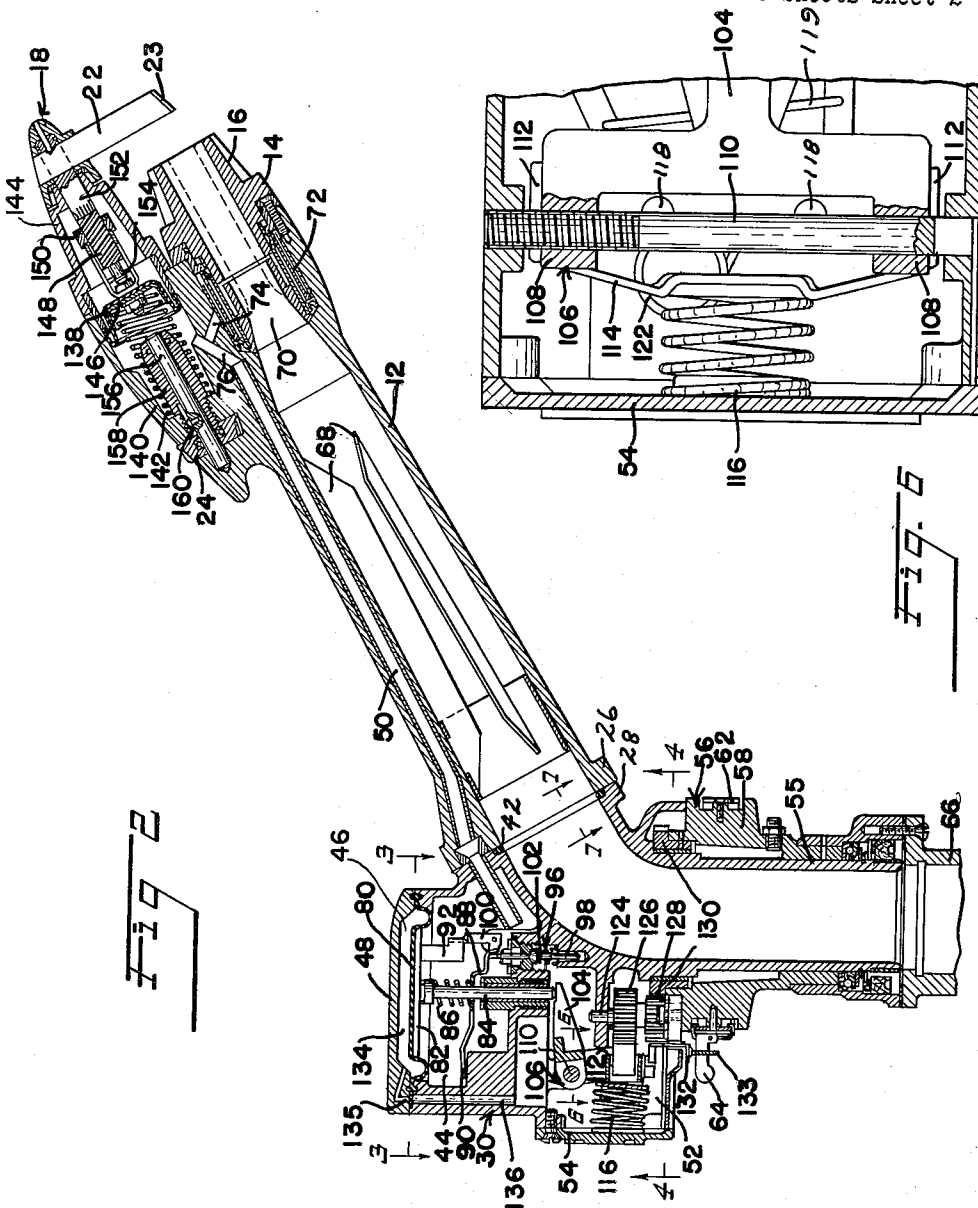
O. HÖLZ

2,993,649

VACUUM OPERATED LIQUID SPRINKLERS

Filed Dec. 12, 1958

3 Sheets-Sheet 2



INVENTOR
OTTO HÖLZ

BY *Patrick D. Henry*
ATTORNEY

July 25, 1961

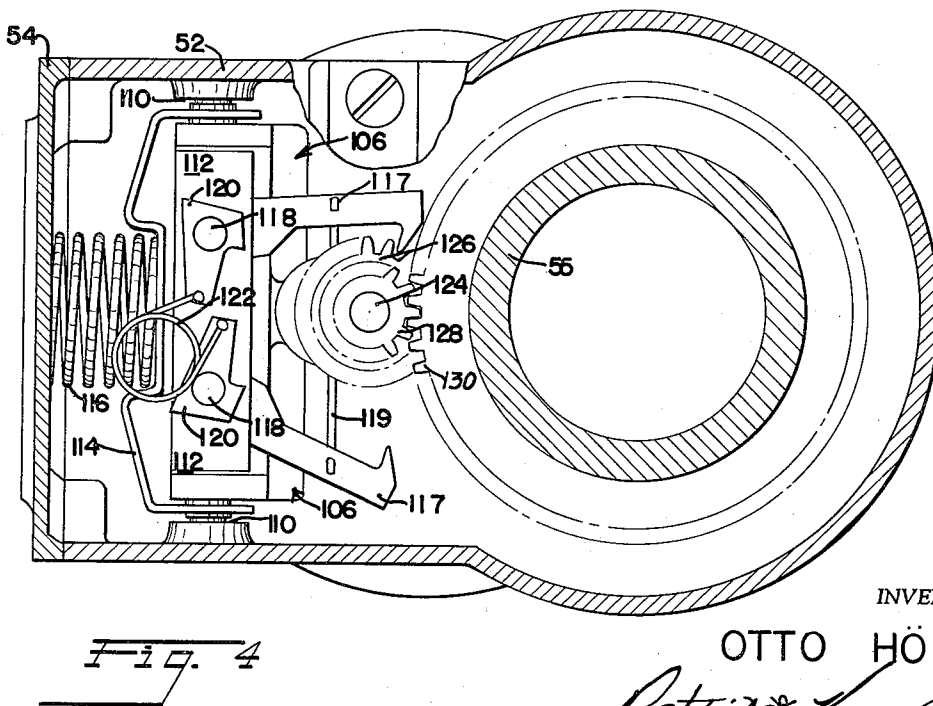
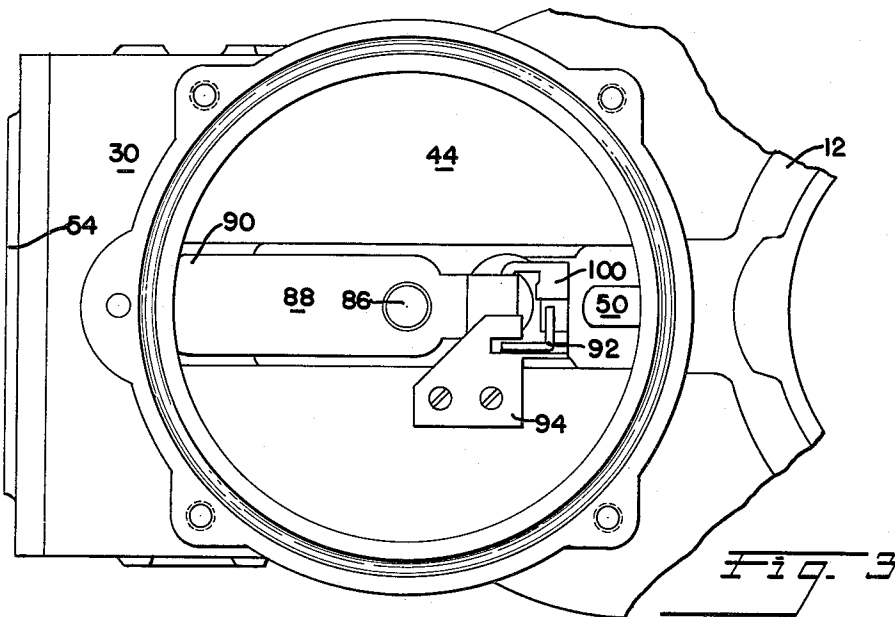
O. HÖLZ

2,993,649

VACUUM OPERATED LIQUID SPRINKLERS

Filed Dec. 12, 1958

3 Sheets-Sheet 3



INVENTOR

OTTO HÖLZ

BY

Patrick D. Henry

ATTORNEY

1

2,993,649

VACUUM OPERATED LIQUID SPRINKLERS

Otto Hölz, Silcherweg 6, Wangen im Allgäu, Germany

Filed Dec. 12, 1958, Ser. No. 780,077

22 Claims. (Cl. 239—232)

This invention relates to a vacuum operated liquid sprinkler of the sort wherein the flow of the liquid through a particular type of nozzle and jet opening produces a vacuum which is selectively used and released to drive the sprinkler nozzle in a moving path. The present device also includes a jet interruptor for striking the water jet as the nozzle moves and selective adjustments to change the direction of throw of the liquid jet for sector irrigation.

Such devices as herein presented have particular application for spraying or watering or irrigating agricultural lands, citrus groves and the like and this one is especially desirable in that it produces its own motion selectively for complete circular spraying or for sector spraying. It can be operated by connecting it to a source of liquid under pressure, usually water pumped from a water system. The particular construction and manner of operation lends itself to making each sprinkler in a large size whereby the volume of water dispersed and the area covered is large. One particular production size can cover an acre.

Generally described, without restriction on the scope of invention, the sprinkler has a sprinkler barrel nozzle which ejects water fed therethrough and the nozzle is constructed to produce a suction at one point internally therein. This suction operates a rubber diaphragm in a sealed compartment in a housing which diaphragm in turn pushes a plunger to move a drive frame on which is mounted a pair of pawl shifters and drive pawls. A bull gear is formed on the base inside the housing holding the nozzle and diaphragm. The drive frame in the housing below the compartment has a coil spring in contact therewith which is compressed when the plunger moves against the drive frame. An air valve is positioned to be contacted by a valve operating member struck by the diaphragm. A pinion gear on the housing is driven by contact with one or the other of the pawl shifters and the pinion gear meshes with the bull gear on the base to drive the housing about the base. A pair of cam members connected to a respective pawl in turn are contacted by a cam shifter mounted on the housing. The cam shifter is actuated by one of a pair of sector setting tabs movable about a ring.

In operation, the suction is repeatedly made and broken to drive the nozzle around the base. First the suction pulls the diaphragm down to move the plunger which shifts the frame to engage a pawl on the pinion gear thereby moving the pinion which moves the entire housing about the bull gear. At the proper moment, the valve is actuated by the diaphragm movement, releasing the suction and the compressed spring returns the diaphragm to normal whereupon the sequence starts again. Each time the pawl grabs the pinion and it turns the housing on the bull gear. The cam members are actuated according to the setting of the section tabs to reverse the direction of rotation at the proper point, if desired.

The end of the nozzle is provided with a jet interruptor also operated by the suction make and break to move a liquid splasher member into the water stream when the nozzle moves. It employs a diaphragm operated by the same suction as the main diaphragm.

More particularly, without using patent or patent claim type terminology, the sprinkler comprises a sprinkler nozzle of barrel-like construction with an internal construction guiding the water hydraulically to produce a suction

2

adjacent the end of the nozzle. A channel or tube connected at one end with the suction end of the nozzle is connected at the other end, which is near the sprinkler base, into a housing in which is formed a chamber having a large, rubber diaphragm mounted therein normally resting on a diaphragm plate spring pressed by a coil spring upwardly but subject to the pull of the suction to move downwardly. A plunger is mounted with the diaphragm plate and it acts with the coil spring against a trip or trigger member normally held up by a spring pressure air valve leading from the diaphragm chamber to the atmosphere in the compartment below. This valve is used to break the suction on the diaphragm to release it back to up position. A bell crank-like lever pivotally mounted on the housing has one part contacting the valve and is itself contactual by the trigger initially braced, or loaded, as the diaphragm moves downwardly and is held from opening the valve too soon by an interlock nose member also fixed on the diaphragm plate and which holds the valve bell-crank-like lever until the right moment. A rocker arm contacted by the plunger has a pair of rockers pushing a frame in the lower housing to compress a coil spring against the back housing plate on the down stroke of the plunger. A pair of shifting pawls on the frame each supports a shifting cam there below and one or the other of said pawls contacts at one point of backward motion a drive gear connected to a pinion gear which meshes with a large bull gear on the fixed sprinkler base. A metal ring on the base has a pair of slidable sector setting tabs thereon with protrusions which contact a cam shifter lever which in turn contacts one or the other of the cams thereby shifting is respective pawl into engagement each time with the drive gear until the cam shifter is contacted again by the other setting tab.

A primary object of this invention is to provide a sprinkler which operates on the suction created by the liquid flow to move the nozzle in a sprinkler path and having setting means thereon to set the particular sector sprinkled for automatic operation.

An additional object resides in the suction arrangement in the nozzle coupled with the diaphragm member actuating a pawl shifter to move the nozzle in a sprinkler pattern.

A further object is found in the operation of the jet interruptor from suction in the nozzle to interrupt the water stream automatically.

Still another object is found in the particular arrangement of pawls and pawl shifters whereby sector spraying is attained automatically after setting a tappet lever.

Many other advantages as well as objects and features of my sprinkler will become apparent from the following description of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side elevation view of the outside of the sprinkler with part of the base broken away.

FIG. 2 is a central, vertical cross-sectional view of sprinkler in FIG. 1.

FIG. 3 is a cross-sectional view taken substantially along the line 3—3 in FIG. 2 which is looking into the diaphragm compartment with the cover removed.

FIG. 4 is a cross-sectional view taken substantially along the line 4—4 in FIG. 2.

FIG. 5 is a front end elevation view of the sprinkler in FIG. 1.

FIG. 6 is a cross-sectional view taken substantially along the line 6—6 in FIG. 2.

FIG. 7 is a cross-sectional view taken substantially along the line 7—7 in FIG. 6.

Referring first to the outside of the sprinkler shown in FIG. 1, the sprinkler designated generally by the number 10, includes an elongated sprinkler barrel and nozzle

12 with a nozzle end 14 with knurled cap 16 and having formed integrally therewith a jet interruptor identified in general as 18. Jet interruptor 18 has thereon a movable, torpedo-shaped end 20 with a small metal deflector plate 22 with bent end 23 hanging in front of the end of nozzle end 14. The rear end of deflector jet interruptor 18 has movable thereon a plastic knob 24 for making an adjustment as explained hereinafter.

The bottom of barrel nozzle 12 is formed with a flange 26 matching with an identical, complementary flanged member 28 on the housing 30. The flange 26 has open bolt depressions or slots 32 to receive the shaft of a pair of attachment bolts 34 which are permanently mounted by pins 36 on the housing 30 to move into and out of engagement in the depressions 32 to hold the barrel on the housing 30. Each bolt 34 is provided with a nut 38 and a washer 40 to compress the flange 26 against flange 28. A circular, rubber washer or gasket 42 is provided between the flanges 26, 28 to form a tight seal.

The top portion of housing 30 is the diaphragm housing 44 of a sealed diaphragm chamber 46 having a removable cover 48. Diaphragm housing 44 is connected with the internal end of nozzle 12 by a channel 50 formed on the top of the nozzle barrel 12. The bottom of housing 30 is formed as the drive mechanism housing 52 in which is contained the drive mechanism for moving the nozzle 12 in a circular path. Housing 52 has a removable back cover 54.

Sprinkler nozzle 12 extends at the bottom 55 as a tube and fits internally of a circular base member generally marked as 56 which has a nave 58. An annular depression 60 is formed in the base 56 and has fitted therein a metal band 62 on which are fitted slidable sector control tappet levers 64 which can be pivoted out of operation. The bottom of base 56 is formed with any conventional pipe fitting, such as an internal female threaded 66 fitting for attaching irrigation pipe and the like.

As readily seen in FIG. 2, the inside of nozzle 12 is formed with baffles or blades or vanes 68 and tapers at the front end 70 with ring members 72 leading by outlet 74 into the channel 50. This formation of nozzle 12 with vanes 68 and end 70 creates a suction from the liquid being moved with velocity therethrough. The suction created acts through the channel 50 and in the diaphragm housing 44. Channel 50 connects by a short passage 76 with the jet interruptor housing 18 and the suction acts therein, as well.

Inside the diaphragm housing 44 is mounted and held in place by cap 48 a flexible rubber diaphragm 80 seated over a metal plate 82 on which is attached a plunger 84. Plunger 84 moves in a bearing in the wall between compartments 44 and 52 and has confined therewith a coil spring 86 interposed between plate 82 and a valve trigger lever 88 having one end 90 resting on the housing. Premature and proper tripping by the diaphragm trip 88 is assured by a interlock consisting of a bent member 92 mounted on plate 80 guided by a grooved plate 94 screwed to the housing. Formed in the housing 30 between compartments 52 and 44 is a valve mechanism 96 with valve 98 having one end in engagement with a valve trip actuating lever 100 mounted on housing 30. Lever 100 is "L-shaped" somewhat like a bell crank with one side in engagement with interlock lever member 92 and the other end contacting valve 98. According to this arrangement, when diaphragm 80 moves downwardly, trigger 88 will actuate valve 98 to open compartment 44 to the atmosphere which will release the suction on diaphragm 80. Valve 98 operates against a spring 102.

The bottom of plunger 84 engages an angle lever 104 mounted on a frame 106 having a pair of depending lugs 108 on a shaft 110. Lugs 108 and shaft 110 support a pawl bracket 112 pivotally mounted thereon on the inside thereof and on the outside they support a spring compression bracket 114. A large coil spring 116 is interposed between the cup shaped bracket 114 and the cap

54 of housing 52. Pawl bracket 112 supports in the center space thereof a pair of spaced pawls 117 each on a respective shaft 118 and connected by a link 119. Mounted with each respective pawl 117, on a respective shaft 118 is a respective cam 120 in the bottom of housing 52 supported from the bottom of pawl bracket 112. Cams 120 are connected by a looped spring 122. Pawls 117 face each other with their teeth in opposition across space. Mounted in this space on a shaft 124 is a drive gear 126 in alignment with the pawls 117 and on the same shaft 124 is a pinion gear 128 in mesh with a large bull gear 130 formed on the nave 58 of base 56. Pivotally mounted between cams 120 is a cam shifter 132 with a small coil spring nose 133 engageable by one or the other of the tappet levers 64.

The sealed chamber 134 above diaphragm 80 and a small nozzle 135 in the passageway 136 determines beforehand, selectively, the relative difference in air pressure above the diaphragm 80 and below same. Therefore, the size of nozzle 135 is selected to control the velocity of the up and down movement of the diaphragm 80. This controls the velocity of the motor as a whole and affects the number of revolutions per minute of the sprinkler. Air nozzle 135 could be any other valve and could be an adjustable valve for pre-setting.

The jet interruptor is driven by the same "make and break" vacuum system as the nozzle 12 itself. In the housing of the jet interruptor 18 is a diaphragm or bellows 138 which braces a return spring 142 and which is sealed in between the two pieces of casing 140, 144 forming the nozzle 18. Attached to a plate 146 backing up the diaphragm 138 is a bifurcated member 148 with a spiral pinion 150 attached on one end thereof. Operating in the pinion 150 is a splasher or jet pin 152 having spiral threads thereon matching with pinion 150 and being attached to a sliding cross plate 154 confined in the slot of the bifurcation of member 148 and locked in the material of casing 144 to prevent pin 152 from turning the entire casing 144. Pinion 150 matches with pin 152 somewhat in the manner of a push drill so that the linear motion of member 148 is transferred into rotational motion in the pin 152. The jet interruptor plate 22 is attached to pin 152 and rotates therewith. The return diaphragm and the force thereon is controlled by the spring 140. A pin 156 with sleeve 158 in the spring 140 has a threaded end 160 which received the internally threaded knob 24. The turning of knob 24 adjusts the compression of spring 140 to set and govern the rate of return of the diaphragm 138 thereby adjusting and controlling the rate of oscillation of jet interruptor plate 22.

When the suction is applied through 76 to the diaphragm 138, at the same time the main diaphragm 80 is subjected to suction, the member 148 is pulled back thereby driving pinion 150 on pin 152 to move pin 152 a slight rotational distance to one side and when the suction is interrupted by the operation of valve 98, the plate 22 returns to its initial position, and so on as long as the sprinkler nozzle is turning. So this action of the interruptor 22 is coupled with the vacuum action and works in phase with it. Therefore, the jet is interrupted when the sprinkler is rotated and the water jet remains undisturbed when the sprinkler stands still at which time the jet reaches its largest throw.

Operation

The overall operation of the sprinkler will now be summed up. It is pointed out that the sector adjustment through tappets 64 and cam shifter 132 is an optional setting that can be used or not as desired. It is an additional advantage for spraying only one particular area by limiting the particular degree of rotation in one direction and reversing the direction of rotation at a given point.

Starting immediately before the suction has been applied to the diaphragm 80, water, or other liquid, moving through nozzle 12 and hydraulically controlled by vanes 68 and ring channel 70, 72, produces a suction

5

through channel 50 which affects diaphragm 80 by pulling same downwardly thereby pushing angle lever 104 to load spring 116. While the air is sucked off, and the diaphragm 80 is pressed down, the two lugs 108 are moving backward bracing the spring 116 and causing one of the pawls 117 in moving backward also to grip the stopping drive gear 126 turning it a little. This causes the pinion 128 to drive about the main bull gear 130. The numbers of the teeth are chosen in a way which alters a little the direction of the sprinkler after every rotation, so that an even spraying at the circumference is granted after several rotations.

When the vacuum in the diaphragm chamber 44 has the diaphragm 80 and plate 82 to their lowest position, the valve lever 100 is disengaged and opens immediately the valve 102 by the action of the initial tension from spring 86 through trip 88. Now, air enters the diaphragm chamber through valve 102 thereby negating and neutralizing the suction on the diaphragm 80 which returns to normal subject to the setting in valve nozzle 135. At the moment when the air is sucked off the chamber 44, the plunger 84 braces the spring 116 and thereafter turns the entire nozzle as above described. This spring 116 brings the diaphragm 80 back through the member 104.

At the same time the diaphragm 80 is actuated, the jet interruptor 22 is started in motion through the same suction. When the air enters through valve 102 and into channel 50 it breaks the suction on the jet diaphragm 138.

There is, therefore, an automatic, steady, continuous cycle of making suction and moving the nozzle a little, then breaking suction, then re-making suction and again moving the nozzle 12 a little and so forth as long as the sprinkler is operated. Lifting and setting the tappets 64 will cause the cam shifter 133 to reverse the pawls 117, thereby producing sector spraying.

While there is shown and described a detailed sprinkler presenting one embodiment of this invention this does not constitute any sort of limitation on this invention since there are other ways the invention may be made and there are various alterations, substitutions, eliminations, changes and departures that may be effected without departing from the scope of this invention shown in the appended claims.

I claim:

1. In a liquid sprinkler of the class described receiving liquid therein under pressure and ejecting same therefrom over a large area, a sprinkler nozzle through which liquid passes under pressure and having an open end therein from which the liquid emits, a means formed internally of said nozzle adjacent the end thereof for creating a vacuum to produce a suction, a diaphragm housing formed on said nozzle normally sealed from the atmosphere, a diaphragm mounted for movement in said housing in response to said suction from said vacuum means in said nozzle, a passage connecting said diaphragm with said vacuum means, a valve in said diaphragm housing operable to admit the atmosphere in said housing, a valve contacting means operated by said diaphragm to open said valve, means closing said valve upon loss of suction, a drive member outside said diaphragm housing, a plunger operable by said diaphragm to move said drive member, a spring means compressed upon movement of said drive member, a drive gear on said base, and drive means operable between said drive member and said drive gear by and upon movement of said plunger to move said nozzle about said drive gear, said valve contacting means operating said valve to break said suction, said spring returning said drive means to original position and said diaphragm returning to normal to receive suction again upon closing of said valve.

2. In a vacuum operated sprinkler of the class described, a sprinkler nozzle receiving liquid therethrough and ejecting same therefrom, a sprinkler base normally

6

fixed with respect to the ground surface, suction, forming means on said nozzle for creating a suction at one place therein, a diaphragm chamber formed on said sprinkler and normally closed from the outside, conduit means connecting said chamber with said suction means, a diaphragm in said chamber subject to said suction means to be moved in one direction in said chamber, a drive means between said nozzle and said base to move said nozzle thereon, a spring pressure means on said sprinkler adapted to be loaded in one direction of movement, said drive means being operated by movement of said spring pressure means upon the release thereof to actuate said drive means, means on said sprinkler for releasing said diaphragm after it has moved a selected amount, and other means actuated by the movement of said diaphragm to selectively load and release said spring pressure means.

3. In a vacuum operated sprinkler of the class described a sprinkler nozzle for receiving liquid therethrough and ejecting same therefrom, a sprinkler base normally fixed with respect to the ground surface, suction forming means on said nozzle for creating a suction at one place therein, a diaphragm chamber formed on said sprinkler and normally closed from the outside, conduit means connecting said chamber with said suction means, a diaphragm in said chamber subject to said suction means to be moved in one direction in said chamber, a drive member fixed on said base, a driven member mounted on said nozzle in engagement with said drive member to move thereon in increments, a spring pressure means on said sprinkler adapted to be loaded in one direction of movement thereof, said driven member being actuated by said spring pressure means upon the release thereof, means on said sprinkler for releasing said diaphragm after it has moved a selected amount, and other means actuated by said diaphragm during the movement thereof to selectively load and release said spring pressure means, whereby said nozzle is driven by the making and releasing of the suction on said diaphragm.

4. In a vacuum operated sprinkler of the class described, a sprinkler nozzle receiving liquid therethrough and ejecting same therefrom, a sprinkler base normally fixed with respect to the ground surface, suction forming means on said nozzle for creating a suction at one point therein, a suction responsive member mounted on said sprinkler, a suction line connecting said member with said suction created by said nozzle, means on said sprinkler for breaking said suction on said suction responsive member, means actuated by said suction responsive member after a determined movement thereof to actuate said suction breaking means, return means for returning said suction responsive member to normal when said suction is released, and drive means on said sprinkler actuated by said suction responsive member each time it moves to drive said nozzle an increment, a splasher member mounted on said nozzle to splash liquid ejected from the end thereof, a second suction responsive member operably connected with said splasher member to drive same, and a suction line connecting said section suction responsive member with said suction breaking means so that said second suction responsive member is released with said other suction responsive member, and means for returning said second responsive member to normal to be again subject to suction.

5. In a vacuum operated sprinkler of the class described, a sprinkler nozzle for receiving liquid therethrough and ejecting same therefrom, a sprinkler base normally fixed with respect to the ground surface, suction forming means on said nozzle for creating a suction at one place therein, a diaphragm chamber formed on said sprinkler and normally closed from the outside, conduit means connecting said chamber with said suction means, a diaphragm in said chamber subject to said suction means to be moved in one direction in said chamber, a spring mounted on said sprinkler to be compressed and

loaded thereon, means actuated by said diaphragm movement to compress and load said spring, valve means on said sprinkler actuated by said diaphragm movement to temporarily break said suction releasing said diaphragm back to normal, said valve means being returned to normal position after breaking said suction, a power transfer means connected with and actuated by said spring upon the release thereof to transfer said spring power, a base gear formed on said base in fixed relation thereon, a driving gear mounted on said nozzle in mesh with said base gear, said transfer means being operated by and upon the release of said spring to actuate said driving gear thereby driving said gear about said base gear to move said nozzle on said base.

6. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed with respect to the ground surface, a nozzle movably mounted on said base for receiving liquid therein and ejecting same therefrom to disperse the liquid over an area, a normally closed diaphragm housing formed on said nozzle, a diaphragm mounted for movement in said housing in response to a suction applied thereto, suction means on said nozzle for creating a suction at one place therein, a suction line connecting said suction means with said diaphragm housing, a plunger mounted in said housing and extending therefrom, said plunger being actuated by said diaphragm upon movement thereof, said housing having an opening therein to the outside through which said suction may be broken, a closure member movably mounted in and sealing said opening, a trip lever mounted on said housing and engaging said closure member, a trip retaining member mounted for actuation by said diaphragm and engaging said trip lever to prevent premature operation thereof, a valve trip having one end contacting said housing and the other end contacting said trip lever, spring means interposed between said diaphragm and said valve trip to apply pressure on said valve trip preparatory to opening said closure, and drive means operated by said plunger to drive said nozzle on said base, said diaphragm driving said nozzle as it moves in response to suction applied thereto and said trip lever temporarily opening said closure to break said suction after said diaphragm has moved the proper distance.

7. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed with respect to the ground surface, an elongated sprinkler nozzle having a sprinkler barrel in communication with a liquid delivered thereto and therethrough, said liquid being emitted from the open nozzle end, a suction responsive means mounted in said chamber and being subject to suction for movement therein, a vacuum suction means on said nozzle creating suction at a point therein, a vacuum suction line connecting said suction responsive means with said suction means to expose same to suction, an opening in said chamber in communication with the outside air and through which said suction may be broken, a closure member normally closing and sealing said opening thereby causing said suction to affect said suction responsive means until said opening is opened to the outside, a means actuable by said suction responsive means when same has moved a determined amount to actuate said closure thereby opening said opening to break said suction, means returning said closure to normal closed position after said suction is broken whereby suction will again apply in said chamber, a driving means on said sprinkler actuated by said suction responsive means as said means moves, and a driven means between said nozzle and said sprinkler base driven by said driving means to move said nozzle an increment on said base each time said driving means moves and then returns to initial position, whereby said suction responsive means moves in response to the suction and returns to normal again to be subject to suction and each time moving said nozzle an increment on said base to move said liquid in a path as it is ejected from the nozzle.

8. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed on the ground, an elongated sprinkler nozzle having a sprinkler barrel in communication with liquid delivered thereto to eject said liquid therefrom, a diaphragm housing formed on said sprinkler, a flexible diaphragm mounted for movement in said housing in response to a suction therein, a diaphragm chamber on one side of said diaphragm and a cover covering said other side of said diaphragm, a suction line leading from said nozzle barrel to said diaphragm chamber providing a passage through which suction may be applied to said diaphragm, an opening in said chamber in communication with the outside, a valve means normally closing said opening thereby maintaining said chamber closed to be subject to suction from said suction line, said valve means being actuated by said diaphragm movement at a determined point, means acting on said diaphragm to return said diaphragm to normal when released from suction, a frame movably mounted on said nozzle outside said chamber to be moved in response to the movement of said diaphragm, a compression bracket mounted with said frame to be moved a limited amount thereby, a confined spring contacted by said compression bracket and being confined on said nozzle to be compressed when said frame is moved, a pawl member pivotally mounted with said frame to be moved a limited amount therewith, a drive gear mounted on said nozzle to be contacted and turned by said pawl when said frame is returned by said released spring, a pinion gear connected with said drive gear, and a base member gear formed on said base member in mesh with said pinion gear whereby said pinion turns said nozzle on said base when said pinion is moved.

9. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed with respect to the ground surface, an elongated sprinkler nozzle having a sprinkler barrel in communication with a liquid delivered thereto and therethrough, said liquid being emitted from the open nozzle end, a vacuum housing on said nozzle having a closed chamber formed therein, a suction member mounted in said chamber and being flexible for movement therein, a vacuum suction means on said nozzle creating suction at a point therein, a vacuum suction line connecting said chamber with said suction means to expose said suction member to suction, a first means mounted with said suction member to be moved thereby, a housing in said suction housing through which said first means operates beyond said chamber, while said chamber remains closed, an opening in said chamber in communication with the outside air and through which said suction may be broken, a closure member normally closing and sealing said opening thereby causing said suction to affect said suction member until said opening is opened to the outside, an actuating means actuable by said suction member when said member has moved a determined amount to actuate said closure thereby opening said opening to break said suction, means returning said closure to normal closed position after said suction is broken whereby suction will again apply in said chamber, a driving means on said sprinkler actuated by said first means as said suction member moves, and a driven means between said nozzle and said sprinkler base driven by said driving means to move said nozzle an increment on said base each time said suction member moves and then returns to initial position, whereby said first means moves in response to the suction and returns to normal again to be subject to suction and each time moving said nozzle an increment on said base to move said liquid in a path as it is ejected from the nozzle.

10. The device of claim 9, wherein there is a splasher member mounted on said nozzle to operate in the path of the liquid, a second splasher suction member on said nozzle for actuating and operating said splasher member, and valve means operating with said suction member

to control the making and release of the suction thereby controlling said splasher member.

11. The device in claim 10, wherein said valve means has a suction line therewith leading to said drive vacuum chamber so that said vacuum is controlled by said closure.

12. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed on the ground, an elongated sprinkler nozzle having a sprinkler barrel in communication with liquid delivered thereto to eject said liquid therefrom, means on said sprinkler for producing suction, a diaphragm housing formed on said sprinkler, a flexible diaphragm mounted for movement in said housing in response to a suction therein, a normally closed diaphragm chamber on one side of said diaphragm, a suction line leading from said nozzle barrel to said diaphragm chamber providing a passage through which suction may be applied to said diaphragm, a plunger mounted with said diaphragm to be moved thereby, a plunger housing formed in said diaphragm chamber through which said plunger operates with said chamber sealed from the outside, an opening in said chamber in communication with the outside, a closure member normally closing said opening thereby maintaining said chamber closed to be subject to suction from said suction line, a trip means interposed between said diaphragm and said closure to actuate said closure when said diaphragm moves a certain amount, means acting on said diaphragm to return said diaphragm to normal when released from suction, a confined spring actuated by said plunger movement and being confined on said nozzle to be compressed when said plunger is moved by said diaphragm, a pawl member pivotally mounted adjacent said spring to be moved a limited amount thereby, a drive means mounted on said nozzle to be contacted and turned by said pawl when said spring is released, a driving member connected with said drive means and means formed on said base member in engagement with said driving member whereby said driving member turns said nozzle on said base when said plunger is moved.

13. The device claimed in claim 12, a second diaphragm splasher housing formed on said nozzle, a suction line connecting said diaphragm housing with said suction means on said nozzle, a splasher member movably mounted on said splasher housing and protruding into the path of liquid delivered from said nozzle end, a splasher pin mounting said splasher on said housing and being movable to move said splasher, a drive pinion in engagement with said pin, an actuating member movably mounted on said housing to drive said pinion, said actuating member being operated by said diaphragm as said diaphragm moves, spring return means engageable with said diaphragm to return said diaphragm to normal position, and means connecting said diaphragm housing with the outside to break said suction in said suction line thereby releasing said diaphragm to move said splasher to one position, said suction then operating to move said splasher back again, and so on to move said splasher in the path of the liquid.

14. In a splasher element for operation on a vacuum operated sprinkler, a diaphragm splasher housing formed on said nozzle, a suction line connecting said diaphragm housing with said suction means on said nozzle, a splasher member movably mounted on said splasher housing and protruding into the path of liquid delivered from said nozzle end, a splasher pin mounting said splasher on said housing and being movable to move said splasher, a drive pinion in engagement with said pin, an actuating member movably mounted on said housing to drive said pinion, said actuating member being operated by said diaphragm as said diaphragm moves, spring return means engageable with said diaphragm to return said diaphragm to normal position, and means connecting said diaphragm housing with the outside to break said suction in said suction line thereby releasing said diaphragm to move said splasher to

one position, said suction then operating to move said splasher back again, and so on to move said splasher in the path of the liquid.

15. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed with respect to the ground surface, an elongated sprinkler nozzle having a sprinkler barrel in communication with a liquid delivered thereto and therethrough, said liquid being emitted from the open nozzle end, a diaphragm housing on said nozzle having a closed diaphragm chamber formed therein, a diaphragm mounted in said chamber and being flexible for movement therein, a vacuum suction means on said nozzle creating suction at a point therein, a vacuum suction line connecting said diaphragm chamber with said suction means to expose said diaphragm to suction, a diaphragm member mounted with said diaphragm to be moved thereby, a second housing in said diaphragm housing through which said diaphragm member operates beyond said diaphragm chamber, while said chamber remains closed, an opening in said chamber in communication with the outside air and through which said suction may be broken, a closure member normally closing and sealing said opening thereby causing said suction to affect said diaphragm until said opening is opened to the outside, a trip means actuatable by said diaphragm when said diaphragm has moved a determined amount to actuate said closure thereby opening said opening to break said suction, means returning said closure to normal closed position after said suction is broken whereby suction will again apply in said chamber, a driving means on said sprinkler actuated by said diaphragm member as said diaphragm moves, and a driven means between said nozzle and said sprinkler base driven by said driving means to move said nozzle an increment on said base each time said plunger moves and then returns to initial position, whereby said diaphragm moves in response to the suction and returns to normal again to be subject to suction and each time moving said nozzle an increment on said base to move said liquid in a path as it is ejected from the nozzle.

16. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed on the ground, an elongated sprinkler nozzle having a sprinkler barrel in communication with liquid delivered thereto to eject said liquid therefrom, suction forming means on said nozzle, a diaphragm housing formed on said sprinkler, a flexible diaphragm mounted for movement in said housing in response to a suction therein, a diaphragm chamber on one side of said diaphragm and a cover covering said other side of said diaphragm, a suction line leading from said nozzle, suction means to said diaphragm chamber providing a passage through which suction may be applied to said diaphragm, a plunger mounted with said diaphragm to be moved thereby, a plunger housing formed in said diaphragm chamber through which said plunger operates with said chamber sealed from the outside, an opening in said chamber in communication with the outside, a closure member normally closing said opening thereby maintaining said chamber closed to be subject to suction from said suction line, a trip lever for said closure member to contact same and to open the chamber to the outside thereby breaking suction therein, a trip member interposed between said diaphragm and said trip lever to trip said lever when said diaphragm moves a certain amount, spring means acting on said diaphragm to return said diaphragm to normal when released from suction, an angle lever movably mounted on said nozzle outside said chamber to be contacted and moved by said plunger, a compression bracket mounted with said angle lever to be moved a limited amount thereby, a spring contacted by said compression bracket and being confined on said nozzle to be compressed when said angle lever is moved, a pawl member pivotally mounted with said angle lever to be moved a limited amount therewith, a drive gear mounted on said nozzle to be contacted and turned by

said pawl when said angle lever is moved, a pinion gear connected with said drive gear, and a gear formed on said base member in mesh with said pinion gear whereby said pinion turns said nozzle on said base when said pinion is moved, said diaphragm being continuously moved and released by the make and break of suction to move said nozzle about said base.

17. In a vacuum operated sprinkler of the class described, a sprinkler base normally fixed on the ground, an elongated sprinkler nozzle having a sprinkler barrel in communication with liquid delivered thereto to eject said liquid therefrom, a diaphragm housing formed on said sprinkler, a flexible diaphragm mounted for movement in said housing in response to a suction therein, a diaphragm chamber on one side of said diaphragm, a cover covering said other side of said diaphragm, a suction line leading from said nozzle barrel to said diaphragm chamber providing a passage through which suction may be applied to said diaphragm, an opening in said chamber in communication with the outside, a closure member normally closing said opening thereby maintaining said chamber closed to be subject to suction from said suction line, means operated by said diaphragm for temporarily actuating said closure to break the suction, means acting on said diaphragm to return said diaphragm to normal when released from suction, an angle lever movably mounted on said nozzle outside said chamber to be moved by the action of said diaphragm, a compression bracket mounted with said angle lever to be moved a limited amount thereby, a confined spring contacted by said compression bracket and being confined on said nozzle to be compressed when said angle lever is moved, a pair of spaced pawl members pivotally mounted with said angle lever to be moved a limited amount therewith, a pawl cam connected with each of said pawls to shift same when contacted, a pawl shifter mounted on said nozzle to shift said cam, spring means interconnecting said cam members, a connecting member connecting said pawls, a drive gear mounted on said nozzle to be contacted and turned by one of said pawls when said angle lever is moved, a pinion gear connected with said drive gear, a gear formed on said base member in mesh with said pinion gear whereby said pinion turns said nozzle on said base when said pinion is moved, a pair of cam shifters mounted on said base, a circular track on said base on which said cam shifters may be moved in selective, spaced position whereby said nozzle will travel until one cam shifter is reached at which time the direction is reversed to the other pawl which in turn drives until the first cam shifter is reached again and so on in a circular pattern, thereby driving said nozzle while said liquid is emitted therefrom.

18. The device in claim 17, wherein there is a second diaphragm housing formed on said sprinkler, a suction line connecting said diaphragm housing with said suction means, a splasher member mounted for movement on said nozzle to operate in the open end thereof to contact the liquid being ejected thereby interrupting same, an actuating means movably mounted on said housing to drive said splasher, said actuating member being operated by said diaphragm as said diaphragm moves, return means engageable with said diaphragm to return said diaphragm to normal, and means connecting said diaphragm housing with the outside to break said suction in said suction line thereby releasing said diaphragm to move said splasher to one position, said suction then operating to move said splasher back again, and so on to move said splasher in the path of the liquid.

19. In a sprinkler of the class described receiving a liquid under pressure and ejecting same over an area, a sprinkler base normally stationary with respect to the ground, an elongated nozzle mounted for movement on said base and having an ejection end from which said liquid emits, a diaphragm housing formed on said nozzle normally sealed from the atmosphere, a drive housing

formed adjacent said diaphragm housing, a vacuum producing means formed in the internal end of said nozzle, a connection between said vacuum producing means and said diaphragm housing, a valve in said diaphragm housing leading to the atmosphere, a valve member for opening said valve, a flexible diaphragm mounted in said diaphragm housing, a plunger mounted in said diaphragm housing and extending into said drive housing, said diaphragm operating said plunger upon movement thereof, a trip lever operable by said diaphragm upon movement thereof, a valve trip actuating lever mounted in said housing, a valve trip retaining member mounted for actuation by said diaphragm to prevent premature operation of said valve trip actuating lever, said valve actuating lever operating said valve member to open said valve when said diaphragm reaches the proper limit of travel, a drive frame in said drive housing having a movable shaft, an angle lever mounted on said shaft to be actuated by said plunger, a spring mounted in said drive housing compressed by said drive frame upon actuation of said diaphragm, a drive pawl mounted on said drive frame and normally out of engagement, a drive gear adjacent said drive pawl to be contacted thereby upon movement of said diaphragm, and a large gear on said base about which said nozzle is driven each time said drive gear is moved by said pawl, said suction operating said diaphragm to drive said pawl which moves said nozzle about said large gear and said valve being opened by said diaphragm to break said suction to re-position said pawl and spring for repeating said drive when said valve closes and said suction again affects said diaphragm.

20. The sprinkler claimed in claim 19, a second jet interruptor diaphragm housing formed on said nozzle adjacent said nozzle end, a diaphragm sealed in said housing, a passage connecting said diaphragm operably with the suction acting on said first drive diaphragm, a jet deflector plate movably mounted in said housing and extending from said housing in front of said nozzle and the stream emitted thereby, a drive member for said plate, and a driving member for said drive member, said driving member being operated by said diaphragm upon suction movement thereof to move said plate in one direction of oscillation and said driving member returning to the other position of oscillation upon break of said suction in said main diaphragm housing.

21. In a vacuum operated sprinkler of the class described, which has a suction means thereon, a sprinkler base normally fixed on the ground, an elongated sprinkler nozzle having a sprinkler barrel in communication with liquid delivered thereto to eject said liquid therefrom, a diaphragm housing formed on said sprinkler, a flexible diaphragm mounted for movement in said housing in response to a suction therein, a diaphragm chamber on one side of said diaphragm and a cover covering said other side of said diaphragm, a suction line leading from said suction means to said diaphragm chamber providing a passage through which suction may be applied to said diaphragm, a plunger mounted with said diaphragm to be moved thereby, a plunger housing formed in said diaphragm chamber through which said plunger operates with said diaphragm chamber sealed from the outside, an opening in said chamber in communication with the outside, a closure member normally closing said opening thereby maintaining said chamber closed to be subject to suction from said suction line, a trip lever for said closure member to contact same and to open the chamber to the outside thereby breaking suction therein, a trip member interposed between said diaphragm and said trip lever to trip said lever when said diaphragm moves a certain amount, spring means acting on said diaphragm to return said diaphragm to normal when released from suction, an angle lever movably mounted on said nozzle outside said chamber to be contacted and moved by said plunger, a compression bracket mounted with said angle lever to be moved a limited amount thereby, a confined

13

spring contacted by said compression bracket and being confined on said nozzle to be compressed when said angle lever is moved, a pair of spaced pawl members pivotally mounted with said angle lever to be moved a limited amount therewith, a pawl cam connected with each of said pawls to shift same when contacted, a pawl shifter mounted on said nozzle to shift said cams, spring means interconnecting said cam members, a connecting member connecting said pawls, a drive gear mounted on said nozzle to be contacted and turned by one of said pawls when said angle lever is moved, a pinion gear connected with said drive gear, a gear formed on said base member and in mesh with said pinion gear whereby said pinion turns said nozzle on said base when said pinion is moved, a pair of cam shifters mounted on said base, a circular track on said base on which said cam shifters may be moved in selective, spaced position whereby said nozzle will travel until one cam shifter is reached at which time the direction is reversed to the other pawl which in turn drives until the first cam shifter is reached again and so on in a circular pattern, thereby driving said nozzle while said liquid is emitted therefrom.

22. The device claimed in claim 21, a second diaphragm splasher housing formed on said nozzle, a suc-

14

tion line connecting said diaphragm housing with said suction means on said nozzle, a splasher member movably mounted on said splasher housing and protruding into the path of liquid delivered from said nozzle end, a splasher pin mounting said splasher on said housing and being movable to move said splasher, a drive pinion in engagement with said pin, an actuating member movably mounted on said housing to drive said pinion, said actuating member being operated by said diaphragm as said diaphragm moves, spring return means engageable with said diaphragm to return said diaphragm to normal position, and means connecting said diaphragm housing with the outside to break said suction in said suction line thereby releasing said diaphragm to move said splasher to one position, said suction then operating to move said splasher back again, and so on to move said splasher in the path of the liquid.

References Cited in the file of this patent

FOREIGN PATENTS

461,380	Italy	Jan. 25, 1951
527,041	Italy	May 26, 1955
1,104,744	France	Nov. 23, 1955