ABSTRACT

A weeper assembly and method for use in a slow diffusion type irrigation system comprising a tubular housing insertable at intervals along a water supply line and having a captive valve therein movable between a plurality of seats including a sub-atmospheric pressure seat and a super-atmospheric pressure seat limiting flow to a desired seepage rate adequate to support plant life within a restricted area. The second seat may be detachably supported at the outlet end of the assembly in different positions to provide flow at different rates, each of said positions being sufficiently close to the fixed seat that the valve seats thereon and cuts off all flow when the second seat is either loosely assembled or fully detached. The second seat is readily replaceable by a sprinkler head having means for supporting the valve off its fixed seat so long as the sprinkler head is in assembled position.

23 Claims, 6 Drawing Figures
WEEPER ASSEMBLY AND METHOD FOR USE IN A SLOW DIFFUSION TYPE IRRIGATION SYSTEM

This invention relates to irrigation systems, and more particularly to an improved weeper assembly connectable at intervals along a water supply line and operable to permit a minute flow of water into a plant or tree root system from a point closely beneath the surface of the ground and including means for holding the valve captive while servicing the weeper assembly or while converting from weeper flow to sprinkler head operation.

Recently conducted experiments have demonstrated that very substantial economies can be achieved in the use of irrigation water by slow diffusion of a surprisingly small amount into the plant root system on a prolonged or a continuous basis. Various devices have been proposed for carrying out this general concept; however, there are numerous problems for which satisfactory answers have not been provided in the devices so far provided. The seepage flow required at each outlet is extremely small and varies, from a flow rate of one half to approximately 10 gallons per hour depending upon the particular prevailing conditions and the size of the root system being irrigated, a flow of 1 to 3 gallons per hour being typical for watering a small tree such as a citrus tree under typical Southern California conditions.

It is at once apparent that precision flow control equipment must be employed and that it is subject to erratic behaviour due to various causes not easily taken into account including pressure variations in the line, the presence of foreign matter in the water supply, and more particularly the presence in the water supply of earth minerals and salts which tend to deposit on surfaces over which the water flows slowly. Stoppage and variation in the rate of flow are readily recognized as intolerable in an irrigation system designed to supply there minimum water requirements. Owing to the need for outlets at frequent intervals and, in the case of larger plants such as trees, close to each tap root, the cost of the weeper assemblies and supply connections must be held to a minimum.

Weeper assemblies as heretofore proposed have failed to meet the foregoing and other critical requirements in various respects. For example, they fail to include suitable provision for servicing the individual assemblies without interrupting the operation of other portions of the system. Another shortcoming is the lack of simple, effective means built into each weeper assembly effective to cut off the water flow through any outlet automatically as that outlet is being opened for inspection and servicing. Prior devices also lack a simple, inexpensive and easily manipulatable means for adjusting the weeper flow rate in the field as well as provision for preventing foreign matter entering the assembly while it is being serviced. Nor do prior systems have provision for quickly and inexpensively shifting from weeper operation to sprinkler operation.

To meet the foregoing and other shortcomings of prior practice in this art, there is provided by the present invention an exceedingly simple, inexpensive, rugged irrigation flow control device and method operable selectively at one or more weepage flow rates, or as a sprinkler, at the user’s option.

Another object of the invention is the provision of a weeper irrigation assembly having a single valve held captively assembled therein between two fixed seats and closing automatically under either sub-atmospheric or super-atmospheric pressure conditions.

Another object of the invention is the provision of a weeper assembly having a single valve held captively assembled therein while the separable weeper valve seat is detached or being serviced.

Another object of the invention is the provision of a weeper assembly having two valve seats closely spaced to one another at the outlet end thereof, including a fixed valve seat and a removable valve seat cooperating with an associated valve to provide a desired weepage flow then held in assembled position and the fixed seat cooperating with the valve to cut off all flow when the removable seat is not held tightly in assembled position.

Another object of the invention is the provision of a weeper outlet having an adjustable valve seat provided with a plurality of valve seating surfaces each notched to provide a different weepage flow rate when the flow control valve is seated thereon.

Another object of the invention is the provision of a convertible weeper assembly having a fixed valve seat adjacent its outlet end and a valve member adapted to be held seated thereon by water pressure and which weeper assembly is convertible to sprinkler head operation when a sprinkler head is attached thereto and having means on its inlet end to hold the weeper valve open as an incident to the connection of a sprinkler head to the weeper assembly.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawing to which they relate.

Referring now to the drawing in which a preferred embodiment of the invention is illustrated:

FIG. 1 is a generally schematic view showing the invention weeper assembly installed in a water supply line with each assembly close to the tap root of a tree irrigated thereby;

FIG. 2 is a cross sectional view on an enlarged scale through a preferred embodiment of the weeper assembly with the valve seats against the weeper inlet passage;

FIG. 3 is a fragmentary enlarged view taken along line 3—3 on FIG. 2 and showing the valve in use to control weepage flow;

FIG. 4 is an elevational view, partly in section, showing the sprinkler head attached to the weeper;

FIG. 5 is a perspective view on an enlarged scale of a portion of the lower end of the sprinkler head; and

FIG. 6 is a view on an enlarged scale of a typical weeper valve seat.

Referring initially more particularly to FIG. 1, there is shown an illustrative installation of the invention including a water supply line 10 extending from any suitable pressurized source past a row of trees to be irrigated. Installed at intervals and close to the tap root of each tree is a unitary weeper assembly 11, the outlet upper end of which being usually located just beneath the surface of the ground and normally concealed and protected by an overlying layer of dirt.

The structural details of assembly 11 are best shown in FIGS. 2 and 3. The assembly includes a T-shaped main body fitting 12 having a tubular housing 13 bonded or otherwise suitably secured in its T-stem. Housing 13 has a central bore 14 formed at its upper end with an integral or fixed first valve seat 15 on which the ball valve 16 can seat under certain conditions.
Valve 16 is held captive assembled within housing 13 by valve seat 15 and by a lower or third valve seat here shown as formed by a short sleeve 18 and inserted from the lower or inlet end of housing 13 and held in place by adhesive or other suitable means. The valve seats on 18 and safeguards against the entry of trash and air as the system is cut off and water gravitates out from lower level ones of the weeper outlets.

As is best shown in FIG. 3, the outlet or upper end of housing 13 is provided with a weeper flow control valve seat formed by a second valve seat ring 20 of non-corrosive material and preferably from smooth-surfaced stainless steel, brass or molded plastic. Ring 20 is formed with a cylindrical bore 21 of substantially smaller diameter than the bore through valve seat 15.

As is made clear by FIG. 3, the inner end of passage 21 is sufficiently close to the seating edge of valve seat 15 as to hold valve 16 unseated therefrom so long as seating ring 20 is held firmly in its assembled position by means which will now be described.

Valve seat ring 20 has a snug fit in a circular recess 23 concentrically of passage 14 through housing 13. Normally ring 20 is held in firmly and in fluid tight assembled position by the cup-shaped cap 25 having threads mating with threads 26 encircling the upper end of housing 13. Threads 26 are slotted crosswise thereof and along at least one side of housing 13 as is indicated at 27 thereby to provide a free flow channel through which the water escapes into the ground, as is indicated by the arrow 28. Seated in a well in the bottom of cap 25 is a resilient pressure member 30 having a channel 31 along which the water flows before entering the escape slot 27. As will be apparent from the foregoing, the tightening of the cap 25 applies pressure through member 30 to the valve seat ring 20 so that the latter is assured of a fluid tight fit with the surfaces of recess 23.

The semi-soft character of pressure member 30 compensates for tolerance variations in the parts and serves to apply and distribute pressure to the ring 20 in a manner holding it firmly in seating contact with recess 23 so long as cap 25 is tightened. If the cap is not tightened, the water pressure interiorly of the assembly will act on valve 16 forcing it upwardly until it seats against the fixed valve seat 15.

As is best shown in FIG. 6, the weeper valve seat ring 20 may and preferably does have one or more minute calibration type passages or notches 35 across its inner rim edge at either end of passage 21. If there are such notches at both ends of passage 21, as there preferably are, these notches may be and preferably are of different size. This makes it a simple matter to change the seepage flow rate by temporarily detaching cap 25 and inverting seat ring 20 to bring the alternate flow notches 35 into operating position relative to valve 16. The cap is then replaced and tightened.

Referring now to FIG. 4, there is shown a unitary sprinkler head assembly 40 having an elongated tubular main body 41 formed with a threaded well 42 at its lower end mateable with the threads 26 of the weeper housing 13. Freely and rotatably supported at the upper end of housing 41 is a conventional type sprinkler head 44 the arms of which radiate in the manner shown and terminating in reaction-type water dispensing jets 45. The outlet openings of these jets are directed outwardly and upwardly in opposite directions in a manner well known to those familiar with sprinkler heads designed for rotation by the reactive forces of the water issuing from their tips.

Frictionally supported at the lower end of the water distributing passage 47 of the sprinkler head is a tubular projection 48 the constructional details of which are best shown in FIG. 5. The lower end of this fitting has a deep V-shape notch 49 so shaped as to have a minimum of contact points with ball valve 16. The exterior diameter of fitting 48 is less than the outlet opening through the fixed valve seat 15. Consequently the fitting is readily received through this opening as the sprinkler head is threaded onto the outer end of housing 13. During this assembly operation, fitting 48 projects downwardly through valve seat 15 so as to cause valve 16 off from seat 15 and holding it clear of this seat so long as the sprinkler head is in assembled position. Although not so shown it will be understood that the inner end of the threaded well at the inlet of the sprinkler head may be provided with a gasket avoiding any possibility of leakage although it will be apparent from FIG. 4 that the flange 50 on member 48 seats against the bottom of recess 23 and provides a fluid tight seal for the sprinkler head.

The operation of the weeper assembly will be quite apparent from the foregoing detailed description of the components and their relationship to one another. Normally, the system is installed as shown in FIG. 1 and the main water valve, not shown, is left in an open position supplying pressurized water, as at 20–30 psi, to all of the weeper assembles 11,11. The main line pressure lifts valve 16 off the lower seat 18 and holds it firmly against the inner end of passage 23 through the weeper seat ring 20. Water escapes through the notches 35, passages 31, and passage 27 into the ground and the adjacent root system being irrigated. In this manner the root system is maintained moist by continual slow seepage of water at the desired rate determined by the size of the calibrated notches 35 in the outer valve seat ring 20.

Should the operator desire to either decrease or increase the seepage rate, he merely brushes away the dirt covering the top of cap 25 and removes the cap. Thereupon, the internal water pressure raises ball 16 into seating engagement with the fixed seat 15 and, in so doing, elevates the outer seat ring 20. If the operator wishes to change the rate to that provided by the notches 35 at the upper end of passage 21, he merely inverts the seating ring and restores it to recess 23 and then reassembles cap 25 until it is firmly tightened. As the cap approaches its tightened position, ring 20 engages valve 16 and depresses it from seat 15 thereby restoring the flow through the new set of weeper passages. If a flow different from that provided by the notches at either end of the ring is desired, the operator merely inserts a substitute valve seat ring having notches of the proper size.

Under certain circumstances inspection of the tree being irrigated may disclose the need for a larger and a more widely dispersed flow of water. In this event, cap 25 is removed along with seating ring 20, and sprinkler head 40 is assembled to housing 13 and firmly tightened. During this assembly operation, fitting 48 at the lower end of the sprinkler head passes through valve seat 15 forcing valve 16 off its seat so that water flows past the valve, through fitting 48, and issues from water jets 45, the latter then being effective to rotate the sprinkler head and disperse the jets of water over
a very considerable area. It will also be recognized that if the operator wishes a larger volume flow without dispersing it widely, he may detach one or both of the sprinkler head jets 45 or he may remove the rotating arms 44 temporarily. As is true of servicing operations performed on weeper assembly 11, installation and detachment of the sprinkler head can be performed without need for shutting off the main water supply or interfering in any way with the normal operation of all other weeper assemblies connected to supply line 10. Nor is there any risk of foreign matter entering the assembly while either cap 25 or the sprinkler head is detached since the main line pressure is then effective to hold valve 16 firmly seated against seat 15. At that time, all exposed parts of the assembly are readily viewed and inspected for the presence of any dirt before the cap or the sprinkler is attached.

Another feature of the invention is the capability and ease with which the outlet assembly can be flushed during the operation without need for cutting off the system or interfering with the operation of any other outlet. The operator merely detaches cap 25 allowing valve 16 to seat and, in so doing, elevates seating ring 20. This ring is then lifted out permitting the operator to use his finger tip or a smaller diameter plunger to depress the valve thereby allowing a fast flowing stream to issue adequate to thoroughly flush away any trash, debris or particles in that portion of the line or that weeper assembly. Following this flushing operation the parts are reassembled.

Although weeper notches 35 are preferably located in the separable valve seat member 20, it will be recognized that they may be formed in the valve seating edge of fixed seat 15 in which event the flow rate of the assembly can be varied only by removing cap 25 and substituting the sprinkler head assembly. Cap 25 serves as a protective cover and safeguards against the entry of trash and foreign matter.

While the particular weeper assembly and method for use in a slow diffusion type irrigation system herein shown and disclosed in detail is fully capable of containing the objects and providing the advantages hereinafter stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the detail of construction or design herein shown other than as defined in the appended claims.

I claim:

1. In a weeper type irrigation system for bleeding a small quantity of water into the ground over a prolonged period to support plant life, that improvement which comprises a weeper outlet assembly having means for connecting the same to a water supply line and including a tubular housing having an inlet end connectable to said supply line, first and second closely spaced aligned valve seat means adjacent the outer end of said tubular housing each having the seats thereof facing in the same direction, means adjacent said inlet end holding a freely movable valve captive in said housing between said water inlet and said first and second valve seat means, said valve adapted to seat against either valve seat of said first and second valve seat means, said second valve seat means being shaped to permit a minute flow of water between said valve and said second valve seat means, means holding said second valve seat means detachably assembled to said housing and normally in position to prevent said valve contacting said first valve seat means, said second valve seat means being effective to seat said valve while fully assembled to said housing and connected to a source of pressurized water and said second valve seat means permitting said valve to seat against said first valve seat means when said second valve seat means is not fully assembled to said housing.

2. A weeper assembly as defined in claim 1 characterized in that said means holding said valve captive in said tubular housing comprises third valve seat means facing toward said second valve seat means and being at a lower elevation than said second valve seat means whereby said valve automatically returns by gravity and assumes a position against said third valve seat means when the pressure at the inlet end to said tubular passage is subatmospheric.

3. A weeper assembly as defined in claim 1 characterized in the provision of protective cap means assembled to the outlet end of said tubular housing effective to prevent entry of foreign matter to the area of said first and second valve seat means and having flow passage means for the water escaping therepast.

4. A weeper assembly as defined in claim 3 characterized in the provision of means for holding said protective cap means readily detachably assembled to the outlet end of said weeper assembly.

5. A weeper assembly as defined in claim 1 characterized in that the water pressure at the inlet end of said tubular housing is normally effective to hold said valve unseated from said first seat means and seated against said second valve seat means.

6. A weeper assembly as defined in claim 1 characterized in that said second valve seat means is provided with at least one small weeper passage along which seepage flow occurs when said valve is seated thereon.

7. A weeper assembly as defined in claim 1 characterized in that said second valve seat means includes a detachable outer valve seat ring having minute flow passage means crosswise of the valve seating surface thereof along which said seepage flow occurs while said valve is held seated thereon by the water pressure in said supply line, and means for holding said second valve seat means detachably assembled to the outlet end of said tubular housing.

8. A weeper assembly as defined in claim 7 characterized in the provision of cap means threaded to the outer end of said tubular housing and cooperating therewith when tightened to hold said second valve seat means fully assembled to said housing, said cap means being effective when partially loosened from said fully assembled position to permit said valve to seat against said first valve seat means and cut off all flow therepast.

9. A weeper assembly as defined in claim 7 characterized in that said second valve seat means is of non-corrosive material and notched at the inner rim edge thereof to provide weepage flow passages.

10. A weeper assembly as defined in claim 9 characterized in that said second valve seat means is notched on the opposite faces at the inner rim edge thereof to provide weepage flow passages of different size, and said second valve seat means being securable to said tubular housing with either face thereof outermost depending on the weepage flow rate desired.

11. A weeper assembly as defined in claim 7 characterized in that said means for holding said second valve seat means in assembled position comprises an inverted cup shaped cap fitting about the outlet end of said tu-
bular housing and having portions thereof mateable with exterior portions of said tubular housing.

12. A weeper assembly as defined in claim 1 characterized in that said means for holding said second valve seat means in assembled position is adjustable between a first position holding said second valve seat means immovably assembled and operable to provide weeper flow and a second position wherein said second valve means is held captively and loosely assembled so that said valve seats on said first valve seat to cut off all water flow.

13. A weeper assembly as defined in claim 1 characterized in the provision of sprinkler head means detachably connectable to the outlet end of said tubular housing and including a tubular water flow passage means equipped with means extensible into the interior of said tubular housing and effective to hold said valve depressed away from the level of said second valve seat means whereby water is free to flow into said sprinkler head means and to escape therefrom.

14. A weeper assembly as defined in claim 13 characterized in that said sprinkler head means includes a rotary water dispensing sub-unit having a plurality of water jet outlets cooperating to rotate said sub-unit by the reaction forces of pressurized water issuing therefrom.

15. A weeper assembly as defined in claim 1 characterized in the provision of protective cap means for the outlet end of said tubular housing and effective to protect said minute flow means against entry of foreign matter and cooperating with the outlet end of said tubular housing to provide an escape passage for water, and said sprinkler head means and said protective cap including means for holding either one thereof selectively assembled to said tubular housing.

16. A weeper assembly as defined in claim 1 characterized in that said assembly is formed essentially of non-metallic components.

17. A weeper assembly as defined in claim 1 characterized in that said second valve seat means and said means for holding the latter detachably assembled to said tubular housing mutually cooperate to control the water flow rate therepast.

18. A weeper assembly as defined in claim 17 characterized in that said second valve seat means is selectively securable in assembled relation on the outer end of said tubular housing in any of a plurality of different positions each effective to permit water flow therepast at a different rate.

19. A weeper assembly as defined in claim 1 characterized in that said means holding said second valve seat means captive comprises cap means having means centrally of its interior to hold said second valve seat means in fluid-tight relation to the outlet end of said tubular housing and adjustable to a position retaining said second valve seat means loosely captive with said valve free to seat on said first valve seat means.

20. A weeper assembly as defined in claim 1 characterized in that said tubular housing is T-shaped and hollow, and the T-head thereof being open at its ends and connectable to a water supply line passing therethrough.

21. In a weeper type irrigation system for bleeding a small quantity of water into the ground to support plant life, that improvement which comprises a weeper outlet assembly having means for connecting the same into a water supply line intermediate the opposite ends thereof, said assembly having a tubular housing opening at one end laterally into said water supply line, means holding a valve loosely captive in said tubular housing and including first and second valve seat means adjacent the other end of said housing, means for varying the relative positions of said first and second valve seat means between first and second positions in the first of which water discharges from said weeper outlet assembly at a predetermined slow rate and in the second of which positions said valve seats against said first valve seat means to cut off all water flow from said weeper outlet assembly.

22. The combination defined in claim 21 characterized in that said second valve seat means comprises a member separable from said tubular housing for servicing while said valve is held seated on said first valve seat means to cut off all water flow.

23. The combination defined in claim 22 characterized in that said means for holding said second valve seat means assembled to said housing comprises cap means embracing the adjacent end of said tubular housing and cooperating therewith to direct water escaping past said second valve seat means to escape along the exterior sidewall of said tubular housing.