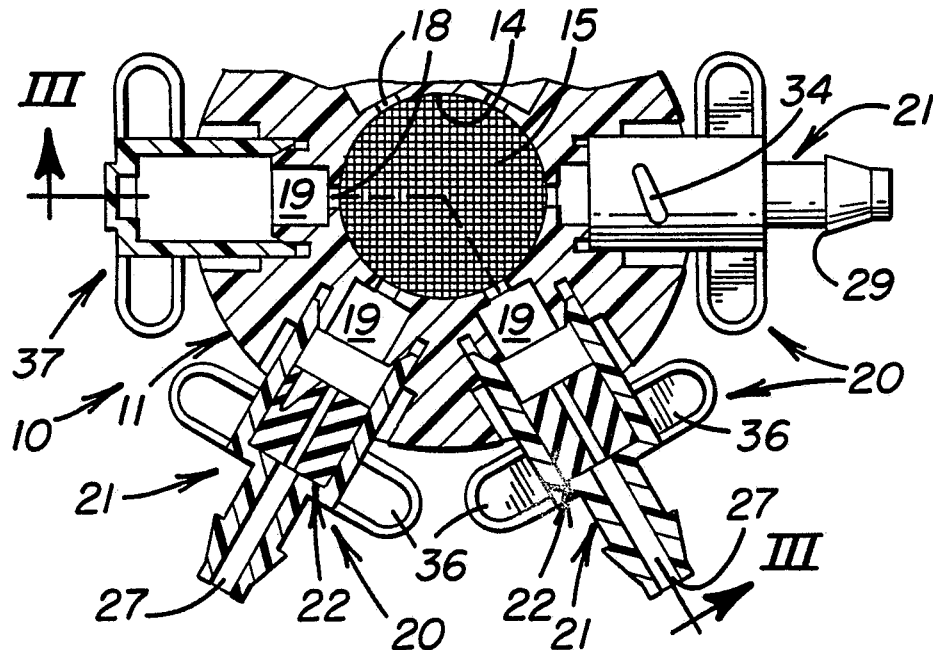




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁵ : B05B 15/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 93/18861 (43) International Publication Date: 30 September 1993 (30.09.93)</p>
<p>(21) International Application Number: PCT/US92/03493 (22) International Filing Date: 28 April 1992 (28.04.92) (30) Priority data: 852,536 17 March 1992 (17.03.92) US (71) Applicant: WADE MANUFACTURING CO. [US/US]; 9995 S.W. Avery Street, Tualatin, OR 97062 (US). (72) Inventor: NEWBEGIN, Edward, H. ; 02340 S.W. Military Road, Portland, OR 97219 (US). (74) Agent: LEMPIO, Paul, S.; Phillips, Moore, Lempio & Fin- ley, 177 Post Street, Suite 800, San Francisco, CA 94108 (US).</p>		<p>(81) Designated States: AU, BR, CA, DE, ES, GB, JP, KR, RU, SD, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, MC, NL, SE). Published <i>With international search report.</i></p>

(54) Title: MULTI-OUTLET EMITTER AND METHOD



(57) Abstract

An emitter (10) has a plurality of circumferentially disposed fittings (21) releasably connected thereon. A pressure-compensated flow control valve (22) is mounted in at least some of the fittings (21) and the control valves (22) have varied flow rates. A plug (37) is inserted into the outlets from the emitter (19) not having a fitting/control valve (22) mounted therein. The emitter (10) is adapted to replace a standard sprinkler head of a sprinkler circuit to provide the circuit with both sprinkler and micro-irrigation capabilities.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICEMULTI-OUTLET EMITTER AND METHODTECHNICAL FIELD

This invention relates to a multiple-outlet emitter for use in micro-irrigation systems and more particularly to an emitter and method for discharging water at selectively varied flow rates from the respective outlets thereof.

BACKGROUND ART

A reoccurring problem with present-day irrigation systems tailored for the landscape market has been the inability to effectively synchronize the water discharge rate and time between drip and sprinkler circuits for a common timing cycle. The sprinkler timing cycle is usually in the range of from five to ten minutes and a relatively high flow rate drip system is designed to discharge approximately one gallon of water during this time period. One costly solution to the problem has been to place the drip and sprinkler circuits on separate timing circuits. A typical standard sprinkler is the type of impulse or impact drive sprinkler disclosed in U.S. Patent No. 5,090,621.

Multiple outlet emitters, such as that disclosed in U.S. Patent No. 5,054,690, are primarily designed for micro-irrigation purposes only, whereby water is discharged from each outlet at about 1 to 6 gph. Further, emitters of

this type must be dismantled for replacement of flow control devices or servicing purposes.

DISCLOSURE OF INVENTION

This invention overcomes the above, briefly described
5 problem by providing a highly efficient and serviceable multi-outlet emitter and method for selectively and expeditiously varying the individual flow rates of fluid discharged from the outlets of the emitter. The emitter is adapted to replace a standard sprayer to incorporate a
10 micro-irrigation sub-circuit into a sprayer circuit.

The emitter comprises a body defining an inlet adapted for connection to a pressurized fluid source, such as a main water line, and a plurality of separate outlets communicating with the inlet and exposed exteriorly on the
15 body. An emitter is releasably connected to at least some of the outlets for discharging the fluid, such as water, at selectively varied flow rates therefrom.

In a preferred embodiment of this invention, each emitter comprises a tubular fitting releasably connected to
20 an outlet of the multi-outlet emitter and an interchangeable pressure compensating flow control valve removably mounted in the fitting.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of this invention will
25 become apparent from the following description and accompanying drawings wherein:

Figure 1 is an isometric view of a multi-outlet emitter of this invention adapted to be incorporated into

an irrigation system;

Figure 2 is a partial transverse sectional view through the emitter; and

Figure 3 is a longitudinal sectional view through the emitter, taken in the direction of arrows III-III in Figure 2.

BEST MODE FOR CARRYING OUT THE INVENTION

Figure 1 illustrates a multi-outlet emitter 10 adapted for micro-irrigation purposes. The emitter comprises a body or housing 11 defining an inlet 12 (Figure 3) having internal threads 13 formed therein adapted for connection to the external threads defined on the distal end of a standard one-half inch riser pipe (not shown). The riser pipe is adapted in a conventional manner to supply the emitter with a pressurized fluid, such as water, from a main water line maintained at a variable pressure level within the approximate range of from 10 psi to 60 psi. In certain irrigation applications, the water can admixed with sulfuric acid, chlorine, fertilizers or the like.

As shown in Figures 2 and 3, pressurized water supplied to inlet 12 is communicated to a cylindrical distributing chamber 14, through a filter, shown in the form of a screen 15. The periphery of the circular screen can be secured to a standard elastomeric O-ring seal 16, adapted to seal the distal end of the riser pipe when emitter 10 is connected thereto. Emitter 10 is vertically disposed on a central longitudinal axis thereof (Figure 3) and body 11 defines an internal cylindrical partition wall

17, defining chamber 14 therein.

A plurality of circumferentially and equally spaced ports 18 are formed through the partition wall to each communicate with a respective outlet 19. The plurality
5 (e.g., six) of separate outlets 19 thus communicate with inlet 13 and are exposed exteriorly on body 11 for easy access. At least some of the outlets has an emitter means 20 releasably connected thereto for discharging water at selectively varied flow rates for micro-irrigation
10 purposes, as described more fully hereinafter.

As shown in Figure 3, each of the emitter means comprises a tubular fitting 21 connected to body 11 and a pressure-compensated flow control valve 22 slip-fit within a bore 23, defined in the fitting. As described in U.S.
15 Patent No. 4,909,441, valve 22 provides pressure-compensating flow control means for discharging the water from the emitter and to a conventional distributing device (dripper, mini-sprayer, etc.) at a preselected and substantially uniform flow rate.

20 In particular and referring to Figure 3, each elastomeric valve 22 comprises a flexible diaphragm 24 that will flex into and cooperate with a centrally disposed flow passage 25 to vary the cross-sectional area of the passage in response to pressure fluctuations in a sub-chamber 26,
25 communicating with outlet 19. Such flexing will maintain the flow rate of the water communicated from flow passage 25 to an outlet passage 27, formed centrally within a distal end 28 of the fitting, at a predetermined near

constant flow rate.

As described more fully hereinafter, valves 22 are designed to have different flow rates for individual emitter means 20. Thus, a single multi-outlet emitter 10 can be utilized to irrigate various types of vegetation requiring varied quantities of water per unit time during a common timing cycle. Although the flow rates of the valves can be selected from the approximate overall range of 1.0 gph to 60 gph for irrigation and other water 10 distributing applications, the valve is particularly adapted for micro-irrigation applications requiring from approximately 1.0 gph to 20.0 gph.

As further described in above-referenced U.S. Patent No. 4,909,441, the disclosure of which is incorporated by 15 reference herein, initial communication of pressurized water from inlet 12 to each valve will initially permit unrestricted flow of water through a fully opened flow passage 25. This feature automatically purges the system and valve of mineral particles and other contaminants that 20 could adversely affect the valve's operation, i.e., the valve is self-purging and self-cleaning. Subsequent increase in water pressure will function to at least partially close the flow passage with the relative opening and closing of the passage by diaphragm 24 being directly 25 responsive to the pressure differential existing between the passage and sub-chamber 26.

A standard circumferential barb 29 is suitably formed on distal end 28 of fitting 21 to secure the end of a

standard plastic tubing (not shown) thereon in a conventional manner. The opposite end of the tubing is suitably connected to a water distributing device, such as an emitter or mini-sprayer, in a conventional manner. A
5 proximal end 30 of fitting 21 is slip-fit within a bore 31, defined in one of a series of circumferentially disposed tubular extensions 32 of body 11.

As further shown in Figures 1-3, connecting means are provided for releasably connecting and sealing each fitting
10 21 to a respective extension 32 of the body. Although other types of connecting means can be utilized, the one shown permits the fitting to be twisted (quarter-turn) and locked into place on the body. In particular, the illustrated connecting means comprises a bayonet-type
15 connection including a pair of circumferentially and diametrically disposed slots 33 formed in a respective extension 32 and a pair of tapered lugs 34 formed on fitting 21 to engage into locking engagement within the slots.

20 In addition, partial tapered threads 35 are formed internally within the outer end of extension 32 to guide lugs 34 into locking engagement within slots 33. Thus, when fitting 21 is twisted in a general clockwise direction into bore 31 in Figure 1, the lugs will be guided into
25 snap-lock engagement within the slots. As further shown, each of the slots and lugs is slightly spiralled and tapered to accommodate expeditious installation of fittings 21 on body 11.

A pair of diametrically opposed and radially outwardly extending finger-engaging ears 36 are formed externally on each fitting 21 to facilitate manual twisting of the fitting for installation or removal purposes. As described above, releasable connection of the fitting to body 11 facilitates interchangeability of the fitting with another fitting, containing a flow control valve 22 having a differed rating. Each of the fittings, as well as valves 22, can be color-coded to indicate different flow rates. Further, selected ones of outlets 19 can be closed by connecting a plug 37 therein, utilizing the same type of connecting means utilized for connecting fitting 21 to selected ones of the outlets.

From the above description, it can be seen that the method for selectively varying the individual flow rates of multi-outlet emitter 11 comprises the initial step of exposing the plurality of separate outlets 19 to a workman. The method further comprises connecting a first fitting 21, having a first control valve 22 exhibiting a first flow rate, to one of the outlets 19, and then connecting a second tubular fitting 21, having a second valve exhibiting a second flow rate different from the first flow rate, to another one of the outlets. In the preferred embodiment, each of the connecting steps comprises twisting and locking each respective one of the tubular fittings on emitter 10.

The method steps may also include connecting plug 37 to at least one of the outlets and color-coding each of the tubular fittings and/or valves. A more specific

application of the method comprises replacing a standard sprinkler, such as the type disclosed in U.S. Patent No. 5,054,690, with emitter 10 to integrate the emitter into a sprinkler circuit.

5

INDUSTRIAL APPLICABILITY

Emitter 10 has been developed primarily for landscape watering. In many landscape irrigation systems it is desirable to replace one or more standard sprinkler heads with a drip irrigation circuit. Because of the short
10 timing cycles typical for sprinkler circuits (10 to 30 minutes), it sometimes proves impracticable to install a sufficient number of standard drip emitters or to utilize a separate micro-irrigation circuit to satisfy varied watering requirements.

15

The most effective system design would find all micro-irrigation devices on separate timing circuits since these devices normally require more time to irrigate than sprays. However, emitters 10 can now be integrated into the same circuit with standard sprinklers of the type disclosed in
20 U.S. Patent No. 5,090,621, for example.

Because standard sprinklers normally have short run-times (compared to micro-irrigation), multi-outlet emitter 10 was developed to apply relatively large volumes of water per outlet in a few minutes to match sprinkler timing.
25 This capacity makes the emitter ideal for use in circuits which are primarily designed for sprinklers and for conversion of a sprinkler location to drip irrigation.

Each outlet is individually flow-controlled by a pre-

selected valve 22 to deliver a rated discharge of from 15 to 60 psi. The chart below lists the discharges for various minutes of irrigation run-time from five different emitter means 20, i.e., a respective emitter means is adapted to discharge fluid (water) at a selected one of a series of substantially uniform flow rates.

As suggested above, since sprinklers have relatively short run-times (e.g. 15 minutes), an adequate number of micro-irrigation emitters or micro-sprayers must be used to supply plant water requirements during this short period. As indicated, tubular fittings 21 can be color-coded to depict their respective calibrated flow rates.

	<u>GPH PER OUTLET</u> (COLOR)	<u>IRRIGATION RUN-TIME</u>			
		<u>5 MIN.</u>	<u>10 MIN.</u>	<u>15 MIN.</u>	<u>20 MIN.</u>
15	6.5 (BLUE)	.5 GAL.	1.1 GAL.	1.6 GAL.	2.2 GAL.
	10.5 (VIOLET)	.9 GAL.	1.8 GAL.	2.6 GAL.	3.5 GAL.
20	12.5 (GREEN)	1.0 GAL.	2.1 GAL.	3.2 GAL.	4.2 GAL.
	16.0 (YELLOW)	1.3 GAL.	2.7 GAL.	4.0 GAL.	5.3 GAL.
25	20.5 (RED)	1.7 GAL.	3.4 GAL.	5.1 GAL.	6.8 GAL.

Any appropriate pressure-compensated and flow-controlled drip and micro-irrigation emitter can be designed into or retro-fitted to sprinkler circuits. Sufficient discharge volume should be utilized to deliver enough water during the shorter irrigation duration.

Modifications within the skill of the art can be made to emitter 10 without departing from the scope of this invention, as prescribed by the claims appended hereto. For example, although emitter means 20 are shown to extend 5 radially outwardly or downwardly from an outer side of body 11, they can be otherwise positioned (e.g., to point upwardly or downwardly) and/or located at an upper or lower side of the body. Wherever located, fittings 21 are exposed exteriorly on body 11 to position them for ready 10 access by a gardener.

I CLAIM:

1. A multi-outlet emitter adapted for irrigation purposes comprising a body defining an inlet adapted for connection to a pressurized fluid source, and a plurality of separate outlets each communicating with said inlet, the
5 improvement comprising said outlets being exposed exteriorly on said body, and emitter means, releasably connected to at least some of said outlets, for discharging said fluid at selectively varied flow rates therefrom.

2. The multi-outlet emitter of claim 1 wherein each said emitter means comprises pressure-compensating flow control means for discharging said fluid from a respective emitter means at a selected one of a series of
5 substantially uniform flow rates.

3. The multi-outlet emitter of claim 2 wherein said emitter means further comprises a tubular fitting releasably connected to said body.

4. The multi-outlet emitter of claim 3 wherein said tubular fitting is releasably connected to said body by connecting means for permitting said tubular fitting to twisted and locked into place on said body.

5. The multi-outlet emitter of claim 4 wherein said connecting means comprises a bayonet connection comprising a plurality of circumferentially disposed slots formed in said body, a plurality of circumferentially disposed lugs
5 formed on said tubular fitting and thread means for permitting said tubular fitting to be twisted into a respective one of said outlets to engage said lugs in locking engagement within said slots.

6. The multi-outlet emitter of claim 3 wherein said flow control means is removably mounted in said tubular fitting.

7. The multi-outlet emitter of claim 3 further comprising barbed extension means on an outer end of said tubular fitting for attaching a flexible tube thereto, adapted to communicate said fluid to a fluid distributing
5 device.

8. The multi-outlet emitter of claim 4 further comprising finger-engaging means extending radially outwardly from said tubular fitting to be grasped and twisted .

9. The multi-outlet emitter of claim 1 wherein said body is disposed on a central longitudinal axis thereof and wherein said outlets and said emitter means are circumferentially disposed and spaced one-from-another
5 about an outer side of said body.

10. The multi-outlet emitter of claim 9 wherein said emitter means extend radially outwardly relative to said axis.

11. The multi-outlet emitter of 9 further comprising a distributing chamber means defined in said body for communicating said inlet and with inlets to each of said emitter means.

12. The multi-outlet emitter of 1 further comprising thread means formed internally within said inlet for releasably connecting said body to an externally threaded riser pipe.

13. The multi-outlet emitter of 1 further comprising plug means, releasably connected to at least one of said outlets, for closing such outlet.

14. The multi-outlet emitter of claim 3 wherein each said fitting is color-coded to visually indicate different flow rates for various flow control means.

15. A method for simultaneously irrigating individual areas from a multi-outlet emitter, the improvement comprising the steps of

5 exposing a plurality of separate outlets defined exteriorly on said emitter,

connecting a first tubular fitting, having a first flow control valve exhibiting a first flow rate, to one of said outlets, and

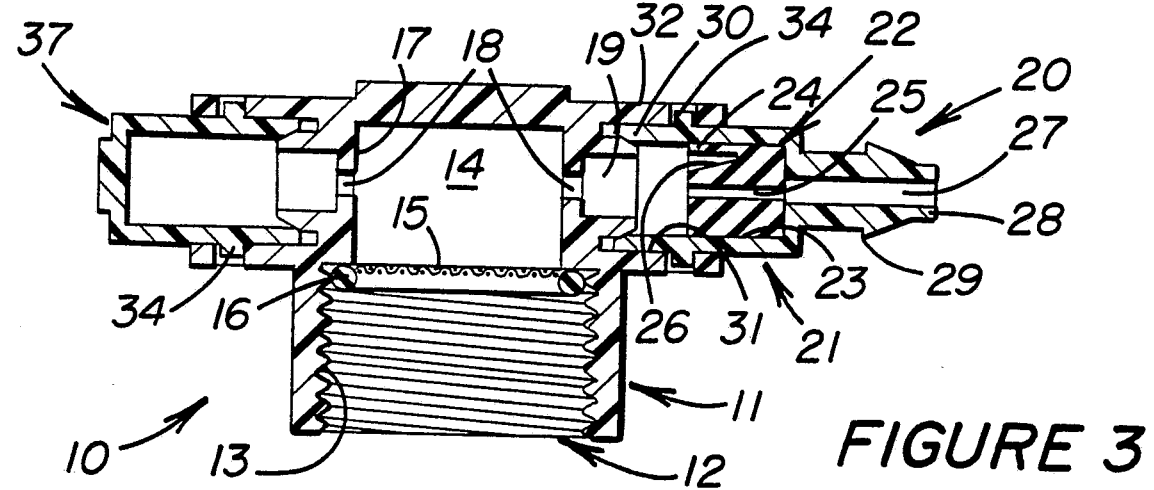
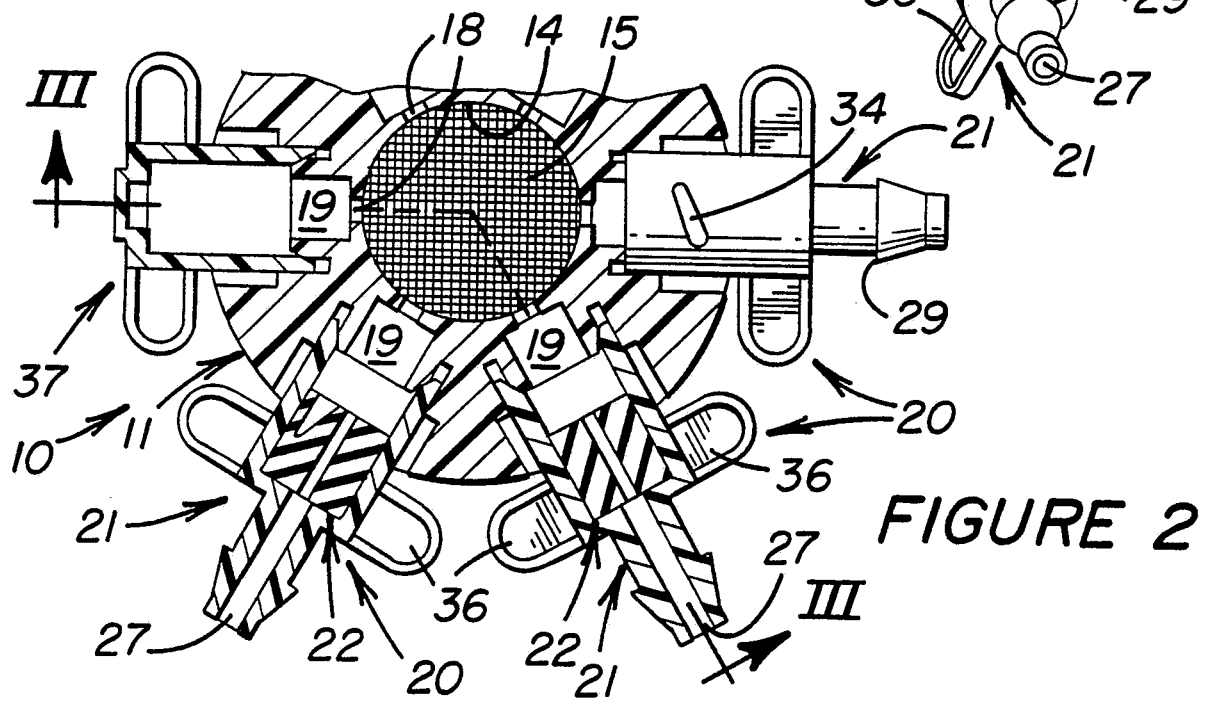
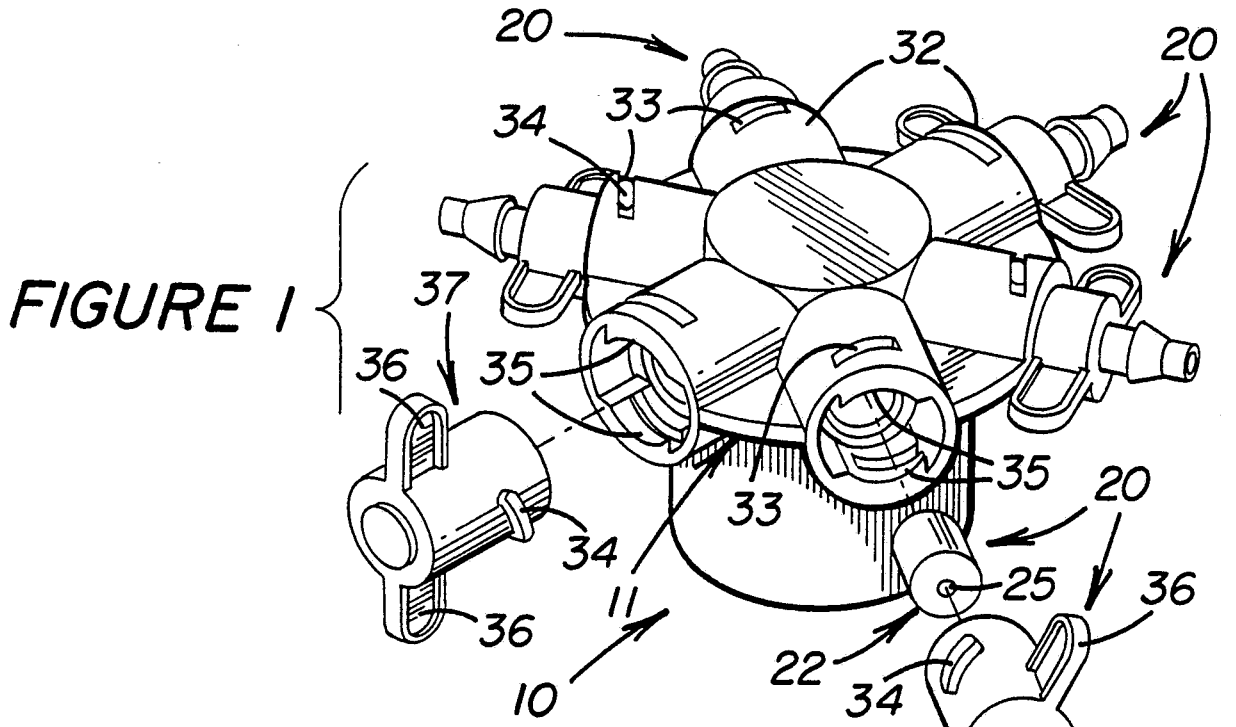
10 connecting a second tubular fitting, having a second flow valve exhibiting a second flow rate different than said first flow rate, to another one of said outlets.

16. The method of claim 15 wherein each of said connecting steps comprises twisting and locking each respective one of said first and second tubular fittings on said emitter.

17. The method of claim 15 further comprising connecting a plug to another one of said outlets.

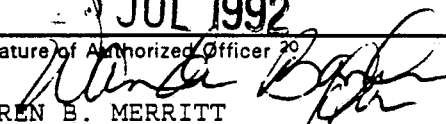
18. The method of claim 15 further comprising color-coding each of said first and second tubular fittings for visually indicating different flow rates for the respective flow control valves thereof.

19. The method of claim 15 further comprising replacing a standard sprinkler, integrated into a sprinkler circuit having a plurality of standard sprinklers each connected to a riser pipe, with said multi-outlet emitter.



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US82/03493

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³				
According to International Patent Classification (IPC) or to both National Classification and IPC				
IPC Class.: B05B 15/00 US CL.: 239/71, 436, 533.13, 542, 600				
II. FIELDS SEARCHED				
Minimum Documentation Searched ⁴				
Classification System	Classification Symbols			
U.S.	239/71, 229, 436, 442, 533.1, 533.13, 542, 548, 551, 562, 565, 600			
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁵				
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴				
Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸		
X	US, A, 2,598,961 (Andrus) 03 June 1952, Note figure 2.	<u>1,9-13,15,17</u> 2-8,14,16, 18,19		
Y	US, A, 4,909,441 (Christy) 20 March 1990, Note figure 5.	2-8,14		
Y	US, A, 3,799,453 (Hart) 26 March 1974, Note elements 15,17, and 25.	4,5,8,16		
Y	US, A, 4,509,692 (Moss) 09 April 1985, Note column 2, lines 13-17.	7		
Y	US, A, 3,779,462 (Bruninga) 18 December 1973, Note column 2, lines 38-41.	14-18		
Y	US, A, 4,036,435 (Pecaro) 19 July 1977, Note figure 1.	19		
A	US, A, 3,814,377 (Todd) 04 June 1974.			
A	US, A, 4,726,527 (Mendenhall) 23 February 1988.			
A	US, A, 4,544,099 (Norris) 01 October 1985.			
A	US, A, 4,570,858 (Bjntner et al.) 18 February 1986.			
<p>* Special categories of cited documents:¹⁵</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; border: none;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p> </td> </tr> </table>			<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>			
IV. CERTIFICATION				
Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²			
25 JUNE 1992	JUL 1992			
International Searching Authority ¹	Signature of Authorized Officer ²⁰			
ISA/US	 KAREN B. MERRITT			

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	US, A, 5,054,690 (Olson) 08 October 1991.
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V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE¹

1. Claim numbers __, because they relate to subject matter (1) not required to be searched by this Authority, namely:
2. Claim numbers __, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out (1), specifically:
3. Claim numbers __, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING²

This International Searching Authority found multiple inventions in this international application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. As all searchable claims could be searched without effort justifying an additional fee, the International Search Authority did not invite payment of any additional fee.

Remark on protest

- The additional search fees were accompanied by applicant's protest.
- No protest accompanied the payment of additional search fees.