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Bruninga

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[54] **STEP-BY-STEP ROTARY SPRINKLER HEAD WITH QUICK-CHANGE AND COLOR-CODED NOZZLE INSERT**

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[52] **U.S. Cl.** **239/230,** 239/390, 239/DIG. 1

[51] **Int. Cl.** **B05b 3/02**

[58] **Field of Search** 239/230, 393, 390, 239/DIG. 1; 285/332.2, 332.3, 355

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[57] **ABSTRACT**

A step-by-step rotary sprinkler head having a nozzle insert provided with exterior straight threads for loosely cooperating with the interior threads of the sprinkler body outlet and an O-ring of resilient material adjacent the threads on the insert for engaging a cylindrical interior surface within the outer end of the outlet in radially inwardly compressed relation so as to provide a water-tight seal between the exterior of the nozzle insert and the interior of the outlet and a constant, non-wedging, frictional force which prevents the nozzle insert from working loose during the high amplitude and high frequency vibrations inherent in the normal operation of the sprinkler head, the arrangement being such that the nozzle insert can be removed and replaced by any one of a series of nozzle inserts having different orifice sizes by a simple digital turning action. The orifice size of the nozzle insert is color-coded by a preformed band of resilient material having a coloring agent dispersed therein mounted within an annular groove formed in the exposed exterior periphery of the nozzle insert by expanding the band over the nozzle insert and allowing it to contract within the annular groove.

7 Claims, 5 Drawing Figures

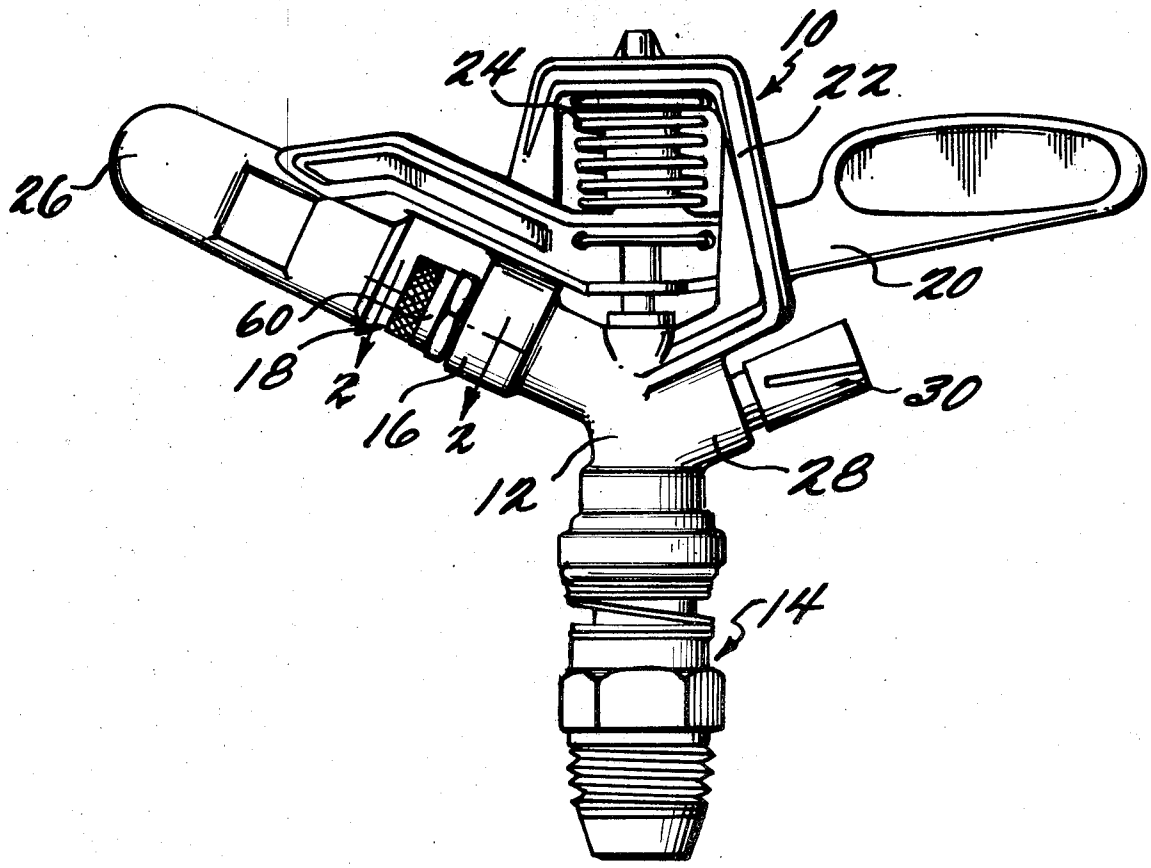
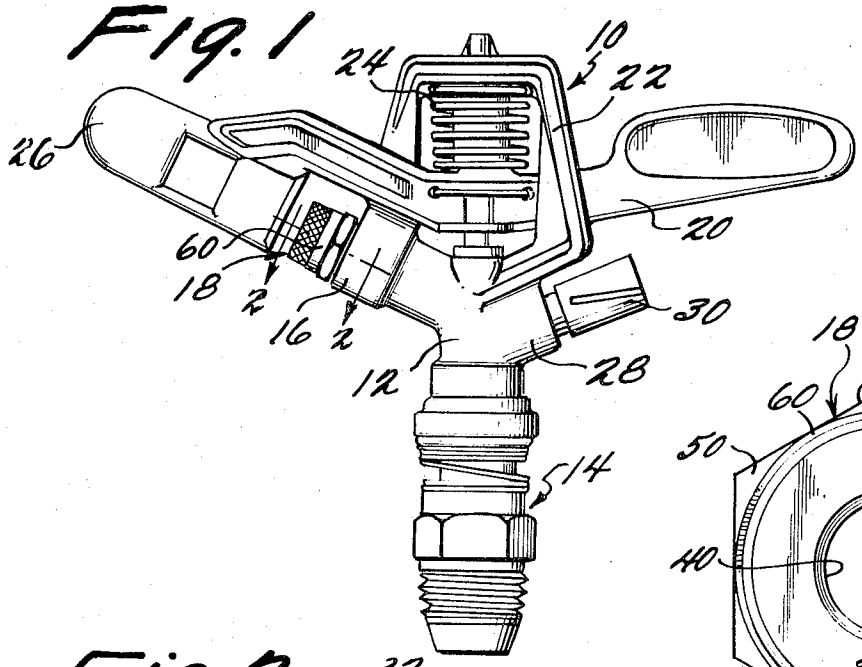


Fig. 1



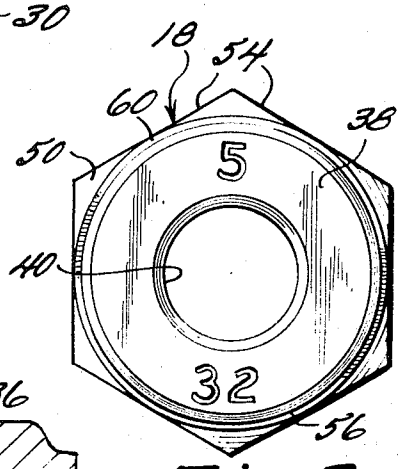


Fig. 3

Fig. 2

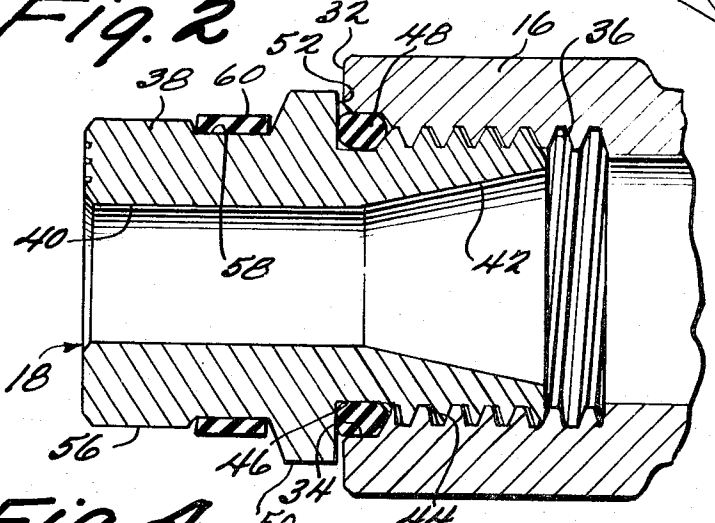
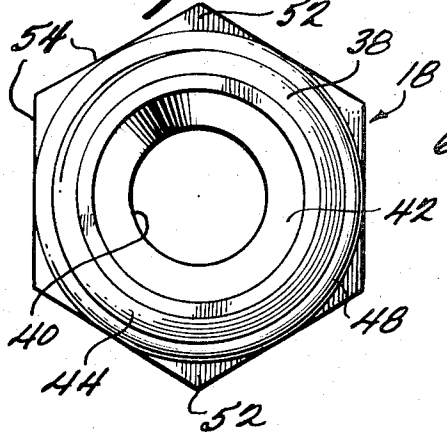


Fig. 4



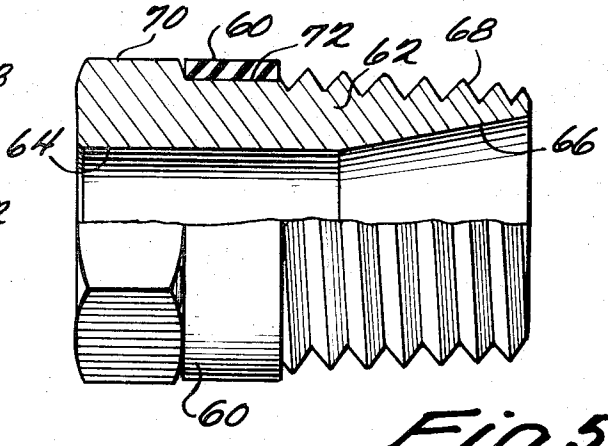


Fig. 5

STEP-BY-STEP ROTARY SPRINKLER HEAD WITH QUICK-CHANGE AND COLOR-CODED NOZZLE INSERT

This invention relates to sprinkler heads and more particularly to step-by-step rotary impact sprinkler heads having improved nozzle inserts.

Step-by-step rotary impact sprinkler heads are well-known and have achieved a high degree of acceptance as perhaps the most efficient manner of effecting the distribution of water on the ground. Sprinkler heads of this type are used almost exclusively in agricultural sprinkler irrigation and in other installations where the ground area to be sprinkled extends beyond that normally encountered in residential lawns and the like.

Impact sprinklers are used in a variety of different agricultural sprinkler irrigation systems. One system in prevalent use, known as a solid set system, involves the utilization of a multiplicity of lengths of aluminum pipe, each having one or more risers extending upwardly therefrom on which is mounted an impact sprinkler head. Solid set systems are particularly useful in vegetable growing, for example, systems of this type are prevalent in the growing of potatoes. The typical use of a solid set system in a potato field involves the laying of the pipe sections in the field after the planting has taken place. The pipes are connected and hooked up to a source of water and periodically operated during the growing season. Just prior to the harvesting of the crop, the pipes are dismantled, removed from the field and stored for use next year.

In many areas of the country, substantial businesses have been established providing rental services of such systems. Where these systems are utilized in relatively large fields or in those situations where a rental agency must handle an extensive number of the component parts of such systems, a significant problem arises in providing a proper capacity and range for each sprinkler head in the system once the system is installed. Ideally each sprinkler head in the system would have the same operative range and capacity. However, this ideal is seldom met in actual practice. It is frequently the case that sprinkler heads mounted within low spots in a field will result in local run-off and water accumulation if its capacity and range is equal to the other sprinkler heads of the system. Consequently, in actual practice, the installation of solid set systems involves the selection of sprinkler heads which may vary in range and capacity, depending upon the particular location in the field.

Variation in range and capacity is obtained by providing the sprinkler head with a discharge nozzle insert of a different size. For example, in the case of a sprinkler head which is causing water accumulation and run-off, this situation can be corrected by replacing the nozzle insert of the sprinkler head with a nozzle insert of a smaller orifice size. To exemplify this situation, take the case of an installation of a size involving a thousand sprinkler heads. It would not be unusual for an installation of this size to require as many as 50 sprinkler heads of a reduced nozzle orifice size with respect to the other 950. Since the normal operation of the system involves the dismantling of the installation into its component parts just prior to the harvesting season, the storage of the dismantled parts until the next season and the installation of the dismantled parts following the planting season in the following year, either in the same field or in a different field, the ability to be able to quickly identify the nozzle size of each sprinkler head and the ability to be able to quickly and easily change the nozzle insert, if necessary, can, in large installations, constitute a severe problem of inconvenience.

The problem is made more difficult by virtue of the fact that the installation and dismantling of the system is normally accomplished by unskilled labor. The skill required in determining the proper nozzle insert sizes to insure that the system functions properly after installation must be provided by personnel other than those handling the pipes. In this regard, it has been the practice in connection with many of the rental service agencies to simply remove all of the nozzle inserts from the sprinkler heads at the time the installation is dismantled in situations where there is no positive assurance that the system will be installed again in the same field. In this way, the rental agency is able to most effectively utilize the unskilled labor in installing the system and then after the installation a foreman or someone having knowledge of the range and capacity requirements of the particular installation makes the proper selection of nozzle inserts for the particular installation. This selection, as indicated above, often involves the selection of nozzle inserts of different sizes within the installation depending upon the land contour and other considerations.

It is standard practice to mark brass nozzle inserts with embossed numbers, indicating the nozzle opening size. Such indicia requires inspection of the nozzle insert at a relatively close proximity in order to determine the nozzle opening size provided thereby. In some rental agency situations, where a more remotely recognized indication is severely needed, agency personnel have gone to the initial trouble of applying paint of a given color to all nozzle inserts of a given size. Such color coding provides a convenience which saves considerable time in multiple installations where vast numbers of component parts are being handled. However, the necessity of providing color indicia by painting involves in and of itself considerable inconvenience. Moreover, experience has shown that paint is readily susceptible to chipping and other types of deterioration when subjected to the elements for extensive periods, as in an agricultural field, particularly under normal operation conditions of high amplitude and high frequency vibration as previously noted.

Accordingly it is an object of the present invention to provide a series of nozzle inserts of different orifice size having improved distinctive color indicia means provided thereon which effectively overcomes the inconveniences and disadvantages noted above.

In accordance with the principles of the present invention, this objective is obtained by providing a preformed band of resilient material having a coloring agent dispersed therein and mounting the same within an annular groove on the exposed exterior periphery of the nozzle insert by initially expanding the band over the nozzle insert and allowing it to contract into engagement with the annular groove. By providing a preformed band of resilient material having a coloring agent dispersed therein, the problems of color deterioration are substantially eliminated and a highly attractive appearance in the finally assembled product is obtained.

The nozzle inserts of conventional construction consist of a body, usually made of brass, provided with a discharge nozzle opening of a given size extending therethrough which has tapered threads formed on the exterior periphery of the inlet end thereof adapted to cooperate with interior threads in the sprinkler body outlet. The changing of a nozzle insert of conventional type involves the loosening of the nozzle insert by a tool, the removing of the nozzle insert, the turning of a new nozzle insert into the outlet opening and finally the tightening of the new nozzle insert by a tool.

The tapered thread construction provides two essential functions. First, it provides a water tight seal between the outer periphery of the nozzle insert and the inner periphery of the sprinkler body outlet. The seal is obtained essentially by deforming the tapered threads of the insert nozzle into the threads of the outlet. The thread deformation necessary to effect the seal can not be obtained by merely manually turning the nozzle insert but requires sufficient torque to necessitate the use of a turning tool such as a wrench or the like. Second, the wedged or thread deformed engagement of the nozzle insert within the outlet opening insures that the nozzle insert will remain in operative position within the outlet during long periods of operation. Here again, the application of a turning torque greater than that which can be applied through a digital gripping action is likewise required to insure the accomplishment of this function. It will be understood that in the normal operation of a step-by-step rotary sprinkler, the sprinkler body is subjected to repeated impact blows which increase in severity as the capacity of the sprinkler head increases. These severe impacts constitute a high amplitude and high frequency vibration to which the connection between the sprinkler body and nozzle insert is subjected throughout its period of operation.

Another object of the present invention is to provide an impact sprinkler head having an improved nozzle insert of the type described which overcomes the inconveniences and disadvantages noted above.

In accordance with the principles of the present invention, this objective is obtained by modifying the conventional tapered threads of the nozzle insert to a straight thread so that the threads will loosely cooperate with the interior threads of the sprinkler body outlet. The nozzle insert is formed with an annular groove adjacent the inner end of the threads within which an O-ring of resilient material is mounted having an exterior diameter greater than the exterior diameter of the threads. The interior periphery of the sprinkler body outlet is modified so as to provide a cylindrical surface adjacent its outer end which has a diameter greater than the trough diameter of the interior threads thereof but less than the exterior diameter of the O-ring seal mounted on the nozzle insert. With this construction, the nozzle insert can be engaged within the outlet by a simple digital turning of the nozzle insert which is facilitated by the loose interengagement of the cooperating threads. During the latter part of the turning action, the O-ring engages the cylindrical surface and is compressed radially inwardly thereby. The compression of the O-ring secures two essential functions, first, it effects a water-tight seal between the exterior periphery of the nozzle insert and the interior periphery of the outlet and second, it provides a frictional force which prevents the nozzle insert from becoming loosened and disengaged from the housing body as a result of the high amplitude and high frequency vibrations to which it is subjected in normal operation. The turning force required to effect the compression of the O-ring into engagement with the cylindrical surface is less than that which is normally capable of being effected by a digital action but yet of sufficient minimum magnitude to insure against turning movement under the severe vibration conditions of operation. Preferably, the nozzle insert is provided with knurling at its outer end to facilitate the digital turning action, as well as a central exterior flange which serves as a turning stop and is shaped to provide tool-receiving flat surfaces, rendering the nozzle insert capable of being optionally tightened by a tool. Since the only modification required in the sprinkler body is the provision of the cylindrical surface in the outer end of the interior of the outlet, the sprinkler body retains the capability of cooperatively receiving existing conventional nozzle inserts.

Another object of the present invention is the provision of a step-by-step rotary impact sprinkler head having an improved nozzle insert therein provided with means for permitting the same to be installed in and removed from the spinkler head body outlet by a simple digital turning action and improved color coding means for visually indicating the nozzle orifice size at relative remote proximity ot the nozzle insert.

Another object of the present invention is the provision of a step-by-step rotary impact sprinkler having improved nozzle insert means of the type described which is simple in construction and effective in operation, and economical to manufacture.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompanying drawings, wherein illustrative embodiments are shown.

In the drawings:

FIG. 1 is a front elevational view of a step-by-step rotary impact sprinkler head embodying the principles of the present invention;

FIG. 2 is an enlarged fragmentary sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a front end view of the nozzle insert assembly shown in FIG. 2;

FIG. 4 is a rear end view of the nozzle insert assembly; and

FIG. 5 is a side elevational view, partly in vertical section, of a nozzle insert assembly of modified construction, embodying the principles of the present invention.

Referring now more particularly to the drawings, there is shown in FIG. 1 thereof a step-by-step rotary sprinkler head, generally indicated at **10**, embodying the principles of the present invention. The sprinkler head **10** includes the usual components comprising a hollow sprinkler body **12** having a downwardly opening inlet connected with a bearing assembly **14** of conventional construction. In accordance with conventional practice, the bearing assembly **14** is adapted to be threadedly engaged on the outlet end of a riser pipe or the like and serves to mount the sprinkler head body **12** for controlled rotational movement about an axis which extends vertically in operation. The rotation is controlled by the usual spring means embodied in the bearing assembly **14**. Of course, the bearing assembly also conventionally serves to communicate a source of

water under pressure with the inlet of the hollow body 12.

The water under pressure communicated with the inlet of the hollow body 12 flows upwardly and outwardly through an outlet 16 within which a nozzle insert assembly, generally indicated at 18, and embodying the principles of the present invention, is mounted. The sprinkler head 10 also includes an impulse arm 20 which is mounted in the usual fashion above the hollow body 12 for oscillatory movement about an axis which, in the embodiment shown, coincides with the rotational axis of the hollow body. The impulse arm 20 is mounted for oscillatory movement toward and away from a limiting position wherein the arm engages an upwardly extending generally inverted U-shaped mounting structure 22 formed integrally with the hollow body 12. In accordance with conventional procedure, the impulse arm 20 is biased into its limiting position by a coil spring 24 which is connected between the impulse arm and the mounting structure 22. Also in accordance with conventional procedure, the impulse arm 20 has a reactant element 26 formed thereon in a position to be engaged by the stream of water issuing from the nozzle insert assembly 18 when the impulse arm is disposed in its limiting position. The reactant element includes the usual outer reactant surface which serves to effect the movement of the impulse arm in a direction away from its limiting position against the bias of the spring 24 and an inner reactant surface which pulls the reactant arm into the stream as the reactant arm approaches the limiting position under the action of the spring 24. It will be understood that the hollow body 12 may be of the type which provides a separate spreader outlet 28 within which a spreader nozzle 30 may be mounted.

Referring now more particularly to FIG. 2, it will be noted that the outlet 16 of the hollow body is defined by an annular wall which includes an end surface 32. Formed in the inner periphery of the annular wall 16 adjacent the end surface 32 is a cylindrical surface 34. Preferably, a slight chamfer is provided at the intersection between the end surface 32 and cylindrical surface 34 to eliminate any sharp edge being formed by such intersection. The inner periphery of the annular wall 16 disposed inwardly of the cylindrical surface 34 is formed with helical threads 36 of conventional straight configuration.

The nozzle insert assembly 18 includes a metallic body 38 which is preferably formed of brass. The body includes an inner or inlet end and an outer or discharge end and has formed therein a discharge orifice 40 adjacent the discharge end thereof which is communicated with the inlet end by a passage 42 which converges in a direction toward the orifice 40.

The exterior periphery of the nozzle insert body 38 adjacent the inlet end thereof is formed with exterior threads 44 which are of straight configuration and adapted to interengage with the threads 36 in a relatively loose fashion. Formed in the exterior periphery of the nozzle insert body 38 adjacent the inner end of the threads 44 is an annular groove 46 adapted to receive an O-ring 48. Formed on the exterior periphery of the nozzle insert body 38 outwardly adjacent the annular groove 46 is an annular flange 50 having an inwardly facing end surface 52 providing a stop for engaging the end surface 32 of the outlet 16 to limit the inward movement of the nozzle insert body 38. Preferably, the exterior periphery of the annular flange 50 is formed with a plurality of intersecting flat surfaces 54. These surfaces are in the form of a hexagon as best shown in FIG. 3, to receive a hand tool such as a wrench or the like. The exterior periphery of the nozzle insert body 38 adjacent its discharge end has knurling 56 formed therein to be engaged by the fingers of an operator to facilitate turning of the nozzle insert into and out of operative engagement within the outlet 16. Finally, the exterior periphery of the nozzle insert body 38 is formed with a second annular groove 58 between the knurling 56 and flange 50 which receives a preformed band 60 of resilient material having a coloring agent dispersed therein. The band 60 is mounted within the groove 58 by expanding the same over the exterior periphery of the nozzle insert body 38 and allowing it to contract into the annular groove 58.

The preferred construction of the nozzle insert body 38 as described above differs from a conventional nozzle insert body, shown in FIG. 5, and indicated at 62. The conventional nozzle insert body 62 also includes the usual orifice 64 and converging passage 66 formed in the interior thereof. The exterior periphery of the conventional nozzle insert body 62 is formed with tapered threads 68 adjacent its inlet and hexagonal flat surfaces 70 adjacent the discharge end thereof for receiving a turning tool, such as a wrench or the like. In the normal operation of the conventional nozzle insert body 62, the threads 68 are initially engaged within the threads 36 of the outlet 16. The nozzle insert body is then initially turned in a direction to move the insert body within the outlet and, finally, a tool, such as a wrench or the like, is engaged on the flat surfaces 70 and the tool is used to tighten the nozzle insert body into its final operative position. The tapered threads 68 of the conventional nozzle insert body serve two essential functions. First, during the final turning movement by the wrench, the tapered threads are deformed within the straight threads 36 of the outlet 16 so as to provide a seal between the exterior periphery of the nozzle insert 62 and the interior periphery of the outlet 16. Second, the deformed interengagement of the tapered threads 68 within the straight threads 36 serve to maintain the nozzle insert 62 tightly wedged in operative position within the outlet against a turning movement in the opposite direction, during the operation of the sprinkler head. During normal operation of the impulse arm 20, the latter is repeatedly moved through a cycle of oscillatory movement including a reactant stroke in a direction away from the limiting position, caused by the action of the stream issuing from the nozzle insert 18, reacting on the reactant element 26, and a return stroke, caused by the action of the spring 24. At the end of the return stroke, the impulse arm 20 engages the attaching structure 22 with an impact action which serves to effect an incremental rotation of the hollow sprinkler body 12 under the control of the spring pressed bearing assembly 14. Because of the high amplitude and high frequency vibrations to which the hollow body 12 of the sprinkler head is subjected during normal operation, it is important to insure that the nozzle insert will be maintained against vibratory movement out of its operative position. The tapered threads 68 of the conventional nozzle insert body 62 insure that this function will be performed while also providing an essential sealing function.

As previously indicated, where a multiplicity of sprinkler heads **10** are utilized in solid set agricultural sprinkler irrigation systems, it is frequently desirable during the operation of these systems over an entire season to replace the nozzle inserts so as to alter the distribution pattern size and capacity of the sprinkler head. In accordance with the principles of the present invention, the preferred construction of the nozzle insert assembly **18** permits the operator to effect a change of orifice size by changing the nozzle insert without the inconvenience of utilizing a turning tool, such as a wrench or the like. With the preferred construction of the nozzle insert assembly **18,** the operator is enabled to remove one nozzle insert from operative position within the outlet **16** by a simple digital turning action and to mount a new nozzle insert into operative position within the outlet **16** by a simple digital turning movement in the opposite direction. This function can be accomplished by virtue of the loose interengagement which is provided between the straight threads **44** and **36.** Contrary to the functions provided by the tapered threads **68** of the conventional nozzle insert body **62,** the threads **44** of the nozzle insert body **38** serve solely to effect an axial movement of the insert body in response to the turning movement thereof. The dual function of providing a water-tight seal between the exterior periphery of the insert body and the interior periphery of the outlet **16** and the maintenance of the insert body within the outlet **16** during the high amplitude and high frequency vibrations of the sprinkler head is provided by the O-ring **48** and its cooperation with the outlet and insert.

In this regard, it will be noted that the cylindrical surface **34** has a diameter slightly greater than the trough diameter of the threads **36** disposed inwardly thereof. The exterior diameter of the O-ring **48** is greater than the diameter of the cylindrical surface **34** so as to insure that during the turning movement of the insert body **38** the O-ring will be moved into radially inwardly compressed relation with the cylindrical surface **34.** The amount of compression to which the O-ring is subjected together with the material of the O-ring, both in terms of its chemical makeup and its resilient characteristics, are important in accomplishing the function of enabling the nozzle insert assembly **18** to be mounted and removed by a digital turning action. The compressed interengagement of the O-ring **48** between the groove **46** and cylindrical surface **34** provides both a sealing interengagement between the nozzle insert body and outlet and a frictional interengagement which provides a constant force resisting the turning movement of the nozzle insert body in an opposite direction. Thus, contrary to the action of the conventional nozzle insert body, wherein the frictional interengagement increases as the inward turning action proceeds, the O-ring **48** provides a substantially constant frictional force as the turning action of the nozzle insert body **38** proceeds.

It will be noted from FIG. **2** that it is not necessary for the stop surface **52** to be in engagement with the end surface **32** when the nozzle insert assembly **18** is disposed in its operative position. Indeed, the stop surface **52** is provided simply to give the operator an indication of when the nozzle insert has been fully engaged into its operative position. No tightening of the nozzle insert with the surfaces **52** and **32** in engagement is contemplated, although where removal is not desired a turning action may optionally be performed by engaging a tool on the flat surfaces **54** during which the surfaces **52** and **32** are wedged into engagement by the action of the interengaging threads.

The exterior diameter and durometer of the O-ring are chosen so that the nozzle insert body **38** can be moved into its operative position with a digital turning action which can be accomplished readily by adult operators. The amount of compression provided, once the insert is in its operative position, is sufficient to prevent the nozzle insert from backing out of its operative position under the high amplitude and high frequency vibrations to which the connection is subjected during the normal operation of the sprinkler head **10** over an extended period of time. The preferred embodiment shown achieves this result by utilizing an O-ring of circular cross-sectional configuration made of synthetic rubber and having a durometer of **70.** The dimensions of the O-ring **48,** annular groove **46** and cylindrical surface **34** being such as to provide a deflection or squeeze of from between 0.0075 to 0.019 inches in the radial direction. It will be understood that the knurling **56** provides the operator with a convenient means for facilitating the digital turning action both in mounting the nozzle insert assembly into operative position and removing the nozzle insert assembly **18** from operative position.

It will also be understood that the coloring agent dispersed within the preformed band **16** has a color which is keyed or coded to correspond with a specific size of the orifice **40.** Thus, the present invention contemplates the provision of a series of nozzle insert assemblies embodying different size orifices **40** each having a distinct coloring agent dispersed in the preformed band **60.** An exemplary series of inserts would be a series of six having orifice sizes respectively of 9/16, 5/32, 11/64, 3/16, 13/64, and 7/32. An exemplary coloring agent in the preformed band **60** associated with each of these sizes could be black, orange, yellow, blue, white and brown respectively. This exemplary series of nozzle inserts **18** would permit the sprinkler head **10,** when operated at a given constant pressure, as for example, 25 psi, to provide the following corresponding capacities in gallons per minute and sprinkler pattern diameter size in inches: 2.88 and 80, 3.52 and 82, 4.24 and 83, 5.00 and 85, 5.90 and 86, and 6.85 and 88.

With reference to FIG. **3,** it is preferable that each nozzle insert assembly **18** be provided with integral numerical indicia in addition to the color band indicia. As shown in FIG. **3,** the numerals **5** and **32** are embossed in the outer end surface of the nozzle insert body **38.** The utilization of numerical indicia provides a close proximity reference to the operator by which the color can be identified with the correct orifice size at all times.

A sprinkler head **10** embodying the principles of the present invention, including the cylindrical surface **34** formed in the outlet **16** and the nozzle insert assembly **18,** thus provides a quick change capability of a color-coded nozzle insert by a simple digital turning action. The arrangement permits the optional utilization of a conventional nozzle insert **62** in conventional fashion in lieu of the quick change insert **18.** Moreover, it is within the contemplation of the present invention to utilize a preformed band of resilient material with a coloring agent dispersed therein in conjunction with a conventional nozzle insert body. As shown in FIG. **5,**

such a body is preferably provided with an annular groove **72** in the exterior thereof in a position between the wrench flat **70** and the tapered threads **68.** A preformed band **60** is mounted within the annular groove **72** by expanding the band over the exterior periphery of the insert body and allowing it to contract into the annular groove **72.**

It will be understood that any conventional type of coloring agent may be dispersed within the preformed band **60.** That is, the agent may either be a pigment or a dye. By utilizing a coloring agent dispersed within a preformed band of resilient material, as, for example, a buna N and vinyl blend or the like, a nozzle insert body of brass or other metal is color-coded to size with a non-deteriorating color by the simple procedure of expanding the band over the periphery and allowing it to contract into a receiving annular groove. This arrangement serves to maintain the color band on the nozzle insert itself and insures an attractive appearance which will be unaffected by exposure to the elements over an extended period.

With the arrangement of the present invention, the manufacturer of the sprinkler head can simplify the assembly procedures where a particular single orifice size only is specified by the customer. The arrangement, however, is particularly useful in the hands of a customer where a multiplicity of sprinkler heads are used in relatively large solid set agricultural sprinkler systems, as aforesaid. It will be understood that the present invention contemplates orifice sizes beyond the range of the exemplary sizes indicated above and that any desired color coding may be utilized. The invention also contemplates or orifice size equal to zero or a plug insert, and the color coding of such a zero size orifice nozzle insert. The utilization of plug nozzle inserts has particular utility in certain operations involved in solid set agricultural irrigation sprinklers. For example, where a solid set irrigation sprinkler system is utilized with strawberries and forecasts predict a cold weather condition sufficient to cause damage to the crop, the system can be operated to cover the strawberry field with a layer of ice surrounding the plants so as to insure that the temperature of the plants will not be reduced to a value below 32°F. The usual practice in accomplishing this operation is to cut off alternate sprinkler heads so that the entire system will deliver a gallonage which is less than that normally produced by the system to permit the freezing of the ice blanket thereover. By providing a quick-change plug, a solid set system which is otherwise not provided with valves to effect the shutdown of alternate sprinkler heads may be provided with this capability.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing preferred specific embodiment has been shown and described for the purpose of illustrating the functional and structural principles of this invention and is subject to change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. A step-by-step rotary sprinkler head comprising a hollow sprinkler body having an inlet and an outlet, means for mounting said hollow body in communication with a source of water under pressure for controlled step-by-step rotary movement about an axis extending generally vertically in operation, an impulse arm mounted on said hollow body for oscillatory movement toward and away from a limiting position with respect to said hollow body, said outlet extending upwardly and outwardly with respect to the axis of rotation of said hollow body and having a nozzle insert mounted therein for directing flow of water under pressure communicated with said inlet outwardly thereof, and means including a reactant element on said arm engageable with a stream issuing from said nozzle insert for effecting successive oscillatory movements of said arm and for effecting successive step-by-step incremental rotational movements of said hollow body about its axis of rotation during each oscillatory movement of said arm, said outlet being provided by an annular wall having an outer end surface, said annular wall having a cylindrical surface formed on the interior thereof adjacent said outer end surface and threads formed on the interior thereof inwardly of said cylindrical surface, said nozzle insert having an inlet end and a discharge end and being formed with a discharge orifice therein adjacent said discharge end communicating with said inlet end by a passage which converges in a direction toward said orifice, said nozzle insert having straight threads formed on the exterior periphery thereof adjacent the inlet end thereof for loosely cooperatively engaging said threads within said annular wall, said nozzle insert having a first annular groove formed in the exterior periphery thereof adjacent the inner end of said threads, an O-ring of resilient material disposed within said annular groove having an exterior diameter greater than the exterior diameter of the adjacent threads on said nozzle insert, said cylindrical surface having a diameter greater than the trough diameter of the threads extending inwardly thereof but less than the exterior diameter of said O-ring so as to engage and compress said O-ring radially inwardly in response to the digital turning of said nozzle insert with said threads in loose cooperative engagement so that the compressive engagement of said O-ring with said cylindrical surface and within said groove provides a water-tight seal between the exterior periphery of said nozzle insert and the interior periphery of said annular wall and a frictional force sufficient to resist turning movement of said nozzle insert in a direction to remove the same as a result of the vibrations to which the sprinkler body is subjected during normal operation of the sprinkler head, said nozzle insert having a second annular groove formed in the exposed exterior periphery thereof, and a preformed band of resilient material having a coloring agent dispersed therein mounted within said annular groove by expanding the band over the nozzle insert and allowing it to contract within said groove, said coloring agent being of a predetermined color associated with the size of said orifice.

2. A step-by-step rotary sprinkler head as defined in claim **1** wherein said sprinkler body and said nozzle insert are made of metal.

3. A step-by-step rotary sprinkler head as defined in claim **2** wherein said nozzle insert has knurling formed in the exterior periphery thereof between the discharge end thereof and said second annular groove operable to be digitally engaged to facilitate the digital turning of said nozzle insert.

4. A step-by-step rotary sprinkler head as defined in claim **3** wherein said nozzle insert includes an annular flange formed in its exterior periphery between the an-

nular grooves therein, said flange having an end surface facing in a direction toward the inlet end thereof providing a stop surface for engaging the end surface of said annular wall so as to limit the inward movement of said nozzle insert by said digital turning action.

5. A step-by-step rotary sprinkler head as defined in claim 4 wherein the periphery of said flange is formed by a plurality of intersecting flat surfaces engageable by a tool so as to provide the optional capability of tightening said end surfaces into engagement with a torque greater than that capable of being applied by said digital turning.

6. A step-by-step rotary sprinkler head as defined in claim 5 wherein said nozzle insert includes an end surface at the discharge end thereof having indicia formed therein indicating the size of said orifice.

7. A step-by-step rotary sprinkler head comprising a hollow sprinkler body having an inlet and an outlet, means for mounting said hollow body in communication with a source of water under pressure for controlled step-by-step rotary movement about an axis extending generally vertically in operation, an impulse arm mounted on said hollow body for oscillatory movement toward and away from a limiting position with respect to said hollow body, said outlet extending upwardly and outwardly with respect to the axis of rotation of said hollow body and having a nozzle insert mounted therein for directing flow of water under pressure communicated with said inlet outwardly thereof, and means including a reactant element on said arm engageable with a stream issuing from said nozzle insert for effecting successive oscillatory movements of said arm and for effecting successive step-by-step incremental rotational movements of said hollow body about its axis of rotation during each oscillatory movement of said arm, said nozzle insert comprising a metallic body having an inlet end and a discharge end, said insert body having a discharge orifice therein adjacent the discharge end thereof communicating with the inlet end thereof by a passage which converges in a direction toward said orifice, said insert body including threads formed on the exterior periphery thereof adjacent the inlet end thereof for cooperatively engaging threads formed within the outlet of the sprinkler head body to mount said insert body in an operative position with respect to said sprinkler head body wherein a discharge portion of said insert body extending from a position adjacent the inner end of the threads thereof to the discharge end thereof is disposed outwardly of the sprinkler head body outlet in exteriorly exposed relation, said insert body also including an annular groove formed in the exterior periphery of said discharge portion in spaced relation to the discharge end thereof, the improvement in combination therewith which comprises a preformed band of resilient material mounted within said annular groove by expanding the band over the nozzle insert and allowing it to contract within said groove, said band having a coloring agent dispersed therein of a distinctive color associated with the specific orifice size of the insert body so that an operator is enabled to ascertain, by visually observing the color of said band, the orifice size of the nozzle insert mounted in operative position with the sprinkler head and hence the range and capacity of the sprinkler head.

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