

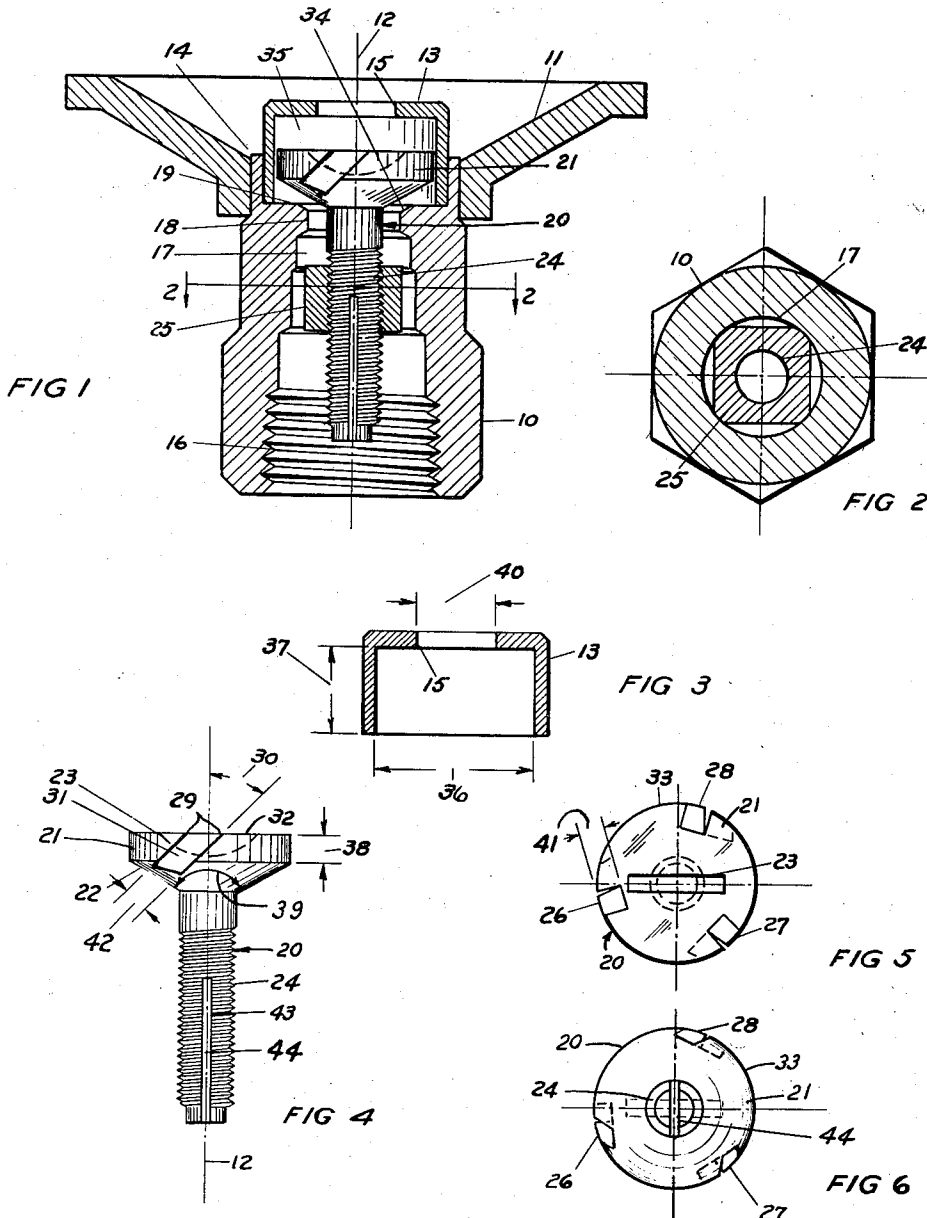
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SPRINKLER HEAD

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## SPRINKLER HEAD

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This invention relates to the construction of sprinkler heads, and has been developed primarily for irrigation systems involving a series of the units connected to an underground supply pipe. The orifice, or discharge outlet, is preferably about at ground level, and the unit does not project to a height that would interfere with a lawn mower. To operate satisfactorily, the units must create a good dispersion of the water in contrast to merely wetting a small spot or ring. Simplicity and reliability requirements prevent the use of moving parts, and the necessary break-up of the supply flow into a fine spray must be accomplished by the relationship of components which are fixed with respect to each other except for adjustment.

The use of a series of units connected to a supply pipe of considerable length requires that the units be adjustable to compensate for various pressures along the line, so that all the units in the series will have a similar delivery. These variations of pressure should be accommodated by the unit at a given delivery rate without excessive distortion of the spray pattern or drop size.

Devices of this type utilizing an adjustable valve system are not new. Applicants have, however, discovered a relationship between the components which results in excellent performance, and which involves a valving action at a point remote from the orifice (as far as the fluid dynamics of the device is concerned). Preferably, the valve unit itself imparts a rotation to the stream by causing it to pass through slots disposed at an angle to the axis of the unit. The slots themselves provide passages of quickly-expanding cross section along the flow path, which seems to have a beneficial effect on the drop-size of the spray. The dimensions of the slots, of the equalization chamber between the slots and the orifice, of the orifice, and the orientation of the slots all appear to be of considerable importance—at least the relationship of each with respect to the others. While it has not been possible at this time to determine a formula establishing the relationship of all the elements with precision, a set of dimensions will be disclosed herein for a model which performs excellently.

The proper functioning of the unit not only requires that the valving action be adjustable; but that once the adjustment is made, it should be maintained. In the preferred form of the invention, the adjustment of the valve with respect to the valve seat is accomplished by providing a threaded engagement between the shank of the valve and a member fixed with respect to the body. It is therefore important that a certain resistance to rotation be provided so that the valve member will not gradually displace itself from the adjusted position as a result of the torque derived from rotating the spray. It is also desirable that the shank of the valve should be maintained as closely as possible in coaxial relationship with the conduit which it controls. Both of these requirements are met, in the preferred form of the invention, by the provision of an axially-extending diametral slot in the threaded portion of the valve shank. This

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slot is filled—preferably with a forced-fit—with a readily-deformable material of the type commonly referred to as “plastic.” This material serves two functions. The first of these is simply that the presence of the forced relationship in the slot tends to expand the threaded shank and force it more tightly into engagement with the internal threads with which it cooperates. It is important to note that the expansion in one direction actually serves the purpose of stabilizing the axis of the device in all directions as a result of the tight engagement of the threads. If an un-threaded engagement were involved, expansion would have to take place on perpendicular axes, but the presence of the threads removes this necessity. The added function of the deformable insert material results from the fact that it is preferably shaped to extend out into a position of interference with the threads of the internally-threaded member. As the valve is forceably rotated into adjusted position, the threads of the internally-threaded member force their way into the deformable material, and a solid pre-determined resistance to rotation results.

The several features of the invention will be analyzed in detail through a discussion of the particular embodiments illustrated in the accompanying drawing. In the drawing:

Figure 1 presents a sectional elevation along the axis of the completely assembled device.

Figure 2 presents a section taken on the plane 2—2 of Figure 1.

Figure 3 presents a section on a somewhat enlarged scale of the cap containing the orifice.

Figure 4 presents a view in elevation on an enlarged scale of the valve member.

Figure 5 presents a top view of the valve member, on the same scale as that of Figure 4.

Figure 6 presents a view from the bottom of the valve member, also on the same scale as that of Figure 4.

Referring to the drawing, the illustrated sprinkler head unit includes the body member generally indicated at 10 which has an outwardly-flared funnel-shaped upper portion 11, the unit ordinarily being installed with this portion of the device approximately at ground level. The axis 12 of the unit is usually vertical. A central bore, which is coaxial with axis 12, receives the lower end of the cap 13, preferably in a fairly close fit. When fully assembled, the cap 13 may be considered as fixed with respect to the body member 10 either through the use of a forced-fit, through the application of solder, or through the upsetting of the lip 14 in a manner as to generate a constricting action inwardly against the cap 13. The hole 15 in the top of the cap 13 provides a discharge orifice for the spray.

A conduit through the body member is provided by the coaxial passages formed by the coupling portion 16, the bore 17, the bore 18, and communicating passages around the insert 25. A shoulder 19 extends between the bore 18 and the bore which receives the cap 13. The inside diameter of the cap 13 may also be considered as the equivalent of a bore which is a continuation of the coaxial group previously referred to.

A valve member generally indicated at 20 has a head 21 having a conical under-surface 22, and a driving slot 23 in the top for cooperation with a screwdriver, or some similar tool, which may be inserted through the discharge orifice 15 when it is desired to adjust the flow characteristics of the device. When the valve member 20 is rotated during such an adjustment, the threaded shank 24 changes its axial position with respect to the insert 25, which has an internal thread cooperating with the threads of the shank 24. Referring to Figure 2, the insert 25 is preferably square in cross-section, and is inserted with a pressed fit into the bore 17, which binds

the insert 25 at its corners, leaving open passages between the insert and the bore 17 communicating between the bore 17 and the coupling portion 16. The insert, therefore, occupies less than the entirety of the cross-section of the bore in which it is positioned, exclusive of the central internally-threaded opening engaged by the shank 24.

The head 21 of the valve member, in the illustrated modification of the invention, is provided with a series of preferably three peripherally-spaced slots 26, 27, and 28. Four has also been found to work satisfactorily. Each of these slots is preferably formed by the action of a milling cutter which engages the head 21 in such a fashion that each slot at the top of the valve member is bisected by a radius to the axis 12 of the unit, the sides 29 of the slot being in parallel planes perpendicular to the base of the slot. A rounded cutter giving a slot which is arcuate in cross-section can be used in place of the illustrated form. The angle of the slot indicated at 30 in Figure 4 with respect to the axis 12 causes a rotary motion to be imparted to the flow of water passing through the slots, which is largely responsible for the lateral projection of the spray. In the illustrated modification, the base or bottom of the slots (as indicated at 31 in Figure 4) is machined in a plane substantially parallel to the axis 12. The result of the geometrical relationships arising from this manner of forming the slots 26, 27, and 28 (which applies to an alternative cutter shape as well), is to create a smaller cross-section to the slots at the conical surface 22 than at the discharge end adjacent the top surface 32 of the head. This variation in cross-section, in view of the relatively high velocity of flow and the turbulence created by the fairly sharp edges of the slot, seems to create a very desirable tendency to reduce the drop-size of the spray. Figures 5 and 6 best illustrate the formation of the slots and the change of cross-section that takes place. The periphery 33 of the top fits within the inside diameter of the cap 13 with a minimum of clearance, resulting in forcing the entire flow of the device through the slots 26, 27, and 28.

While the quantity of flow through the unit is principally determined by the distance between the conical surface 22 of the valve unit 20 and the beveled seat 34 at the juncture of the shoulder 19 and the bore 18, the effect on the flow of water caused by the valving action itself may be considered as isolated from the discharge orifice 15. The entire flow passes from the valving area through the slots 26, 27, and 28, and the equalization chamber 35 provided between the top surface 32 of the valve and the under side of the cap 13 is substantial enough in height so that the variations in height of the valve member to secure the necessary flow adjustment do not result in sufficient altering of the characteristics of the equalization chamber to cause any appreciable difference in the spray characteristics. Flow in the equalization chamber 35 rotates at a rapid rate as a result of the emergence of the flow from the inclined slots 26, 27, and 28; and on emerging from the discharge orifice, the rotation imparts a sufficient centrifugal force to generate the desirable dispersion of the spray in a lateral direction.

The dimensional relationships of the various components seem to be rather important in the over-all performance of the unit. Since it has not been possible to determine with precision a formula which will positively establish the relationship of the various dimensions, including the allowable variations from the preferred dimensions, a set of dimensions will be disclosed herein which have been found to create a very satisfactory unit. It is intended that this disclosure of specific dimensions will illustrate approximately the proportional relationships involved, and is not to be understood as the only set of dimensions that will form an operative device. Using a diameter of approximately  $\frac{1}{2}$  inch for the bore 17, and  $\frac{3}{8}$  inch for the bore 18, an inside diameter of approximately  $\frac{21}{32}$  inch (indicated at 36 Figure 3) for

the cap has been found satisfactory. The inside height of the cap 13 (indicated at 37 Figure 3) is preferably approximately  $\frac{3}{8}$  inch. The thickness of the peripheral edge 33 of the head 21 is preferably approximately  $\frac{3}{32}$  inch (this dimension being indicated at 38 in Figure 4). The cone angle of the surface 22 (indicated at 39) is preferably approximately 120 degrees. With these proportions, the discharge orifice diameter indicated at 40 in Figure 3 should be approximately  $\frac{1}{16}$  inch. The thickness of the material at the top of the cap 13 (through which the discharge orifice 15 extends) is approximately  $\frac{3}{64}$  inch.

With regard to the slots in the head of the valve member, a slot depth (indicated at 41 in Figure 5) of  $\frac{3}{32}$  inch appears to be adequate. The width of the slot (indicated at 42 Figure 4) in a direction perpendicular to the direction of flow through the slot has also been found to be adequate at  $\frac{3}{32}$  inch. The angle 30 of these slots with respect to the axis 12 appears to be most effective when established at approximately 45 degrees.

In order to stabilize the valve members 20, both with respect to the coaxial relationship to the internally-fitted insert 25 and also against shifting of its rotary adjustment, the threaded shank 24 is slotted at 43 with a diametral slot extending from the lower end of the shank upward to a sufficient extent so that the slotted area is normally at all times within the area encountering the threaded insert 25. A strip of plastic material (indicated at 44) is preferably forced into engagement with the slot 43, or the opposite sides of the shank 20 may be sprung together after the slot 43 has been machined. In any event, the plastic material should be fairly well clamped in engagement with the shank 24 to maintain its position with respect thereto. It is preferable, however, that the dimensions of the plastic piece 44 be such as to normally spread the opposite sides of the shank into a more secure engagement with the internally threaded member 25 than would be the case if the shank were left unslotted. This arrangement results in driving the threads on the opposite sides of the shank into firm relationship with the internal threads, which stabilizes the valve member in its coaxial relationship with the unit. When the threads are forced into tight engagement, this action results not only in stabilizing the valve in a plane perpendicular to the slot 43, but also against displacement in the plane of the slot itself. This action results from the fact that a V-shaped member, when driven into solid engagement with a similarly-shaped groove cannot be rotated about an axis parallel to the direction of the application of pressure.

In addition to this function, it is preferable that the plastic member 44 extend radially outward on the opposite sides a sufficient amount to reach a position of interference with the internal threads of the insert 25. Since the plastic is relatively more easily deformable than the brass of which the shank 24 and the insert 25 are usually formed, the rotation of the valve member into engagement with the insert 25 will cause the threads of the insert 25 to create threads in the exposed portions of the plastic strip 44. Since material is forcibly displaced during this operation, a firm pre-determined resistance to rotation results which maintains the adjusted position of the valve member. It may also be noted that, if a high degree of compression exists between the slot 43 and the material of the plastic strip 44, such compression will tend to cause the plastic member to move outwardly into more close engagement with the threads. It is well known that plastic tends to flow to a very limited degree under the application of continuous pressure.

The particular embodiments of the present invention which have been illustrated and discussed herein are for illustrative purposes only and are not to be considered as a limitation upon the scope of the appended claims. In these claims, it is our intent to claim the entire in-

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vention disclosed here, except as we are limited by the prior art.

We claim:

1. A sprinkler head, comprising: a body member having an outwardly flared portion at the normally uppermost end thereof, said body member having a bore coaxial with said flared portion, a conduit communicating with said bore and extending through said body portion and having a smaller diameter from that of said bore and also having an annular shoulder extending between said conduit and said bore; a member disposed within said conduit and fixed with respect thereto, said member having a threaded hole coaxial with said bore, and said member occupying less than the full cross-section of said conduit at said threaded member exclusively of said threaded hole; a valve member having a threaded shank engaging said threaded hole, and including a head provided with a conical surface adjacent said shank having a diameter greater than that of said conduit at said shoulder, and having a driving recess in the side opposite from said shank, said head having a series of slots spaced about the periphery thereof and inclined to the axis of said shank by approximately forty-five degrees, said slots increasing in cross-sectional area proceeding from the side of said head adjacent said shank; and means forming a chamber closely surrounding said head and communicating with said conduit, said chamber being fixed with respect to said body member and having an orifice coaxial with said conduit.

2. A sprinkler head, comprising: a body member, said body member having a bore, a conduit communicating with said bore and extending through said body portion and having a smaller diameter from that of said bore and also having an annular shoulder extending between said conduit and said bore; a member disposed within said conduit and fixed with respect thereto, said member having a threaded hole coaxial with said bore, and said member occupying less than the full cross-section of said conduit at said member exclusively of said threaded hole; a valve member having a threaded shank engaging said threaded hole, and including a head provided with a conical surface adjacent said shank having a diameter greater than that of said conduit at said shoulder, and having a driving recess in the side opposite from said shank, said head having a series of slots spaced about the periphery thereof and inclined to the axis of said shank by approximately forty-five degrees, the base of said slots extending along a plane substantially parallel to the axis of said valve member, said slots increasing in cross-sectional area proceeding from the side of said head adjacent said shank; and means forming a chamber closely surrounding said head and communicating with said conduit, said chamber being fixed with respect to said body member and having an orifice coaxial with said conduit.

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3. A sprinkler head, comprising: a body member, said body member having a bore, a conduit communicating with said bore and extending through said body portion and having a smaller diameter from that of said bore and also having an annular shoulder extending between said conduit and said bore; a member disposed within said conduit and fixed with respect thereto, said member having a threaded hole coaxial with said bore, and said threaded member occupying less than the full cross-section of said conduit at said member exclusively of said threaded hole; a valve member having a threaded shank engaging said threaded hole, and including a head having a diameter greater than that of said conduit at said shoulder, and having a driving recess in the side opposite from said shank, said head having a series of slots spaced about the periphery thereof and inclined to the axis of said shank, said slots increasing in cross-sectional area proceeding from the side of said head adjacent said shank; and means forming a chamber closely surrounding said head and communicating with said conduit, said chamber being fixed with respect to said body member and having an orifice coaxial with said conduit.

4. A sprinkler head, comprising: a body member, said body member having a bore, a conduit communicating with said bore and extending through said body portion and having a smaller diameter from that of said bore and also having an annular shoulder extending between said conduit and said bore; a member disposed within said conduit and fixed with respect thereto, said member having a threaded hole coaxial with said bore, and said threaded member occupying less than the full cross-section of said conduit at said member exclusively of said threaded hole; a valve member having a threaded shank engaging said threaded hole, and including a head having a diameter greater than that of said conduit at said shoulder, and having a driving recess in the side opposite from said shank, said head having a series of slots spaced about the periphery thereof and inclined to the axis of said shank; and means forming a chamber closely surrounding said head and communicating with said conduit, said chamber being fixed with respect to said body member and having an orifice coaxial with said conduit.

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