This invention relates to rotary sprinkler units, and is specifically concerned with units of that type in which a number of streams pass through the sprinkler head. The device herein described may advantageously derive power for rotation of the sprinkler head from the reaction of liquid flowing through its channels under pressure.

A primary object of the invention is to provide a sprinkler unit so low in cost that it may be used in multiples to attain wide coverage without involving excessive expenditure. At the same time, and of equal importance, the invention aims to provide a rugged, dependable and effective mechanism, capable of ensuring uniform distribution of liquid throughout the entire area of its maximum coverage.

The structure for attaining these objectives embodies a spinner head adapted to be rotated by the velocity reaction of water flowing through it. Each of the streams which passes through the spinner head discharges in a plane which is perpendicular to the radius in which the discharge orifice lies, so that the trajectories of the individual streams will be generally tangential to the circle in which all discharge orifices lie. Each stream discharges, however, at a different angle of elevation, with reference to the plane of rotation of the spinner head.

The structure also includes a housing in which the spinner is mounted for rotation in a plane transverse its axis, together with retaining means for providing for rotation of the spinner but preventing it from dropping out of the housing.

In its preferred form the retaining means for the spinner is a pivot pin which is coaxial with the spinner and has an enlarged head engaging the spinner. At its "up-stream" end, the pivot pin engages a bridge-piece mounted cross-wise of the housing.

The invention may be best understood, and its advantages best appreciated from a description of the device itself, illustrated in certain preferred embodiments in the accompanying drawings. These drawings—

Fig. 1 is a vertical section through a device embodying the improvements.
Fig. 2 is a plan view of Fig. 1.
Fig. 3 is a developed view, showing the orientation of the fluid channels.
Figs. 4 and 5 illustrate, partly in section and partly in elevation, alternative embodiments of the invention shown in Fig. 1:
Figs. 6 and 7 are vertical sections, illustrating adaptation of the invention to a somewhat different form of use.

Referring first to Fig. 1, the device is illustrated as it would be employed in a multiple installation. Reference letter A designates the outer layer of a double-jacketed protective apron or other garment, such as might be worn by firemen. The inner wall of this jacket is indicated at B, and a body of fluid filling the interspace is indicated by dotted lines at C. The fluid is, of course, under pressure, and may be supplied through any convenient hose connection (not shown).

In this embodiment of the invention, the spinner head is indicated in general by the reference number 11, and the housing is in the form of a cup, having a lateral flange 12, a cylindrical wall 13 supported thereby, and a bottom closure 14. This bottom closure, in the embodiment shown, corresponds to the bridge piece heretofore referred to. The pivot pin which connects the housing and the spinner is, according to this embodiment, the hollow tubular pin 31 which spans the gap between the bridge piece 14 and the bottom 16 of the spinner head proper, here indicated by the reference number 15.

Considering the spinner head itself, in this embodiment of the invention, it will be seen that the primary structural element is nothing more than a short length of rod stock 17, which is drilled out to provide a water space 18 terminating in the conical surface 21. (The conical configuration of that surface is of no consequence other than to the shape of the drill point used in forming it.) A series of water channels is drilled through the spinner head extending from the surface 21 to such a depth as to establish communication with the exterior of the spinner. The delivery ends of these channels, as may be more clearly seen in Fig. 2, lie in a common circle with reference to the axis of rotation of the spinner head itself.

That is to say, they are disposed in such a manner that, on the periphery of the circle, 21, the discharge opening 22 is diametrically opposite the one 122. The discharge opening 122, however, is a little larger than the corresponding one 22. Thus, the discharge opening 22 marks the outer terminus of the water channel 122; the discharge opening 23 marks the outer terminus of water channel 123, etc.

In this embodiment of the invention, the channels are simply drilled through the spinner head. Their discharge openings are preferably spaced at such angular distances about the circle in which all of the discharge openings lie.

In the device illustrated in the drawing, there are eight discharge openings spaced 45° apart around the periphery of the circle. It is, of course, apparent that a larger or smaller number of channels may be provided, if desired. However, in order to reduce the tendency of the spinner head to wobble during rotation, I find it very desirable to space the discharge openings equal angularly from each other, no matter how many such openings may be used.

As is indicated in dotted lines in Fig. 1, and quite clearly illustrated in Fig. 3, the water channels 122 to 129, inclusive, are oriented at different angles to the outer surface 21 of the spinner. Fig. 3 is a developed view of the imaginary cylindrical surface in which the openings of all channels would lie. It will be seen that the passage 122 lies at an angle of approximately 70°. The channel diametrically opposite thereto, namely, channel 126, lies at a slightly less sharp angle, namely, 65°. The channel 123, at 45°, is the lowest angle shown, and its diametrically opposite number, channel 127, is only 5° steeper, that is 50°. Channel 124 is normal to the plane of the surface 21, while channel 128 is very nearly, but not quite, normal thereto, being, as here illustrated, at an angle of 80°. Channel 125 lies at 55°, while its opposite number, channel 129, is pitched at 60°.

It will be seen that streams delivered from any pair of channels on diametrically opposite sides of the spinner will develop reaction against the spinner head of approximately the same magnitude. This is an especially desirable arrangement, since it promotes stability during rotation or, to state it in other words, reduces the wobbling which might result if the loading imposed by stream reaction were not roughly balanced. It is also to be observed that the 90° channel 124, which delivers no reaction thrust in the plane of rotation, is adjacent to channel 123 which delivers maximum thrust in that plane.

In this embodiment of the invention, in which each of the channels are drilled through the spinner head, and therefore have straight axes, it may generally be observed that the water stream discharged from any discharge opening will lie in a plane which is substantially normal to the radial plane containing both that opening and the spinner axis. Insofar as the plane of rotation is concerned, all of the streams except that delivered through discharge orifice 24 will be tangent to the periphery of all discharge openings lie. Considered in the axial direction, the discharge through channel 124 will be parallel to the axis of the spinner but radially spaced therefrom, whereas the discharge from all the other channels will be at an angle to the spinner axis.

Where the device of the present invention is to be used in multiple installations, it is preferable to restrict the amount of flow through each unit. This is readily accomplished, according to the showing of Fig. 1, by construct-
In the embodiment illustrated in Fig. 5, wherein the cylindrical wall of the spinner head 115 is a separate tubular member, and the spinner block 115 is of an outside diameter to make a driving fit inside the tube. The water channels (those numbered 225 to 229 are shown in this view) are formed by milling the cylindrical wall of the clock 115, so that in this embodiment the water channels will not be tangential to the circle in which the disk openings lie, but will instead have a helical orientation. Nevertheless, because of the kinetic energy imparted, the streams, as soon as they are discharged, assume a tangential orientation.

In order to ensure uniform spacing as between the block 115 and the washer 116, I prefer to insert a thin spacer ring 36, closely fitting the inner surface of the wall 118. If such a ring is used, it is desirable, in order not to restrict the size of the inner openings of the water channels, to use a pin 31, whereby selected tubular pivot pin having the desired bore, it is easy to control the amount of water which will be discharged through it, in such a way as to ensure that all units of a group will be supplied with equal pressure.

Rotation is accomplished by forming the counter-sunk aperture 19 so that it will have a loose or running fit with the inner end 30 of the pivot pin, whereby the pin either has a driving fit in opening 32, or else is peened over as here illustrated.

The several parts of the mechanism just described are, of course, separately manufactured. The flanged cup housing shown in Fig. 1 is formed in a single die-stamping operation, the aperture 32 being subsequently punched or drilled, or being formed at the same time as the housing by means of a punching die. A tube of the desired bore is flared at one end, and cut off at the proper length to form the tubular pivot pin 31. The spinner head is preferably drilled first to form the water space 17 and then drilled again to form the water channels. The collar member 16 for the water space 17 is cut to have a driving fit with the depending walls 18 of the spinner head proper. It is then counterbored so as to accommodate the flared end of the tubular pivot pin.

In assembling the device, a layer of hard wax or other hard but meltable material is spread over the upper surface of the cup bottom 14. Then 31, is inserted through the disc 16, and thereafter the through the opening 32 in the cup bottom 14. At this point the lower end of the tubular pivot pin 31 is peened over or expanded to secure it firmly in the aperture 32. Thereafter, the spinner head is driven into the cup, so as to form the disc 16 into engagement with the depending cylindrical wall 18 of the spinner head. Then the meltable material is heated and permitted to flow out of the cup. The hard wax or low-melting-point solder or like material is, of course, for the purpose of preserving a small gap between the fixed bottom member 14 and the rotating closure member 16 constituting the base of the spinner head. It is by this means that the flared end of the pivot pin is prevented from gripping the counter-bore openings in the disc 16. If, after the meltable material has been removed, it is found that the spinner head does not rotate freely upon the pivot pin, a light tap on the face of the spinner head will drive the head and the washer 16 downwardly so as to free the counter-bored surface from the flared end of the pivot pin.

The embodiment of the invention shown in Fig. 4 is somewhat different in character. In this embodiment, the spinner head is retained in position by means of a bridge piece 33 provided with a pivot point 34, which engages the conical pivot seat 35 formed in the center of the spinner head. The member 33 is a thin wire or strap which extends diametrically across the outer surface of the housing and is welded, soldered, or otherwise secured at its opposite ends to the circular flange 12. When this type of construction is used, it is not necessary to provide the hollow pivot pin 131 with a flared end, nor to counterbore the washer 116. Instead, the washer 116 is driven into the open end of the spinner head before the spinner is inserted in the housing, and the pivot pin is inserted from the bottom of the housing 14. When the parts have been assembled as described, the bridge piece 33 is laid across the top and lightly soldered or tack welded to the lateral flange 12.

Where the device is to be produced in quantity, a simplification of the manufacturing technique is possible by using the water channels instead of drilling them. This embodiment is illustrated in Fig. 5, wherein the cylindrical wall of the spinner head 115 is a separate tubular member, and the spinner block 115 is of an outside diameter to make a driving fit inside the tube. The water channels (those numbered 225 to 229 are shown in this view) are formed by milling the cylindrical wall of the clock 115, so that in this embodiment the water channels will not be tangential to the circle in which the disk openings lie, but will instead have a helical orientation. Nevertheless, because of the kinetic energy imparted, the streams, as soon as they are discharged, assume a tangential orientation.

In order to ensure uniform spacing as between the block 115 and the washer 116, I prefer to insert a thin spacer ring 36, closely fitting the inner surface of the wall 118. If such a ring is used, it is desirable, in order not to restrict the size of the inner openings of the water channels, to use a pin 31, whereby selected tubular pivot pin having the desired bore, it is easy to control the amount of water which will be discharged through it, in such a way as to ensure that all units of a group will be supplied with equal pressure.

Rotation is accomplished by forming the counter-sunk aperture 19 so that it will have a loose or running fit with the inner end 30 of the pivot pin, whereby the pin either has a driving fit in opening 32, or else is peened over as here illustrated.

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The embodiment of the invention shown in Fig. 4 is somewhat different in character. In this embodiment, the spinner head is retained in position by means of a bridge piece 33 provided with a pivot point 34, which engages the conical pivot seat 35 formed in the center of the spinner head. The member 33 is a thin wire or strap which extends diametrically across the outer surface of the housing and is welded, soldered, or otherwise secured at its opposite ends to the circular flange 12. When this type of construction is used, it is not necessary to provide the hollow pivot pin 131 with a flared end, nor to counterbore the washer 116. Instead, the washer 116 is driven into the open end of the spinner head before the spinner is inserted in the housing, and the pivot pin is inserted from the bottom of the housing 14. When the parts have been assembled as described, the bridge piece 33 is laid across the top and lightly soldered or tack welded to the lateral flange 12.

Where the device is to be produced in quantity, a simplification of the manufacturing technique is possible by using the water channels instead of drilling them. This embodiment is illustrated in Fig. 5, wherein the cylindrical wall of the spinner head 115 is a separate tubular member, and the spinner block 115 is of an outside diameter to make a driving fit inside the tube. The water channels (those numbered 225 to 229 are shown in this view) are formed by milling the cylindrical wall of the clock 115, so that in this embodiment the water channels will not be tangential to the circle in which the disk openings lie, but will instead have a helical orientation. Nevertheless, because of the kinetic energy imparted, the streams, as soon as they are discharged, assume a tangential orientation.

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Rotation is accomplished by forming the counter-sunk aperture 19 so that it will have a loose or running fit with the inner end 30 of the pivot pin, whereby the pin either has a driving fit in opening 32, or else is peened over as here illustrated.
cular band or a series of concentric circles on the surface to be covered, as distinct from a water blanket which uniformly reaches all of that surface. In the design of the present invention, the actual pattern of water drops, as the droplets reach the ground, is substantially uniform over the entire area, without noticeable dry spots or bands. This is entirely due to the orientation given to the discharge streams, which are all substantially tangential to the radius of the sprinkler head at the point of discharge, yet leave the plane of rotation at different angles.

The term "tangential" has necessarily been employed rather loosely herein, because there is no term which describes the orientation of these discharge streams with strict engineering accuracy. Their trajectories will lie in a plane which is roughly at right angles to the cylinder radius at the point of discharge. If the plane of rotation be regarded as the azimuth, the angle of elevation of the various streams preferably ranges from 45° to 90°.

1. A rotary sprinkler unit comprising a rotatably-mounted spinner head in the form of a right cylinder having a discharge face and an inlet face and a cylindrical wall extending below the inlet face, said spinner head having a plurality of discharge openings in its discharge face spaced at equal radii from the axis of rotation, a plurality of inlet apertures in its inlet face, and a delivery channel interconnecting each discharge opening with one inlet opening, said channels being oriented to discharge fluid in a plane at right angles to the spinner radius at the point of discharge, and at least one of said channels being oriented to discharge fluid at an elevational angle substantially above the plane of rotation but less than 90°; said sprinkler unit also comprising a fixed sleeve member surrounding said spinner head and adapted for connection to a source of high pressure fluid, and support means carried by said sleeve member and rotatably mounting the spinner head in fixed axial relation to the sleeve member.

2. A device according to claim 1, wherein the spinner head has a plurality of water channels milled into the peripheral wall of the cylinder, and the cylindrical wall is a tubular member surrounding said cylinder and of greater axial length than said cylinder.

3. A device according to claim 1, wherein one of the delivery channels is oriented at an angle of 90° to the plane of rotation.

4. A device according to claim 1, wherein there are more than two discharge openings, angularly spaced apart by equal arcs, and supplied by delivery channels oriented at different elevational angles.

5. A device according to claim 4, wherein there are eight channels, with their discharge openings 45° apart.

6. A device according to claim 4, wherein the angular elevation from the plane of rotation of any given channel varies by more than 10° from the angular elevation of a diametrically opposite channel.

7. The device of claim 1, wherein there are more than two water channels, with their delivery openings equally spaced angularly from each other, each channel being at a different elevational angle, but none being at a lesser angle than 45° nor at a greater angle than 90° to the plane of rotation.

8. A device according to claim 1, wherein a closure member having a central aperture encloses a space between the inlet face of the spinner and the base of the cylindrical wall, a closure member having a central aperture extends crosswise of the fixed sleeve below the base of the skirt, and a hollow pivot pin secured in the aperture last named extends through the aperture first named to deliver fluid to the enclosed space referred to.

9. A device according to claim 1, wherein a central socket is provided in the discharge face of the spinner head and a narrow bridge piece spanning the fixed sleeve member carries a socket-engaging pivot element.

10. A device according to claim 1, wherein the fixed sleeve member has an inturned lip adjacent the discharge face of the spinner head, and the spinner head is cut away to form an angular bearing surface in running engagement with said lip, said fixed sleeve member further having a snap ring adjacent the inlet end of the skirt on said spinner head.

11. In a rotary sprinkler, a hollow rotary cylindrical spinner having a discharge head traversed by non-radial fluid channels, a cylindrical wall extending below the head, and a base closure member having a central aperture therein; a mounting for said spinner having a cylindrical wall in running engagement with said spinner, and having a base closure provided with a central aperture co-axial with the aperture in the spinner base, mounting means on said mounting member for connection to a source of fluid under pressure, and a hollow tubular pivot pin immovably fixed in the aperture in the base of the mounting member and extending through the aperture in the base of the spinner closure member in running engagement therewith; said pivot pin having within the spinner a portion of greater diameter than the aperture in the spinner closure member, whereby to limit axial movement of the spinner away from the base of the supporting member.

12. A device according to claim 11, wherein a bearing surface is formed around the aperture in the spinner closure member, and the pivot pin is provided with an external bearing surface mating therewith.

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