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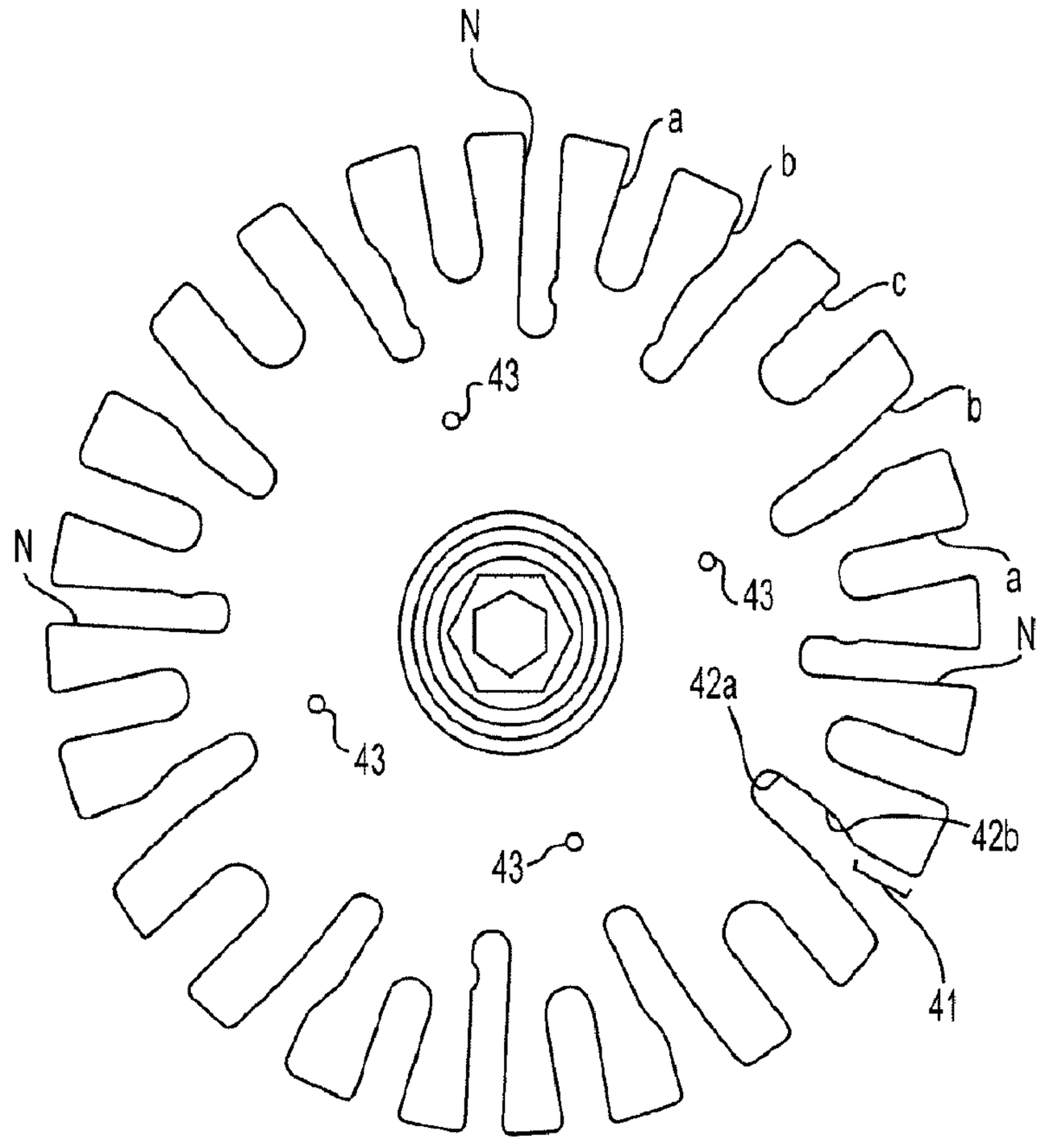
(54) **Titre : TETE D'EXTINCTEUR PENDANTE POUR LUTTER CONTRE LES INCENDIES DOMESTIQUES**
(54) **Title: PENDENT RESIDENTIAL FIRE PROTECTION SPRINKLERS**



(57) **Abrégé/Abstract:**
A pendent residential fire prevention sprinkler has a frame structure extending from the sprinkler body, and a system for blocking an outlet to prevent fluid from passing through the outlet until occurrence of a predetermined condition and for unblocking the outlet in

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(57) **Abrégé(suite)/Abstract(continued):**
response to occurrence of the condition. A deflector is supported by the frame structure at a predetermined distance from the outlet, at a position to be impinged upon by the fluid leaving the outlet. The deflector has a central portion and a peripheral portion, and slots formed in the periphery, defining tines therebetween. The slots include a first plurality of slots, each of which extends inward from the deflector periphery with a uniform width, a second plurality of slots, each of which has a first portion and a second portion between the deflector periphery and the slot's closed end, where the first portion has a width that varies at different points, while the second portion has a uniform width.

ABSTRACT OF THE DISCLOSURE

A pendent residential fire protection sprinkler includes a sprinkler body having an inlet and an outlet, a seal that releasably seals the outlet, and a release mechanism that maintains the seal in the outlet until occurrence of a predetermined condition. A frame structure extends from the sprinkler body, and forms a hub into which a set-screw that supports the release mechanism is inserted. A deflector is mounted to the hub of the frame structure with the set-screw. The deflector has a central portion and a peripheral portion that includes a first plurality of slots, each having a uniform width, and a second plurality of slots, each having a first portion near an open end portion at the periphery of the deflector and has a width that varies, and a second portion between the first portion and a closed end portion, and the second portion has a uniform width.

TITLE

PENDENT RESIDENTIAL FIRE PROTECTION SPRINKLERS

RELATED APPLICATION

This application claims benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 60/954,072, filed on August 6, 2007.

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] Our invention relates to pendent residential fire protection sprinklers, and more particularly, relates to pendent residential fire protection sprinklers suitable for the protection of relatively large residential spaces, by providing the required coverage of a large space with the required uniformity and required throughput (i.e., flow, measured, e.g., in gallons per minute) at

relatively low water pressures. The invention also relates to residential fire protection systems utilizing such pendent residential fire protection sprinklers.

Related Art

[0002] Fire protection sprinklers are conventionally connected to a conduit to receive a pressurized fire-extinguishing fluid, such as water. A typical fire protection sprinkler has a base portion with a threaded portion for connection to the conduit, and an output orifice to output the fire-extinguishing fluid to provide fire control and/or suppression. The output orifice is sealed by a seal cap that is held in place by a release mechanism. The release mechanism is designed to release the seal cap under predetermined conditions, thereby initiating the flow of the fire-extinguishing fluid. A typical release mechanism includes a thermally-responsive element, e.g., a frangible bulb, and may include a latching mechanism.

[0003] Certain conventional fire protection sprinklers have a pair of arms that extend from the base portion and meet at a hub portion to form a frame. The hub portion is spaced apart from the output orifice of the base portion and lies on the longitudinal axis thereof (i.e., the axis, roughly, along which the stream of the fire-extinguishing fluid flows through the output orifice). The hub portion may have a set-screw configured to apply a pre-tension force to the thermally-responsive element and the latching mechanism. A deflector may be mounted on the hub, transverse to the output orifice, to provide dispersion of the output fire-extinguishing fluid.

[0004] Fire protection sprinklers may be mounted on the conduit running along a ceiling and may either depend downward from the conduit, referred to as a "pendent" configuration, or may extend upward, referred to as an "upright" configuration. An area to be protected may include an entire room, in which case the relevant fire protection standards, e.g., Underwriters'

Laboratories' Standard 1626 (UL® (a registered trademark of UL LLC, of Northbrook, IL, USA) 1626), requires, among other things, that the fire-extinguishing fluid flow to reach each of four walls surrounding a coverage area, and to impinge on the coverage area evenly. For fire protection sprinklers having a relatively large K-factor, defined by $K = Q/\sqrt{p}$, where Q is the flow rate in gallons per minute, and p is the residual pressure at the inlet of the sprinkler in pounds per square inch, the National Fire Protection Association (NFPA®, a registered trademark of the National Fire Protection Association of Quincy, MA, USA) sets forth the requirements based on the application. For example, fire protection sprinklers used in residential occupancies greater than four stories must meet the requirements set forth in the Standard for Fire the Installation of Sprinkler Systems (NFPA 13) (0.1 gpm/ft^2 density, 4-head hydraulic calculation). Other applicable standards published by the NFPA® include the Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes (NFPA 13D) (0.5 gpm/ft^2 density, 2-head design for hydraulic calculation), and the Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies (NFPA 13R), including the standards for residential occupancies up to and including four stories (0.5 gpm/ft^2 density, 4-head design for hydraulic calculation). Providing a fire protection sprinkler that meets these requirements for residential installations is especially difficult, because the available water pressure in residences is generally below the available water pressure that can be utilized in a commercial space. To this end, it is desired to increase the ability of the fire protection sprinkler to deliver a certain amount of fire-extinguishing fluid per unit time (i.e., to deliver the fire-

extinguishing fluid at a required rate), as a function of the available water pressure. This ability is generally indicated by the K-factor of the fire protection sprinkler.

[0005] In addition to achieving the ability to spray the fire-extinguishing fluid at the required rate, a fire protection sprinkler must also meet certain standards pertaining to the evenness with which that fire-extinguishing fluid is delivered over the surfaces of the area to be protected (i.e., the fire protection sprinkler must provide a required coverage).

[0006] Both of these requirements constitute challenges in the design of a residential fire protection sprinkler. Moreover, although compiled and tabulated data indicates the characteristics of fire protection sprinklers based on the K-factor and the water pressure used, a fire protection sprinkler may not perform as predicted based on the data. Frequently, a fire protection sprinkler requires a greater water pressure to deliver the fire-extinguishing fluid at the required rate.

[0007] As a result, designing a fire protection sprinkler having a given K-factor and that will provide the required coverage at a particular water pressure is a challenging task.

SUMMARY OF THE INVENTION

[0008] Our invention is directed to a new pendent residential fire protection sprinkler having a relatively large K-factor and that operates with excellent results at a relatively low water pressure.

[0009] In one aspect of our invention, a pendent residential fire protection sprinkler has a sprinkler body with an outlet, a frame structure extending from the sprinkler body, and a mechanism that seals the outlet to prevent a fluid from passing through the outlet until occurrence of a predetermined condition, and that unseals the outlet in response to occurrence of

the predetermined condition. A deflector is supported by the frame structure at a predetermined distance from the outlet, at a position such that the deflector is impinged upon by the fluid flowing from the outlet. The deflector has a central portion, a peripheral portion, and slots formed in a periphery of the peripheral portion, the slots defining tines therebetween. The slots include a first plurality of slots, each of which extends inward from the periphery with a uniform width, a second plurality of slots, each of which has a first portion having a varying width, and a second portion, having a uniform width, the first portion and the second portion being provided between the periphery and a closed end thereof.

[0010] In another embodiment of our invention, a pendent residential fire protection sprinkler has a sprinkler body with an outlet, a frame structure extending from the sprinkler body, and a mechanism that seals the outlet to prevent a fluid from passing through the outlet until occurrence of a predetermined condition, and that unseals the outlet in response to occurrence of the predetermined condition. A deflector is supported by the frame structure at a predetermined distance from the outlet, at a position such that the deflector is impinged upon by the fluid flowing from the outlet. The deflector has a central portion, a peripheral portion, and slots formed in a periphery of the peripheral portion, the slots defining tines therebetween. In this embodiment of the invention, each pendent residential fire protection sprinkler provides a fluid flow of 40 gallons per minute at a gauge fluid pressure of 27.7 psi.

[0011] Our invention also relates to a residential fire protection system utilizing such pendent residential fire protection sprinklers.

BRIEF DESCRIPTION OF THE FIGURES

[0012] Fig. 1 is a side view, partly in section, of a first embodiment of the invention.

[0013] Fig. 2 is a cross-sectional view of the embodiment, taken along section line 2-2, shown in Fig. 1.

[0014] Fig. 3 is a detail view of the embodiment shown in Fig. 2.

[0015] Fig. 4 is an end view of the deflector of the embodiment shown in Fig. 1.

[0016] Fig. 5 shows tables listing the results of tests that compared the performance of the embodiment shown in Fig. 1 with that of other commercially available residential fire protection sprinklers.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] In one aspect, our invention provides a pendent fire protection sprinkler 10, shown in Fig. 1. Since several portions of the preferred embodiment are common to many fire protection sprinklers, fire protection sprinklers, these portions will not be described in full detail, although additional detail of these portions may be found in commonly-assigned U.S. Patent No. 6,516,893.

[0018] The pendent fire protection sprinkler 10 of this embodiment has a body 11 having an inlet orifice 12, an output orifice 13, and an axial passage 21 (see Fig. 2) through the body 11, the axial passage being provided between the inlet orifice 12 and the output orifice 13. An exterior of the body 11 adjacent the inlet orifice 12 is threaded to permit the pendent fire protection sprinkler 10 to be connected to a piping system (not shown) that delivers a fire-extinguishing fluid to the pendent fire protection sprinkler 10. The fire-extinguishing fluid is often water, and for simplicity, the fire-extinguishing fluid will generally be referred to hereinafter as water, although other fluids can be substituted without departing from the scope of the invention. The pendent fire protection sprinkler 10 is installed with the inlet orifice 12 upwards, and the

remaining portions of the pendent fire protection sprinkler 10 depending therefrom. The pendent fire protection sprinkler 10 may be mounted with a cover or may be exposed (i.e., visible), although both arrangements are well known and therefore, a detailed description thereof is omitted.

[0019] Two frame arms 14 extend from the body 11, and are joined together at a hub 18 at a distance from the body 11. The two frame arms 14 define a plane. A seal cap 15 blocks (i.e., seals) the output orifice 13 so as to prevent the flow of the water from the output orifice 13, and a thermally-responsive element 16 holds the seal cap 15 in place. The thermally-responsive element 16 may be, for example, a glass bulb containing a thermally-responsive liquid that, upon being heated sufficiently, will cause the glass bulb to break. The thermally-responsive element 16 has one end positioned against the seal cap 15, and another end supported by a load screw 17 that is mounted in the hub 18. The load screw 17 and the hub 18 are together referred to as a "hub assembly" for convenience. The thermally-response element 16, the seal cap 15, and the hub assembly together serve to block the output orifice 13 until occurrence of a sufficient temperature condition that causes the thermally-responsive element 16 to break, as described above. When this occurs, as is well known, the seal cap 15 is no longer held in place in the output orifice 13, and a pressure of the water in the piping system and the force of gravity remove the seal cap 15, allowing the water to flow from the output orifice 13. (This can be visualized most easily from Fig. 2.)

[0020] The pendent fire protection sprinkler 10 also includes a deflector 19 supported at a bottom the frame arms 14 by the hub assembly (as shown in Fig. 2). The deflector 19 is a disc, as can be appreciated more easily from Fig. 4. The deflector 19 has an upper face and a lower

face. When the pendent fire protection sprinkler 10 is actuated, the stream of the water that flows, under pressure, from the output orifice 13 first impinges upon an exposed tip of the load screw 17 and the hub 18, and then, strikes the upper face of the deflector 19. The deflector 19 is structured (as described below) to disperse the water so as to achieve the required flow, distributed properly over the area protected by the pendent fire protection sprinkler 10. The exposed tip of the load screw 17 and the hub 18 direct the water onto the deflector 19, and thereby play a key role in the proper operation of the pendent fire protection sprinkler 10. That is, by directing the water so that it impinges on precisely the right portion of the deflector 19, the exposed tip of the load screw 17 and the hub 18 help to achieve the best possible distribution of the water over the area to be protected. In a preferred embodiment, the pendent fire protection sprinkler 10 has a K factor of 7.6 gpm/(psi)$^{1/2}$ or more.

[0021] To achieve a desired coverage, with the desired evenness, a number of features and relationships among portions of the pendent fire protection sprinkler 10 are important, and some features and relationships are critical. The deflector 19 must have a correct total area, and the water must strike the deflector 19 with a proper velocity. Also, it is necessary for the water to impinge on the deflector 19 a certain location. Furthermore, to achieve proper coverage of the area to be protected, it is not possible to use a deflector having a conventional structure. Rather, the deflector 19 must have a number of unconventional features, as described below.

[0022] In the preferred embodiment, the exposed tip of the load screw 17 is sized, shaped, and positioned so as to create a spread in a column of the water from the output orifice 13 onto a disc-shaped area of a correct diameter in the middle of the deflector 19. Controlling the size of this disc-shaped area is very important in achieving the desired operational characteristics at the

low pressures for which the pendent fire protection sprinkler 10 is intended to be suitable. Moreover, the spacing between the output orifice 13 and the deflector 19 influences the velocity with which the water impinges on the deflector 19, and is important in achieving an even distribution of the water onto the walls of the area without the water being deflected up onto the ceiling.

[0023] Fig. 3 shows an enlarged view, partly in section, of the hub assembly. A lower end of the thermally-responsive element 16 is visible, resting on an upper surface of the tip 31 of the load screw 17. The load screw 17 is threaded into a central bore 32 in the hub 18. The tip 31 of the load screw 17 protrudes a certain distance (in the preferred embodiment, 0.075 inch) from an upper surface of the hub 18, and has lateral sides 33 at a slight angle (8.5° in the preferred embodiment) relative to a longitudinal axis of the pendent fire protection sprinkler 10 (that axis being the line extending from the center of the output orifice 13 to a center of the deflector 19). The upper surface of the tip 31 should not be excessively small (in the preferred embodiment it is 0.108 inch). Moreover, the hub 18 itself plays an important role, and the size of the upper surface of the hub 18 greatly factors into reduction of dispersion of a water column (i.e., reduction of the energy or velocity of the water). In the preferred embodiment, the upper surface of the hub 18 has a diameter of 0.285 inch. The same consideration applies to the cross-sectional width of the frame arms 14 at the zone of their convergence with the hub 18 (in this embodiment, the frame arms are teardrop-shaped in cross section).

[0024] The hub 18 includes lateral sides 34 that are sloped at a slight angle to the longitudinal axis of the pendent fire protection sprinkler 10 (in the preferred embodiment, the angle is 8.5°). It is not necessary for the entire height of each of the lateral sides 34 to be sloped, and in the

preferred embodiment, only an upper portion measuring 0.285 inch in length of each of the lateral sides 34 is sloped at the angle. Finally, an upper edge of the hub 18, where the lateral sides 34 meet the upper surface, should not present a sharp edge to the water flow, but should be radiused. In the preferred embodiment, the upper edge of the hub 18 is radiused at 0.04 inch.

[0025] Also, to achieve delivery of the proper amounts of the water to the walls and to the floor of the area to be protected, and with a correct distribution as between the walls and the floor, the deflector 19 has a number of features that are not conventional. Although it is known to provide a deflector with slots formed in a circumference thereof, the deflector 19 of our invention includes slots differing from conventional arrangements in a number of ways, as will be described with reference to Fig. 4. While a conventional deflector includes slots that are formed exactly radially, the deflector 19 of our invention has a first group of four slots N that are not exactly radial. These four slots N are distributed 90° apart from each other around the circumference of the deflector 19, with two of the four slots N being in the plane defined by the frame arms 14, and the other two of the four slots N lying in a plane perpendicular to the plane defined by the frame arms 14. The four slots N are unconventional in that they deviate from being exactly radial by a small amount. The four slots N are also unconventional in that they have slightly chamfered edges on the surface of the deflector 19 that faces toward the floor (i.e., the lower face of the deflector 19).

[0026] The deflector 19 also includes a number of other slots a, b, and c that are formed in such a way as to define four structures resembling a bent fork (defined by slots c and the tines adjoining those slots), each of which is angled at about 45° relative to one of the four slots N. These structures are particularly important in ensuring that the water is delivered all the way into

the corners of the area to be protected, which is especially difficult when the fire protection sprinkler must operate with a low water pressure.

[0027] As shown in Fig. 4, each of the slots of the deflector 19 has one of four different shapes. In a clockwise direction from one of the four slots N, the deflector 19 has a relatively wide, shallow (or short) slot a, a deep and asymmetrical slot b, a slot c that is the widest and also (by a small margin) the shallowest of the four shapes, then another asymmetrical slot b, and another slot a, creating a pattern of six slots. This pattern of six slots is repeated a total of four times around the circumference of the deflector 19, once in each quarter of the circumference.

[0028] Each of the asymmetrical slots b has an outer portion 41 in which a slot width decreases from the periphery of the deflector 19 towards the center of the deflector 19, and an inner portion 42, in which the slot width is constant. The inner portion 42 includes both a region 42a in which the direction of the slot is radial, and another region 42b in which the slot b extends in a direction that is at an angle to a radius of the deflector 19, as shown in Fig. 4.

[0029] Thus, one feature of the deflector 19 is that it has a first plurality of slots (slots a, c, and N), each of which has a constant width (although they are not all of the same width), and which extends at least approximately radially toward the center of the deflector 19 (although not exactly, in the case of the four slots N), and a second plurality of slots, each of which has a portion that is non-radial (i.e., does not align with a radius of the deflector 19), as well as a portion having a variable width (slots b).

[0030] In addition, each of the first plurality of slots and the second plurality of slots has a root diameter (i.e., the width of the slot at a closed end nearest the center of the deflector 19) that is relatively large.

[0031] In the preferred embodiment, the deflector 19 has a diameter of 1.56 inches. The length of each of the four slots N is 0.305 inch, and the width of each of the four slots N is 0.065 inch. The length of each of the slots a is 0.23 inch, and the width of each of the slots a is 0.08 inch. The length of each of the slots c is 0.22 inch, and the width of each of the slots c is 0.10 inch. Each of the asymmetrical slots b has a total depth (i.e., a distance from the deflector periphery to the root of the slot) of 0.3175 inch. The region 42a of each asymmetrical slot b, nearest to the center of the deflector 19, has a length of 0.118 inch (not including the length of the radiused closed end), and a width of 0.07 inch. The region 42b of each asymmetrical slot b extends at an angle of 12.5° relative to a radius of the deflector 19, from the region 42a to a point that is 0.10 inch from the periphery of the deflector 19. In addition, the region 42b has a width of 0.07 inch. The portion 41 of each asymmetrical slot b extends an additional 0.10 inch from the region 42b to the periphery of the deflector 19, and has a width that increases linearly.

[0032] Also, in the preferred embodiment, the angular spacing between each of the four slots N to the nearest asymmetrical slot b is 32.5°, measured from a center of each of the four slots N at the periphery of the deflector 19 to a radius that intersects a center of the root of the nearest asymmetrical slot b. The angular spacing between each of the four slots N to the nearest slot a is 15°, measured from the center of N at the deflector periphery to the radius each of the four slots N at the periphery of the deflector 19 to a radius that lies on the nearest edge of the nearest slot a. The angular spacing between each of the four slots N to the nearest slot c is 45.0°, measured from the center of each of the four slots N at the periphery of the deflector 19 to a center of the nearest slot c.

[0033] In addition, the deflector 19 is provided with a number of small holes 43 (in Fig. 4, the deflector 19 has four holes 43) that permit additional delivery of the water to the floor beneath the pendent fire protection sprinkler 10. In the preferred embodiment, the holes 43 are countersunk, having a relatively larger bore on the lower face of the deflector 19, and a relatively smaller bore on the upper face of the deflector 19. In the preferred embodiment, the holes 43 have a diameter of 0.045 inch on the upper face of deflector 19, and a maximum diameter of 0.078 inch on the lower face of the deflector 19 (the bore on the lower face of the deflector 19, is preferably formed with so that it forms a wall at an angle of 60° relative to the longitudinal axis of the pendent fire protection sprinkler 10).

[0034] The placement of the holes 43 also is unconventional, in that, on a conventional deflector, such holes would commonly be placed in line with the plane defined by the frame arms 14, or along a line perpendicular to the plane defined by the frame arms 14, while the holes 43, according to our invention, are positioned offset from the conventional locations (and 90 degrees apart from each other relative to a center of the deflector 19). In the preferred embodiment, each of the holes 43 are 22.5° from one of the four slots N, measured from the center of the one of the four slots N at the periphery of the deflector 19 to a radius of the deflector 19 that passes through a center of the hole 43. The positioning of the holes 43 also has been found to be important in achieving the desired operation of the pendent fire protection sprinkler 10.

[0035] These features of the deflector 19 help to ensure that the water is distributed in the desired way as between the floor and the walls of the area to be protected, and that water is delivered into the corners of the area to be protected at a sufficient rate.

[0036] The attached drawings are to scale, and the contents of those drawings are part of the disclosure of the present invention.

[0037] It should also be noted that, while one preferred embodiment of the pendent fire protection sprinkler of our invention is illustrated, it is also contemplated to use the pendent fire protection sprinkler in a concealed version, employing a standard cup and a cover plate.

[0038] The tables shown in Fig. 5 provides a comparison of flows and pressures for a pendent/recessed fire protection sprinkler having 0.05 density and for a pendent/recessed pendent fire protection sprinkler having a 0.1 density, and more specifically, provides a comparison of the preferred embodiment of the present invention (in the columns labeled "RASCO®", a registered trademark of The Reliable Automatic Sprinkler Co., Inc., of Elmsford, NY, USA) with a number of other, conventional residential fire protection sprinklers (identified in the table by their respective manufacturers). In each column of data, the first number is the water flow achieved by the fire protection sprinkler, in gallons per minute, and the second number (in parentheses) is the gauge pressure, in pounds per square inch, required for the fire protection sprinkler to achieve that flow.

[0039] Based on the data shown in these tables, the pendent fire protection sprinkler of the present invention achieves the desired operation at relatively lower pressures as compared with the other sprinklers tested (i.e., the fire protection sprinklers produced by the other manufacturers). As is well known, this is advantageous to an end user, since the lower pressure demand on the fire protection system reduces the installation cost.

CLAIM SHEET

1. A pendent residential fire protection sprinkler comprising:

(A) a sprinkler body having an inlet configured to receive a fire-extinguishing fluid, an outlet configured to output the fire-extinguishing fluid, the inlet and the outlet defining a sprinkler axis, and an axial passage from the inlet to the outlet that aligns with the sprinkler axis;

(B) a seal that releaseably seals the outlet to prevent the fire-extinguishing fluid from passing through the outlet, the seal being configured to seal the outlet until occurrence of a predetermined condition and configured to unseal the outlet in response to the occurrence of the predetermined condition;

(C) a release mechanism configured to maintain the seal in the outlet, and configured to release the seal from the outlet in response to the occurrence of the predetermined condition;

(D) a frame structure extending from the sprinkler body and forming a hub that aligns with the sprinkler axis;

(E) a set-screw, inserted through the hub along the sprinkler axis, and configured to support the release mechanism when the release mechanism maintains the seal in the outlet; and

(F) a deflector that is mounted to the hub of the frame structure with the set-screw, the deflector being positioned at a predetermined distance from the outlet, and configured to be impinged upon by the fire-extinguishing fluid output from the outlet, the deflector having:

(a) a central portion; and

(b) a peripheral portion having a plurality of slots extending from an open end portion, at a periphery of the deflector, generally toward the central portion, a closed end portion, the plurality of slots including:

(i) a first plurality of slots, each of which extends inward from the periphery of the deflector and has a uniform width, the first plurality of slots including:

(1) a first group of slots having a first length and having a first width;

(2) a second group of slots having a second length that is less than the first length and a second width that is greater than the first width; and

(3) a third group of slots having a third length that is less than the second length and a third width that is greater than the second width; and

(ii) a second plurality of slots, each of which has a first portion near the open end portion at the periphery of the deflector, the first portion having a width that varies, and a second portion between the first portion and the closed end portion, the second portion having a uniform width.

2. A pendent residential fire protection sprinkler in accordance with claim 1, wherein the frame structure comprises two frame arms lying in a first plane that extends from the outlet to the hub,

wherein two of the first group of slots are located in the first plane, and another two of the first group of slots are located in a second plane that is perpendicular to the first plane,

wherein the second group of slots includes eight slots, each of the second group of slots being disposed on each side of one of the first group of slots and spaced from the one of the first group of slots around the periphery of the deflector by an angle of 15°, and

wherein the third group of slots includes four slots, each of the third group of slots being located between two slots of the second group of slots and being evenly spaced from the two slots of the second group of slots around the periphery of the deflector.

3. A pendent residential fire protection sprinkler in accordance with claim 2, wherein each of the second plurality of slots also has a third portion, provided between the first portion and the second portion, the third portion having a uniform width and having an axis that does not coincide with a radius of the deflector.

4. A pendent residential fire protection sprinkler in accordance with claim 2, wherein the second plurality of slots includes eight slots, each of which is located between one of the second group of slots and one of the third group of slots, and that is spaced from one of the first group of slots at an angle of about 32.5°.

5. A pendent residential fire protection sprinkler in accordance with claim 1, wherein each of the first group of slots has chamfered edges.

6. A pendent residential fire protection sprinkler in accordance with claim 1, wherein the central portion of the deflector includes a plurality of holes that are evenly spaced apart from each other with respect to a center of the deflector.

7. A pendent residential fire protection sprinkler in accordance with claim 6, wherein each of the plurality of holes is countersunk and has an upper bore on an upper surface of the

deflector, and a lower bore on a lower surface of the deflector, the lower bore being larger than the upper bore.

8. A pendent residential fire protection sprinkler in accordance with claim 6, wherein each of the plurality of holes is spaced apart from a nearest slot of the first group of slots at an angle of 22.5°.

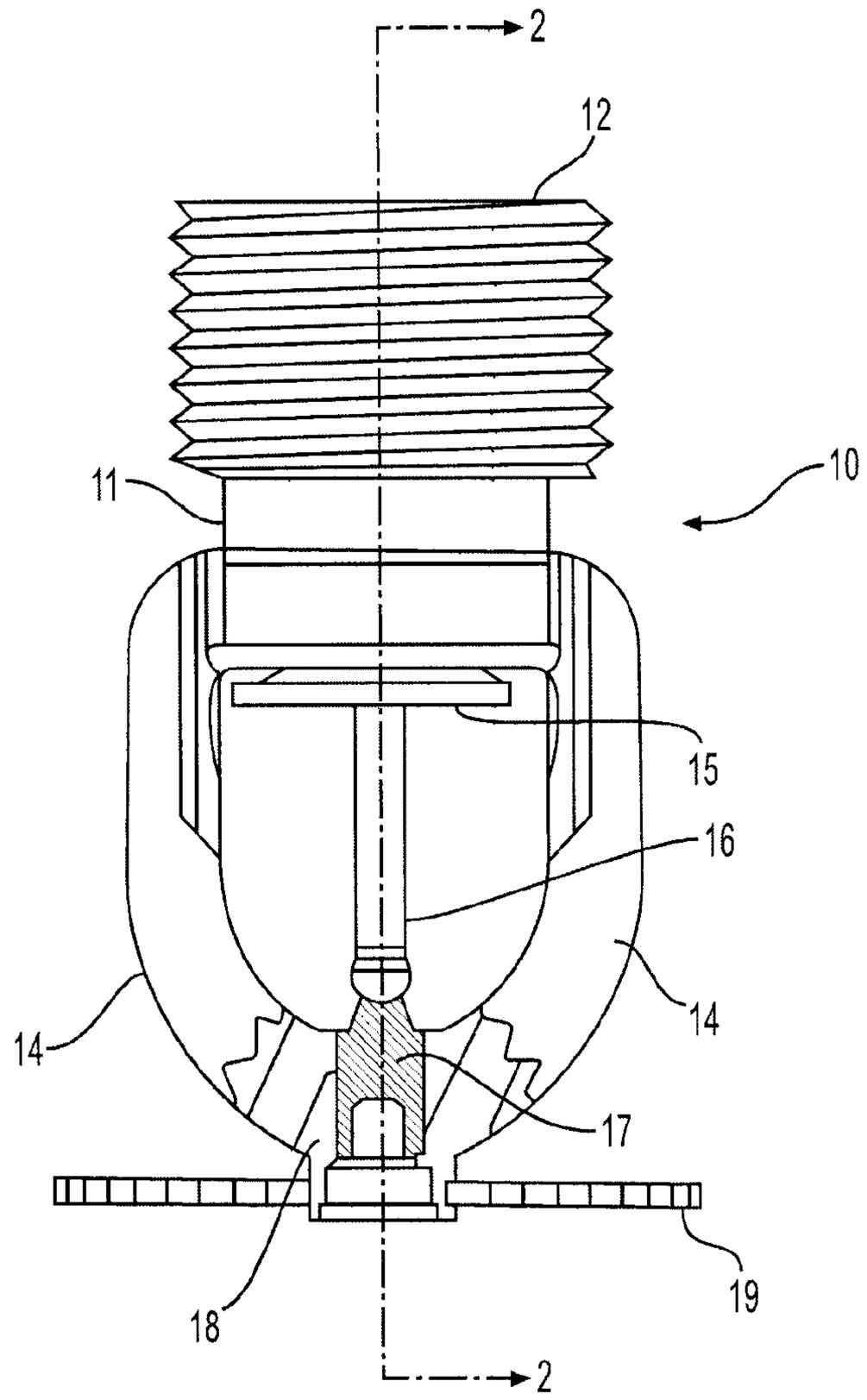


FIG. 1

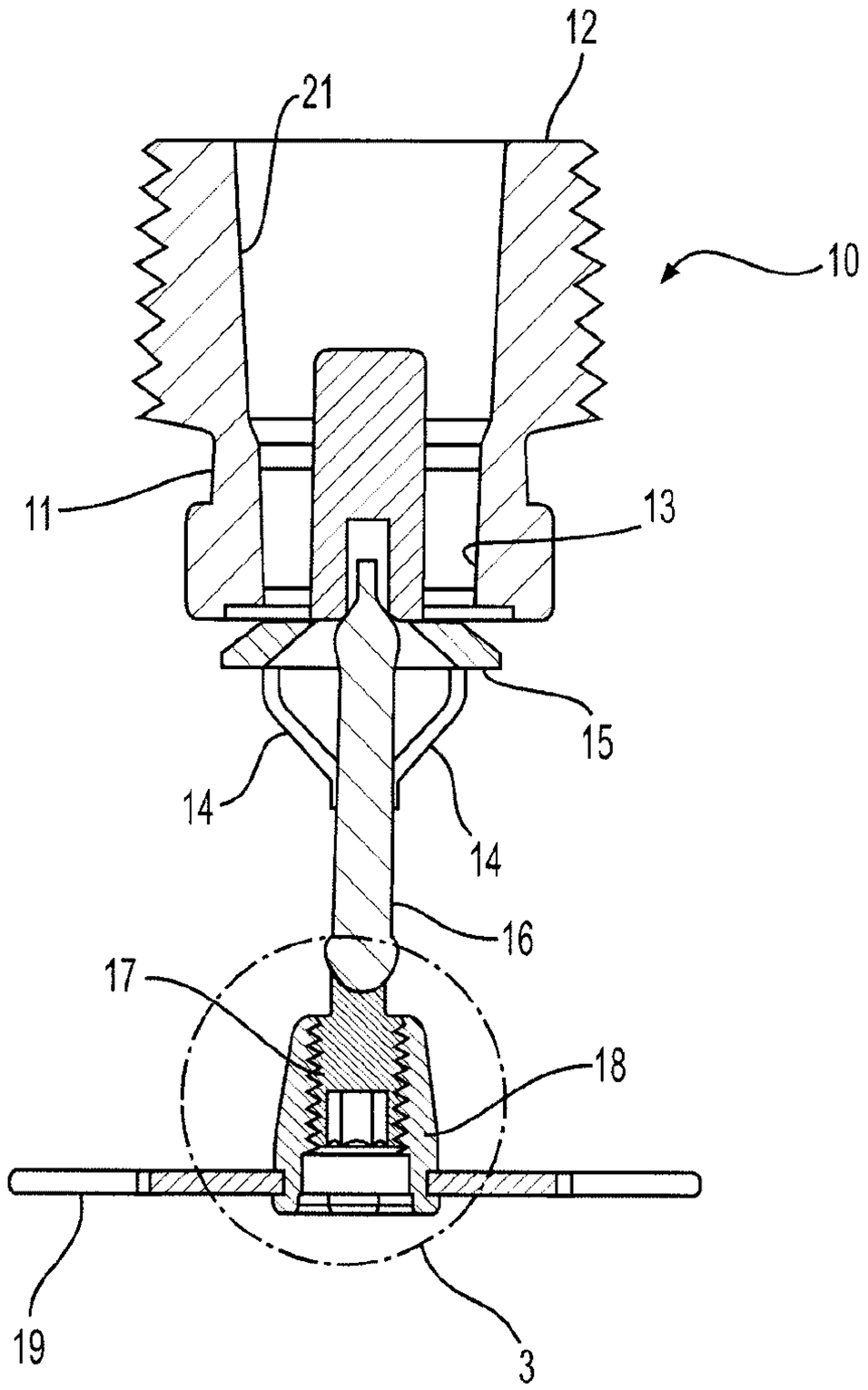


FIG. 2

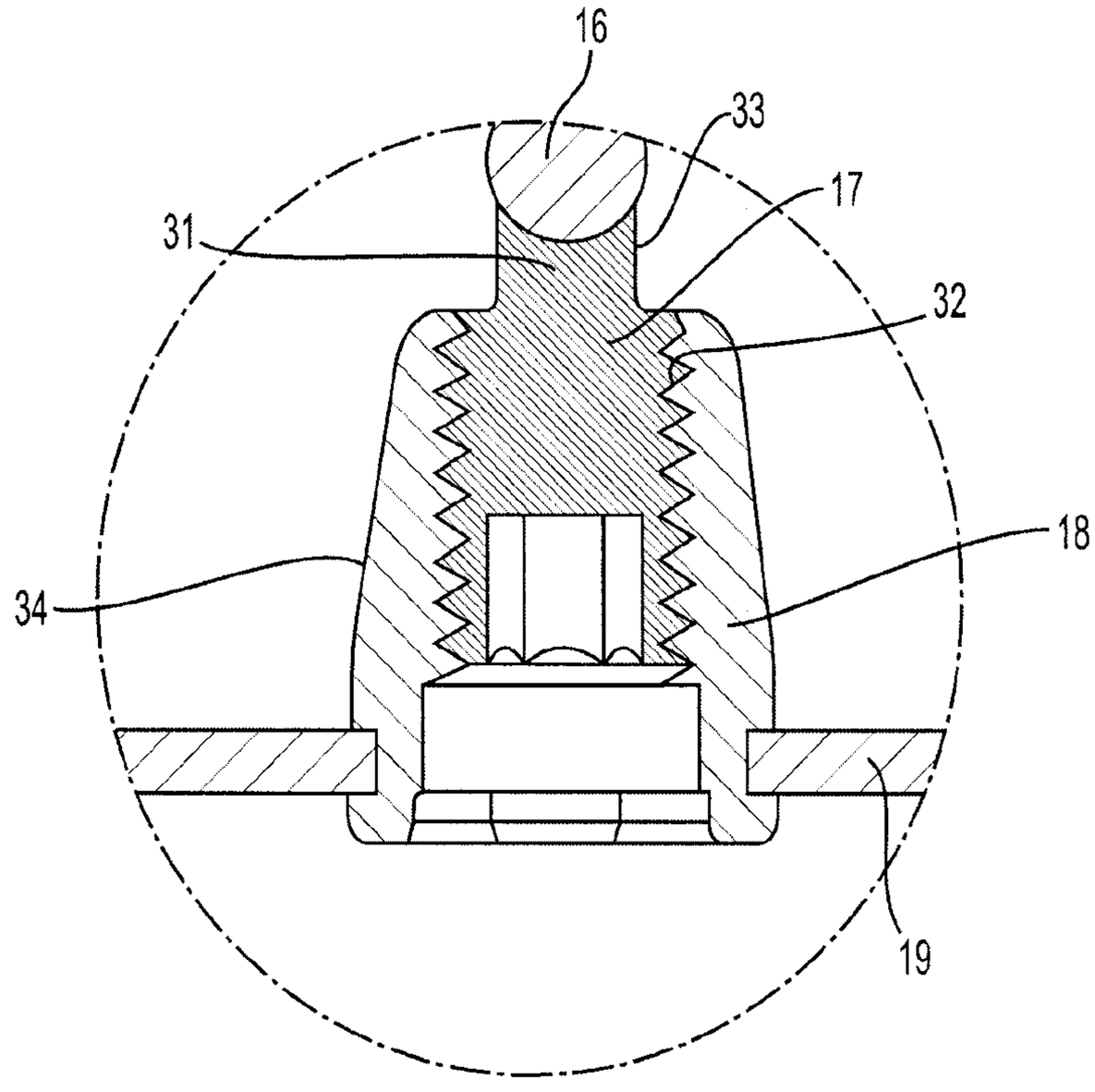


FIG. 3

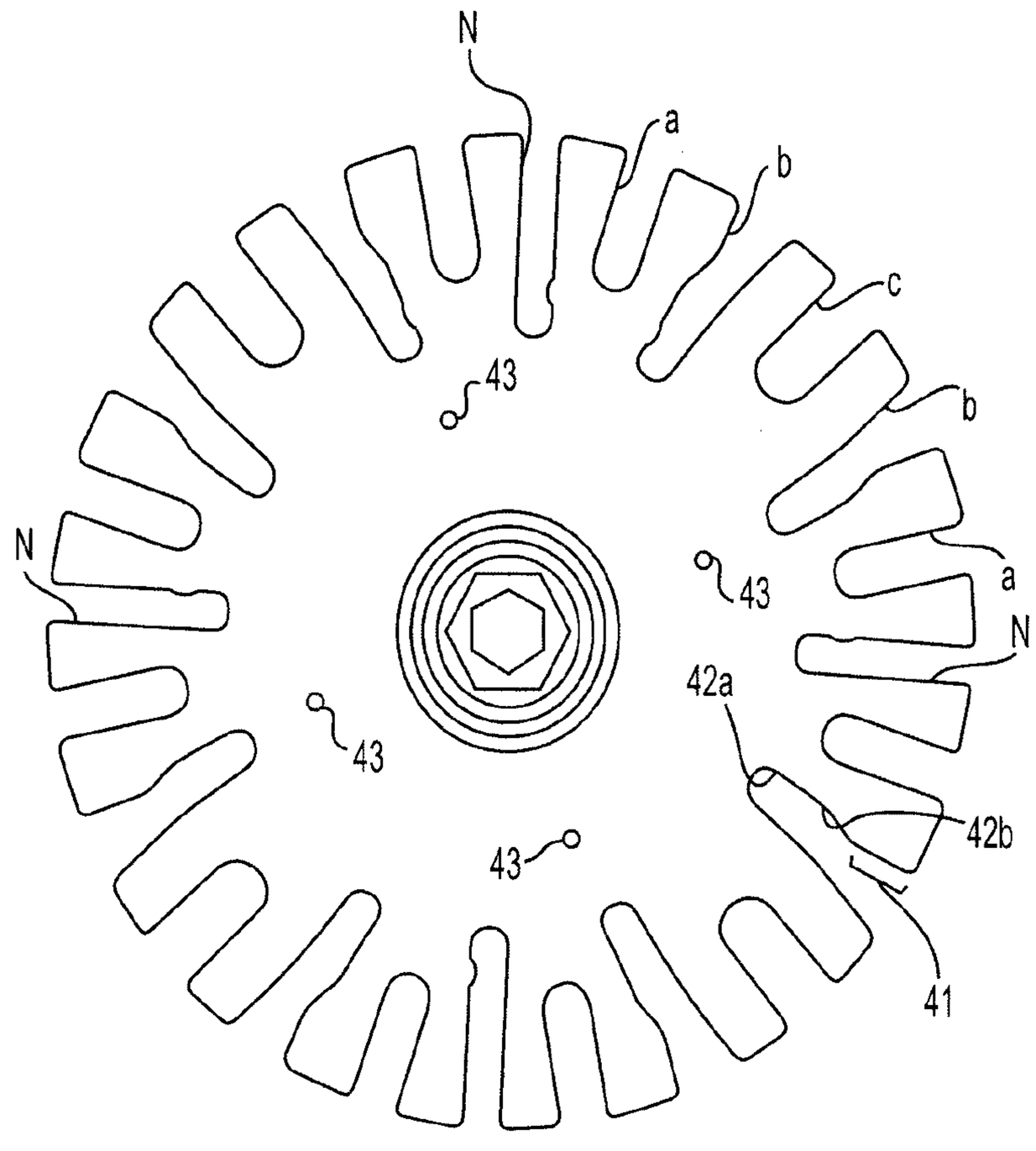


FIG. 4

F1 RES 76 FLOWS AND PRESSURES

PENDENT/RECESSED PENDENT FOR 0.05 DENSITY

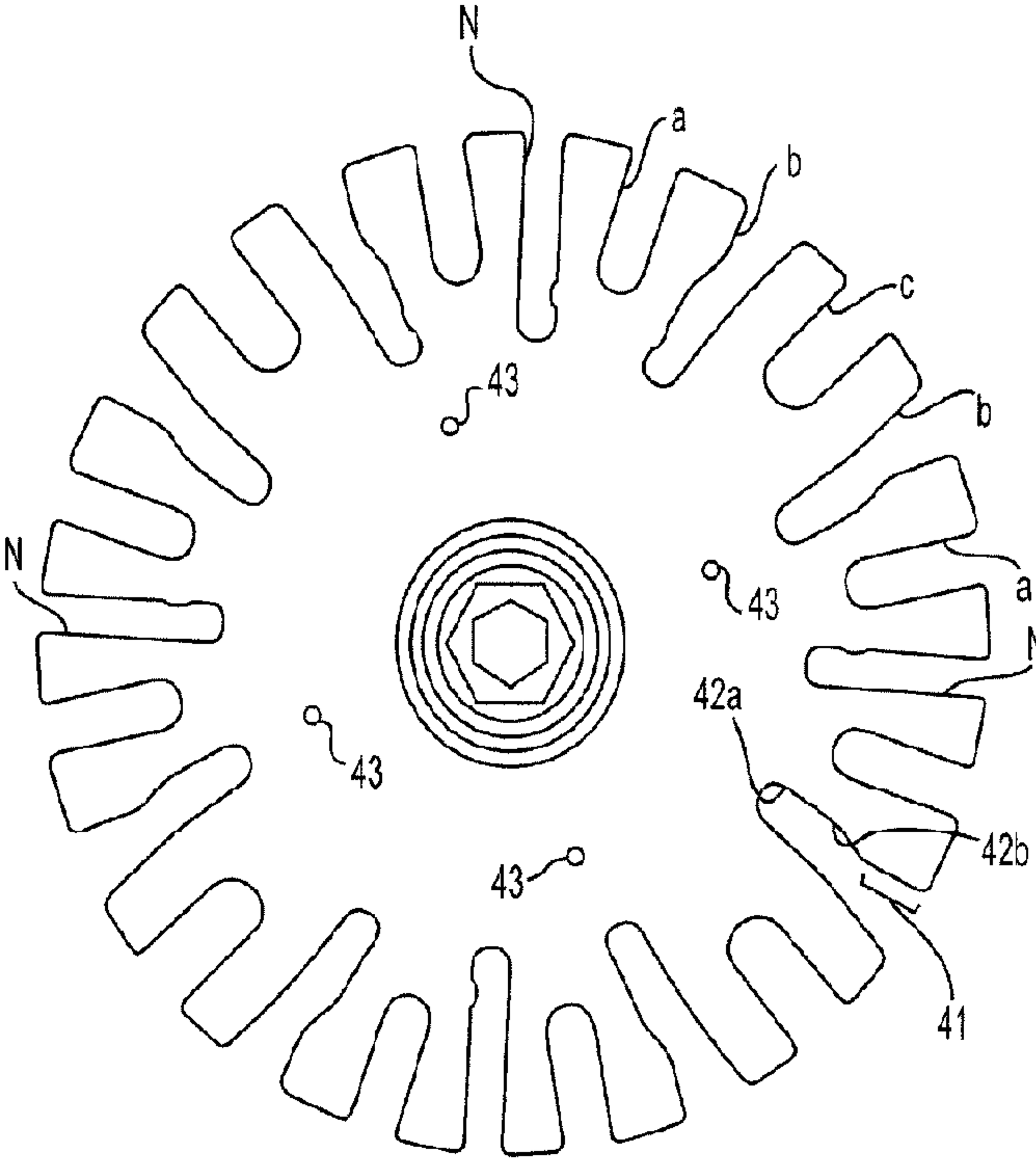
SPACINGS (FT X FT)	AREA X DENSITY = (SQ. FT X GPM/SQ. FT) =	MIN. FLOWS (GPM)	FLOWS AND PRESSURES				
			RASCO® GPM (PSI)	RASCO® GPM (PSI)	TYCO® GPM (PSI)	VIKING® GPM (PSI)	VICTAULIC® GPM (PSI)
			K-FACTOR = 7.6	K-FACTOR = 5.8	K-FACTOR = 6.9	K-FACTOR = 7.4	K-FACTOR = 6.9
20 X 20	400 X .05 =	20	23 (9.2)	22 (14.4)	22 (10.2)	24 (10.5)	22 (10.2)
18 X 18	324 X .05 =	17	21 (7.6)	19 (10.8)	19 (7.6)	22 (8.8)	20 (8.4)
16 X 16	256 X .05 =	13	21 (7.6)	16 (7.6)	19 (7.6)	20 (7.3)	20 (8.4)
14 X 14	196 X .05 =	10	21 (7.6)	16 (7.6)	19 (7.6)	20 (7.3)	20 (8.4)
12 X 12	144 X .05 =	8	21 (7.6)	16 (7.6)	19 (7.6)	20 (7.3)	20 (8.4)

PENDENT/RECESSED PENDENT FOR 0.1 DENSITY

SPACINGS (FT X FT)	AREA X DENSITY = (SQ. FT X GPM/SQ. FT) =	MIN. FLOWS (GPM)	FLOWS AND PRESSURES				
			RASCO® GPM (PSI)	RASCO® GPM (PSI)	TYCO® GPM (PSI)	VIKING® GPM (PSI)	VICTAULIC® GPM (PSI)
			K-FACTOR = 7.6	K-FACTOR = 5.8	K-FACTOR = 6.9	K-FACTOR = 7.4	K-FACTOR = 6.9
20 X 20	400 X .1 =	40	40 (27.7)	40 (47.6)	40 (33.6)	40 (29.2)	40 (33.6)
18 X 18	324 X .1 =	32.4	32.4 (18.2)	32.4 (31.2)	32.4 (22.0)	32.4 (19.2)	32.4 (22.0)
16 X 16	256 X .1 =	25.6	25.6 (11.3)	25.6 (19.5)	25.6 (13.8)	25.6 (12.0)	25.6 (13.8)
14 X 14	196 X .1 =	19.6	21 (7.6)	20 (11.9)	20 (8.4)	20 (7.3)	20 (8.4)
12 X 12	144 X .1 =	14.4	21 (7.6)	16 (7.6)	19 (7.6)	20 (7.3)	20 (8.4)

5/5

FIG. 5


N
a
b
c
b
43
N
43
a
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42a
42b
43
41