

FIRE PROTECTION DEVICE

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Priority Data & Incorporation By Reference

[0001] This international application claims the benefit of U.S. Provisional Application No. 61/584,641, filed January 9, 2012, which is incorporated by reference in its entirety.

Technical Field

[0002] The invention relates generally to a fire protection device for providing a uniform distribution of fire fighting fluid, e.g., water, in a horizontal area located below and distal of the device. More specifically, the invention is directed to a fire sprinkler device for horizontal mounting to provide a distribution of fire fighting fluid, e.g., water, in horizontal area located below and distal of the device.

Summary of the Invention

[0003] Preferred embodiments of a subject fire protection device include a structure and preferred installation orientation to substantially uniformly distribute a fire fighting fluid, e.g., water, in a horizontal area located below and distal of the device. In one preferred embodiment, a fire protection device includes a frame having a body with an inlet and an outlet disposed spaced along a longitudinal axis to define a passageway with a nominal K-factor of 16.8 or greater. The body has a proximal end for coupling the fire protection device to a fluid supply line and a distal end opposite the proximal end. The frame further preferably includes a pair of arms disposed in a first plane generally parallel to the longitudinal axis and coupled to the distal end of the body.

[0004] The preferred fire protection device also includes a deflector assembly coupled to the arms. The preferred deflector assembly has a generally planar face portion distally spaced from

the outlet of the body and substantially orthogonal to the longitudinal axis, the face portion further preferably includes two openings disposed on opposing sides of a second plane perpendicular to and intersecting the first plane along the longitudinal axis. A canopy portion is preferably supported on a first side of the first plane and spaced from a first perimeter section of the face portion disposed on the first side of the first plane. The deflector assembly further preferably includes a plurality of tines extending along a second perimeter section of the face portion disposed on a second side of the first plane opposite the first side. Each of the tines having an outer edge preferably defining an arc length of a common circle having a center aligned along the longitudinal axis.

[0005] In one preferred embodiment of the deflector assembly, each of the two openings of the generally planar face portion comprise a generally triangular flow aperture. The triangular flow aperture is preferably defined by a rectangular shaped portion disposed to one side of the first plane and a triangular shaped portion disposed to the other side of the first plane, the rectangular portion defines a length of elongation, a side of the triangle extending in the direction of the elongation for a distance that is less than the length of elongation.

[0006] In another particular preferred embodiment of the deflector assembly, the plurality of tines includes a planar portion angled with respect to the generally planar face portion to define an included angle angled with respect to the generally planar face portion, the included angle ranging between 15° and 20°. The preferred deflector assembly is symmetrical about the second plane, the plurality of tines are radially spaced apart to define a plurality of slots symmetrically disposed about the second plane, the plurality of slots including a central slot bisected by the second plane. Each of the preferred slots includes an opening entrance region and a closed end region with a transition region between the opening entrance and closed end regions, each region defining a slot width region length, the regions further defining a slot length measured from the entrance region at the outer edge to a portion of the closed end region closest to the longitudinal axis, the length of the entrance region defining a region length-to-slot length ratio, the central slot having the greatest region length-to-slot length ratio.

[0007] In one aspect of the preferred fire protection device when installed in a horizontal installation, the deflector assembly distributes a substantially uniform density of water ranging between 0.1 gpm/ft² to 0.4 gpm/ft² in each square foot of a rectangular area located approximately eighteen feet below and extending distally of the deflector assembly, the

rectangular area having a first zone and a second zone, the first zone having a length of three feet extending distally of the deflector assembly, the second zone having a length of twenty-two feet extending distally of the first zone, the width of the first and second zones being equal, wherein the density range in the first zone is 0.3 to 0.4 gpm/ft² and the density range in the second zone is 0.15 to 0.3 gpm/ft².

Brief Descriptions of the Drawings

[0008] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary embodiments of the invention, and, together with the general description given above and the detailed description given below, serve to explain the features of the invention.

[0009] FIG. 1 is a side view of a preferred embodiment of a fire protection device.

[0010] FIG. 1A is a side perspective view of a preferred embodiment of a fire protection device.

[0011] FIG. 2 is a side view of a preferred embodiment of the fire protection device along line II—II in FIG. 1.

[0012] FIG. 3 is a front view of the preferred embodiment of the fire protection device of FIG. 1.

[0013] FIG. 4 is a cross-sectional view of the deflector assembly for use in the device of FIG. 1.

[0014] FIG. 5 is a detailed view included in the area V of the deflector assembly in FIG. 3 prior to bending the tines as seen in FIG. 4.

[0015] FIG. 6 is a detailed view included in the area VI of the deflector assembly in FIG. 3 prior to bending the tines as seen in FIG. 4.

[0016] FIG. 7 is a detailed view included in the area VII of the deflector assembly in FIG. 3 prior to bending the tines as seen in FIG. 4.

Detailed Description of the Preferred Embodiments

[0017] Referring to FIGS. 1, FIG. 1A and 2, a preferred embodiment of the fire protection device 100 is shown. The fire protection device 100 is preferably mounted as a fire protection

device oriented so as to distribute water over the area to be protected. The fire protection device 100 has a proximal end 110 and a distal end 120 extending along a longitudinal axis A-A. The longitudinal axis A-A is preferably the central axis of the fire protection device 100. The fire protection device 100, preferably includes a frame 200 and a deflector assembly 300. The frame 200 preferably includes a body 210 with an inlet 202, outlet 204 and a passageway 206 therebetween to define a nominal K-factor for a suitable application. In a preferred embodiment, the passageway defines a nominal K-factor of 16.8 or greater, and in particular, a nominal K-factor of 25. As used herein, the nominal K-factor is defined as a constant representing the sprinkler discharge coefficient, that is quantified by the flow of fluid in gallons per minute (GPM) from the sprinkler outlet divided by the square root of the pressure of the flow of fluid fed into the inlet of the sprinkler passageway in pounds per square inch (PSI). The nominal K-factor is expressed as $\text{GPM}/(\text{PSI})^{1/2}$. Industry accepted standards, such as for example, the National Fire Protection Association (NFPA) standard entitled, "NFPA 13: Standards for the Installation of Sprinkler Systems" (2013 ed.) ("NFPA 13") provides for a rated or nominal K-factor or rated discharge coefficient of a sprinkler as a mean value over a K-factor range. For example, for a K-factor greater than 14, the following nominal K-factors are provided (with the K-factor range shown in parenthesis): (i) 16.8 (16.0-17.6) $\text{GPM}/(\text{PSI})^{1/2}$; (ii) 19.6 (18.6-20.6) $\text{GPM}/(\text{PSI})^{1/2}$; (iii) 22.4 (21.3-23.5) $\text{GPM}/(\text{PSI})^{1/2}$; (iv) 25.2 (23.9-26.5) $\text{GPM}/(\text{PSI})^{1/2}$; (v) 28.0 (26.6-29.4) $\text{GPM}/(\text{PSI})^{1/2}$. The preferred device 100 is configured to operate with a supply of fluid at a preferred operating discharge pressure sufficient to provide a distribution of fluid to effectively address a fire event. Preferably, the operating pressure ranges from about fifteen pounds per square inch to about sixty pounds per square inch (15-60 psi.), preferably ranging from about fifteen pounds per square inch to about forty-five pounds per square inch (15-45 psi.), and is more preferably about sixteen pounds per square inch (16 psi.) so as to provide a preferred flow rate of approximately 100 gallons per minute (100 gpm.).

[0018] Referring to FIGS. 1 and 2, the body 210 preferably includes a mount 212 spaced from the body and disposed on the longitudinal axis by a pair of frame arms 214. The pair of arms are preferably spaced about the body 210 and disposed in a plane P1 preferably parallel to and more preferably including the longitudinal axis A-A. To connect the fire protection device 100 to the fire protection system piping, the body 210 can include an outer surface provided with a threaded portion 216 and multiple-flat portion 218 connected by a transition portion 220. The

threaded portion 216 preferably includes threads of about 1 inch National-Pipe-Thread ("NPT") and can include threads greater than or less than 1 inch NPT; or other suitable threading configuration. The flat portion 218 can include a surface for tool engagement, for example, a four-sided flat for engagement with an installation tool such as an adjustable wrench.

[0019] Referring to FIG. 1 and FIG. 3, the deflector assembly 300 includes a generally planar face portion 310 substantially perpendicular to the longitudinal axis A-A. The generally planar face portion 310 preferably defines a preferably central through bore 312 for engagement with the mount 212 to secure the deflector assembly 300 to the frame 200 of the fire protection device assembly. The generally planar face portion 310 can be secured to the mount 212 by way of an interference fit such as, for example, by way of a flared or crimped portion of mount 212. Alternatively, the generally planar face portion 310 can be fastened to the mount 212 by a rivet or other mechanical fastening device. The generally planar face portion 310 preferably includes a perimeter with a first section 310a disposed to one side of the plane P1 and a second section 310b on the opposite side of the plane P1 extends perpendicular to the longitudinal axis A-A.

[0020] The generally planar face portion 310 is preferably defined by a central portion 320, and a pair of side portions 330a, 330b disposed about the central portion 320. The central portion 320 preferably includes the bore 312 and the first and second sections 310a, 310b of the perimeter of the generally planar face portion 310. Each of the side portions 330a, 330b preferably include a flow aperture 332 defined by a preferably generally triangular shaped perimeter 334a, 334b, 334c, as shown for example in FIG. 5. Alternatively, the apertures 332 may be defined by another geometry such as, for example, circular, oval, rectangular or square in shape. One of the perimeters 334a that defines the apertures 332 preferably further defines lateral edges of the generally planar face portion 310.

[0021] The preferably triangular-shaped aperture 332 is preferably formed by a rectangular portion 332a, and a triangular portion 332b. More specifically, the deflector assembly 300 is preferably secured to the frame 200 such that the plane P1 intersects the apertures 332 such that the rectangular portion 332a is disposed to one side of the plane P1 and the triangular portion 332b is disposed on the opposite side of the plane P1 as seen in FIG. 3. With reference to FIG. 5, the rectangular portion 332a is preferably elongated in the lateral direction to define the length of the rectangular portion. In one preferred embodiment, the long side of the rectangle is about 0.5 inch and the short side of the rectangle is preferably greater than 0.1 inch and is more

preferably about 1/8 inch. The triangular portion 332b has a side extending parallel to the direction of elongation for a distance that is preferably less than the length of the rectangular portion 332a. In the preferred embodiment, the lateral edge 334a is preferably less than about 0.5 inch and more preferably about 0.4 inch, with the lateral edge 334a and perimeter edge 334c defining a preferred included angle of about 60° and more preferably about 57°.

[0022] Referring to FIGS. 1, 3 and 4, the deflector assembly 300 further includes a canopy portion 340 that extends longitudinally. Canopy portion 340 of the preferred embodiment is at least substantially or generally planar and is supported from the face portion 310, oriented parallel to or slightly angled with respect to a plane parallel to the plane P1 such as, for example, to define an angle of less than ten degrees and more preferably define an included angle of less than five degrees and more preferably about 4°. The preferred canopy portion 340 is at least essentially planar and is located adjoining but spaced from the first section 310 of the perimeter of the generally planar face portion 310 and is supported by a pair of preferably curvilinear supports 350a, 350b of the deflector assembly 300 disposed preferably equidistantly about the central bore 312. The curvilinear portion 350a in one preferred embodiment is substantially U-shaped in profile, as seen for example in FIG. 4, with a preferred radius of curvature of about 1/8 inch. Moreover, the curvilinear supports 350a, 350b locate the planar face portion 310 relative to the distal edge of the canopy portion 340 and more preferably locates the face portion 310 at a distance of about one inch proximally of the distal edge of the canopy 340.

[0023] Referring to FIG. 3, the canopy portion 340, the supports 350a, 350b and the generally planar face portion 310 define therebetween a flow opening 360 of the deflector assembly 300. Further, in addition or alternatively, wherein the flow opening 360 defines an opening width extending in a direction from one support to the other support with the pair of supports each having a curvilinear portion 350a, 350b closest to the opening of the body; and the canopy having a distal linear edge furthest from the opening, the linear distance between the curvilinear portion of the supports and the linear edge of the canopy is preferably approximately equal to the opening width.

[0024] The deflector assembly 300 further preferably includes a plurality of tines 370 disposed to one side of the plane P1 opposite the canopy portion 340. Preferably, the plurality of tines 370 extend from the second section 310b of the perimeter of the generally planar face portion 310. Each of the tines 370 preferably has a planar portion 370a, a pair of side edges

370b, and an outer edge 370c. Preferably the side edges 370a, 370b are configured differently such that the tine 370 is asymmetric about a radial line extending from the longitudinal axis and bisecting the tine 370. The outer edge 370c of each of the tines 370 is preferably disposed on a perimeter of a common circle C such that each outer edge 370c defines an arc length of the common circle C. For the preferred embodiment, the plurality of tines defines at least two different arc lengths. In addition or alternatively, where the canopy defines a canopy width extending in a direction from one support to the other support 350a, 350b, the common circle C has a preferred diameter approximately equal to the canopy width with its center aligned with or located along the longitudinal axis A--A. Referring to FIG. 4, each of the outer edges 370c of each of the tines 370 is preferably located between the generally planar face portion 310 and the outlet 204 of the body 210 so that the planar portions 370a extend at an angle with respect to the generally planar face portion 310. More preferably, each of the tines 370 are angled with respect to the planar face portion 310 at a bend line 372 which is preferably located at a radius of about one-half inch from the longitudinal axis A--A. With reference to FIG. 4, the planar portions 370a of the tines 370 are preferably angled toward the longitudinal axis A—A so as to define an included angle ranging between about 10° and 30°, preferably between 10° and 20° and more preferably between about 15° and 20°, and is even more preferably 16° with respect to the generally planar face portion 310. Alternatively, the planar portions 370a may be aligned with the generally planar face portion 310 provided the deflector distribute water with one or more aspects of the water distribution described herein.

[0025] The plurality of tines 370 are preferably radially spaced apart to define a plurality of slots 380 therebetween as shown, for example, in FIG. 3. The deflector assembly 300 is preferably symmetrical about a second plane P2 disposed perpendicular to the first plane. In the preferred embodiments, the plurality of slots 380 are symmetrically disposed about the second plane that includes axis B--B so as to define a central slot 380a bisected by the second plane P2. Preferably symmetrically disposed about the central slot are one or more radially spaced slots, 380b, 380c . . . 380n. Thus, where for example, the number of tines in the assembly is x and x is an even number, then the number of slots is x-1. For the preferred deflector assembly 300 of FIG. 3, there are preferably six tines 370 such that x = 6. However, alternate embodiments may have fewer or more tines provided that the tines distribute water with one or more aspects of the water distribution described herein.

[0026] Each of the plurality of the slots 380 extend from an opening entrance region 390 which initiates at the outer edges 370c of the tines to a radially innermost closed end region 392. Formed between the opening entrance region 390 and the closed end region 392 is a transition region 394 of the slot, which is of a preferably variable width along its radial length. Moreover, the opposed side edges 370a, 370b of radially adjacent and spaced tines 370 are configured such that the slots 380 are preferably symmetrical about a radial line extending from the longitudinal axis A—A and bisecting the slot 380. The central slot 380a is an illustrative example showing the regions of a slot 380. Referring to FIG. 3 and FIG. 6, the central slot 380a includes an opening entrance region 390a, a closed end region 392a and a transition region 394a between the opening entrance and closed end regions.

[0027] Each slot 380 is defined by a slot length L which extends preferably parallel to a line bisecting the slot from the opening entrance region 390 at the outer edge 370c of the adjacent tines to a portion of the closed end region 392 radially closest to the central through bore 312. Each slot 380 is further defined by a slot width W which extends perpendicular to the slot bisecting line and can vary from region to region in the slot or additionally vary within a particular region of the slot. Referring again to the central slot 380a in FIG. 6, the opening region 390a has a preferred constant width $W1a$, which extends over a length of the opening region $L1a$ from the slot opening at the outer edge 370a to the start of the transition region 394a. The start of the transition region 394a is preferably defined by the change in slot width $W1a$ from the opening region 390a to a second different slot width $W2a$. More preferably, the slot width $W2a$ of the transition region 394a tapers narrowly in the direction of the closed end region 392a at a preferably constant rate over the length $L2a$ of the transition region 394a. Accordingly, the slot width of the transition region 394a can be characterized by the included angle α between the tine side edges 370b of the radially adjacent tines 370 defining the slot 380a. The closed end region 392a is preferably defined by a radius of curvature R which extends from a center of curvature P disposed along the bisecting line of the slot 380a. Accordingly, the junction of the transition region 394a to the closed end region 392a is preferably defined where second width $W2a$ of the transition region 394a is equal to two times the radius of curvature R . Thus, the maximum slot width $W3a$ of the closed end region is preferably defined by two times the radius of curvature R . Alternatively or in addition to, the slot width $W3a$ of the closed end region 392a preferably narrows in the radial direction towards the portion of the closed end region 392a

closest the central bore 312. Each of the plurality of slots can be characterized by the ratio of the length L_1 , L_2 , L_3 of any slot region 390, 392, 394 to the overall length L of the slot 380, i.e., region length-to-slot length ratio. Accordingly, the preferred dimensions of the embodiments described herein can be varied while substantially maintaining the ratio relationships described herein to provide or maintain the desired water distribution performance also described herein.

[0028] Accordingly a combination of the previously described slot features can be used to form the embodiments of the deflector assembly to carry out the water distribution described herein. More particularly, for the preferred deflector assembly 300, the central slot 380 defines a slot length L_1 ranging from about 0.575 inch to about 0.6 and more preferably about 0.58 inch with an opening entrance region 390a having a preferably constant width W_{1a} of about 0.1 inch and a region length L_{1a} of about 0.2 inch so as to define a preferred length-to-slot length ratio $L_{1a}:L_1$ of about 0.3. For the preferred central slot 380a, the transition region 394a is defined by an included angle α of about 7° between the side edges 370b forming the slot 380a. The length L_{3a} of closed end region 392a is preferably defined by and equivalent to its radius of curvature R_a being about 0.05 inch with the maximum width W_{3a} of the central slot being twice the radius of curvature.

[0029] The preferred deflector assembly 300 includes a first pair of preferably symmetric slots 380b laterally disposed about the central slot 360a. The central slot 380 and each of the first slots 380b define a preferred included angle therebetween ranging from about 20° to about 25° and is preferably about 23° . Each of the first pair of slots 380b defines a slot length L_2 ranging between about 0.575 inch to about 0.6 inch and is more preferably about 0.57 inch with an opening entrance region 390b having a preferably constant width W_{1b} of about 0.1 inch and a region length L_{1b} of about 0.1 inch so as to define a preferred length-to-slot length ratio, $L_{1b}:L_2$ of about 0.2. For the preferred first lateral slot 380b, the transition region 394b is preferably defined by a first portion 394b' having a constant slot width W_{2b} of greater than 0.1 inch, for example, about 0.15 inch, and more preferably about 0.13 inch; and a second region 394b'' having an included angle α_b of about 14° between the side edges 370b forming the slot 380b. The length L_{3b} of closed end region 392b is preferably defined by and equivalent to its radius of curvature R_b ranging from about 0.045 inch to 0.05 inch with the maximum width W_{3b} of the central slot being twice the radius of curvature. Preferably, the radius of curvature R_b is less than that of the central slot.

[0030] Referring to FIG. 3 and FIG. 7, the preferred deflector assembly 300 includes a second pair of preferably symmetric slots 380c laterally disposed about the central slot 380a and more preferably laterally disposed about the first pair of slots 380b. Preferably, each of the second slots 380c are radially spaced at an angle of about 45° with respect to the central slot 380a. Each of the second pair of slots 380c defines a slot length L3 ranging from about 0.575 inch to about 0.6 inch and is more preferably about 0.58 inch with an opening entrance region 390c having a preferably constant width W1c of about 0.1 inch and a region length L1c of about 0.1 inch so as to define a preferred length-to-slot length ratio, L1c:L3 of about 0.2. Accordingly, for the preferred deflector assembly, the entrance region of the central slot 380a defines the greatest length-to-slot ratio of the plurality of the slots 380. For the preferred second lateral slot 380c, the transition region 394c is preferably defined by a constant slot width W2c of greater than 0.1 inch, for example, about 0.15 inch, and more preferably about 0.13 inch; and a length L2c ranging from about 0.20 inch to about 0.25 inch and more preferably 0.22 inch. The closed end region 392b is preferably defined by its radius of curvature Rc being about 0.05 inch and its length L3c of about 0.25 inch. Moreover, the adjacent tines 370 disposed laterally outside of and defining the second pair of symmetrical slots 680c include a side edge 370b that is spaced from and preferably extends parallel to the longest edge 334c of the triangular perimeter to the aperture 332.

[0031] The laterally outer tine 370 of each of the second slots 380c is spaced from the perimeter 334c of the triangular opening 332 to define an opening 480 which extends radially in a direction toward the bore 312. As seen in the view of the deflector assembly in FIG. 3, and the detailed view of FIG. 5, the laterally outer tine 370 of the second slot 380c and the perimeter 334c of the triangular opening preferably define a constant width therebetween along the radial length of the opening 480. Moreover, the perimeter 334c preferably extends radially further from the bore 312 as compared to the tine 370. In the preferred embodiment, the laterally outer tine 370 of the second slot 380c is preferably angled relative to the generally planar face portion in manner as previously described; and the perimeter 334c of the triangular opening is in the same plane as the generally planar portion. Accordingly, the side edge 370b of tine 370 defining the opening 480 preferably has a variable axial distance from the outlet 204 of the frame 200; and the edge of the perimeter 334c preferably defines a constant axial distance from the outlet 204.

[0032] The fire protection device 100 is configured to distribute water such that a rectangular area in a horizontal plane that is located approximately eighteen feet below the sprinkler and distal to the deflector of the fire protection device receives a substantially even distribution of water. That is, the density of the water distributed in gallons per minute per square foot (gpm/ft²) is relatively constant over the entire area. The relative constant distribution of water provides for a fire protection device that can address a fire located in an area to be protected, e.g. the rectangular area beneath and distal the deflector. In a preferred embodiment of the fire protection device, the deflector is configured to distribute the water so that each square foot of area receives between 0.1 and 0.40 gallons per minute. More particularly, the deflector distributes the water in a manner such that the rectangular area is provided with at least two zones of density distribution. Preferably, a first zone of a selected number of feet extending away from the fire protection device is provided with a first range of density, and a second zone ending from the first zone for a greater distance than the first zone is provided with a second range of density. In a preferred application, the first and second zones have the same width of preferably about 16 feet. The length of the first preferred zone is approximately three feet and the second zone is approximately 22 feet. The density range in the first zone is 0.3 to 0.4 gpm/ft² and the density range in the second zone is 0.15 to 0.3 gpm/ft². In a further preferred embodiment, the density in the first zones is thirty percent greater than the density in the second zone. For example, average density in gpm/ft² in the first zone is approximately 0.32 to 0.35 with a deviation of less than 0.02 gpm/ft² and average density in the second zone is 0.15 to 0.21 with a deviation of less than 0.03 gpm/ft². Thus, the rectangular area is provided with a substantially uniform density over the entire area and, in a preferred embodiment, the density is greatest closest to the fire protection device; however, the distribution is uniform over the entire area so that each portion of the area receives approximately the same rate of water. Alternatively or in addition to, the preferred fire protection and deflector assembly provide for a substantially uniform distribution in a rectangular area below and distal of the deflector assembly. In view of the average density provided in the second zone, the preferred device can provide for uniform density in a rectangular area having a width of about 16 feet with a length initiating from about five feet distal of the deflector assembly and extending about 22 feet. The uniform distribution of the device is believed to be advantageous, for example, in protection of a tunnel space and in particular for installation in a deluge system for protection of a tunnel space.

[0033] While the present invention has been disclosed with reference to certain embodiments, numerous modifications, alterations, and changes to the described embodiments are possible without departing from the sphere and scope of the present invention, as defined in the appended claims. Accordingly, it is intended that the present invention not be limited to the described embodiments, but that it has the full scope defined by the language of the following claims, and equivalents thereof.

WHAT IS CLAIMED IS:

1. A fire protection device comprising:
 - a frame including:
 - a body having an inlet and an outlet disposed spaced along a longitudinal axis to define a passageway with a nominal K-factor of 16.8 or greater, the body having a proximal end for coupling the fire protection device to a fluid supply line, the body having a distal end opposite the proximal end;
 - a pair of arms disposed in a first plane generally parallel to the longitudinal axis, the arms being coupled to the distal end of the body; and
 - a deflector assembly coupled to the arms, the deflector assembly including:
 - a generally planar face portion distally spaced from the outlet of the body and substantially orthogonal to the longitudinal axis, the face portion further including two openings disposed on opposing sides of a second plane perpendicular to and intersecting the first plane along the longitudinal axis;
 - a canopy portion supported on a first side of the first plane and spaced from a first perimeter section of the face portion disposed on the first side of the first plane; and
 - a plurality of tines extending along a second perimeter section of the face portion disposed on a second side of the first plane opposite the first side, each of the tines having an outer edge defining an arc length of a common circle having a center aligned along the longitudinal axis.
2. The fire protection device of claim 1, wherein each of the two openings comprise a generally triangular flow aperture defined by a rectangular shaped portion disposed to one side of the first plane and a triangular shaped portion disposed to the other side of the first plane, the

rectangular portion defining a length of elongation, a side of the triangle extending in the direction of the elongation for a distance that is less than the length of elongation.

3. The fire protection device of claim 2, wherein the outer edges are longitudinally disposed between the outlet of the body and the generally planar face portion.

4. The fire protective device of claim 3, wherein each of the plurality of tines includes a planar portion angled with respect to the generally planar face portion to define an included angle angled with respect to the generally planar face portion, the included angle ranging between 15° and 20°.

5. The fire protective device of any one of the above claims, wherein each of the plurality of tines is asymmetrical about a line extending radially from the longitudinal axis and bisecting the tine.

6. The fire protection device of claim 1, wherein the deflector assembly is symmetrical about the second plane, the plurality of tines being radially spaced apart to define a plurality of slots symmetrically disposed about the second plane, the plurality of slots including a central slot bisected by the second plane.

7. The fire protection device of claim 6, wherein the number of tines is x , x being an even number, and the number of slots is $x-1$.

8. The fire protective device of claim 5, wherein $x = 6$.

9. The fire protective device of any one of claims 6-8, wherein each of the slots includes an opening entrance region and a closed end region with a transition region between the opening

entrance and closed end regions, each region defining a slot width region length, the regions further defining a slot length measured from the entrance region at the outer edge to a portion of the closed end region closest to the longitudinal axis, the length of the entrance region defining a region length-to-slot length ratio, the central slot having the greatest region length-to-slot length ratio.

10. The fire protection device of claim 9, wherein the entrance region of the central slot defines a region length-to-slot length ratio of about 0.3 inch and a constant slot width, the transition region of the central slot defining a slot width that tapers narrowly at a constant rate in the direction from the entrance region to the closed end region.

11. The fire protection device of claim 10, wherein the plurality of slots include a first pair of slots laterally disposed about the central slot, wherein the entrance region of each of the first pair of slots define a region length-to-slot length ratio of about 0.2 inch and a constant slot width, the transition region of each of the first pair of slots having a first portion and a second portion, the first portion defining a constant slot width, the second portion defining a slot width that tapers narrowly at a constant rate in the direction toward the closed end region.

12. The fire protection device of claim 11, wherein the plurality of slots include a second pair of slots laterally disposed about the first pair of slots, wherein the entrance region of each of the second pair of slots define a region length-to-slot length ratio of about 0.2 inch and a constant slot width, the transition region of each of the second pair of slots defining a constant slot width greater than the slot width of the entrance region, the closed end region of each of the second pair of slots defining a radius of curvature with a center of curvature located along a bisecting

line of the slot, the length of the closed end region in each of the second pair of slots being greater than radius of curvature.

13. The first protection device of claim 12, wherein the closed end region of each of the central and first pair of slots are defined by a radius of curvature with a center of curvature located along a bisecting line of the slot, the length of each closed end region of each of the central and first pair of slots being equal to the radius of curvature.

14. The fire protection device of claim 1, wherein the outer edges of the plurality of tines define at least two different arc lengths along the common circle; and wherein further the slots each define an opening of equal width between the outer edges of the plurality of tines.

15. The fire protection device of claim 1, wherein the canopy defines a canopy width extending in a direction from one support to the other support, the common circle having a diameter approximately equal to the canopy width.

16. A fire protection device comprising:

a frame including:

a body having an inlet and an outlet disposed spaced along a longitudinal axis to define a passageway with a nominal K-factor of 25, the body having a proximal end for coupling the fire protection device to a fluid supply line, the body having a distal end opposite the proximal end;

a pair of arms disposed in a plane generally parallel to the longitudinal axis, the arms being coupled to the distal end of the body; and

a mount supported by the pair of frame arms distal the outlet and aligned with the longitudinal axis; and

a deflector assembly including:

a generally planar face portion distally spaced from the outlet of the body and secured to the mount; the generally planar face portion being substantially orthogonal to the longitudinal axis, the generally planar face portion having a central portion and side portions disposed laterally about the central portion, each of the side portions defining a generally triangular flow aperture;

a canopy portion disposed on one side of the plane;

a pair of supports spaced about the central portion of the generally planar face to couple the canopy to the generally planar face to define a flow opening between the generally planar face portion, the pair of supports, and the canopy; and

a plurality of tines extending from the generally planar face portion, each of the tines having a planar portion, a pair of side edges, and an outer edge, the outer edge of each of the tines being disposed on a perimeter of a common circle, and each of the outer edges of each of the tines being located between the generally planar face portion and the outlet of the body, each of the tines being spaced apart about the perimeter of the common circle to define a plurality of slots.

17. The fire protection device of claim 16, wherein each of the generally triangular flow apertures define a rectangular shaped portion disposed to one side of the plane and a triangular shaped portion disposed to the other side of the plane, the rectangular portion defining a length of elongation, a side of the triangle extending in the direction of the elongation for a distance that is less than the length of elongation.

18. The fire protection device of any one of claims 16-17, wherein the plane of the frame arms defines a first plane and the deflector is symmetrical about a second plane disposed

perpendicular to and intersecting the first plane along the longitudinal axis, the plurality of slots being symmetrically disposed about the second plane and including a central slot bisected by the second plane.

19. The fire protection device of any one of claims 16-18, wherein the number of tines is x , x being an even number, and the number of slots is $x-1$.

20. The fire protection device of any one of claims 18, wherein the outer edges of the plurality of tines define at least two different arc lengths along the common circle; and wherein further the slots each define an opening of equal width between the outer edges of the plurality of tines.

21. The fire protection device of any one of claims 16-20, wherein the canopy defines a canopy width extending in a direction from one support to the other support, the common circle having a diameter approximately equal to the canopy width.

22. The fire protection device of any one of claims 16-21, wherein the flow opening defines an opening width extending in a direction from one support to the other support, the pair of supports each having a curvilinear portion closest to the opening of the body, the canopy having a linear edge furthest from the opening, the linear distance between the curvilinear portion of the supports and the linear edge of the canopy being approximately equal to the opening width.

23. The fire protection device of claim 18, wherein the generally planar face portion and the outer edges of the tines define therebetween a distance in the direction of the longitudinal axis, the distance being greater than the maximum width defined by any one of the plurality of slots, and being less than two times the minimum width defined by any one of the plurality of slots.

24. A fire protection device comprising:

a frame including:

a body having an inlet and an outlet disposed spaced along a longitudinal axis to define a passageway with a nominal K-factor, the body having a proximal end for coupling the fire protection device to a fluid supply line, the body having a distal end opposite the proximal end;

a pair of arms defining a plane parallel to and intersecting the longitudinal axis, the arms being coupled to the distal end of the body; and

a mount supported by the pair of frame arms distal the outlet and aligned with the longitudinal axis; and

a deflector assembly coupled to the mount, the deflector assembly including:

a generally planar face portion distally spaced from the outlet of the body and substantially orthogonal to the longitudinal axis

a canopy portion supported on a first side of the plane and spaced from a first perimeter section of the face portion disposed on the first side of the plane; and

a plurality of tines extending along a second perimeter section of the face portion disposed on a second side of the plane opposite the first side, each of the tines having an outer edge defining an arc length of a circle having a center aligned along the longitudinal axis.

25. The fire protection device of claim 24, wherein the face portion further includes two openings disposed on either side of the central axis and on opposing sides of a second plane that is perpendicular to and intersecting the plane of the frame arms along the longitudinal axis.

26. The fire protection device of claim 25, wherein each of the two openings comprise a generally triangular flow aperture defined by a rectangular shaped portion disposed to one side of

the plane and a triangular shaped portion disposed to the other side of the plane, the rectangular portion defining a length of elongation, a side of the triangle extending in the direction of the elongation for a distance that is less than the length of elongation.

27. The fire protection device of any one of claims 24-26, wherein the outer edges are disposed between the outlet of the body and the generally planar face portion.

28. The fire protection device of any one of claims 24-27, wherein the plane of the frame arms defines a first plane and the deflector is symmetrical about a second plane disposed perpendicular to the first plane, the plurality of tines being radially spaced to define a plurality of slots therebetween, the plurality of slots being symmetrically disposed about the second plane and including a central slot bisected by the second plane.

29. The fire protection device of claim 28, wherein the number of tines is x , x being an even number, and the number of slots is $x-1$.

30. The fire protection device of any one of claims 28-29, wherein the outer edges of the plurality of tines define at least two different arc lengths along the common circle; and wherein further the slots each define an opening of equal width between the outer edges of the plurality of tines.

31. The fire protection device of any one of claims 24-30, wherein the canopy defines a canopy width extending in a direction from one support to the other support, the common circle having a diameter approximately equal to the canopy width.

32. The fire protection device of any one of claims 24-31, wherein the flow opening defines an opening width extending in a direction from one support to the other support, the pair of

supports each having a curvilinear portion closest to the opening of the body, the canopy having a linear edge furthest from the opening, the linear distance between the curvilinear portion of the supports and the linear edge of the canopy being approximately equal to the opening width.

33. The fire protection device of any one of claims 28-32, wherein each of the plurality of slots includes an opening entrance region and a closed end region with a transition region between the opening entrance and closed end regions, each region defining a slot width region length, the regions further defining a slot length measured from the entrance region at the outer edge to a portion of the closed end region closest to the longitudinal axis, the length of the entrance region defining a region length-to-slot length ratio, the central slot having the greatest region length-to-slot length ratio.

34. A fire protection device comprising:

a frame including:

a body having an inlet and an outlet disposed spaced along a longitudinal axis to define a passageway with a nominal K-factor, the body having a proximal end for coupling the fire protection device to a fluid supply line, the body having a distal end opposite the proximal end;

a pair of arms disposed in a first plane generally parallel to and including the longitudinal axis, the arms being coupled to the distal end of the body; and

a mount supported by the pair of frame arms distal the outlet and aligned with the longitudinal axis; and

a deflector assembly including:

a generally planar face portion distally spaced from the outlet of the body and substantially orthogonal to the first plane, the generally planar face portion further including

two flow apertures disposed on opposing sides of a second plane that intersects the longitudinal axis and is perpendicular to the first plane, each flow aperture having a generally triangular perimeter;

a canopy portion supported on one side of the first plane and spaced from the generally planar face portion; and

a plurality of spaced apart tines extending along a peripheral edge of the generally planar face portion to define a plurality of slots.

35. The fire protection device of claim 34, wherein each of the generally triangular flow apertures define a rectangular shaped portion disposed to one side of the first plane and a triangular shaped portion disposed to the other side of the plane, the rectangular portion defining a length of elongation, a side of the triangle extending in the direction of the elongation for a distance that is less than the length of elongation.

36. The fire protection device of any one of claims 34-35, wherein the deflector is symmetrical about the second plane, the plurality of slots being symmetrically disposed about the second plane and including a central slot bisected by the second plane.

37. The fire protection device of any one of claims 34-36, wherein the number of tines is x , x being an even number, and the number of slots is $x-1$.

38. The fire protection device of any one of claims 34-37, wherein the outer edges of the plurality of tines define at least two different arc lengths along the common circle; and wherein further the slots each define an opening of equal width between the outer edges of the plurality of tines.

39. The fire protection device of any one of claims 34-38, wherein deflector assembly includes a pair of supports supporting the canopy, the canopy defining a canopy width extending in a direction from one support to the other support, the common circle having a diameter approximately equal to the canopy width.
40. The fire protection device of claim 39, wherein the canopy is spaced from the general planar face portion to define a flow opening having a width extending in a direction from one support to the other support, the pair of supports each having a curvilinear portion closest to the opening of the body, the canopy having a linear edge furthest from the opening, the linear distance between the curvilinear portion of the supports and the linear edge of the canopy being approximately equal to the opening width.
41. The fire protection device of any one of claims 34-40, wherein each of the plurality of slots includes an opening entrance region and a closed end region with a transition region between the opening entrance and closed end regions, each region defining a slot width region length, the regions further defining a slot length measured from the entrance region at the outer edge to a portion of the closed end region closest to the longitudinal axis, the length of the entrance region defining a region length-to-slot length ratio, the central slot having the greatest region length-to-slot length ratio.
42. The fire protection device of any one of the above claims, wherein the deflector assembly distributes a density of water ranging between 0.1 gpm/ft² to 0.4 gpm/ft² in each square foot of a rectangular area located approximately eighteen feet below and extending distally of the deflector assembly, the rectangular area having a first zone and a second zone, the first zone having a length of three feet extending distally of the deflector assembly, the second zone having

a length of twenty-two feet extending distally of the first zone, the width of the first and second zones being about sixteen feet, wherein the density range in the first zone is 0.3 to 0.4 gpm/ft² and the density range in the second zone is 0.15 to 0.3 gpm/ft².

43. The fire protection device of any one of the above claims, wherein the deflector assembly distributes a density of water ranging between 0.1 gpm/ft² to 0.4 gpm/ft² in each square foot of a rectangular area located approximately eighteen feet below and disposed distally of the deflector assembly, the rectangular area having a width of about sixteen feet and a length initiating 5 feet distal of the deflector assembly and extending about 22 feet distally, wherein the density range in the rectangular area is 0.15 to 0.3 gpm/ft².

44. The fire protection device of claim 12, further comprising a radially extending opening disposed between one of the second pair of slots and one of the two openings disposed on opposing sides of the second plane, the two openings being generally triangular and the radially extending opening being defined by a laterally outer line of one of the second pair of slots and a perimeter of one of the two openings, the outer line having a variable axial distance from the outlet of the body and the perimeter having a constant axial distance from the outlet.