



(51) International Patent Classification:

A62C 35/68 (2006.01) B05B 1/26 (2006.01)  
A62C 31/02 (2006.01) B05B 15/16 (2018.01)  
A62C 31/28 (2006.01)

(21) International Application Number:

PCT/US2020/037775

(22) International Filing Date:

15 June 2020 (15.06.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/862,502 17 June 2019 (17.06.2019) US

(71) Applicants: **MINIMAX VIKING RESEARCH & DEVELOPMENT GMBH** [DE/US]; Industriestraße 10/12, 23840 Bad Oldesloe (DE). **VIKING GROUP, INC.** [US/US]; 5150 Beltway Dr. SE, Caledonia, MI 49316 (US).

(72) Inventors: **PLEYTE, Gary, William**; 1832 Briar Hill Dr., Hastings, MI 49058 (US). **FRANSON, Scott T.**; 50 Mead

Street, Hastings, MI 49058 (US). **WORKMAN, Martin H.**; 6970 S. Norris Road, Delton, Michigan 49046 (US).

(74) Agent: **BALTAZAR, David, J.** et al.; Perkins Coie LLP, 700 Thirteenth Street, N.W., Suite 600, Washington, DC 20005 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,

(54) Title: FIRE PROTECTION SPRINKLER GUARD

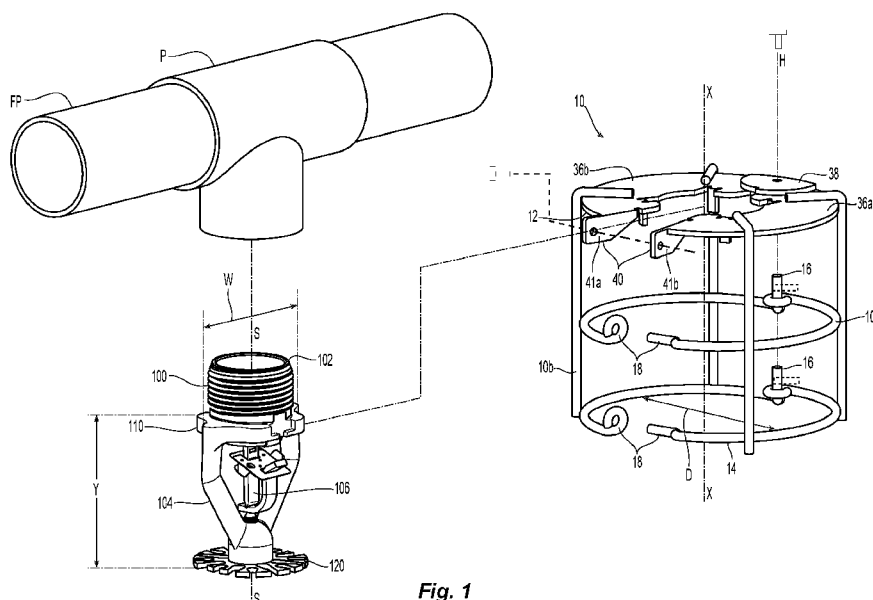


Fig. 1

(57) Abstract: Sprinkler guards to protect fire protection sprinklers in their installed and operative positions. A fire protection sprinkler guard includes a structure with a hinged arrangement to flexibly receive a fire protection sprinkler. A latch connection operates in combination with the hinge of the guard to form a rigid cage structure to shield and protect the sprinkler.



EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,  
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,  
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

**Published:**

— *with international search report (Art. 21(3))*

## Fire Protection Sprinkler Guard

### *Priority Claim & Incorporation By Reference*

[0001] This application claims the benefit of U.S. Provisional Application No. 62/862,502  
5 filed June 17, 2019 which is incorporated by reference in its entirety.

### *Technical Field*

[0002] The present invention relates generally to protection devices for fire protection  
sprinklers. More particularly, the present invention is directed to a sprinkler guard for  
protecting a sprinkler in its installed and operative position.

### 10 *Background Art*

[0003] Generally, automatic fire protection sprinklers include a frame for connection to a  
supply pipe of firefighting fluid and a deflection member coupled to the frame for distribution  
of the fluid to address a fire. The frame includes a formed body having an internal passageway  
with a fluid inlet for receipt of the fluid and a fluid outlet defining a discharge orifice from  
15 which the fluid is discharged. Externally formed about the sprinkler body proximate the outlet  
is a boss or enlarged formation for engagement by an installation tool such as a wrench to  
facilitate sprinkler installation. In an automatic sprinkler, the fluid discharge is automatically  
controlled by operation of a thermally responsive trigger or actuator that maintains a fluid tight  
seal at the discharge orifice by, for example, exertion of pressure on a sealing assembly  
20 disposed within the outlet. When the temperature surrounding the sprinkler is elevated within  
a range of the nominal temperature rating of the trigger, the trigger operates thereby permitting  
ejection and release of the sealing assembly and the discharge of fluid through the discharge  
orifice. The discharged fluid impacts the fluid deflection member and is distributed in a  
designed spray pattern and density in order to effectively address a fire and wet the surrounding  
25 area. Several factors can influence the water distribution patterns of a sprinkler including, for  
example, the installation orientation and the geometry of the fluid deflection member, the

distance between the deflection member and the discharge orifice, and/or the shape of the sprinkler frame to which the deflection member is coupled. Accordingly, the fluid control, distribution and performance of an automatic sprinkler is dependent upon the integrity of the sprinkler assembly and its individual components.

5 [0004] Automatic sprinklers are installed in a variety of environments which can expose the sprinkler to accidental impact. For example, storage type automatic sprinklers can be installed in a storage warehouse beneath the warehouse ceiling and above the storage area and commodities to be protected. In the storage environment, stored commodities are stacked and moved by operating personnel or material handling equipment such as forklifts. The movement  
10 of material or mechanical equipment proximate to an installed automatic sprinkler exposes the sprinkler to possible accidental impact and damage. If the trigger of the sprinkler is damaged, water may discharge from the sprinkler; or if the deflector or frame is damaged, the sprinkler may not distribute fluid in the proper pattern.

[0005] It is well known to use a sprinkler guard to protect an installed sprinkler. Generally,  
15 the sprinkler guard includes a caged enclosure with one open-ended base. The guard is installed by sliding the guard over the sprinkler through the base so that the sprinkler is coaxially centered within the cage. The guard is affixed to the sprinkler by securing the open-ended base about the sprinkler body against the enlarged boss of the sprinkler body. Sprinkler guards are configured for protecting sprinklers installed in an upright orientation, in which fluid is  
20 discharged from the sprinkler body toward the ceiling and then redirected downward by the fluid deflection member toward the protection area or a pendent orientation. Sprinkler guards are also configured for protecting sprinklers installed in a pendent orientation, in which fluid is discharged downward to impact the fluid deflection member for distribution below the sprinkler over the protection area. In the case of suppression type sprinklers such as, for  
25 example, Early Suppression Fast Response (ESFR) fire protection sprinklers, a portion of the

spray pattern is directed or thrust axially downward below the sprinkler toward the area being protected. Illustrative examples of these known sprinkler guards are shown and described in U.S. Patent Nos. 3,797,746; 5,632,339; and 5,893,418. Examples of commercially available sprinkler guards are shown and described in technical data publication *TFP784: Model EG-25*  
5 *Sprinkler Guard For Model ESFR-25 Pendent Sprinkler* (December 2017) from Tyco Fire Products, LP and technical data publication Form F\_012798: Sprinkler Guards (Oct. 11, 2018, Rev. 16.1) from Viking Corp.

[0006] Although these caged enclosures can protect a sprinkler, a design concern remains in ensuring that the cage structure itself does not interfere with or inhibit the fluid distribution  
10 performance of the sprinkler. This can be of particular concern where the cage structure or portion thereof is in the spray path directly below or proximate the sprinkler fluid deflection member. Accordingly, there remains a need for sprinkler guard structures that provide sufficient protection to a sprinkler while minimizing or eliminating interference with the spray pattern of the sprinkler. In addition, some of these known sprinkler guards present an  
15 installation complexity. More specifically, due to the single open end of the guard through which the sprinkler is inserted, there is limited flexibility when installing the guard about the sprinkler. This can be difficult when working around the surrounding pipe. In addition, some of these known guards use a sliding clip or ring to secure the guard about the sprinkler and require a specific installation tool which can add to the complexity in affixing the sprinkler  
20 guard to the sprinkler. Other known sprinkler guards, as seen for example in U.S. Patent No. 1,469,336 use a hinged base at the open end of a wire sprinkler guard to secure the guard to the sprinkler body. Although the hinged base can swing open and closed about the sprinkler body, locating the sprinkler centrally within the guard still requires insertion of the sprinkler through the open end of the wire guard. Accordingly, there remains a need for a sprinkler guard that  
25 provides for a simplified and flexible manner of installation.

***Disclosure of Invention***

[0007] Preferred devices and methods to protect fire protection sprinklers are provided. Preferred embodiments of a fire protection sprinkler guard include a cylindrical structure with two guard portions in a hinged arrangement. The preferred hinge configuration of the sprinkler guard operates to flexibly receive a fire protection sprinkler. The hinged sprinkler guard defines an open state for receipt of the fire protection sprinkler and a closed state for surrounding and guarding the fire protection sprinkler. One preferred embodiment of the sprinkler guard includes a first guard portion having a first end and a second end axially spaced from one another with a first end plate disposed at the first end and a first grid of wire members affixed to the first end plate. A preferred second guard portion of the preferred sprinkler guard has a first end and a second end axially spaced from one another with a second end plate disposed at the first end of the second guard portion and a second grid of wire members affixed to the second end plate. The preferred sprinkler guard includes a hinged connection between the first guard portion and the second guard portion to pivot the first and second guard portions with respect to one another and define an open state of the sprinkler guard for receipt of the fire protection sprinkler and a closed state of the sprinkler guard to form a cage structure with a central guard axis for surrounding and guarding the fire protection sprinkler.

[0008] Preferred embodiments of the sprinkler guard include a latched configuration that operates in combination with the hinge of the guard to form a rigid cage structure to shield and protect the sprinkler from lateral impact. Additionally, preferred embodiments of the guard are configured for pendent-type fire protection sprinklers. The preferred sprinkler guard includes an open end that circumscribes the sprinkler proximate its fluid deflection member leaving the path below the sprinkler unimpeded so as to minimize or eliminate interference with the fluid distribution spray pattern of the protected sprinkler.

[0009] A preferred embodiment of a sprinkler guard having a central guard axis includes a first guard portion having a first end, a second end axially spaced from one another and a first end plate disposed at the first end. A second guard portion has a first end, a second end axially spaced from one another and a second end plate disposed at the first end. A preferred plurality of hinged connections between the first and second guard portions are axially aligned with one another, radially spaced from and extending parallel to the central guard axis. The plurality of hinged connections defines an open state of the sprinkler guard for receipt of a fire protection sprinkler and a closed state of the sprinkler guard for surrounding and guarding the fire protection sprinkler. In a closed state of the sprinkler guard, the first ends of the first and second guard portions circumscribe the central guard axis to define a first end of the sprinkler guard with the first and second end plates disposed for cooperatively engaging a body of the fire protection sprinkler. The second ends of the first and second guard portions circumscribe the central guard axis in the closed state of the guard to define a second end of the guard axially spaced from the first end of the guard portions.

[0010] Another preferred embodiment of a sprinkler guard includes a first guard portion having a first end, a second end axially spaced from one another and a plurality of eyelets axially aligned with one another between the first and second ends of the first guard portion. The preferred guard also includes a second guard portion having a first end, a second end axially spaced from one another and a plurality of pins axially aligned with one another between the first and second ends of the second guard portion. In the preferred guard a plurality of hinged connections between the first and second guard portions are defined by each of the plurality of eyelets being engaged by one of the plurality of pins. The plurality of hinged connections are preferably axially aligned with one another, radially spaced from and extending parallel to the central guard axis, the plurality of hinged connections defining an open state of the sprinkler guard for receipt of a fire protection sprinkler and a closed state of the sprinkler

guard for surrounding and guarding the fire protection sprinkler. In the closed state of the sprinkler guard, the first ends of the first and second guard portions circumscribe the central guard axis to define a first end of the sprinkler guard, and the second ends of the first and second guard portions circumscribing the central guard axis to define a second end of the guard axially spaced from the first end of the guard. Other preferred embodiments of the sprinkler guard include a plurality of latch connections in which another plurality of eyelets is engaged by a plurality of latch pins. The latch connections preferably form a frictional engagement such that the closed state of the sprinkler guard forms a rigid structure.

**[0011]** Preferred methods of protecting a fire protection sprinkler include obtaining or providing a sprinkler guard having a first guard portion and a second guard portion with each guard portion having a first end with an end plate and grid of wire members affixed to the end plate. The preferred methods include pivoting the first and second guard portions with respect to one another between an open state of the sprinkler guard for receipt of the fire protection sprinkler and a closed state of the sprinkler guard for forming a cage structure with a central guard axis for surrounding and guarding the fire protection sprinkler. A preferred method of protecting a fire protection sprinkler includes obtaining a sprinkler guard that includes a first end, a second end and a plurality of hinge connections axially aligned with one another between the first and second ends that operate to define an open state of the sprinkler guard and a closed state of the sprinkler guard. The preferred method also includes providing the sprinkler guard to protect an installed fire protection sprinkler.

**[0012]** Preferred embodiments of the sprinkler guard provide for a simplified and flexible structure for installation about a fire protection sprinkler. Preferred embodiments of the sprinkler guard include a first end and a second end axially spaced from one another along a central guard axis. The preferred guard defines an internal space between the first and second end for housing the fire protection sprinkler; and a hinged connection between the first and

second ends for operation along a pivot axis radially spaced and parallel to the central guard axis such that each of the first and second ends of the guard hinge open about the pivot axis to receive the fire protection sprinkler.

### ***Brief Description of Drawings***

5 [0013] 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. It should be understood that the preferred embodiments are some examples of the invention as provided by the appended claims.

10 [0014] FIG. 1 is a schematic exploded perspective view of a preferred embodiment of a sprinkler guard to protect an installed fire protection sprinkler.

[0015] FIG. 2 is an exploded view of the sprinkler guard of FIG. 1.

[0016] FIG. 3A is one guard portion for use in the sprinkler guard of FIG. 1.

[0017] FIG. 3B is another guard portion for use with the guard portion of FIG. 3A and the  
15 sprinkler guard of FIG. 1.

### ***Mode(s) For Carrying Out the Invention***

[0018] Shown in FIG. 1 is a preferred embodiment of a sprinkler guard 10 for the protection of a fire protection sprinkler, such as for example, sprinkler 100. The sprinkler guard 10 has a first end 12 and a second end 14 axially spaced from the first end 12 along a central  
20 guard axis X--X. Preferred embodiments of the guard 10 define an internal space between the first and second ends 12, 14 for housing the fire protection sprinkler; and a hinged arrangement between the first and second ends 12, 14 such that each of the first and second ends 12, 14 of the guard hinge open to receive the fire protection sprinkler into the internal space and hinge close to enclose the sprinkler. The guard 10 is preferably a cylindrical structure and more

preferably a substantially circular cylindrical structure with two or more guard portions 10a, 10b in a hinged arrangement. More preferably, the guard 10 includes two guard portions 10a, 10b in the hinged arrangement that pivot with respect to one another about a pivot axis H--H that extends parallel to the central guard axis X--X. As shown, the preferred guard 10 is hinged axially from the first end 12 to the second end 14 with a hinged connection 16, and more preferably a group of hinge connections 16, operating about the hinge axis H--H to pivot the two guard portions with respect to one another. The preferred hinge configuration operates to flexibly receive the sprinkler 100 which may be installed in an operative condition affixed to a fluid supply pipe FP, as schematically shown, that is filled with a firefighting fluid under fluid pressure. The hinged connections 16 individually and collectively define an open state of the guard 10 for receipt of the fire protection sprinkler 100 and a closed state for surrounding and guarding the fire protection sprinkler 100. In addition, the preferred sprinkler guard 10 includes a latched configuration in which a latch 18, more preferably a group of latches 18, operate in combination with the preferred hinge connections 16 to surround and enclose the sprinkler 100 within the guard 10 and form a preferably rigid cage structure to shield and protect the sprinkler 100 from lateral impact. The guard 10 can define an alternate geometry such as, for example conical, provided the conical guard can provide for the hinged operation to define the closed and open states of the sprinkler.

**[0019]** In the closed configuration of the sprinkler guard 10 about the sprinkler 100, the first end 12 of the sprinkler guard 10 is preferably configured to engage the sprinkler frame 110 in a manner that centers the sprinkler 100 within the guard 10 and substantially coaxially aligns the sprinkler axis S--S with the guard axis X--X. The second end 14 of the guard 10 is preferably open ended with the second end 14 preferably configured to circumscribe the fluid deflection member 120 of the sprinkler 100 thereby minimizing or eliminating interference with the spray coming off the deflection member 120 upon actuation of the sprinkler 100.

[0020] Generally, the hinge connection 16 between the guard portions 10a, 10b are provided by respective interlocking elements of the guard portions 10a, 10b. Shown in FIG. 2 is an exploded view of the preferred sprinkler guard 10 and its two portions 10a, 10b. The first guard portion 10a has a first end 12a and a second end 14a axially spaced from the first end 12a. A group of closed loop formations or eyelets 20 are preferably axially aligned with one another between the first and second ends 12a, 14a of the first guard portion 10a. The second guard portion 10b has a first end 12b and a second end 14b axially spaced from one another. The second guard portion 10b preferably includes a group of peg formations or pins 22 that are axially aligned with one another between the first and second ends 12b, 14b of the second guard portion 10b. In the preferred embodiment of the sprinkler guard assembly 10 shown, each of the eyelets 20 is engaged by one of the plurality of pins 22 to form the preferred hinged connections 16 of the guard 10. The hinged connections 16 are radially spaced from and extend parallel to the central guard axis X--X.

[0021] A preferred embodiment of the pin 22 is preferably elongated and oriented to extend along the hinge axis H--H parallel to the guard central axis X--X. In a preferred aspect, each of the pins 22 includes a base 22a that is affixed and more preferably integrally formed with the rest of the second guard portion 10b. Each pin 22 preferably includes a free end 22b opposite the base 22a to engage a corresponding eyelet 20 of the first guard portion 10a. In addition, the pins 22 are preferably oriented with the free end 22b above the base 22a. The eyelets 20 of the first guard portion 10a are preferably formed and oriented such that the geometric opening and center of the eyelets 20 are aligned to circumscribe the hinge axis H--H for coaxial receipt of the elongate pins. The interlocking elements 20, 22 can define alternative configurations provided the interlocking elements can provide a hinge connection as described herein. The pin 22 can include one or more bends, for example as shown in phantom in the hinge connection 16 of FIG. 1, with the free end 22b bent perpendicular to the

remainder of the pin 22. Further in the alternative, instead of the linear pin received in an eyelet, the interlocking elements can include two non-linear elements engaged with one another to form hinged rotation about a hinge axis H--H.

[0022] Dimensionally, the preferred pins 22 are preferably narrower than the openings  
5 defined by the respective eyelets 20. Moreover, the pins 22 define a preferred axial length between the base 22a and free end 22b that is greater than the axial height or thickness of the eyelets 20. The dimensional differences between the preferred pins 22 and the eyelets 20 and their respective orientations provide for flexibility in assembly and operation of the guard 10. Each of the first and second guard portions 10a, 10b are formed and fabricated from wire and  
10 more preferably from cold drawn steel wire. A preferred gauge (A.S.W) of the wire ranges from 7-10 of which the wire diameter can range from 0.125 inch to 0.177 inch. Accordingly, the pins 22 have a preferred diameter that ranges from 0.125 inch to 0.177 inch and the pins 22 are preferably formed to axial length of about 1/2 inch, preferably ranging from 0.45 inch to 0.5 inch. The wire is preferably looped to form the eyelets 20 with an eyelet width or internal  
15 diameter that preferably ranges from 0.15 inch to 0.18 inch with the axial thickness equivalent to that of the wire ranging from 0.125 inch to 0.177 inch. In preferred embodiments of the guard 10, the ratio of external diameter-to-internal diameter ranging from 1.03:1 to 1.5:1. In another preferred aspect, the ratio of pin length-to-eyelet axial thickness ranges from 4:1 to 3:1.

[0023] In assembling the preferred sprinkler guard 10, the eyelets 20 slide over the pins  
20 22 in a downward direction under the force of gravity and are vertically restrained by the base 22a. With the pins 22 of the second guard portion 10b being of a diameter that is less than that of the receiving eyelets 20 of the first guard portion 10a, the two guard portions 10a, 10b can freely rotate with respect to one another about the hinge axis H--H with minimal to no binding. This flexibility in the hinge operation can facilitate installation of the guard 10 about an  
25 installed sprinkler as described herein.

[0024] The preferred wire construction of each of the first and second guard portions 10a, 10b form one half of the cage sprinkler guard 10. In preferred embodiments, each of the first and second guard portions 10a, 10b include a grid of wire members including at least two vertical members 24a, 24b extending parallel to the guard axis X--X and a group of arcuate members 26a, 26b interconnecting the at least two vertical members 24a, 24b. The wire members 24, 26 are preferably affixed to one another by appropriate means including, for example, spot welding. The arcuate members 26 are preferably disposed perpendicular to the adjoining vertical members so that each arcuate member 26 partially circumscribes the sprinkler guard axis X--X and more preferably spans 180 degrees about the guard axis. In each of the first and second guard portions 10a, 10b, the arcuate members 26a, 26b preferably define a common radius of curvature so that in the closed state of the guard 10, the arcuate members 26a, 26b define the preferred cylindrical bounds of the guard 10. In the preferred formation of the hinge connections 16, one or more of the arcuate members 26a of the first guard portion 10a have one end configured with the preferred eyelet 20. In one or more of the arcuate members 26b of the second guard portion 10b, one end is configured with the preferred pin 22 for engagement with an eyelet 20 of the first guard portion 10a to form the preferred hinged connections 16.

[0025] With the hinge connections 16 formed, the sprinkler guard 10 can operate between its open and closed states. In a preferred aspect of the guard 10, the first and second guard portions 10a, 10b form a preferred frictional engagement that renders the first guard portion 10a rigidly affixed with respect to the second portion 10b in the closed state of the guard 10. With reference to FIG. 1, preferred embodiments of the sprinkler guard 10 include a latch and more preferably a group of latch connections 18 diametrically opposed to the hinge connections 16 to join the first and second guard portion 10a, 10b and provide a rigidity to the guard structure. The plurality of latch connections 18 of the guard 10 are preferably axially aligned

with one another parallel to the guard axis X--X diametrically opposite the hinged connections 16. Preferably, the latch connections 18 are formed by an engagement between a second set of pin members 30 and eyelets 32. Referring again to FIG. 2, two or more of the arcuate members 26a of the first guard portion 10a are configured with a preferred latch pin 30 at the end opposite the eyelet 20. In two or more of the arcuate members 26b of the second guard portion 10b, the end opposite the pin 22 is configured with an eyelet 32 for engagement with one of the latch pins 30 of the first guard portion 10a to form the latch connections 18. Alternatively, the parts can be reversed with the eyelets 32 formed on the arcuate members of the first guard portion 10a and the latch pins formed on the second guard portion 10b. Moreover, the latch connections 18 can be formed by differently configured interlocking members provided the resulting latch connection joins the two guard portions 10a, 10b together so as to securely maintain the sprinkler guard 10 in the closed state.

**[0026]** With reference to FIG. 3B, in the first guard portion 10a, each latch pin 30 is preferably elongated and oriented to be skewed and more preferably orthogonal with respect to the hinge axis H--H and the central guard axis X--X. In a preferred aspect, each of the latch pins 30 includes a base 30a that is affixed and more preferably integrally formed with the rest of the preferred arcuate member 26a. Each latch pin 30 includes a free end 30b opposite the base 30a to engage a corresponding eyelet 32 of the second guard portion 10a. In addition, the latch pins 30 are preferably radially located at a radial distance RR from the hinge axis H--H so that the latch pins 30 form a frictional engagement with the eyelets 32. The eyelets 32 of the second guard portion 10b, shown in FIG. 3A, are preferably formed and oriented such that the geometric opening of the eyelet 32 is sufficiently exposed to the free end 30b of the latch pin 30 to receive the latch pins 30 and form the preferred frictional engagement. Dimensionally, the latch pins 30 are preferably narrower than the openings defined by the respective eyelets 32 to form the latch connections 18. Upon receipt within the eyelet 32, the latch pin is

preferably axially offset so as to contact the inner surface of the eyelet and form the preferred frictional engagement. Alternatively or additionally, the latch pin 30 can contact or rest against the bottom or lowest point along the inner surface of the eyelet. In one preferred embodiment, the radial distance RRR of the latch eyelet 32 from the hinge axis H--H, shown in FIG. 3A, is greater than the radial distance RR between the latch pin 30 and the hinge axis H--H, shown in FIG. 3B. By forming a frictional engagement, the first and second guard portions 10a, 10b become rigidly engaged with respect to one another in the closed configuration of the sprinkler guard 10. The preferred latch connections 18 can be used with alternate hinge configurations 16. For example, the preferred latch connections 18 can be used with a single hinge connection 16 located diametrically opposed to the latch connections 18 to provide a rigid closed configuration of the sprinkler guard 10.

**[0027]** With reference to FIG. 1, the first and second guard portions 10a, 10b respectively include a first end plate 36a and a second end plate 36b at their respective first ends 12 for cooperatively engaging the sprinkler frame 110 in the closed state of the sprinkler guard 10. Generally, the end plates 36a, 36b together circumscribe the central guard axis X--X to form a centralized opening through which the sprinkler body protrudes for connection to a fluid supply pipe. The end plates 36a, 36b are preferably affixed to respective vertical members 24 of the first and second guard portions so that the substantially planar end plates are disposed generally perpendicular to the central axis X--X.

**[0028]** The end plates 36a, 36b cooperate with one another to form one or more of a hinged connection 38 or a latch connection 40. In a preferred embodiment, the end plates include a hinged connection 38 axially aligned with the hinge axis H--H and a latch connection 40 that is aligned with the latch connections 18 joining the first guard portion 10a to the second guard portion 10b. Each of the connections 38, 40 can be formed by joining axially aligned through holes formed in the end plates 36a, 36b with an appropriate mechanical fastener such as, for

example, a rivet, a threaded fastener or a bolt and nut assembly. The inclusion of a hinge connection 38 and a latch connection 40 adds stability to the overall guard assembly 10. In particular, the hinge connection 38 adds another hinge connection at the first end 12 of the sprinkler guard 10 to stabilize the assembly during opening and closing operation of the guard.

5 Moreover, in forming the preferred hinge connection 38, a portion of the first end plate 36a and a portion of the second end plate 36b overlap one another to form a preferred sliding engagement between the end plates 36a, 36b. In the preferred embodiments shown in FIGS. 1 and 2, the first end plate 36a includes a semi-circular shelf 39a that overlaps a correspondingly formed quarter circle formation 39b to engage the shelf 39a in a rotational surface engagement  
10 about the hinge axis H--H. In a preferred aspect, the amount of overlap between the end plates 36a, 36b is preferably about 15%--20% of the surface area of any one of the end plates 36a, 36b.

[0029] The latch connection 40 reinforces and adds rigidity to the closed state of the sprinkler guard 10. In the preferred embodiment of the guard 10 shown in FIGS. 1 and 2, each  
15 of the end plates 36a, 36b include an angled formation 41a, 41b that mate and cooperate with one another to form the latch connection 40. Each of the mating surfaces of the angled formations 41a, 41b are defined by a length L extending radially to the guard axis X--X and a depth *dd* extending parallel to the guard axis X--X. The length L of the mating surface can be constant over the depth *dd* of the mating surface or alternately vary over the depth *dd* of the  
20 mating surface. When the mating surfaces of the angled formations 41a, 41b join one another, the preferably cylindrical guard 10 defines a preferably substantially consistent internal diameter D over the height of the guard 10. In a preferred aspect, the length L of the mating surfaces define a preferred ratio with respect to the internal diameter D in which the ratio of the internal diameter D-to-length L of the mating surface (D:L) preferably ranges 5:1 to 6:1.

[0030] Each of the end plates 36a, 36b include surfaces between the hinge connection 38 and the latch connection 40 that define the central opening in the closed state of the sprinkler guard 10 through which the sprinkler protrudes for connection to a fluid supply pipe. In the closed state of the guard 10, the end plate surfaces contact the sprinkler frame to securely support and coaxially center the sprinkler within the guard and prevent its rotation therein. The supporting surfaces of the end plates 36a, 36b can include a combination of linear edges, arcuate edges and planar surfaces that contact complimentary surfaces of the sprinkler frame to form a supporting surface engagement. In the closed state of the sprinkler guard 10, each of the end plates 36a, 36b preferably have central arcuate edges that contact curved surfaces of the sprinkler body. Moreover, each of the end plates 36a, 36b each preferably include planar tabs disposed about the arcuate edge that extend parallel to the guard axis X--X to contact flat surfaces of the sprinkler frame, for example, located at the wrench flat.

[0031] The second end 14 of the sprinkler guard 10 is preferably open ended with no guard structure crossing or traversing the circumscribed area of the second end 14. In preferred embodiments of the sprinkler 100, the second end 14 of the guard 10 consists of two cooperating arcuate members 26a, 26b having one hinged connection 16 and a latch connection 18 joining the arcuate members 26a, 26b to one another in the closed state of the guard 10. By providing an open end at the second end 14 of the guard 10, the guard structure avoids or minimizes disruption to the spray pattern from the protected sprinkler.

[0032] The sprinkler guard 10 is preferably configured for protection of a pendent-type sprinkler and preferably an installed suppression pendent-type sprinkler. With reference to FIG. 1, the pendent sprinkler 100 and its frame 110 includes a body 102 with a fluid inlet and discharge outlet. Fluid discharged from the body 102 impacts the fluid deflection member 120 to address a fire and/or wet the surrounding area. The sprinkler body 102 is configured for coupling to the supply pipe FP of firefighting fluid such as, for example, water in which the

supply pipe is suspended below a ceiling of an area to be protected by the sprinkler 100. The body 102 can include an external thread for connection to a pipe fitting P such as, for example, a tee-fitting or pipe nipple. The body 102 can alternatively be externally configured for connection to a pipe coupling, for example, a grooved coupling. The frame 110 shown includes a pair of frame arms 104 that extends from the body 102 to support the fluid deflection member 120 at a coaxial distance from the sprinkler body 102. The sprinkler 100 can be configured as an automatic sprinkler with a thermally responsive trigger 106 disposed between the frame arms 104 and axially aligned along the sprinkler axis S--S. The trigger can be configured as a thermally responsive soldered mechanical assembly 106 or a frangible thermally responsive glass bulb. Upon thermal actuation of the trigger, a seal is ejected from the sprinkler outlet and firefighting fluid is discharged from the body 102 to impact the fluid deflection member 120 for distribution. The fluid deflection member 120 includes an arrangement of slots about the sprinkler axis S--S to define an angular arrangement of tines about the sprinkler axis S--S. Firefighting fluid delivered to the sprinkler body 102 at an operating pressure of the sprinkler 100 is distributed by the fluid deflection member to provide a sprinkler performance such as, for example, fire suppression or control. In the case of suppression fluid distribution, the firefighting fluid is thrust coaxially downward below the sprinkler from the fluid deflection member 120.

**[0033]** To protect an installed pendent sprinkler 100, the guard 10 is placed in an open state by operation of the hinge connections 16 and wrapped about the sprinkler 100. The guard 10 is preferably oriented, as schematically shown in FIG. 1, about the sprinkler 100 so that the hinge connection 16 and latch connections 18 are aligned in a common plane with the frame arms 104. To enclose the sprinkler 100, the hinge connections 16 are operated to bring the first and second guard portions 10a, 10b together about the sprinkler 100. The end plates 36a, 36b are preferably located between the sprinkler body 102 and frame arms 104 to coaxially align

the central guard axis X--X with the sprinkler axis S--S leaving the sprinkler body 102 protruding outside the guard 10. The first and second guard portions 10a, 10b are drawn together to engage the preferred latch pins 30 with the eyelets 32 to form the latch connections 18 and provide a rigid guard assembly 10 about the sprinkler 100.

5 [0034] With the sprinkler 100 enclosed, the preferably cage structure of the guard 10 protects the sprinkler frame 110, the thermally responsive trigger and the fluid deflection member 120 while sufficiently exposing the trigger to the ambient environment to appropriately thermally respond to a fire and/or rise in temperature. The preferably cylindrical guard 10 had an internal diameter D that defines a preferred ratio with respect to the maximum  
10 width W of the sprinkler 100 in which the ratio of guard diameter D-to-maximum sprinkler width W (D:W) ranges from 1.4:1 to 1.5:1. The internal space of the guard 10 between the first end 12 and the second end 14 provides sufficient space for housing the operational components of the sprinkler such as, for example, as its thermal trigger to operate and clear the fluid discharge path from the body to the fluid deflection member. In a preferred embodiment,  
15 the internal diameter of the closed configuration of the sprinkler guard 10 preferably ranges from 2-7/8 inch to 3 inches. The maximum sprinkler width W can be defined by the outer surfaces of the frame arms 104, as illustrated in FIG. 1, or alternatively, the maximum sprinkler diameter W can be defined by the fluid deflection member 120.

[0035] In addition, the preferably open second end 14 of the guard 10 defines a preferably  
20 unobstructed area axially below the fluid deflection member 120 of the pendent sprinkler 100. With no guard structure in the fluid deflection path of the sprinkler 100, the spray pattern of the sprinkler 100 is unimpeded. Accordingly, for a suppression type pendent sprinkler, in which a component of the fluid spray is thrust axially downward, the preferred open end 14 of the sprinkler guard 10 is desirable. Moreover, to maximize the efficiency of fluid distribution  
25 of the protected sprinkler, the guard 10 can be configured so as to locate the fluid deflection

member 120 with respect to the wire members forming the guard 10. In a preferred aspect of the guard 10, the engagement with the sprinkler 100 preferably axially locates the fluid deflection member between the axially spaced arcuate members 26. With reference to FIG. 3, either one or both of the height YY1 of the guard 10, as defined by the vertical members 24, and the axial spacing YY2 between the arcuate members 26, is preferably configured so as to locate the fluid deflection member 120 between the axially spaced arcuate members 26. In one preferred embodiment, the height of the guard YY1 is preferably greater than the axial distance Y in the sprinkler 100 defined between the end of the external threads of the body 102 and the fluid deflection member 120 as seen in FIG. 1 so as to locate the fluid deflection member 120 between the axially spaced arcuate members 26.

**[0036]** Embodiments of the sprinkler guard 10 provide preferred methods of protecting a fire protection sprinkler. For example, a preferred method includes obtaining a sprinkler guard 10, as described herein, in which the guard 10 has a first end, a second end and a plurality of hinge connections axially aligned with one another between the first and second ends that operate to define an open state of the sprinkler guard and a closed state of the sprinkler guard. The preferred method further includes providing the sprinkler guard to protect an installed fire protection sprinkler. Obtaining the preferred sprinkler guard 10 can include manufacturing, fabricating or purchasing the guard 10 and preferably providing the guard 10 can include supplying and/or selling the guard 10.

**[0037]** 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 sprinkler guard having a central guard axis, the sprinkler guard comprising:
  - a first guard portion having a first end, a second end axially spaced from one  
5 another and a first end plate disposed at the first end;
  - a second guard portion having a first end, a second end axially spaced from  
one another and a second end plate disposed at the first end; and
  - a plurality of hinged connections between the first and second guard portions,  
the plurality of hinged connections being axially aligned with one another, radially spaced  
10 from and extending parallel to the central guard axis, the plurality of hinged connections  
defining an open state of the sprinkler guard for receipt of a fire protection sprinkler and a  
closed state of the sprinkler guard for surrounding and guarding the fire protection sprinkler,  
in the closed state of the sprinkler guard, the first ends of the first and second guard portions  
circumscribe the central guard axis to define a first end of the sprinkler guard with the first  
15 and second end plates disposed for cooperatively engaging a body of the fire protection  
sprinkler, and the second ends of the first and second guard portions circumscribing the  
central guard axis to define a second end of the sprinkler guard axially spaced from the first  
end of the guard portions.
2. The sprinkler guard of claim 1, wherein each of the first and second guard portions  
20 include a grid of wire members including a plurality of vertical members extending parallel to  
the central guard axis and a plurality of arcuate members interconnecting the at least two  
vertical members, at least two of the arcuate members of the first guard portion engaged with  
and at least two of the arcuate members of the second guard portion to form the plurality of  
hinged connections.

3. The sprinkler guard of claim 1, wherein the first guard portion includes a plurality of eyelets axially aligned with one another between the first and second ends of the first guard portion, the second guard portion includes a plurality of pins axially aligned with one another between the first and second ends of the second guard portion, the plurality of hinged  
5 connections being defined by each of the plurality of eyelets being engaged by one of the plurality of pins.

4. The sprinkler guard of claim 3, wherein each of the first and second guard portions include a grid of wire members including at least two vertical members extending parallel to the central guard axis and a plurality of arcuate members interconnecting the at least two  
10 vertical members, at least two of the arcuate members of the first guard portion each having one end including one of the plurality of eyelets, at least two of the arcuate members of the second guard portion each having one end including one of the plurality of pins for engagement with one of the plurality of eyelets to form one of the plurality of hinged connections.

15 5. The sprinkler guard of any one of claims 3-4, wherein each one of the eyelets of the first guard portion are oriented to circumscribe a hinge axis extending parallel to the guard axis, each pin of the second guard portion having a portion extending along the hinge axis upon engagement with one of the eyelets.

6. The sprinkler guard of any one of claims 3-4, wherein each eyelet defines an internal  
20 diameter and the pin defines an external diameter, the ratio of external diameter-to-internal diameter ranging from 1.03:1 to 1.5:1.

7. The sprinkler guard of claim 6, wherein each eyelet defines an internal diameter and each pin defines an axial thickness, the ratio of pin length-to-eyelet diameter ranging from 4:1 to 3:1.
8. The sprinkler guard of any one of the above claims, wherein the closed state of the guard, the first and second guard portions form a frictional engagement to render the first guard portion rigidly affixed with respect to the second guard portion.
9. The sprinkler guard of any one of the above claims, further comprising a latch connection being located diametrically opposite the plurality of hinged connections between the first and second ends of the first and second guard portions.
10. The sprinkler guard of claim 9, wherein the latch connection includes a latch pin of the first guard portion and an eyelet of the second guard portion.
11. The sprinkler guard of claim 10, wherein the latch pin of the first guard portion defines a first radial distance to the plurality of hinge connections, the eyelet of the second guard portion defining a second radial distance to the plurality of hinge connections, the second distance being greater than the first distance so that the latch pin and eyelet are axially offset.
12. The sprinkler guard of any one of claims 9-11, wherein the first and second end plates include a latch connection therebetween that is aligned with the latch connection located between the first and second ends of the guard.
13. The sprinkler guard of any one of the above claims, wherein the first and second end plates include a hinged connection therebetween that is axially aligned with the plurality of hinge connections between the first and second guard portions.

14. The sprinkler guard of claim 13, wherein the first end plate includes a first portion and the second end plate includes a second portion overlapped by the first portion to define the hinge connection, the amount of overlap being 15-20% of the surface area defined by either one of the first end plate and the second end plate.
- 5 15. The sprinkler guard of claim 14, wherein the first portion of the first end plate defines a semi-circular shelf and the second portion of the second end plate defines a quarter circular portion for surface and rotational engagement with the semi-circular shelf.
16. The sprinkler guard of any one of the claims, wherein the closed state of the guard about a sprinkler, the second end of the sprinkler guard defines an open end that is greater  
10 than a maximum width of the sprinkler received in the sprinkler guard.
17. The sprinkler guard of any one of the above claims, wherein the closed state of the guard, the guard has a constant internal diameter.
18. The sprinkler guard of any one of the above claims, wherein the closed state of the guard, the guard has a cylindrical cage structure.
- 15 19. A sprinkler guard having a central guard axis, the sprinkler guard comprising:  
a first guard portion having a first end, a second end axially spaced from one another and a first end plate disposed at the first end; and  
a second guard portion having a first end, a second end axially spaced from one another and a second end plate disposed at the first end; and  
20 a hinged connection between the first and second guard portions to define an open state for receipt of a fire protection sprinkler and a closed state for surrounding and guarding the fire protection sprinkler,

wherein the closed state, the first and second guard portions form a plurality of latch connections radially spaced from and extending parallel to the central guard axis with the first ends of the first and second guard portions circumscribing the central guard axis to define a first end of the sprinkler guard with the first and second end plates disposed for cooperatively engaging a body of the fire protection sprinkler and the second ends of the first and second guard portions circumscribing the central guard axis to define a second end of the guard axially spaced from the first end of the guards.

20. The sprinkler guard of claim 19, wherein the first guard portion includes a plurality of latch pins between the first and second ends of the first guard portion and the second guard portion includes a plurality of eyelets between the first and second ends of the second guard portion, the plurality of latch connections being defined by each of the plurality of eyelets of the second guard portion being engaged by one of the plurality of latch pins of the first guard portion.

21. The sprinkler guard of claim 20, wherein each of the plurality of latch pins engage the plurality of eyelets to form a frictional engagement.

22. The sprinkler guard of claim 21, wherein the latch pins are axially offset from the eyelets.

23. The sprinkler guard of any one of claims 19-22, wherein the hinged connection includes a plurality of hinged connections axially aligned with and radially spaced from the central guard axis, the plurality of hinged connections and the plurality of latch connections being diametrically opposed from one another.

24. The sprinkler guard of any one of claims 19-23, wherein each of the first and second guard portions include a grid of wire members including a plurality of vertical members extending parallel to the central guard axis and a plurality of axially spaced apart arcuate members interconnecting the at least two vertical members, at least two of the arcuate members of the first guard portion being engaged with at least two of the arcuate members of the second guard portion to form the plurality of latch connections.

25. The sprinkler guard of claim 24, wherein in the closed state of the sprinkler guard, a fluid deflection member of the sprinkler received in the sprinkler guard is axially located between the axially spaced apart arcuate members.

26. The sprinkler guard of any one of claims 19-25, wherein the first and second end plates include a latch connection therebetween that is aligned with the plurality of latch connections located between the first and second ends of the guard.

27. The sprinkler guard of any one of claims 19-26, wherein the first and second end plates include a hinged connection therebetween that is aligned with the hinge connection of the guard.

28. The sprinkler guard of any one of claims 19-27, wherein the closed state of the sprinkler guard, the second end of the sprinkler guard defines an open end that is greater than a maximum width of the sprinkler received in the sprinkler guard.

29. The sprinkler guard of any one of claim 19-28, wherein the closed state of the guard, the guard has a constant internal diameter.

30. The sprinkler guard of any one of claims 19-29, wherein the closed state of the guard, the guard has a substantially cylindrical cage structure.

31. A sprinkler guard for protection of a fire protection sprinkler, the sprinkler guard comprising:

a first guard portion having a first end, a second end axially spaced from one another, a first end plate disposed at the first end and a first grid of wire members affixed to the first end plate;

a second guard portion having a first end, a second end axially spaced from one another, a second end plate disposed at the first end of the second guard portion and a second grid of wire members affixed to the second end plate; and

a hinged connection between the first guard portion and the second guard portion to pivot the first and second guard portions with respect to one another and define an open state of the sprinkler guard for receipt of the fire protection sprinkler and a closed state of the sprinkler guard to form a cage structure with a central guard axis for surrounding and guarding the fire protection sprinkler.

32. The sprinkler guard of claim 31, wherein the closed state, the first and second end plates define a centralized opening centered along the sprinkler guard axis for contacting and supporting the fire protection sprinkler and the first and second grid of wire members define an open end of the sprinkler guard for circumscribing the fire protection sprinkler.

33. The sprinkler guard of any one of claims 31-32, wherein the hinge connection includes a plurality of hinge connections axially spaced apart from one another along a pivot axis extending parallel to the central guard axis.

34. The sprinkler guard of claim 33, wherein each of the first and second grid of wire members includes a plurality of arcuate members axially spaced apart from one another, each arcuate member partially circumscribing the central guard axis in the closed state of the

sprinkler guard, the plurality of arcuate members of the first grid of wire members including arcuate members engaged with the plurality of arcuate members of the second grid of wire members to form the plurality of hinge connections.

35. The sprinkler guard of claim 34, wherein each of the first and second grid of wire  
5 members, the axially spaced apart arcuate members are interconnected to one another by wire members extending parallel to the central guard axis.

36. The sprinkler guard of any one of claims 31-35, wherein the closed state, the sprinkler guard includes a latch connection between the first and second grid of wire members.

37. The sprinkler guard of any one of claims 31-36, wherein the closed state, the sprinkler  
10 guard includes a latch connection between the first and second end plates.

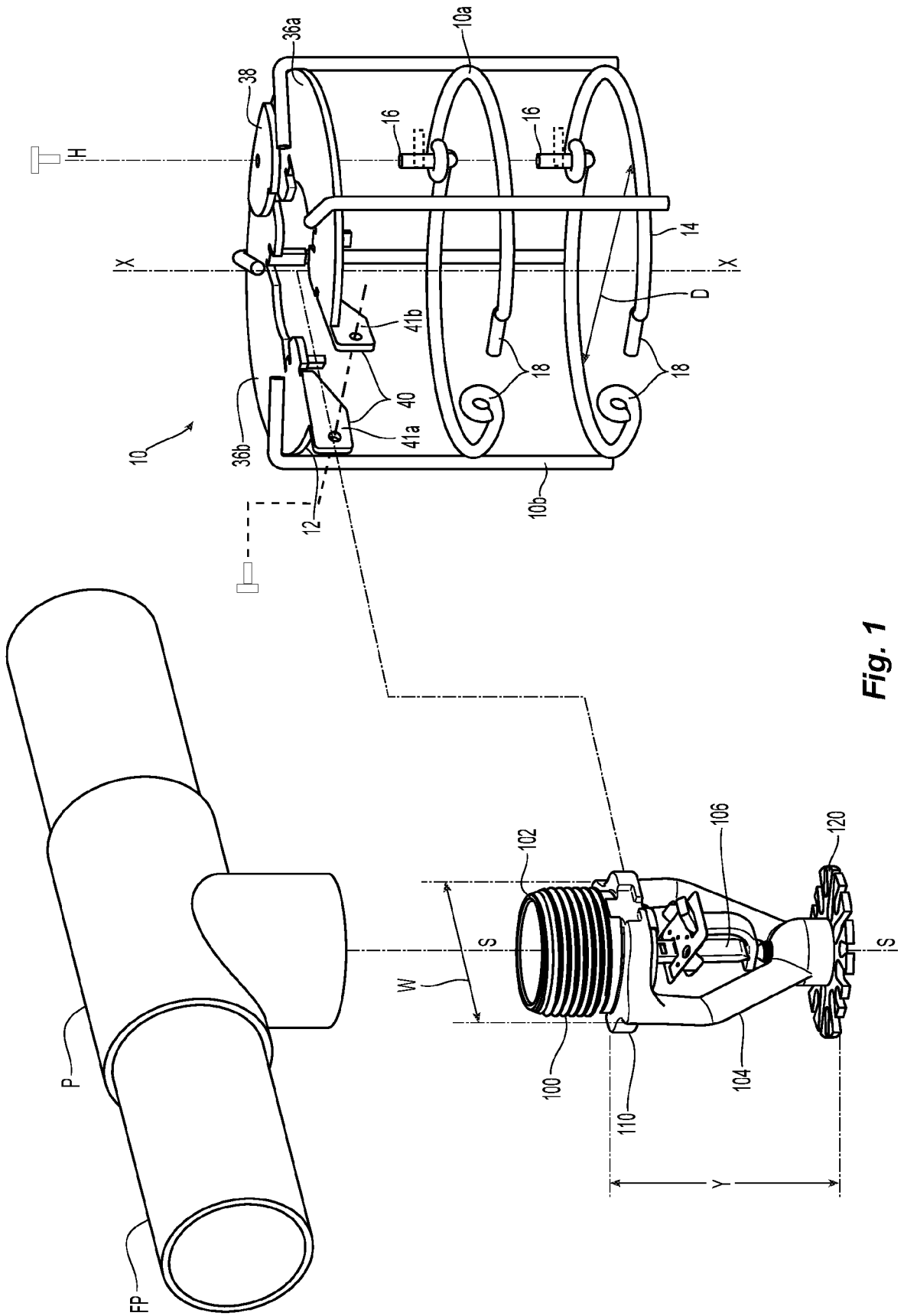


Fig. 1

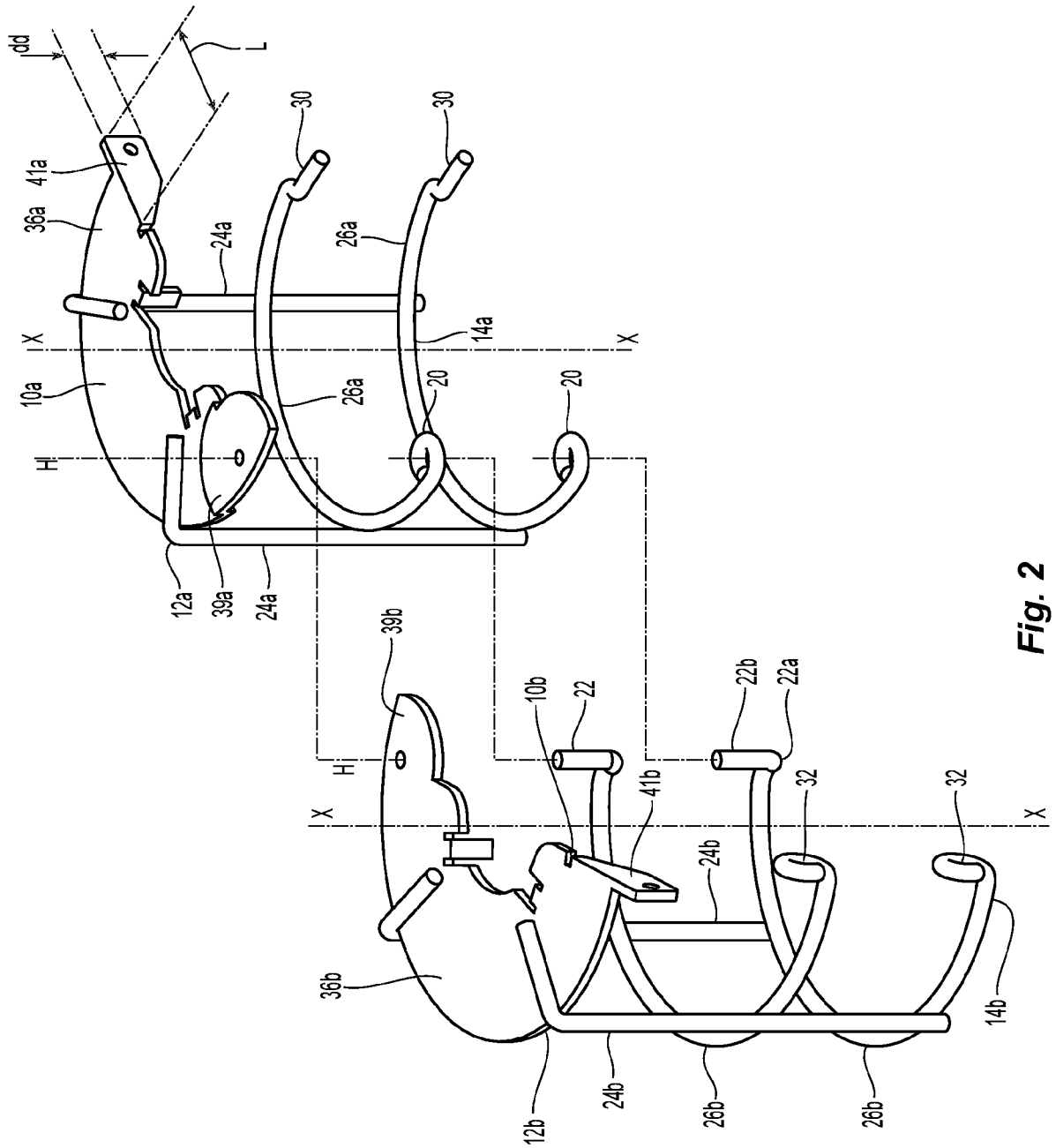


Fig. 2

3/3

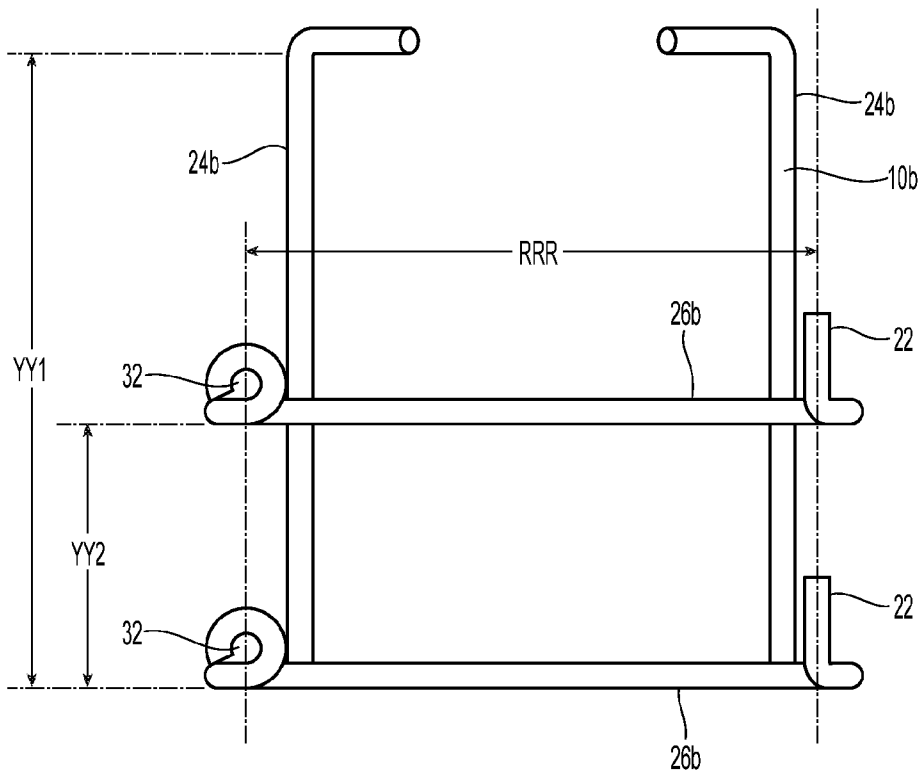


Fig. 3A

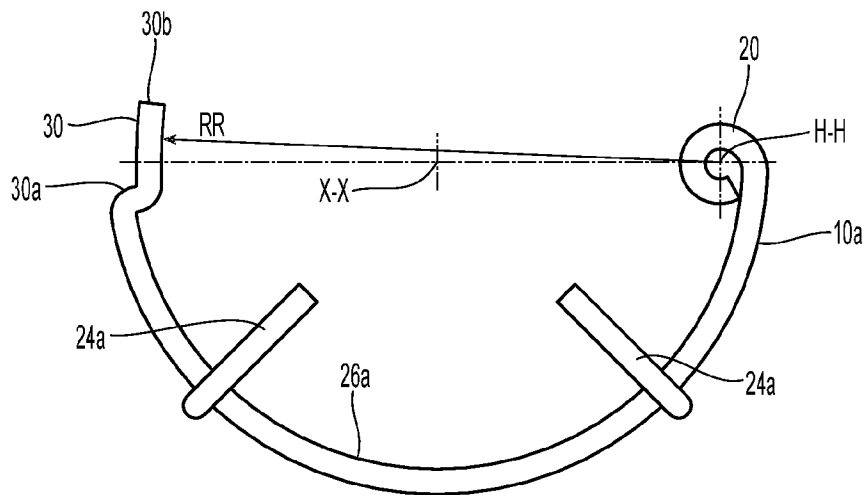


Fig. 3B

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/037775

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A62C 35/68; A62C 31/02; A62C 31/28; B05B 1/26; B05B 15/16 (2020.01)

CPC - A62C 35/68; A62C 31/02; A62C 31/28; B05B 1/265; B05B 15/16 (2020.05)

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

see Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

see Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

see Search History document

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/0267453 A1 (DEVANEY) 25 October 2012 (25.10.2012) entire document	1
---		---
Y		2, 19, 23, 31-33
Y	US 5,893,418 A (PONTE) 13 April 1999 (13.04.1999) entire document	2, 19, 23, 31-33
A	WO 2019/090135 A1 (TYCO FIRE PRODUCTS LP) 09 May 2019 (09.05.2019) entire document	1-7, 19-23, 31-35
A	US 2007/0256844 A1 (BLASING et al) 08 November 2007 (08.11.2007) entire document	1-7, 19-23, 31-35
A	US 3,797,746 A (GRAY et al) 19 March 1974 (19.03.1974) entire document	1-7, 19-23, 31-35

 Further documents are listed in the continuation of Box C. See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

28 July 2020

Date of mailing of the international search report

20 AUG 2020

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

Telephone No. PCT Helpdesk: 571-272-4300

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/037775

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.: 8-18, 24-30, 36, 37  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.