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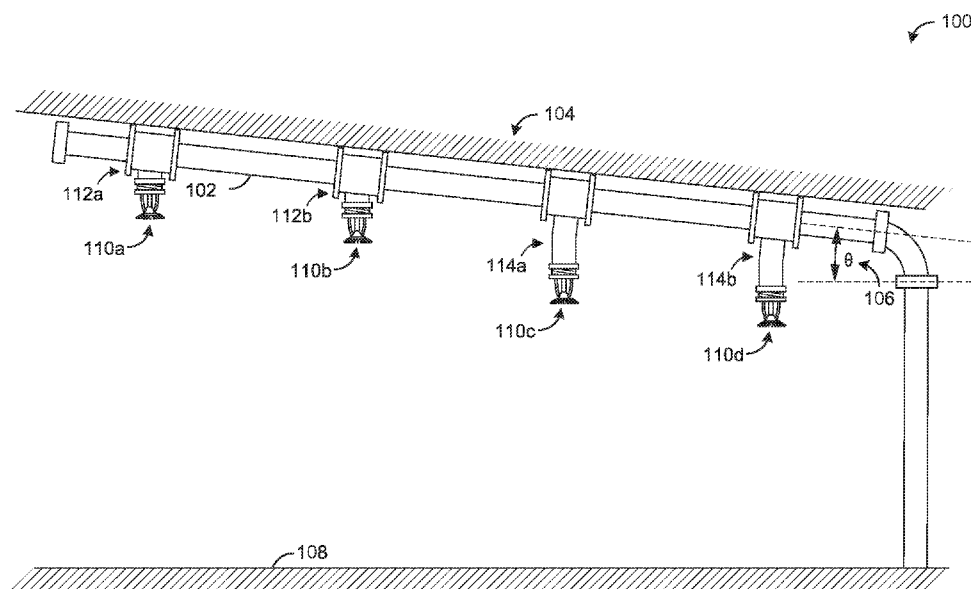


FIG. 1

(57) Abstract: A fire protection system can include at least one pipe coupled with a ceiling, the ceiling oriented at an angle relative to a floor. The system can include a fitting coupled with the at least one pipe, the fitting selected from among a plurality of fittings based on the angle, a first threshold, and a second threshold greater than the first threshold. The system can include a sprinkler connected with an outlet end of the fitting.



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SYSTEMS AND METHODS OF ANGLED FITTINGS FOR SLOPED CEILINGS

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims the benefit of and priority to U.S. Provisional Application No. 62/907,127, filed on September 27, 2019, and U.S. Provisional Application No. 62/975,967, filed on February 13, 2020, each of which are incorporated herein by reference in its entirety.

BACKGROUND

[0002] Sprinkler systems can be provided in buildings to address fire conditions. Sprinkler systems can include fire protection sprinklers that connect with piping systems to receive fluid to address the fire conditions.

SUMMARY

[0003] At least one aspect relates to a fire protection system. The system can include at least one pipe coupled with a ceiling, the ceiling oriented at an angle relative to a floor. The system can include a fitting coupled with the at least one pipe, the fitting selected from among a plurality of fittings based on the angle, a first threshold, and a second threshold greater than the first threshold. The system can include a sprinkler connected with an outlet end of the fitting.

[0004] At least one aspect relates to a fitting for coupling a sprinkler with at least one pipe. The fitting includes an inlet end that engages with the at least one pipe. A cross-section of the inlet end defines an inlet axis centered through the cross-section and extending parallel through a centerline defined by the at least one pipe. The fitting also includes an outlet end that engages with the sprinkler. The outlet end extends along an outlet axis that is angled relative the inlet axis. The outlet axis is angled relative the inlet axis based on angle of a ceiling relative a ground, a first threshold, and a second threshold greater than the first threshold.

[0005] At least one aspect relates to a method of installing a sprinkler of a fire protection system. The method can include determining an angle of a ceiling relative to a floor. The method can include comparing the angle to first threshold and a second threshold

greater than the first threshold. The method can include, responsive to the angle being less than the first threshold, selecting a first fitting having an outlet perpendicular to a length of the first fitting and connecting the first fitting with at least one pipe of the fire protection system. The method can include, responsive to the angle being greater than or equal to the first threshold and less than the second threshold, determining a difference between the ceiling angle and the first threshold and selecting a particular second fitting from a plurality of second fittings based on the difference, each of the plurality of second fittings having a different outlet angle relative to a respective length of the second fitting and connecting the particular second fitting with the at least one pipe. The method can include, responsive to the angle being greater than the second threshold, installing at least one sprinkler using at least one of a rack or a false ceiling.

[0006] These and other aspects and implementations are discussed in detail below. The foregoing information and the following detailed description include illustrative examples of various aspects and implementations, and provide an overview or framework for understanding the nature and character of the claimed aspects and implementations. The drawings provide illustration and a further understanding of the various aspects and implementations, and are incorporated in and constitute a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The accompanying drawings are not intended to be drawn to scale. Like reference numbers and designations in the various drawings indicate like elements. For purposes of clarity, not every component can be labeled in every drawing. In the drawings:

[0008] FIG. 1 is a schematic diagram of a fire protection system associated with a sloped ceiling and fittings for connecting sprinklers with piping of the fire protection system.

[0009] FIG. 2 is a schematic diagram of a fire protection system associated with a sloped ceiling and fittings with brackets and hoses for connecting sprinklers with piping of the fire protection system.

[0010] FIG. 3 is a schematic diagram of a tee fitting for use with a sloped ceiling.

[0011] FIG. 4 is a schematic diagram of an angled union for use with a sloped ceiling.

[0012] FIG. 5 is a schematic diagram of a flexible fitting for use with a sloped ceiling.

[0013] FIG. 6 is a schematic diagram of a fire protection system associated with a sloped ceiling.

[0014] FIG. 7 is a flowchart depicting a method of selecting a sprinkler fitting.

[0015] FIGS. 8 and 9 are schematic diagrams of a tee fitting for use with a sloped ceiling

[0016] FIG. 10 is a schematic diagram of a fire protection system associated with a sloped ceiling.

[0017] FIGS. 11 and 12 are schematic diagrams of fittings for use with a sloped ceiling.

DETAILED DESCRIPTION

[0018] The present disclosure relates generally to the field of fire protection systems, and more particularly to systems and methods of angled fittings for sloped ceilings.

Following below are more detailed descriptions of various concepts related to, and implementations of angled fittings for sloped ceilings. Angled fittings can be used where piping may be angled relative to a floor, such as due to being connected with a sloped ceiling. The various concepts introduced above and discussed in greater detail below can be implemented in any of numerous ways, including in new installations as well as retrofits of fire protection systems and sprinklers.

[0019] In some situations, piping of a fire protection system can be at an angle relative to ground. This may result in sprinklers connected with the piping, including the deflectors thereof, also being angled relative to ground, so that a spray pattern from the sprinkler (which may be specifically tailored to the geometry of the building or other environment in which the sprinkler is installed based on the configuration of the deflector) does not have desired characteristics in the space that the sprinkler is intended to address a fire, which can reduce the effectiveness of the fire protection. Installing the fire protection system may depend on certification from authorities such as FM Global or NFPA, which may establish standards regarding angles between the deflector and the floor.

[0020] The present solution can enable sprinklers to be installed in fire protection systems attached to sloped ceilings, in both new installations and retrofits, in a manner that allows the deflector of the sprinkler to be oriented at an angle relative to the floor that satisfies various thresholds. As such, the spray pattern from the sprinkler can remain effective even if the sprinkler is connected with a sloped ceiling. For example, a method of installing a sprinkler of a fire protection system can include determining an angle of a ceiling relative to a floor. The method can include comparing the angle to first threshold and a second threshold greater than the first threshold. The method can include, responsive to the angle being less than the first threshold, selecting a first fitting having an outlet perpendicular to a length of the fitting and connecting the first fitting with at least one pipe of the fire protection system. The method can include, responsive to the angle being greater than or equal to the first threshold and less than the second threshold, determining a difference between the ceiling angle and the first threshold and selecting a particular second fitting from a plurality of second fittings based on the difference, each of the plurality of second fittings having a different outlet angle relative to a respective length of the second fitting. The method can include, responsive to the angle being greater than the second threshold, installing the at least one sprinkler using at least one of a rack or a false ceiling.

[0021] The first threshold may be a threshold angle between the ceiling and the floor (or the piping and the floor) below which it can be appropriate to install a fitting where the angle of the outlet is perpendicular (e.g., greater than 85 degrees and less than 95 degrees; greater than 88 degrees and less than 92 degrees; greater than 89 degrees and less than 91 degrees) to a length of the fitting (e.g., along an axis of the fitting by which fluid flows through the fitting). The first threshold may be five degrees. The first threshold may be ten degrees. The first threshold may vary based on various factors.

[0022] The second threshold may be a threshold angle greater than the first threshold, such that if the angle is between the first threshold and the second threshold, it can be appropriate to install a fitting where the angle of the outlet is angled relative to the length of the fitting, such as at an angle of five degrees, ten degrees, or fifteen degrees. The angle may be an angle between 4 degrees and 19 degrees, inclusively (e.g., 8 degrees, 13 degrees, or 18 degrees). These angles are examples and other angles may be implemented. For example, various fittings may have various predetermined outlet

angles, and the fitting can be selected for installation based on the difference between the angle between the ceiling and the floor and the first threshold. For example, if the angle between the ceiling and the floor is fifteen degrees, and the first threshold is five degrees, a fitting having an outlet angle of ten degrees can be selected so that the effective angle between the deflector of the sprinkler connected with the fitting and the floor can be reduced to five degrees (which can thus satisfy the first threshold of five degrees). If the angle between the ceiling and the floor is greater than the threshold, then the fitting and sprinkler can be installed using a rack or false ceiling, to facilitate an appropriate spray pattern from the sprinkler. The second threshold can be twenty degrees. The second threshold may vary based on various factors.

[0023] FIG. 1 depicts piping of a fire protection system 100 including at least one pipe 102 coupled with a ceiling 104 that is angled at an angle 106 measured relative to a ground 108. Angle 106 may include any value, but for ease of clarity and for exemplary purposes, angle 106 is assumed to have a value of twelve degrees relative to ground (e.g., greater than the first threshold and less than the second threshold).

[0024] Angle 106 can be defined as an angle measured between ceiling 104 and ground 108. For example, ceiling 104 defines a ceiling plane which is oriented parallel to ceiling 104. Accordingly, ground 108 defines a ground plane which is oriented parallel to ground 108. By extending the ceiling plane and the ground plane to a line of intersection between the ceiling plane and the ground plane, angle 106 can be determined by measuring the angle between the ceiling plane and the ground plane. It should be understood that, although the previous example defines that ceiling plane as being oriented parallel to ceiling 104, the ceiling plane may be alternatively oriented parallel to a centerline of pipe 102.

[0025] A plurality of sprinklers 110a-110d are coupled with the pipe 102 via tee fittings 112a-b or angled unions 114a-b. Tee fittings 112a and 112b are used for new construction installations to respectively couple sprinkler 110a and 110b with pipe 102. Tee fittings 112a and 112b are structured to reduce the angle between the sprinklers 110a and 110b and the ground 108 to be less than the first threshold. Angled unions 114a and 114b are used for retrofit installations to respectively couple sprinkler 110c and 110d

with pipe 102. Angled unions 114a and 114b are structured to reduce the angle between the sprinklers 110c and 110d and the ground 108 to be less than the first threshold.

[0026] The tee fittings and angled unions include an outlet end configured for engagement with a sprinkler. The outlet end is angled relative to a tee axis that is perpendicular to a pipe axis defined by a centerline of the at least one pipe. A particular fitting may be selected from a plurality of fittings having different angles (e.g., 5 degrees, 10 degrees, 15 degrees) based on the ceiling angle, a first threshold value, and a second threshold value. For example, with reference to FIG. 1, the ceiling is shown to be orientated at 12 degrees relative to the ground. Accordingly, this is greater than the first threshold value (e.g., 5 degrees, 10 degrees) but less than the second threshold value (e.g., 20 degrees). As such, a particular fitting (e.g., a tee fitting, an angled union) is selected based on a difference between the ceiling angle (i.e., 12 degrees) and the first threshold value (e.g., 5 degrees, 10 degrees) so that a cross-section of the outlet end is angled (relative to the ground) at an angle equal to or less than the first threshold value.

[0027] FIG. 2 depicts piping of a second fire protection system 200 including the at least one pipe 102 coupled with ceiling 104. Ceiling 104 is angled at the angle 106 measured relative to ground 108. Angle 106 can be, for example, an angle of twelve degrees relative to ground (e.g., greater than the first threshold and less than the second threshold). The plurality of sprinklers 110a-d are respectively coupled with the pipe 102 via flexible fittings 202a-d. A flexible fitting 202 can be used for new construction or retrofit applications to facilitate reducing the angle between the sprinkler 110 and the ground 108 to be less than the first threshold. For example, the flexible fitting 202 can include a flexible hose coupled with a bracket, which can protect the flexible hose and allow the hose to be adjusted to various angles relative to how the hose is connected with the fitting or piping. The flexible fitting 202 can include a bolt, such as a knurled bolt, to allow fine angle adjustment by being able to be selectively coupled with one or more slots in the bracket. The flexible fitting 202 can provide a viewing window via one or more openings in the bracket to allow for viewing of a current angle of the flexible hose. The fitting can include or be associated with a level, such as a bubble level magnet install tool, to facilitate aligning the hose to an appropriate angle. For new installations, the flexible hose can be connected directly to a tee fitting. For retrofit installations, a

grooved or threaded adapter can be provided to connect the flexible hose to the piping of the sprinkler system.

[0028] The flexible hose includes an inlet end for coupling with a pipe and outlet end for coupling with a sprinkler. The angle of the outlet end can be adjusted relative to an axis that is perpendicular to a cross-section of the inlet end. The angle of the outlet end can be determined based on a difference between a ceiling angle and the first threshold value. For example, with reference to FIG. 2, the ceiling is oriented at an angle of twelve degrees relative to the ground. Assuming the first threshold value is 10 degrees, the difference is 2 degrees. Accordingly, the angle of the outlet end may be adjusted by engaging the bolt with a corresponding slot allowing for the angle of the outlet end to be at least 2 degrees.

[0029] FIGS. 3-4 respectively depict tee fitting 112 and angled union 114. The tee fitting 112 and angled union 114 each include an outlet end selectively angled (e.g., a ten degree angle and/or a fifteen degree angle, however the angle may range from 5-18 degrees, for example) to allow for adjusting the angle between sprinkler 110 coupled with the particular fitting and ground 108 to within appropriate tolerances (e.g., less than the first threshold). Referring specifically to FIG. 3, the tee fitting 112 includes a tee portion 302 and a sprinkler portion 304. The tee portion 302 defines a channel extending from a first end 306 towards a second end 308 along a fitting axis 310. The fitting axis 310 may be defined by a centerline of the channel defined by the tee portion 302. The first end 306 can couple with an upstream end of pipe 102. Second end 308 can couple with a downstream end of pipe 102. Upon engagement of the first end 306 with the upstream end of pipe 102 and the second end 308 with downstream end of pipe 102, fitting axis 310 aligns with a pipe axis defined by pipe 102. That is, coupling first end 306 with the upstream end of pipe 102 and second end 308 with the downstream end of pipe 102 allows for fluid communication between the upstream end of pipe 102 and the downstream end of pipe 102. For example, the tee portion 302 receives a fire suppression material from the upstream end via the first end 306 and transmits, through the tee portion 302, the fire suppression material to the downstream end via the second end 308.

[0030] The sprinkler portion 304 extends outwardly from the tee portion 302 and outward in a direction away from the fitting axis 310. The sprinkler portion 304 may be centered along a length of the tee portion 302. The sprinkler portion 304 includes an outlet end 312 that engages with a corresponding sprinkler and may include one or more structures, components, or features to engage a sprinkler with the outlet end 312. For example, outlet end 312 may include a threaded structure (not shown) disposed on an interior surface of the sprinkler channel that engages with a corresponding threaded structure of a sprinkler and secure the location of the tee fitting 112 relative to the tee fitting 112. The sprinkler portion 304 defines a sprinkler channel extending therethrough and in fluid communication with the channel defined by the tee portion 302. The outlet end 312 is angled relative to a tee axis 314. Tee axis 314 is perpendicular to fitting axis 310. The outlet end 312 may be angled at 5 degrees. The outlet end 312 may be angled at 10 degrees. The outlet end 312 may be angled at 15 degrees.

[0031] A particular fitting may be selected from a plurality of fittings having different angles (e.g., 5 degrees, 10 degrees, 15 degrees) based on the angle 106, a first threshold value, and a second threshold value. For example, with reference to FIG. 1, the ceiling 104 is shown to be orientated at angle 106 of 12 degrees relative to the ground 108. Accordingly, this is greater than the first threshold value (e.g., 5 degrees, 10 degrees) but less than the second threshold value (e.g., 20 degrees). As such, a particular fitting (e.g., tee fitting 112, angled union 114) is selected based on a difference between the angle 106 (i.e., 12 degrees) and the first threshold value (e.g., 5 degrees, 10 degrees) so that a cross-section of the outlet end is angled (relative to the ground 108) at an angle equal to or less than the first threshold value.

[0032] As depicted in FIG. 4, the angled union 114 includes an inlet end 402 and an outlet end 404 that defines a union channel extending therethrough. The inlet end 402 can engage with an outlet provided by pipe 102 and may include any structure, components, or features to engage the inlet end 402 with pipe 102 and secure the angled union 114 relative the pipe 102. Upon engagement of the inlet end 402 with the outlet of pipe 102, the union channel is in fluid communication with a channel defined by pipe 102. Inlet end 402 extends along an inlet axis 406 extending through a cross-section of the inlet end 402. Inlet axis 406 is perpendicular to a reference axis 410. Upon engagement of the inlet end 402 with the outlet of pipe 102, reference axis 410 extends

parallel to the centerline defined by pipe 102. The outlet end 404 is angled relative to inlet axis 406. The outlet end 404 may be angled at 5 degrees. The outlet end 404 may be angled at 10 degrees. The outlet end 404 may be angled at 15 degrees.

[0033] FIG. 5 depicts flexible fitting 202 which can be used for new construction or retrofit applications to facilitate reducing the angle between the sprinkler 110 and the ground 108 to be less than the first threshold. Flexible fitting 202 includes a flexible hose 502 having an inlet end 504 for coupling with pipe 102 and an outlet end 506 for coupling with sprinkler 110. Flexible fitting 202 can include a bracket 508 coupled with the flexible hose 502. The bracket 508 can protect the flexible hose 502 and allow for the flexible hose 502 to be adjusted to various angles relative to how the flexible hose 502 is coupled with the pipe 102. Flexible fitting 202 can include a bolt 510, such as a knurled bolt, coupled with the flexible hose 502 that can be selectively coupled with one or more slots 512 in the bracket 508 allowing for fine angle adjustment of the flexible hose 502. The flexible fitting 202 can provide a viewing window via one or more openings 514 to allow for viewing of a current angle of the flexible hose. For new installations, the flexible hose can be connected directly to a tee fitting. For retrofit installations, a grooved or threaded adapter can be provided to connect the flexible hose to the piping of the sprinkler system.

[0034] The angle of the outlet end 506 can be adjusted relative to an axis that is perpendicular to a cross-section of the inlet end 504. The angle of the outlet end can be determined based on a difference between the angle 106 and the first threshold value. For example, with reference to FIG. 2, the ceiling is oriented at an angle 106 of twelve degrees relative to the ground. Assuming the first threshold value is 10 degrees, the difference is 2 degrees. Accordingly, the angle of the outlet end 506 may be adjusted by engaging the bolt 510 with a corresponding slot 512 allowing for the angle of the outlet end 506 to be at least 2 degrees.

[0035] FIGS. 6 and 9 depict how a particular tee fitting 112 can be selected from a plurality of different tee fittings 112 having various angles, based on a slope of pipe 102 with which the tee fitting 112 can be connected, to facilitate orienting the sprinkler 110 to within appropriate tolerances. Selecting a particular tee fitting 112 may involve determining an angle (e.g., a slope) of the ceiling 104 (and a fire protection system

coupled therewith) relative to a floor. The determined angle may be compared to a first threshold value and a second threshold value that is greater than the first threshold value. The first threshold value may be greater than or equal to five degrees and less than or equal to ten degrees. The second threshold value may be twenty degrees. Selecting a particular fitting may involve determining a particular type of fitting (e.g., tee fitting 112, angled union 114) based on a type of installation (e.g., retrofit, new construction). Tee fitting 112 may be selected for a new construction installation. Angled union 114 may be selected for a retrofit installation.

[0036] Responsive to determining that the ceiling angle is less than the first threshold, a first fitting having an outlet that is substantially perpendicular (e.g., greater than 85 degrees and less than 95 degrees; greater than 88 degrees and less than 92 degrees; greater than 89 degrees and less than 91 degrees) to a length of the fitting is selected. Accordingly, the first fitting is coupled with the pipe 102 of the fire protection system.

[0037] Responsive to determining that the ceiling angle is greater than or equal to the first threshold value and less than the second threshold value, a difference between the ceiling angle and the first threshold value is determined. For example, assume ceiling 104 is angled at 15 degrees. For a first threshold value of 5 degrees and a second threshold value of 20 degrees, it is determined that the ceiling angle (i.e., 15 degrees) is greater than the first threshold value and less than the second threshold value. Accordingly, the difference between the ceiling angle and the first threshold value is 10 degrees. A particular fitting is selected from a plurality of second fittings based on the difference. Each of the plurality of second fittings have a different outlet angle that is oriented relative to an axis that is perpendicular to the angle of the ceiling. For example, based on the difference being 10 degrees, a particular fitting having an outlet end of 10 degrees is selected. Responsive to the ceiling angle being greater than the second threshold, a sprinkler is installed using at least one rack or a false ceiling.

[0038] FIG. 6 depicts a sloped ceiling 104 and piping 102 adjacent to the sloped ceiling 104, indicating how a fitting can be shaped to be angled relative to the slope of the piping 102 in order to orient the sprinkler 110c to within appropriate tolerances. The angle of the outlet end (measured relative to an axis that is perpendicular to a pipe centerline) allows for a sprinkler and deflector associated therewith to be oriented at an

angle within the appropriate tolerances. By orienting the sprinkler 110c within the tolerances via the fitting 112b, a desired spray pattern is facilitated by striking a fire suppression material against the deflector.

[0039] FIG. 7 depicts a method 700 for selecting a fitting for use in a fire protection system for sloped ceilings. The method 700 can be implemented using various devices and systems described herein, such as the tee fitting 112 or the angled union 114.

[0040] At 702, the angle of the ceiling relative to the ground is determined. This can be facilitated by, for example, determining a maximum height of the ceiling by measuring the vertical distance from the ground to the point on the ceiling furthest from the ground, determining a horizontal distance between the point on the ground at which the vertical distance was measured and a particular wall at which the ceiling and a top portion of the wall connect, and determining a height of the wall. A height differential between the vertical distance and the height of the wall is determined by subtracting the height of the wall from the vertical distance. The angle of the ceiling relative the ground can be determined by calculating the inverse tangent of the height differential divided by the horizontal distance.

[0041] At 704, it is determined if the angle of the ceiling is less than or equal to the first threshold by comparing the value of the angle of the ceiling by the value of the first threshold (e.g., 5 degrees). Responsive to determining that the angle of the ceiling is less than or equal to the value of the first threshold, at 706, a first fitting having an outlet extending along an axis perpendicular to an axis defined by a centerline of the pipe is selected.

[0042] At 708, the selected first fitting is connected with the pipe. This can be facilitated by various methods of fastening the first fitting to a pipe, such as, for example, using a hose clamp to secure the fitting relative the pipe. Connecting the selected first fitting with the pipe can include connecting a sprinkler assembly with the connected first fitting.

[0043] Responsive to determining that the angle of the ceiling is not less than the first threshold, it is determined if the angle of the ceiling is less than or equal to the second threshold by comparing the value of the angle of the ceiling by the value of the second threshold (e.g., 20 degrees). Responsive to determining that the angle of the ceiling is

less than or equal to the value of the second threshold, at 712, a difference between the ceiling angle and the first threshold is determined. The difference can be determined with the following equation:

$$D = \theta_c - T_1$$

In the previous equation, D is the difference, θ_c is the angle of the ceiling, and T_1 is the value of the threshold.

[0044] At 714, a second fitting is selected based on the determined difference. For example, responsive to the difference being 5 degrees, a second fitting with an angle of 5 degrees can be selected. Selecting the second fitting can include selecting a tee fitting (e.g., tee fitting 112) for use in a new construction installation. Selecting the second fitting can include selecting an angle union (e.g., angled union 114) for use in a retrofit installation. Selecting the second fitting may include determining a particular type of installation (e.g., new construction, retrofit) to allow for proper selection of the type (e.g., tee fitting 112, angled union 114) of fitting. Selecting the second fitting can include selecting a flexible fitting. Selecting the second fitting can include selectively coupling a bolt of the flexible fitting with a corresponding slot of a bracket of the flexible fitting to allow for a flexible hose to be angled based on the difference.

[0045] At 716, the selected second fitting is connected with the pipe. This can be facilitated by various methods of fastening the second fitting to a pipe, such as, for example, using a hose clamp to secure the second fitting relative the pipe. Selecting the second fitting can include connecting a sprinkler assembly to the connected second fitting. If a tee fitting is selected for the second fitting, selecting the second fitting can include coupling a first end of the tee fitting with an upstream end of the pipe and a second end of the tee fitting with a downstream end of the pipe.

[0046] Responsive to determining that the angle of the ceiling is greater than the second threshold, at 718, a sprinkler can be installed using at least one of a rack or false ceiling structure.

[0047] FIG. 8 depicts tee fittings 112 having a ten degree angle or a fifteen degree angle, for example, to allow for adjusting the angle between a sprinkler connected with the

fitting and a floor to within appropriate tolerances (e.g., less than the first threshold).

The fittings include a pipe portion 802 for coupling the tee fitting 112 with at least one pipe and defining a pipe centerline 810. A first end 806 of the pipe portion 802 may be coupled with an upstream end of the at least one pipe. A second end 808 of the pipe portion 802 may be coupled with a downstream end of the at least one pipe.

Accordingly, coupling the first end 806 of the fitting with the upstream end and the second end 808 of the fitting with the downstream end allows for fluid communication between the upstream end of the at least one pipe and the downstream end of the at least one pipe. For example, the pipe portion 802 receives a fire suppression material from the upstream end via the first end and transmits, through the pipe portion 802, the fire suppression material to the downstream end via the second end.

[0048] The fittings 112 also include a tee portion 804 extending outwardly from the pipe portion 802. The tee portion 804 may be centered along a length of the pipe portion 802. The tee portion 804 includes an inlet end fluidly coupled with the pipe portion 802 and an outlet end 812. The outlet end 812 is configured for coupling with a sprinkler. The tee portion 804 receives a fire suppression material from the pipe portion 802 via the inlet end and transmits, through the tee portion 804, the fire suppression material to the sprinkler via the outlet end 812. The outlet end 812 of the tee portion 804 is angled relative to an axis 814 that is perpendicular to the pipe centerline 810. The outlet end 812 may be angled at 5 degrees, 10 degrees, or 15 degrees.

[0049] FIG. 10 depicts a piping 102 adjacent to a sloped ceiling, indicating how a fitting 1000 can be shaped to be angled relative to the slope of the piping 102 in order to orient a sprinkler 110 to within appropriate tolerances. The angle of the outlet end (measured relative to an axis 1006 that is perpendicular to a pipe centerline 1004) allows for the sprinkler 110 and deflector associated therewith to be oriented at an angle within the appropriate tolerances. For instance, the angle may any angle between 5 and 28 degrees inclusively (e.g., 5 degrees, 8 degrees, 10 degrees, 13 degrees, 15, degrees, 18 degrees). The fitting 1000 may be an angled weldolet or an angled threadolet. The angled weldolet or an angled threadolet may be inserted into a drilled hole 1002 of the piping 102. As such, instead of having T-outlets with grooved ends, the sprinkler would appear to be a single angled section of pipe (e.g., welded to an outlet of the weldolet instead of grooved couplings). Alternatively, the sprinkler 110 may be threaded into an outlet of

the threadolet. By orienting the sprinkler within the tolerances via the fitting, a desired spray pattern is facilitated by striking a fire suppression material against the deflector.

[0050] FIGS. 11 and 12 depict various fittings 1000. The angling of the fitting 112 relative to the piping 102 can may be achieved with a shaped inlet. For instance, as shown in FIG. 11, the fitting 1000 includes a saddle shape at an inlet end configured to be oriented at an angle. Alternatively, as shown in FIG. 12, the fitting 1000 is a fixed angled fitting such that a first portion is angled from a second portion to a halfway point along the length of the fitting 112. The desired angle may be 5 degrees, 10 degrees, or 15 degrees. Further, the angle may be 8, 13, or 18 degrees. In order to achieve as close to 0 degrees parallel to the ground, the deflector may be orientated at a negative angle in relation to the ground. The fittings 112 are configured to maintain a 0 +/-2 degree orientation.

[0051] A fitting can be selected from a plurality of fittings having different angles (e.g., 8 degrees, 13 degrees, 18 degrees) based on the ceiling angle, a first threshold value, and a second threshold value. For example, with reference back to FIG. 1, the ceiling is shown to be orientated at 15 degrees relative to the ground. Accordingly, this is greater than the first threshold value (e.g., 8 degrees, 13 degrees) but less than the second threshold value (e.g., 18 degrees). As such, a particular fitting (e.g., a weldolet fitting, a fixed angled fitting) is selected based on a difference between the ceiling angle (i.e., 15 degrees) and the first threshold value (e.g., 8 degrees, 13 degrees) so that a cross-section of the outlet end is angled (relative to the ground) at an angle equal to or less than the first threshold value, as close to 0 +/-2 degrees orientation as possible.

[0052] Having now described some illustrative implementations, it is apparent that the foregoing is illustrative and not limiting, having been presented by way of example. In particular, although many of the examples presented herein involve specific combinations of method acts or system elements, those acts and those elements can be combined in other ways to accomplish the same objectives. Acts, elements and features discussed in connection with one implementation are not intended to be excluded from a similar role in other implementations or implementations.

[0053] The phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including” “comprising” “having”

“containing” “involving” “characterized by” “characterized in that” and variations thereof herein, is meant to encompass the items listed thereafter, equivalents thereof, and additional items, as well as alternate implementations consisting of the items listed thereafter exclusively. In one implementation, the systems and methods described herein consist of one, each combination of more than one, or all of the described elements, acts, or components.

[0054] Any references to implementations or elements or acts of the systems and methods herein referred to in the singular can also embrace implementations including a plurality of these elements, and any references in plural to any implementation or element or act herein can also embrace implementations including only a single element. References in the singular or plural form are not intended to limit the presently disclosed systems or methods, their components, acts, or elements to single or plural configurations. References to any act or element being based on any information, act, or element can include implementations where the act or element is based at least in part on any information, act, or element.

[0055] Any implementation disclosed herein can be combined with any other implementation or embodiment, and references to “an implementation,” “some implementations,” “one implementation” or the like are not necessarily mutually exclusive and are intended to indicate that a particular feature, structure, or characteristic described in connection with the implementation can be included in at least one implementation or embodiment. Such terms as used herein are not necessarily all referring to the same implementation. Any implementation can be combined with any other implementation, inclusively or exclusively, in any manner consistent with the aspects and implementations disclosed herein.

[0056] Where technical features in the drawings, detailed description or any claim are followed by reference signs, the reference signs have been included to increase the intelligibility of the drawings, detailed description, and claims. Accordingly, neither the reference signs nor their absence have any limiting effect on the scope of any claim elements.

[0057] Systems and methods described herein may be embodied in other specific forms without departing from the characteristics thereof. Further relative parallel,

perpendicular, vertical, or other positioning or orientation descriptions include variations within +/-10% or +/-10 degrees of pure vertical, parallel, or perpendicular positioning.

Angles given here include anything within +/- 1 degrees. References to “approximately,” “about” “substantially” or other terms of degree include variations of +/-10% from the given measurement, unit, or range unless explicitly indicated otherwise. Coupled elements can be electrically, mechanically, or physically coupled with one another directly or with intervening elements. Scope of the systems and methods described herein is thus indicated by the appended claims, rather than the foregoing description, and changes that come within the meaning and range of equivalency of the claims are embraced therein.

[0058] The term “coupled” and variations thereof includes the joining of two members directly or indirectly to one another. Such joining may be stationary (e.g., permanent or fixed) or moveable (e.g., removable or releasable). Such joining may be achieved with the two members coupled directly with or to each other, with the two members coupled with each other using a separate intervening member and any additional intermediate members coupled with one another, or with the two members coupled with each other using an intervening member that is integrally formed as a single unitary body with one of the two members. If “coupled” or variations thereof are modified by an additional term (e.g., directly coupled), the generic definition of “coupled” provided above is modified by the plain language meaning of the additional term (e.g., “directly coupled” means the joining of two members without any separate intervening member), resulting in a narrower definition than the generic definition of “coupled” provided above. Such coupling may be mechanical, electrical, or fluidic.

[0059] References to “or” can be construed as inclusive so that any terms described using “or” can indicate any of a single, more than one, and all of the described terms. References to at least one of a conjunctive list of terms may be construed as an inclusive OR to indicate any of a single, more than one, and all of the described terms. For example, a reference to “at least one of ‘A’ and ‘B’” can include only ‘A’, only ‘B’, as well as both ‘A’ and ‘B’. Such references used in conjunction with “comprising” or other open terminology can include additional items.

[0060] Modifications of described elements and acts such as variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations can occur without materially departing from the teachings and advantages of the subject matter disclosed herein. For example, elements shown as integrally formed can be constructed of multiple parts or elements, the position of elements can be reversed or otherwise varied, and the nature or number of discrete elements or positions can be altered or varied. Other substitutions, modifications, changes, and omissions can also be made in the design, operating conditions and arrangement of the disclosed elements and operations without departing from the scope of the present disclosure.

[0061] References herein to the positions of elements (e.g., “top,” “bottom,” “above,” “below”) are merely used to describe the orientation of various elements in the FIGURES. It should be noted that the orientation of various elements may differ according to other exemplary embodiments, and that such variations are intended to be encompassed by the present disclosure.

WHAT IS CLAIMED IS:

1. A fire protection system, comprising:
 - at least one pipe coupled with a ceiling, the ceiling oriented at an angle relative to a floor;
 - a fitting coupled with the at least one pipe, the fitting selected from among a plurality of fittings based on the angle, a first threshold, and a second threshold greater than the first threshold; and
 - a sprinkler connected with an outlet end of the fitting.
2. The fire protection system of claim 1, comprising:
 - the fitting is an angled union having an inlet end, and the outlet end is angled relative to an inlet axis extending through a cross-section of the inlet end.
3. The fire protection system of claim 1, comprising:
 - the fitting is a tee fitting, comprising:
 - a tee portion extending between a first end coupled with an upstream end of the at least one pipe and a second end coupled with a downstream end of the at least one pipe; and
 - a sprinkler portion extending outwardly from the tee portion, the sprinkler portion is angled relative to an axis that is perpendicular to an tee axis extending between the first end and the second end.
4. The fire protection system of claim 1, comprising:
 - the fitting is a flexible fitting, comprising:
 - a flexible hose extending between an inlet end to the outlet end;
 - a bracket coupled with the flexible hose and having a plurality of slots;
 - and
 - a bolt coupled with the flexible hose, the bolt is selectively coupled with a particular one of the plurality of slots to orientate the outlet end relative to an axis perpendicular to a cross-section of the inlet end.
5. The fire protection system of claim 1, comprising:

the outlet end is angled relative to an axis that is perpendicular to an inlet end, the angle is selected from a range of 4 degrees to 19 degrees.

6. The fire protection system of claim 1, comprising:

the first threshold is greater than or equal to five degrees and less than or equal to ten degrees; and

the second threshold is twenty degrees.

7. The fire protection system of claim 1, comprising:

the fitting is at least one of a weldolet and a threadolet fitting, comprising a fixed angled body extending between an inlet end to the outlet end to orientate the outlet end relative to an axis perpendicular to a cross-section of the inlet end.

8. The fire protection system of claim 1, comprising:

the fitting is at least one of a weldolet and a threadolet fitting, comprising a saddle inlet configured to orientate the outlet end relative to an axis perpendicular to a cross-section of the inlet end.

9. A sprinkler fitting, comprising:

an inlet end that engages with at least one pipe, a cross-section of the inlet end defines an inlet axis centered through the cross-section and extending parallel through a centerline defined by the at least one pipe;

an outlet end that engages with a sprinkler, the outlet end extends along an outlet axis that is angled relative the inlet axis, the outlet axis is angled relative the inlet axis based on angle of a ceiling relative to a ground, a first threshold, and a second threshold greater than the first threshold.

10. The sprinkler fitting of claim 9, comprising:

the inlet end is coupled with a tee portion extending between a first end coupled with an upstream end of the at least one pipe and a second end coupled with a downstream end of the at least one pipe.

11. The sprinkler fitting of claim 9, comprising:

the outlet end is angled at an angle between 4 degrees and 19 degrees.

12. The sprinkler fitting of claim 9, comprising:

a flexible hose extending between the inlet end and the outlet end, the outlet end is selectively angled by engaging a bolt coupled with the flexible hose with a particular slot provided by a bracket coupled with the flexible hose.

13. The sprinkler fitting of claim 9, comprising:

the outlet end includes a threaded structure that engages with a corresponding threaded structure of the sprinkler.

14. The sprinkler fitting of claim 9, comprising:

a flexible hose extending between the inlet end to the outlet end;
a bracket coupled with the flexible hose and having a plurality of slots; and
a bolt coupled with the flexible hose, the bolt is selectively coupled with a particular one of the plurality of slots to orientate the outlet end relative to the inlet axis.

15. The sprinkler fitting of claim 9, comprising:

a tee portion extending between a first end coupled with an upstream end of the at least one pipe and a second end coupled with a downstream end of the at least one pipe; and

a sprinkler portion extending outwardly from the tee portion and between the inlet end and the outlet end.

16. A method of installing a sprinkler, comprising:

determining an angle of a ceiling relative to a floor;
comparing the angle to a first threshold and a second threshold greater than the first threshold; and

based on the comparison, at least one of

(i) selecting a first fitting having an outlet perpendicular to a length of the first fitting and connecting the first fitting with at least one pipe;

(ii) determining a difference between the angle and the first threshold and selecting a particular second fitting from a plurality of second fittings based on

the difference, each of the plurality of second fittings having a different outlet angle relative to a respective length of the second fitting, and connecting the particular second fitting with the at least one pipe; and

(iii) installing at least one sprinkler using at least one of a rack or a false ceiling.

17. The method of claim 16, comprising:

selecting the first fitting or the second fitting as an angled union or a tee fitting based on installing the first fitting or the second fitting in a new construction installation or a retrofit installation.

18. The method of claim 16, comprising:

the first threshold is greater than or equal to five degrees and less than or equal to ten degrees; and

the second threshold is twenty degrees.

19. The method of claim 16, comprising:

the first threshold is greater than or equal to eight degrees and less than or equal to thirteen degrees; and

the second threshold is eighteen degrees.

20. The method of claim 16, comprising:

coupling a bolt of a flexible fitting with a particular slot of the flexible fitting based on the difference.

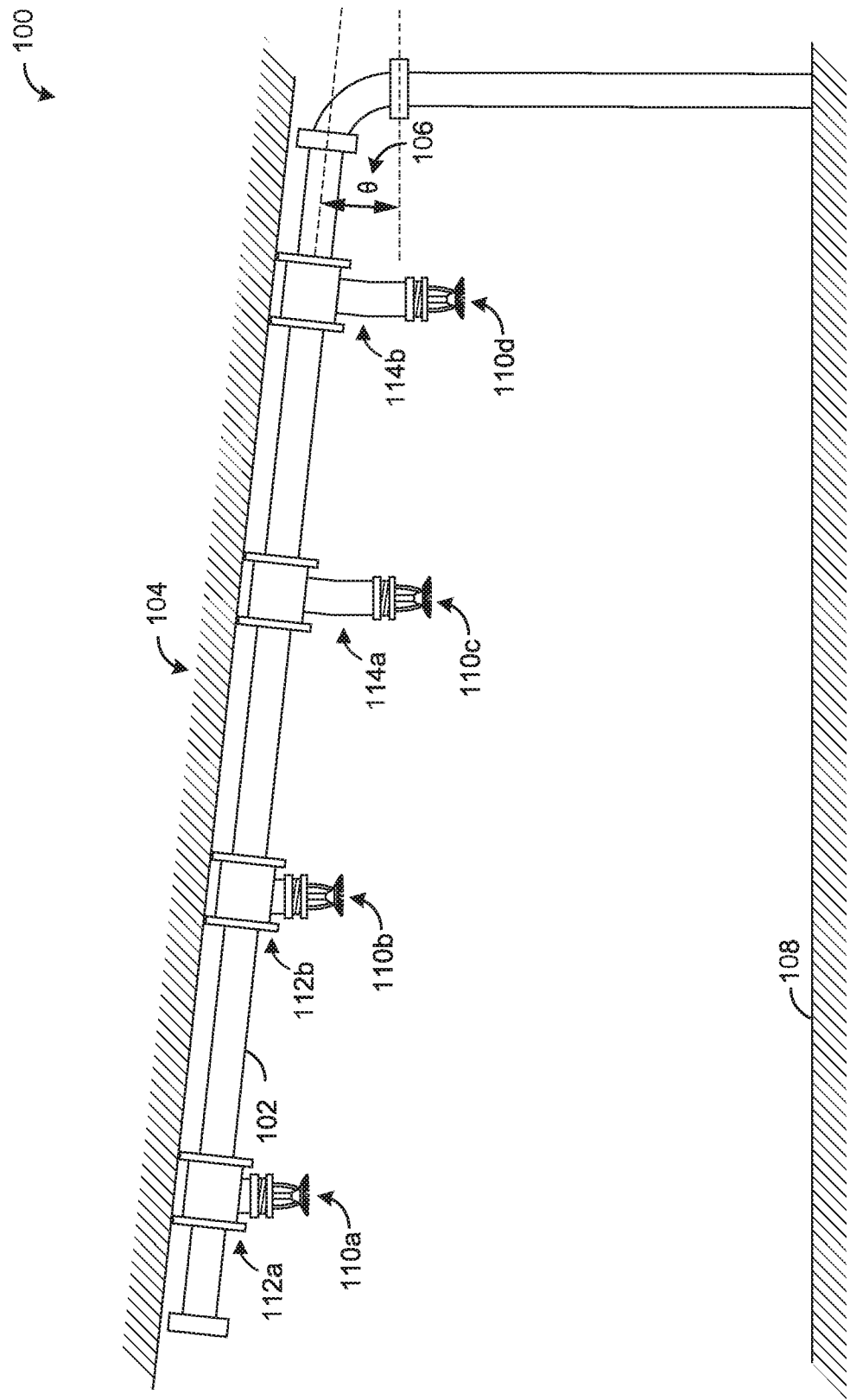


FIG. 1

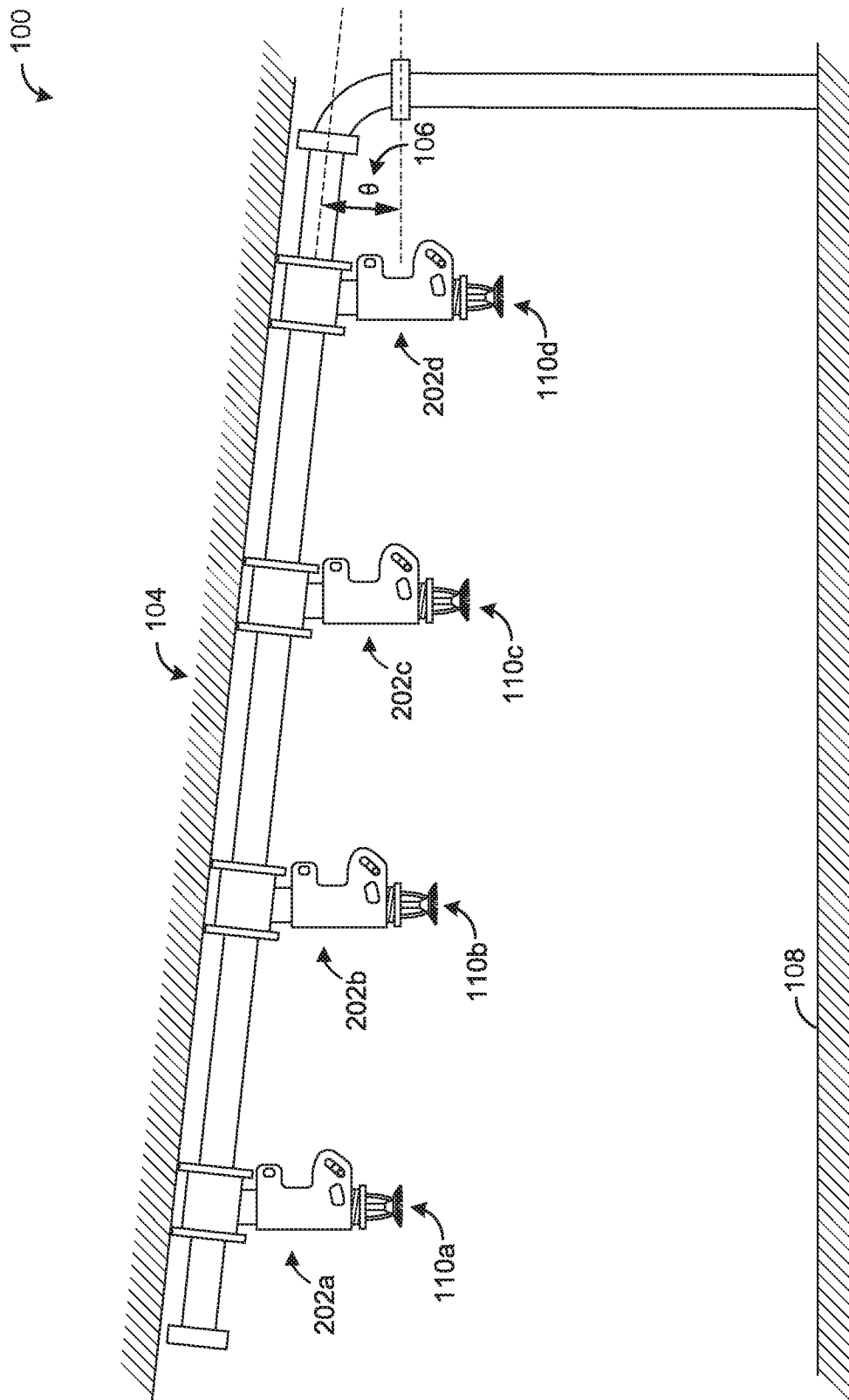


FIG. 2

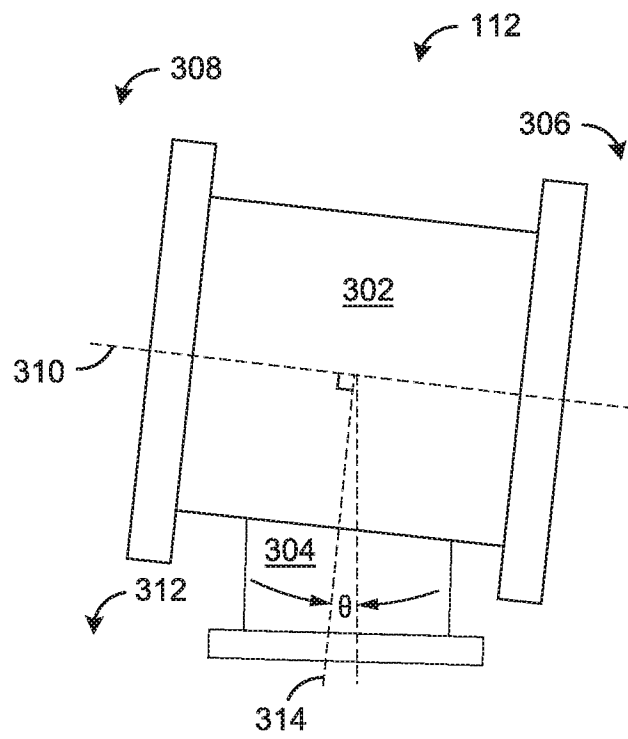


FIG. 3

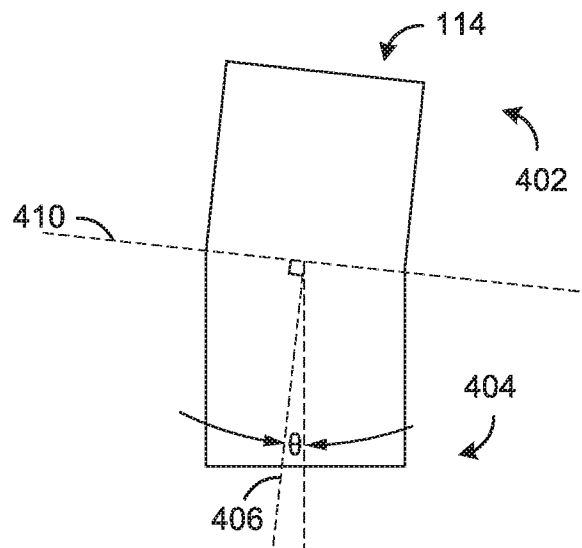


FIG. 4

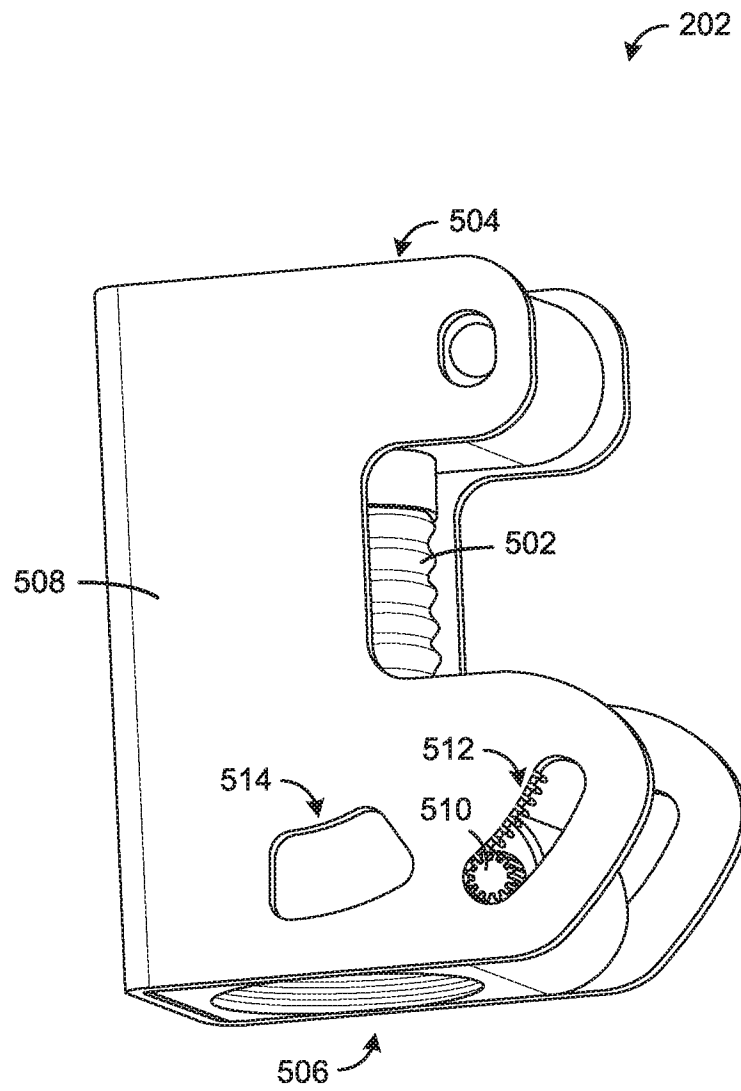


FIG. 5

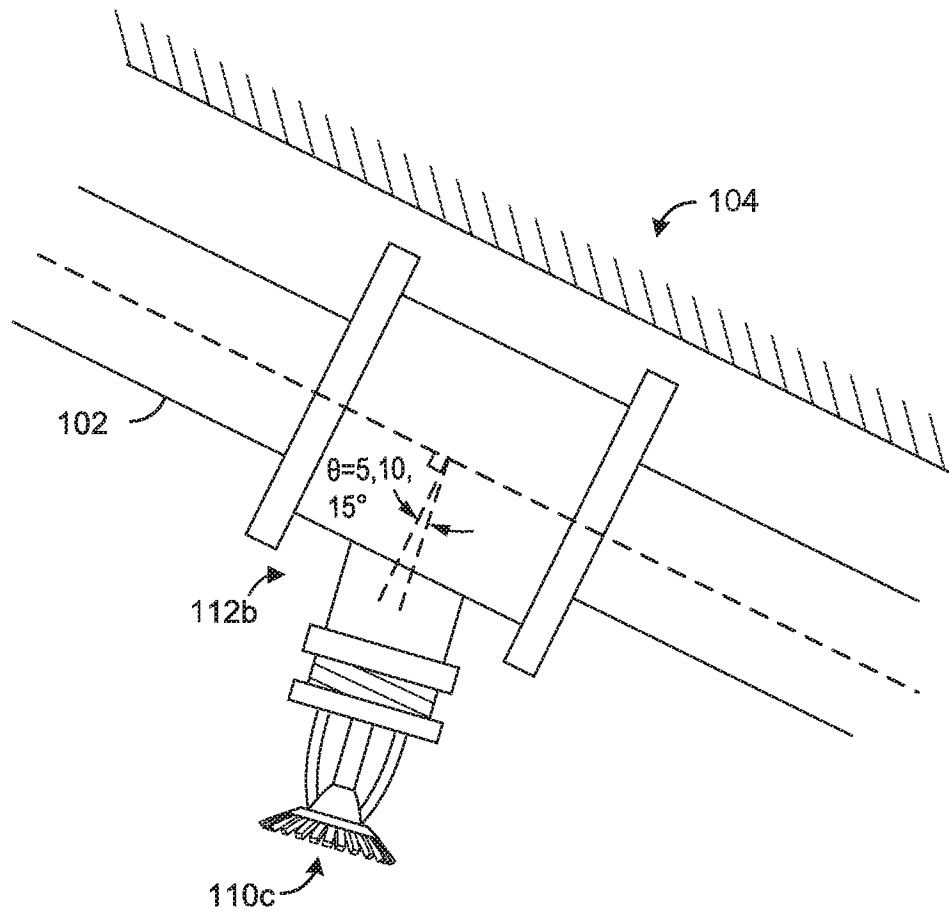


FIG. 6

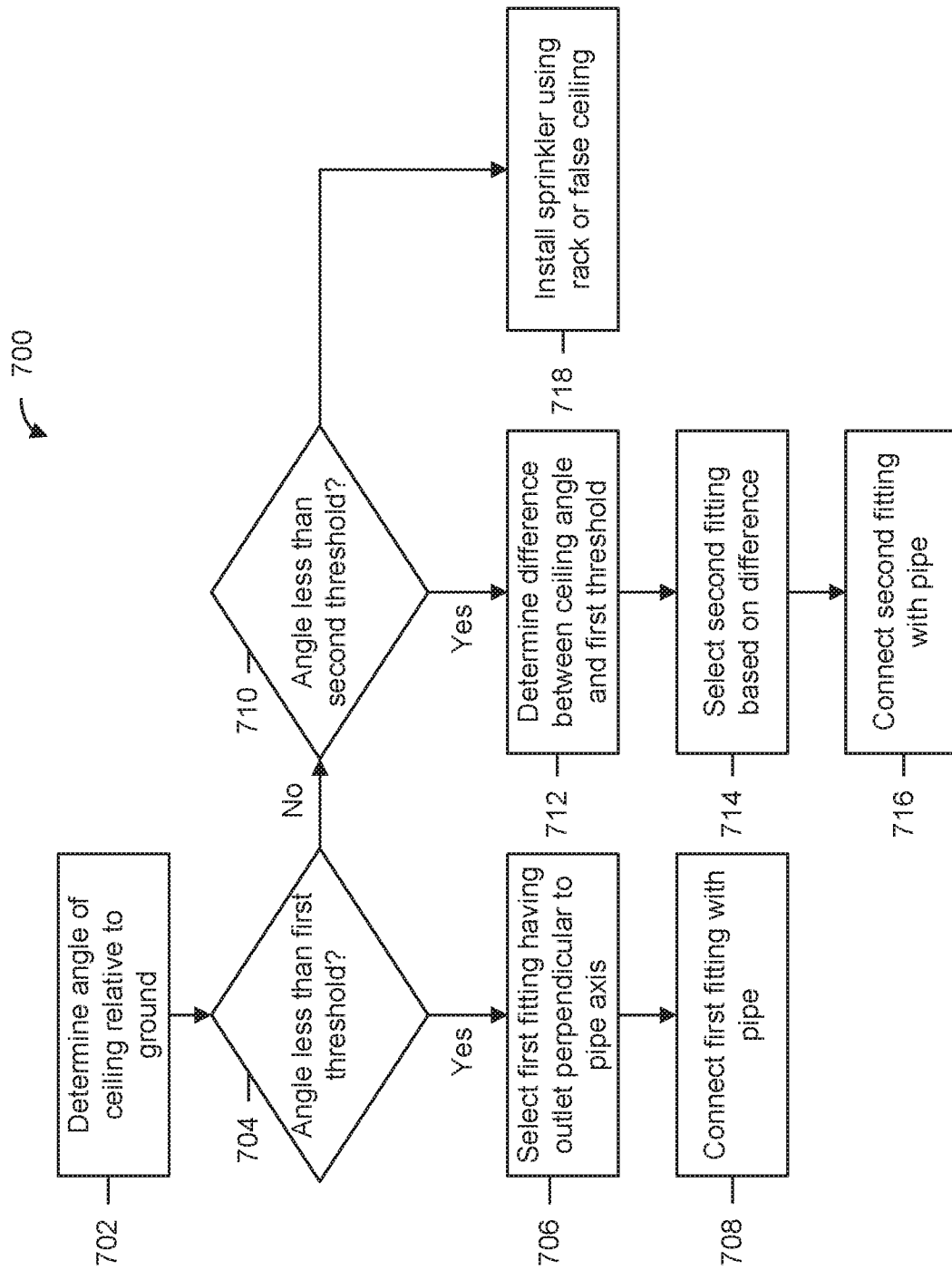


FIG. 7

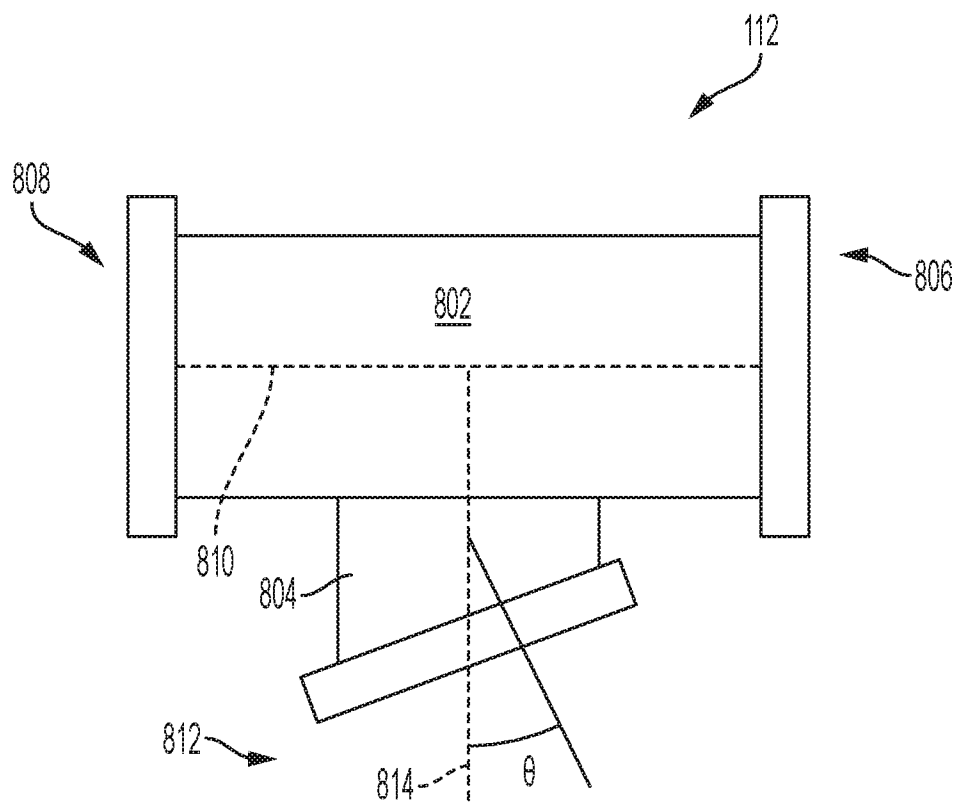


FIG. 8

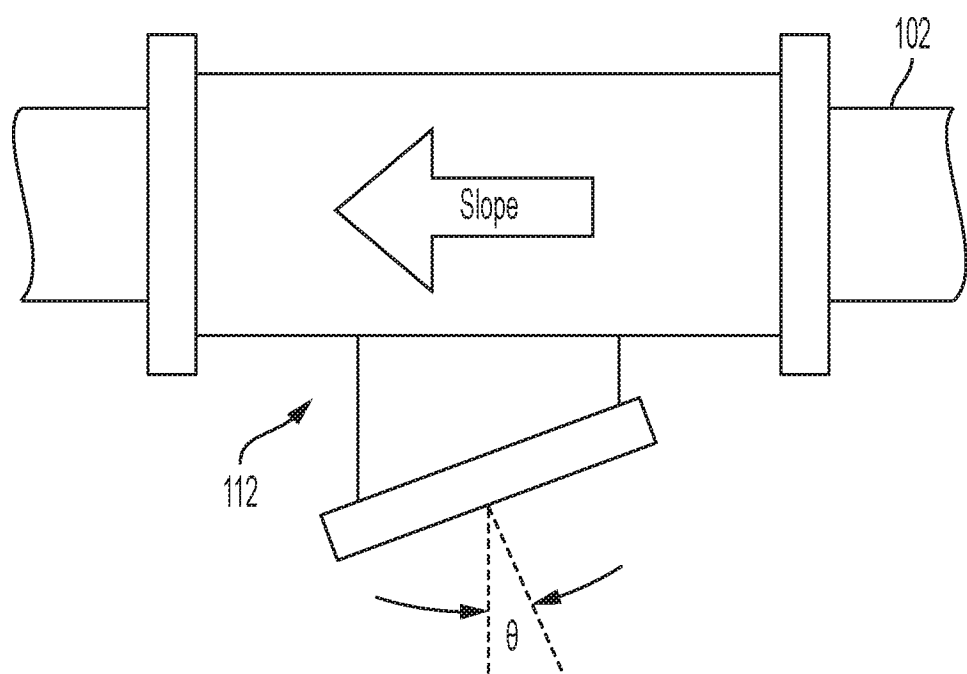


FIG. 9

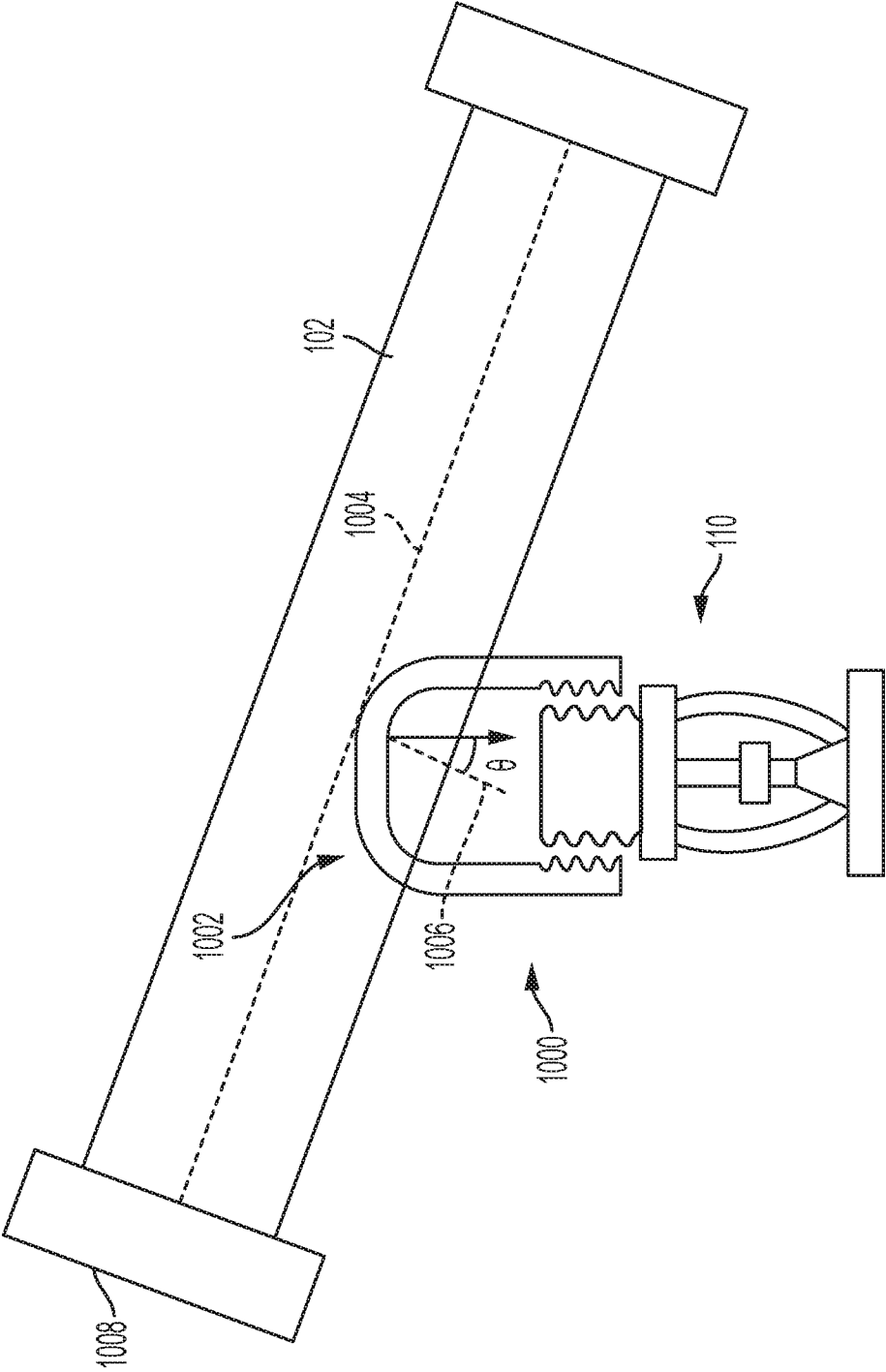


FIG. 10

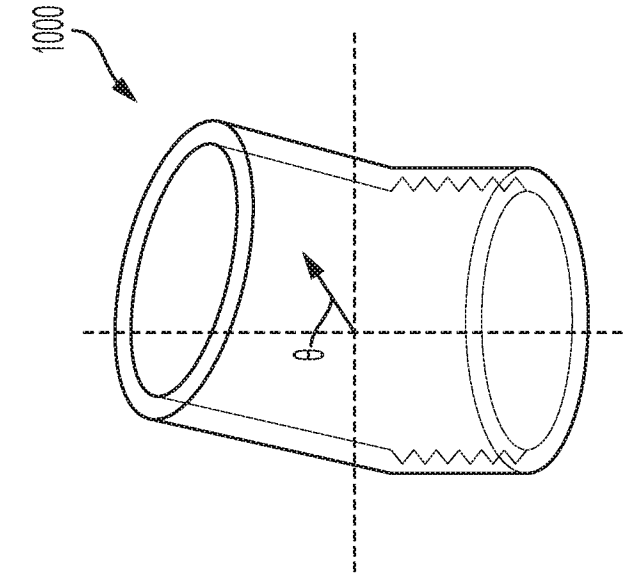


FIG. 12

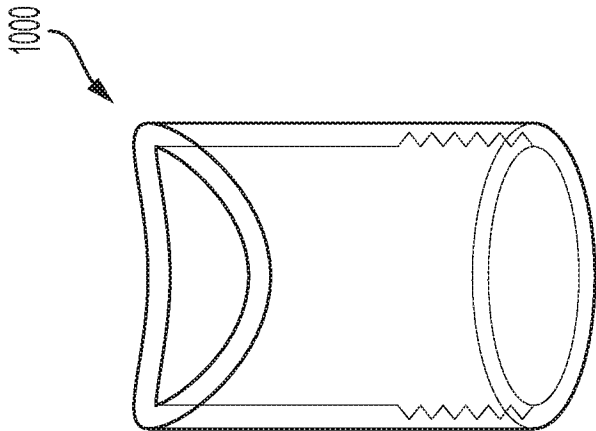


FIG. 11