# FIRE SAFETY SPRINKLER HEAD, FIRE PREVENTION AND/OR EXTINGUISHING INSTALLATION AND METHOD FOR PROTECTING A FIRE PREVENTION AND/OR EXTINGUISHING INSTALLATION AGAINST CORROSION

The invention relates to a fire safety sprinkler head for preventing and/or extinguishing fire, comprising a main body through which liquid can flow, an outflow opening in the main body arranged for the flowing out of liquid therefrom in an outflow direction, and a splitter, disposed in an extension of the outflow opening as seen in the outflow direction at a splitting position.

Such a fire safety sprinkler head is known per se, and is sometimes referred to as open fire safety sprinkler head or medium velocity nozzle. The indication ‘open’ is used since liquid can permanently flow through the fire safety sprinkler head via a permanently open passage in the sprinkler head. When the fire safety sprinkler head is installed, i.e. connected to a system of conduits, the outflow opening is directly connected to such a conduit. An extinguisher liquid inside the conduit will therefore directly flow out through the fire safety sprinkler head.

These open fire safety sprinkler heads are therefore used in so-called open deluge or open dry fire safety systems. In such systems there is normally, i.e. in a no-fire situation, no extinguisher liquid in the conduits, in other words the conduits are dry. Only when a fire is detected is the extinguisher liquid pumped through the conduits. It will then flow directly out of the fire safety sprinkler head, because it is open.

An alternative fire safety sprinkler head is also known, wherein a sealing element is provided between the splitter and the outflow opening. These fire safety sprinkler heads are therefore called sealed fire safety sprinkler heads. In many cases the sealing element is a breaking glass. The sealing element seals the outflow opening so that the conduits can be permanently filled with an extinguisher liquid. The extinguisher liquid can normally not exit the system through the fire safety sprinkler head because the sealing element seals the outflow opening thereof. The extinguisher fluid is permanently held under pressure. The sealing element releases the outflow opening in case of fire. In the example of the breaking glass, this is achieved because the increased temperatures associated with fire cause the breaking glass to break. The outflow opening is thereby released, so that extinguisher fluid present in the conduits can flow out through the fire safety sprinkler head. In general the sealed fire safety sprinkler heads perform a detection function also, because they open (by the breaking of the sealing element) when a fire is present. For this reason sealed fire safety sprinklers are used in vastly different applications than open fire safety sprinkler heads. Sealed fire safety installation are used to extinguish a fire using one or more fire safety sprinkler heads close to the fire, which are triggered by the breaking of the sealing element due to their proximity to the fire.

Open systems, such as deluge system, are used in for example the oil and gas industry and for instance chemical industries to protect fire hazardous installations. These installations require cooling as a preventative measure when a fire is detected elsewhere in the facility. Open systems therefore require an external trigger for activation, and do not rely on the detection function of its associated fire safety sprinkler heads. Due to the fire hazardous installations they protect, the flawless functioning of these open systems is of paramount importance. Therefore, open systems are normally tested at least once a year. In some facilities, like oil rigs, yearly testing of open fire safety systems is a requirement imposed by local authorities and/or insurers or by a users own safety regulations.

When testing, extinguisher liquid is pumped through the conduits as if in case of fire. During the test it is confirmed whether all fire safety sprinkler heads release extinguisher fluid, and whether the desired spraying area coverage and spraying density are achieved.

Testing however can lead to a great increase in maintenance costs, because especially in open systems, some extinguisher liquid remains in the conduits. Even flushing the conduits with ambient air does not sufficiently prevent some extinguisher liquid remaining in some parts of the conduits. Because the extinguisher liquid is mostly seawater or fresh water, the conduits become subject to corrosion. Over a time period of several years, corrosion inside the conduits causes debris which will eventually build up in the fire safety sprinkler heads and clog them. Moreover the debris increases flow resistance in the conduits, to the detriment of the through flow capacity and ultimately to the detriment of spraying density. This in turn results in a malfunction of the fire safety system, causing it to fail tests or even insufficiently perform its fire safety function. As a result, clogged conduits and fire safety sprinkler heads have to be replaced relatively often with new, unclogged ones, to maintain a flawlessly functioning fire safety installation. This brings about large maintenance costs, as the fire safety sprinkler heads are often installed in difficult to reach places.

It is therefore an object of the invention to reduce corrosion in fire safety installations.

This object may be achieved with a fire safety sprinkler head according to the preamble, wherein the splitter is moveable in the outflow direction between said splitting position, in which the splitter leaves free the outflow opening, and a sealed position, in which the splitter seals the outflow opening.

The fire safety sprinkler head has the advantage that it may be sealed or open depending on the position of the splitter. During normal use, i.e. a non-fire situation, the fire safety sprinkler head may be sealed. Due to the fire safety sprinkler head being sealed, it is possible to at least partly fill the system of conduits to which the fire safety sprinkler head is connected with for example an inert gas. The inert gas replaces ambient air and therefore the oxygen in the ambient air, thereby preventing or reducing corrosion.

Throughout this application, the inert gas could be substituted by or supplemented with a corrosion inhibitor and/or biocide.

The corrosion inhibitor and/or biocide may be provided in a mixture with the inert gas and/or ambient air in a vapor form. Using the fire safety sprinkler head as described above, a relatively small amount of corrosion inhibitor and/or biocide could be used to protect the normally open system of conduits. Additionally, the fire safety sprinkler head prevents leakage of the corrosion inhibitor and/or biocide via the fire safety sprinkler head in an uncontrollable way, which may aid in mitigating environmental pollution.

The applicant has found that for example an inert gas may be used to prevent corrosion. In particular, nitrogen may be used. A nitrogen content of at least 98% inside the conduits was found to greatly reduce corrosion and thereby increase the lifetime of fire safety installations.

In the case of a fire the system of conduits may then be filled with an extinguisher liquid at a higher pressure, which forces open the fire safety sprinkler head by moving the splitter away from the outflow opening in the outflow direction towards its splitting position. The extinguisher liquid will then flow through the fire safety sprinkler head. To facilitate this, the splitter may be configured for withstanding a predetermined pressure in its sealed position, whilst moving towards its splitting position and thereby opening the outflow opening when subjected to a higher pressure.

This may be achieved in a variety of ways, one particular example of which is by providing the fire safety sprinkler head with pretensioning means for pretensioning the splitter towards the sealed position. This brings about the additional advantage that the pretensioning means automatically reseals the fire safety sprinkler head after a test or fire situation has occurred.

The invention departs from known fire safety sprinkler heads, which may be understood to have a permanently open position. Their splitters are not movable, and their outflow openings are not sealable by the splitter. The invention lies in providing a sealing position for the splitter, in which it seals the outflow opening. Accordingly, the splitter may be used to seal the fire safety sprinkler head multiple times. This advantage may be achieved even without pretensioning the splitter, e.g. by clamping or otherwise fixating the splitter in its sealing position so that it will move to its splitting position upon application of a strong enough force in the outflow direction. After a test or fire situation has occurred the splitter may be brought back to its sealing position in any suitable way, for example manually or by applying a mechanical or electromagnetic force thereon.

The invention may bring about a further advantage, in that when the fire safety sprinkler head is tested by running an extinguisher liquid through it, its splitter is simultaneously cleaned by the extinguisher liquid. This may increase the sealing capabilities of the splitter in its sealing position.

An even further advantage may be found in that the splitter, which is used for sealing the outflow opening, does not form an obstruction in the flow path of the extinguisher liquid when

liquid is flowing out of the outflow opening. As a matter of fact, the presence of a splitter may usually be required to divide the flow across a deflector to achieve a desired flow pattern.

It is noted that the splitter does not necessarily split the flow of extinguisher fluid into separate flows of liquid. Rather, the splitter normally divides a jet of extinguisher fluid coming from the outflow opening across a deflector, which deflects the extinguisher liquid into the desired directions. The splitter is however denoted as a splitter here, because it is the commonly used term in the technical field of fire safety sprinkler heads. As is known in the art, fire safety engineers choose a suitable cross section for the outflow opening and a suitable deflector morphology to achieve the desired flow pattern of extinguisher liquid. The flow pattern is also referred to as spray pattern and spray density.

Since the invention may provide for an unchanged flow path for extinguisher liquid compared to prior art fire safety sprinkler heads, i.e. with a fixed splitter, the same design parameters may be employed to achieve a desired spray pattern and spray density. The fire safety sprinkler head according to the invention is therefore particularly easy to implement in existing systems.

It is further noted that since liquids can flow through the main body as explained above, gases can also flow through the main body. Therefore, any fluid could flow through the main body.

Although the fire safety sprinkler head described above may be used to extinguish fire, it is most often used to prevent fire by cooling a fire hazardous installations before they would be ignited.

The extension of the outflow opening is herein understood to comprise a collection of positions achieved by projecting the outflow opening in the outflow direction. Although not strictly necessary, the outflow direction is normally substantially perpendicular to a plane in which the outflow opening extends. In a common fire safety sprinkler head arrangement, in which the fire safety sprinkler head is attached to a ceiling, the outflow direction points downwards from the outflow opening which itself extends in a horizontal plane just below the ceiling. In another common fire safety sprinkler head arrangement, multiple fire safety sprinkler heads are arrange at different circumferential positions around an object to protect, e.g. a tank containing flammable liquid. In such arrangements, the fire safety sprinkler head may for instance be mounted horizontally, the outflow direction of each fire safety sprinkler head pointing inwards to the object to be protected, and the outflow opening lying in a plane normal to the outflow direction. According to the invention however many different arrangements are possible.

Throughout this application liquid or extinguisher liquid may for example refer to seawater, brackish water, possibly fresh surface or potable water, possibly mixed together in any arbitrary ratio, possibly mixed with any kind of foaming agent.

It is noted that the fire safety sprinkler head described herein is particularly suitable for application in so called traditional open fire safety installations. Although upon application of the fire safety sprinkler head according to the invention to an open system, the system is arguable ‘closed’ by the splitter, such open systems still differ significantly from traditional sealed fire safety installations. A first difference is that according to the invention the outlet opening is sealed by the splitter in stead of by a separate breaking element. Furthermore, the traditional sealed systems rely on the detection function of the sealed fire safety sprinkler heads brought about by the breaking of the sealing element, whereas the fire safety sprinkler head according to the invention comprises no such breaking element.

The fire safety sprinkler head may comprise or consist of seawater and/or corrosion resistant materials.

In a particular embodiment of the fire safety sprinkler head according to the invention, the pretensioning means comprise a spring. The spring may be particularly suitable for providing a pretensioning force with which the splitter seals the outflow opening to keep the inert gas inside the conduit. However, when the pressure inside the conduit increases, e.g. due to the provision of extinguisher fluid at high pressure, the pretensioning force of the spring may be overcome so that the splitter moves to its splitting position.

The spring may for instance be made from or comprise a material that can withstand high temperatures, and/or low temperatures and/or corrosion. For example, the spring may be made from iconel or stainless steel entirely or in part.

It is noted that the spring, its dimensions and its stiffness, may be suitably chosen, for example dependent on the required force with which the splitter is pretensioned in is sealing position.

In another particular embodiment of the fire safety sprinkler head according to the invention, the splitter is mounted on a pin, which extends in the extension of the outflow opening, wherein the pin is moveably attached in its longitudinal direction with respect to the outflow opening by means of a guide. The pin and guide connection may allow movement of the splitter in only the outflow direction, which contributes to achieving the desired flow pattern by keeping the splitter at its splitting position when a liquid is flowing out of the outflow opening at sufficient speed and volume.

The guide may be attached to the main body by means of at least one arm and may be positioned at a side of the splitter opposite the main body. In this manner, it provides no flow obstruction between the splitter and the outflow opening. Preferably two opposing arms are provided.

The spring may in particular be a helical spring, which is coaxially provided around the pin.

Alternatively or additionally, the spring may be a compression spring provided between the splitter and the guide. This provides a compact construction.

In another embodiment of the fire safety sprinkler head the force with which the pretension means pretension the splitter to the sealed position is adjustable. By adjusting said force, differences in end point pressure may be compensated. The end point pressure may be defined here as the pressure in the system of conduit at the sprinkler head's location. The end point pressure may differ from one fire safety sprinkler head to another, for example due to the difference in length of conduit between them and the supply of inert gas, and/or due to a difference in altitude at which they are placed.

The fire safety sprinkler head according to the invention may comprise an adjustment screw for adjusting said force. The adjustment screw allows to easily and/or precisely adjust said force when installing the fire safety sprinkler head.

The adjustment screw may be tubular in shape, and be provided with an external thread on its outside. The thread may correspond to an internal thread on the inside of the guide, so that the adjustment screw can be screwed into the guide. The pin on which the splitter is attached may run through the tubular adjustment screw and be guided by it reciprocally in the outflow direction. The adjustment screw may include an abutment against which the compression spring between the splitter and the guide abuts. By screwing the adjustment screw further into the guide, or out of the guide, the abutment may be moved closer to or further from the outflow opening, thereby respectively increasing or decreasing the force with which the compression spring pretensions the splitter. The adjustment screw may be fixable in a desired position.

In another particular embodiment of the fire safety sprinkler head according to the invention the force with which the pretension means pretension the splitter towards the sealed position corresponds to an overpressure at the outflow opening of 0.5 bar, 1.5 bar or any value therebetween in steps of 0.1 bar. Corresponding to the overpressure herein means that the pretension force is equal to the gas pressure inside the system of conduits at the outflow opening multiplied by the surface area of the outflow opening. The applicant has found that such a pressure is high enough to prevent or reduce corrosion in the system of conduits when it is supplied with an inert gas, and low enough to guarantee opening of the fire safety sprinkler head when an extinguisher liquid is provided at its normal pressure. This normal pressure is usually around 10 – 12 bar. Moreover, when the pretensioning means comprise a spring chosen to provide such a force, the outflowing extinguisher liquid will push the splitter completely back into its splitting position, because the extinguisher liquid provides a force much bigger than the force provided by the pretensioning means. Therefore, the desired flow pattern can be determined with the assumption that the splitter is in its splitting position when extinguisher fluid is applied. Accordingly, the process of choosing the deflector morphology and outlet opening dimension can be unaltered with

respect to the prior art when a fire safety sprinkler head according to the invention is used with respect to a prior art fire safety sprinkler head.

The splitter may be made of or comprise a material known for its sealing properties. For example, the splitter may be made of or comprise plastic or rubber. The use of these materials, due to their elastic and/or deformable and/or compressible properties, may contribute to creating an effective seal with the main body to seal the outlet opening whilst being strong enough to divide the extinguisher fluid correctly over the deflector. In particular a sealing surface of the splitter may be made of or comprise plastic or rubber.

To make the fire safety sprinkler head more resistant to harsh environmental circumstances, the splitter may comprise a uv and/or heat and/or cold resistant material. In particular the fire safety sprinkler head may be configured for temperatures ranging from -50°C – +250°C.

The splitter may be substantially cone shaped, wherein an apex of the cone faces the outflow opening. A splitter of this shape creates a very effective seal of the outlet opening, while also allowing for a desired flow pattern of extinguisher fluid.

The effective sealing capabilities of the splitter may also be enhanced by providing the main body with a seal along the circumference of the outflow opening against which the splitter seals the outflow opening in its sealed position. Such a seal may be made of a material known for its sealing properties, such as e.g. rubber or silicon. In this case the splitter does not necessarily comprise a material known for its sealing properties, such as e.g. plastic or rubber, and may even be made of relatively hard material such as metal. The hard material may contribute to achieving the desired flow pattern, since it effectively divides the extinguisher fluid across the deflector.

The invention also relates to a fire prevention and/or extinguishing installation, comprising a system of conduits, a liquid supply which can be switched on and off connected to the system of conduits, a detection system configured to switch on the liquid supply in response to detecting a fire or fire hazard, at least one fire safety sprinkler head as described above in any one or more of the above described embodiments and/or having any one or more of the features described above, which sprinkler head is connected to the system of conduits, and a supply of inert gas and/or corrosion inhibitor and/or biocide connected to the system of conduits, arranged for at least partially filling the system of conduits with inert gas and/or corrosion inhibitor and/or biocide.

At least partially filling the system of conduits with inert gas may reduce corrosion inside said system of conduits, thereby preventing debris which could clog fire safety sprinkler heads and/or increase flow resistance in the system of conduits. The inert gas can for example be kept at high concentrations, e.g. at or above 98%, inside the system of conduits due to the closed state of the fire safety sprinkler head. When a fire is detected and the liquid supply is turned on, the pressure inside the system of conduits may rise, forcing open the fire safety sprinkler heads by

moving the splitters thereof to their splitting positions. The inert gas may flow out of the fire safety sprinkler heads first, after which liquid from the liquid supply flows out of the fire safety sprinkler heads for preventing or extinguishing fire.

As explained above, a corrosion-inhibitor and/or biocide may be used in stead of or in combination with the inert gas to prevent corrosion and/or microbial growth to bring about the advantages listed above with respect to the corrosion inhibitor and/or biocide.

To avoid leakages in the system, all fire safety sprinkler heads may be fire safety sprinkler heads as described above.

It is noted that the liquid supply may also be switched on for testing purposes without the detection of fire or fire hazard. In such a case, no fire or fire hazard is necessary for switching on the liquid supply.

Practically the liquid supply may be a liquid pump. The pump may for instance pump seawater from the sea into the system of conduits when activated.

The inert gas may be any suitable inert gas, which may usually be nitrogen. The supply of inert gas may be a nitrogen generator equipped with a possibly small buffer tank, which takes up ambient air and isolates nitrogen therefrom. The nitrogen generator may provide nitrogen at an elevated pressure of e.g. several bars.

It may be advantageous if a device for adjusting a gas pressure inside the system of conduits is provided between the supply of inert gas and/or corrosion inhibitor and/or biocide and the system of conduits. Using such a device the gas pressure may be kept substantially constant. In particular the device may be a so called Air Maintenance Device (AMD) which includes a pressure reducer. The AMD may be provided with an inert gas at a relatively high pressure, for instance nitrogen from the nitrogen generator, and allow the inert gas to flow into the system of conduits when the pressure inside the system of conduits is lower then a preset threshold. The AMD thus has the advantage that a minimum pressure of inert gas may be maintained, even if some inert gas leaks out of the system of conduits.

The system of conduits may further be provided with a gas purging device for continuously purging a preset amount of gas per unit of time. Using such a gas purging device may have one or more of the following advantages. Firstly, it provides an outflow for the mixture of gases inside the system of conduits. The mixture of gases comprises the inert gas and/or the corrosion inhibitor and/or the biocide, along with any impurities such as ambient air (if pure inert gas is desired) and vapor of extinguisher liquid. When the mixture is purged, some of the impurities are also purged. In combination with the device for adjusting the gas pressure this may be especially advantageous, since the gas pressure may then be supplemented with pure inert gas and/or the corrosion inhibitor and/or the biocide in the desired concentration. Thus, the concentration of inert gas and/or corrosion inhibitor and/or biocide in the system of conduits may continuously increase or tend

towards a desired concentration equal to the concentration in which it is supplied, and any newly introduced impurities in the system of conduits may be gradually removed. Secondly, when the gas is continuously purged in combination with the device for adjusting gas pressure, new inert gas and/or corrosion inhibitor and/or biocide is continuously introduced. This may contribute to lowering the dew point of the gas inside the system of conduits, thereby lowering the amount of extinguisher vapor in the gas. Corrosion may be reduced therewith.

The invention also relates to a method for protecting a fire prevention and/or extinguishing installation against corrosion, comprising the steps of: a) providing a system of conduits with at least one sealable fire safety sprinkler head, for example as explained above in any one or more of the above described embodiments and/or having any one or more of the features described above, wherein the sealable fire safety sprinkler head is sealed and opens at a certain overpressure; and b) at least partially filling the system of conduits with an inert gas and/or corrosion inhibitor and/or biocide.

As explained above the inert gas and/or corrosion inhibitor and/or biocide may be used to prevent corrosion in the system of conduits. The inert gas and/or corrosion inhibitor and/or biocide is substantially prevented from escaping the system of conduits via the sealed fire safety sprinkler heads. As explained below the gas may be purged controllably in stead. In case of fire, or in case of a test, an extinguisher liquid may be fed to the system of conduits at a pressure above said certain overpressure, thereby opening the sealable fire safety sprinkler head, for example by moving the splitters thereof to their splitting positions. The extinguisher fluid can then exit the fire safety sprinkler head to prevent or extinguish the fire.

The corrosion inhibitor and/or biocide may be provided in a mixture with the inert gas and/or ambient air in a vapor form. In the method as described above, a relatively small amount of corrosion inhibitor and/or biocide could be used to protect the normally open system of conduits. Additionally, the fire safety sprinkler head prevents leakage of the corrosion inhibitor and/or biocide via the fire safety sprinkler head, which may help to mitigate environmental pollution.

The inert gas may be nitrogen.

Step b) may be performed once, e.g. until a desired concentration of the inert gas is achieved inside the system of conduits. The desired concentration is preferably 98% or higher.

The method is particularly advantageous if a fire safety sprinkler head as described above in relation to the pretensioning means is used, since such a fire safety sprinkler will reseal itself after use. Therefore, after testing or after a fire situation, the fire safety sprinkler does not have to be reset manually or by any other suitable resetting means. In stead, the system of conduits can immediately be filled by the inert gas again, so that corrosion is once more prevented or reduced.

The method may further comprise a step of c) continuously supplementing the inert gas and/or corrosion inhibitor and/or biocide in the system of conduits up to a predetermined minimum

pressure, wherein said minimum pressure is less than said overpressure. Continuously supplementing the inert gas and/or corrosion inhibitor and/or biocide may aid in maintaining a desired gas pressure and/or maintaining and/or achieving a desired concentration and/or in reducing the dew point. The continuous supplementing may be achieved by an AMD, preferably connected to a nitrogen generator, preferably in combination with a purger as explained below.

Step c) may be performed after step b) has been completed, i.e. after a desired concentration has been achieved.

The method may also comprise the step of d) continuously purging a predetermined amount of gas per unit of time. As explained above, this may aid in removing impurities to increase the inert gas concentration and to lower the dew point of gas inside the system of conduits.

Before step b) the system of conduits may be flushed with fresh water and/or ambient air and/or a wide spectrum corrosion inhibitor, in any arbitrary suitable sequence. In particular, sea water may be used as extinguisher liquid. Fresh water may then be used to remove the salty sea water at least partly from the conduits, thereby reducing corrosion. Ambient air may be used after sea water or fresh water to remove water from the system of conduits, thereby also reducing corrosion. The corrosion inhibitor may be used to further prevent corrosion and/or microbial growth which may also damage or corrode the system of conduits.

The wide spectrum corrosion inhibitor may be supplied after flushing the system of conduits with fresh clean water and before the inert gas is introduced into the system. The wide spectrum corrosion inhibitor may be supplied in the form of a vapor.

It is especially advantageous if the wide spectrum corrosion inhibitor prevents microbial growth of anaerobic organisms. In combination with the replacement of oxygen by the inert gas as explained above, such a corrosion inhibitor prevents almost all microbial growth.

At least partly filling the system with inert gas in step b) may comprise temporarily supplying the inert gas at a pressure above said overpressure. This is particularly advantageous when after use, extinguisher liquid and/or ambient air is present in the system of conduits. By increasing the inert gas pressure to above said overpressure, the fire safety sprinkler heads will open, so that the extinguisher fluid and the ambient air can exit the system of conduits via the fire safety sprinkler heads. By supplying only pure inert gas and/or corrosion inhibitor and/or biocide in the desired concentration, the concentration of inert gas inside the system of conduits quickly increases or tends towards the desired concentration. The system of conduits may in this way be filled up to a relatively high concentration of inert gas, e.g. at least 95%, possibly even 98% or higher depending on nitrogen generator capacity, relatively quickly, e.g. in a matter of minutes or hours. It is especially advantageous if resealing fire safety sprinkler heads are used, so that upon reduction of the pressure, after sufficient reduction of the pressure, the fire safety sprinkler heads reseal and close the system of conduits automatically. The resealing fire safety sprinkler heads may

be those referred to above as comprising pretensioning means. The inert gas at elevated pressure may be temporarily supplied from high pressure inert gas cylinders to avoid the need of a larger generator and/or larger buffer tank. After the temporary supply of inert gas at elevated pressure, a continuous purging in combination with a continuous supply of inert gas and/or corrosion inhibitor and/or biocide may be applied to increase the inert gas concentration to 98% or above, or to achieve a desired concentration of corrosion inhibitor and/or biocide, over the following days or weeks.

The invention will be further explained with reference to the appended drawings, in which:

Figures 1A and 1B show a first embodiment of the fire safety sprinkler head in accordance with the invention schematically in side view, wherein figure 1A shows a splitter of the fire safety sprinkler head in a sealing position and figure 1B shows the splitter in a splitting position;

Figures 2 and 3 show a second embodiment of the fire safety sprinkler head in accordance with the invention, including an adjustment screw in differently adjusted states;

Figure 4 schematically shows an embodiment of the fire prevention and/or extinguishing installation according to the invention; and

Figure 5 schematically shows an embodiment of the method for protecting a fire prevention and/or extinguishing installation against corrosion according to the invention.

In the figures like reference numerals are used to refer to like elements. Like elements of different embodiments are referred to with reference numerals increased by one hundred (100).

Figures 1A and 1B show a fire safety sprinkler head 1 which can be used for preventing and/or extinguishing fire. The fire safety sprinkler head 1 includes a main body 2 through which liquid can flow (see arrow P in figure 1B). The liquid can be an extinguisher liquid, such as water or sea water. For this purpose the main body 2 is provided with a passage 3 between an inflow opening 4 and an outflow opening 5. The main body 2 comprises or consists of a seawater and corrosion resistant material, which may be a copper alloy with zinc or tin. Alternatively a stainless steel material or titanium could be used, or a combination of some or all of these materials. The skilled person appreciates that other parts of the fire safety sprinkler head 1 can be made of a the same or different materials, possibly having the same seawater and corrosion resistant properties. The main body 2 is provided on its outside with a thread 6. The thread 6 is normally used to attach the fire safety sprinkler head 1 to a conduit (not shown) which transports extinguisher fluid. Liquid flowing through the passage 3 in the main body 2 flows out the outflow opening 5 in an outflow direction 7. The fire safety sprinkler head 1 further comprises a splitter 8.

In figure 1B the splitter 8 is shown in an extension of the outflow opening 5 as seen in the outflow direction 7 at a splitting position. With the splitter 8 at this position, liquid flowing out of the outflow opening 5 moves in the outflow direction 7 until it reaches the splitter 8. Generally the liquid at this point has the form of a jet. The splitter 8 then divides the liquid by bending it

somewhat outwards. For this reason, the splitter 8 shown is of conical shape. An apex of the conical shape faces the outflow opening 5. Next, the liquid reaches a deflector 9 which is connected to or integrally formed with the splitter 8 at an downstream end of the splitter 8 as seen in the outflow direction 7 and which deflects at least some of the liquid even further outwards. The flowing liquid is shown by dotted lines 10. In some embodiments, the deflector also allows passage of liquid in an undeflected manner, so as to create a dense flow pattern downstream of the fire safety sprinkler head 1. By choosing a suitable splitter and/or deflector, a suitable spray pattern and spray density is obtained.

The splitter 8 of the fire safety sprinkler head 1 according to the invention is moveable in the outflow direction 7. In this case, it is moveable back and forth in the outflow direction 7. The splitter 7 may move between the splitting position as shown in figure 1B, wherein the outflow opening 5 is left free, i.e. unblocked and/or not sealed by the splitter 8, and a sealed position shown in figure 1A. In the sealed position the splitter 8 seals the outflow opening 5, thereby blocking it, so that no liquidand/or gas can flow out of the outflow opening 5. The splitter 8 is maintained in its sealed position and only moves from its sealed position to its splitting position upon the application of sufficient force upon the splitter 8 in the outflow direction 7. This may be achieved for instance by clamping or otherwise fixating the splitter 8 in the outlet opening 5 in the main body, or using pretension means as explained below, wherein the splitter will move to its splitting position when for example a flow of extinguishing liquid with sufficient pressure is fed to the fire safety sprinkler head 1.

As an example, the fire safety sprinkler head 1 shown in figures 1A and 1B is provided with pretensioning means 11, which pretension the splitter 8 towards its sealed position. Because of its conical shape, the splitter 8 somewhat protrudes into the passage 3 through the outlet opening 5, and seals the outlet opening 5 by pushing against the main body 2 along the circumference of the outlet opening 5, due to the pretensioning force of the pretensioning means 11. As a result, a liquid and/or gas inside the passage 3 will not exit the fire safety sprinkler head 1 through the outlet opening, unless it is under a pressure large enough to overcome the pretensioning force with which the pretensioning means 11 force the splitter 8 against the main body 2. When the pressure of liquid or gas in the passage 3 increases, for example by increasing the pressure in a system of conduits upstream of the fire safety sprinkler head 1, said liquid or gas will push the splitter 8 away from the main body 2 and the outflow opening 5 as a result of the increased force. When the surface area of the outflow opening 5 multiplied by the pressure of the liquid or gas exceeds the pretensioning force, a net force on the splitter 8 in the outflow direction 7 will remain. The splitter 8 will therefore move in the outflow direction 7, i.e. away from the main body 2 and the outflow opening 5, thereby no longer sealing or blocking the outflow opening 5 as shown in figure 1B. As a result, the liquid or gas present in the passage 3 will be pushed out through the outflow opening 5,

hit the splitter 8 and finally be deflected by the deflector 9. The liquid or gas exiting the outflow opening 5 continues to hit the splitter 8 also in the splitting position thereof, since it is disposed in an extension of the outflow opening 5 in the outflow direction 7, i.e. in a position corresponding to a projection of the outflow opening 5 in the outflow direction 7. The liquid or gas therefore continues to apply a force in the outflow direction 7 on the splitter 8, thereby forcing it into and keeping it in its splitting position as long as the flow of liquid or gas is of sufficient velocity and volume. When the supply of liquid or gas is stopped or sufficiently reduced, i.e. by lowering the pressure upstream of the fire safety sprinkler head 1, the liquid or gas no longer pushes the splitter 8 away from the outflow opening 5 with a force strong enough to overcome the pretensioning means 11. The pretensioning means 11 therefore bring the splitter 8 back to its sealing position, thereby automatically resealing the outflow opening 5, so that the fire safety sprinkler head 1 is again sealed.

The fire safety sprinkler head 1 can be used advantageously to prevent corrosion in systems of conduits to which the fire safety sprinkler head 1 can be attached. Using the sealed position of the splitter 8, the system of conduits can be at least partially filled with an inert gas, such as nitrogen, which the applicant has found reduces corrosion dramatically, especially when nitrogen concentrations of 98% are used. Alternatively or additionally a corrosion inhibitor and/or a biocide in a desired concentration could be used. The inert gas is supplied at a relatively low pressure, i.e. not enough to overcome the pretensioning force, so that the fire safety sprinkler heads 1 remain sealed and nitrogen stays within the system of conduits. In case of a fire, the pressure inside the system of conduits is increased by feeding an extinguisher liquid, such as water, to the system of conduits. By virtue of the increase in pressure, the fire safety sprinkler heads 1 will open as explained above and allow fire prevention or extinguishing. Although the fire safety sprinkler head 1 shown has pretensioning means 11, it may very well function without such pretension means 11. The fire safety sprinkler head 1 could for instance withstand a determined amount of pressure by clamping or otherwise fixating the splitter 8 in the outflow opening 5, or by comprising actuators connected with a fire detection system for moving the splitter to its splitting position.

In the shown embodiment however, pretensioning means 11 are provided as a spring 11. The spring 11 is a helical compression spring 11, which is disposed coaxially around a pin 12 which is movably guided by a guide 13. The pin 12 is disposed parallel to the outflow direction 7 with its longitudinal axis, and is in particular disposed coaxial with the outflow opening 5, and can move in its longitudinal direction with respect to the guide 13. Therefore, the pin 12 can move reciprocally with respect to the guide 13 back and forth in the outflow direction 7. The spring 11 is a compressing spring 11 disposed between the guide 13 and the splitter 8. The splitter 8 is fixed on the pin 12, and therefore reciprocally movable with the pin 12 with respect to the guide 13 back and forth in the outflow direction 7. The guide 13 is fixed to the main body 2 by two arms 14.

Another number of arms 14 could be used. The arms 14 fix the guide 13 behind the splitter 8 as seen in the outflow direction 7, i.e. on a side of the splitter 8 opposite the main body 2. Therefore, liquid or gas flowing out of the outflow opening 5 can flow unobstructed to the splitter 8. This contributes to creating a desired flow pattern downstream of the fire safety sprinkler head 1. The pin 12 may be made of or comprise the same materials as the main body 2.

The pretensioning means 11 of the embodiment shown in figures 1A and 1B push the splitter 8 against the main body 2 at the outflow opening 5 with a force of approximately 0,6 bar. However, other forces between 0,5 bar and 1,5 bar, in steps of 0,1 bar may be used. The desired force may for example be achieved by chosing a spring with a desired spring constant. The splitter 8 in this embodiment comprises a plastic, although a rubber could also have been used. The plastic or rubber deforms slightly to provide an effective seal around the circumference of the outflow opening 5 to the main body 2. Alternatively or additionally, the circumference of the outflow opening 5 could be provided with a seal, of e.g. plastic or rubber material, so that the splitter 8 can effectively seal the outflow opening 5. Using such a seal, the splitter 8 may be made of a relatively hard material such as metal. Advantageously the splitter shown is made of a uv, heat and cold resistant material.

Figures 2 and 3 show a second embodiment of the fire safety sprinkler head 101 according to the invention, which is equal to the embodiment shown in figures 1A and 1B unless stated otherwise. The fire safety sprinkler head 101 of the second embodiment is provided with an adjustment screw 115 which can be fixed in a desired position. The adjustment screw 115 is tubular in shape and is provided with an external thread 116 with which it is connected to the guide 113, which for this purpose is provided with an interior thread 117. The pin 112 runs through the adjustment screw 115 and is guided therein. The adjustment screw 115 allows reciprocal motion of the pin 112 along its longitudinal axis, i.e. in the outflow direction 107. The adjustment screw 115 is provided with an abutment 118 against which the pretensioning means 111 abut. By screwing the adjustment screw 115, the abutment may be moved closer to or further away from the outlet opening 105. Therefore, the available space for the pretensioning means 111 can be reduced or decreased by screwing the adjustment screw 115. Figure 2 shows the second embodiment in a first situation, wherein the adjustment screw is rotated away from the outlet opening 105, thereby leaving more space for the pretensioning means 111, which are therefore relatively less compressed in figure 2. Therefore, the force of the pretensioning means, with which they force the splitter 108 against the main body 102 at the outflow opening 105 is relatively small. In figure 3 however, the adjustment screw 115 has been rotated with respect to the guide 113, and thereby moved further towards the outlet opening 105. A smaller distance for the pretensioning means 111 therefore exists between the abutment 118 and the outlet opening 105. Consequently the pretensioning means 111 of figure 3 are more compressed than those of figure 2. The force of the

pretensioning means 111 on the main body 102 is therefore bigger. As understood from figures 2 and 3 and the description above, the adjustment screw 115 can be used to adjust the force with which the pretensioning means 111 pretension the splitter towards its sealed position. Although in the example shown this has been achieved by an adjustment screw 115, other ways of adjusting the pretensioning force are considered.

Figure 4 shows a fire prevention and/or extinguishing installation 250. The installation 250 includes a system of conduits 251 capable of conducting liquids and gases. The system of conduits is connected to a liquid supply 252 which can be switched on and off as desired. The liquid supply 252 is connected, for instance electrically, with a detection system 253 capable of detecting fire or fire hazards. Upon detection of a fire or fire hazard, the detection system 253 switches on the liquid supply 252, which then fills the system of conduits 251 with liquid. The liquid may be an extinguisher liquid such as water or seawater. The system of conduits 251 supplies at least one fire safety sprinkler head 201 with liquid or gas. The fire safety sprinkler head 201 may be a fire safety sprinkler head 1, 101 as described above. The installation 250 further includes a supply of inert gas 254, which can at least partially fill the system of conduits with inert gas. The inert gas can be nitrogen the supply of inert gas may alternatively or additionally supply a corrosion inhibitor and/or biocide, preferably in a vapor form. The corrosion inhibitor and/or biocide may be provided in a mixture with e.g. the inert gas or ambient air, in a desired concentration. In a normal situation, i.e. when no fire or fire hazard is detected, the liquid supply 252 is switched off. The supply of inert gas 254 is then used to fill the system of conduits 251 with inert gas. This reduces or prevents corrosion of the conduits in system of conduits 251. The fire safety sprinkler heads 201 are at this point sealed, since the inert gas is supplied at a relatively low pressure, which is not high enough to open the sealed fire safety sprinkler heads 201. In case of a fire or fire hazard, the detection system 253 switches on the liquid supply 252, which provides liquid to the system of conduits in 251 at relatively high pressure, i.e. at a pressure high enough to open the fire safety sprinkler heads 201, so that the liquid will flow out of the fire safety sprinkler heads 201 as shown in the figure. The liquid supply 252 may also be switched on to test the installation 250, without detecting fire or a fire hazard.

Optionally the installation 250 is provided with a device 255 for adjusting the gas pressure inside the system of conduits 251 between the inert gas supply 254 and the system of conduits 251. The device 255 may be a so called Air Maintenance Device (AMD). The AMD may include a pressure redactor, for reducing pressure coming from the inert gas supply 254 to a preset pressure (preferably below the pressure required for opening the fire safety sprinkler heads 201). The installation 250 optionally also comprises a gas purger 256 for continuously purging a preset amount of gas per unit of time. The combination of the AMD and the gas purger 256 conduce an installation 250 which is continuously supplied with an amount of inert gas. This may contribute to

increasing the concentration of inert gas in the system of conduits, e.g. to above 98%, and to reducing moisture by lowering the dew point.

In practice the liquid supply 252 may be a pump for pumping sea water into the system of conduits. The inert gas supply may be a nitrogen generator which extracts nitrogen from ambient air and outputs it at increased pressure.

Figure 5 schematically shows the steps of the method M according to the invention. The method begins with a first step S1 of providing a system of conduits with at least one sealable fire safety sprinkler head, wherein the sealable fire safety sprinkler head is sealed and opens at a certain overpressure. The fire safety sprinkler heads may be those according to the invention as described above, or any other suitable sealable fire safety sprinkler head. The method continues with a second step S2 of at least partially filling the system of conduits with an inert gas, such as nitrogen at a concentration of 98% or more. The second step S2 may be performed by temporarily supplying the inert gas to the system of conduits at a pressure above said overpressure. The method M may end there. However, a first optional step O1 may be included after the second step S2 of continuously supplementing the inert gas in the system of conduits up to a predetermined minimum pressure, wherein said minimum pressure is less than said overpressure. A second optional step O2 of continuously purging a predetermined amount of gas per unit of time may also be performed. The first and second optional steps O1 and O2 may be conduced continuously and simultaneously as long as desired. Before the second step S2, a third optional step O3 of flushing the system of conduits with fresh water and/or ambient air and/or wide spectral corrosion inhibitor, in any arbitrary suitable sequence, may be performed.

It is noted that the invention is not limited to the shown embodiments but also extends to variants within the scope of the appended claims.

**Conclusies**

1. Brandbeveiligingssprinklerkop voor preventie en/of het blussen van brand, omvattende:

- een door vloeistof doorstroombaar hoofdlichaam;
- een uitstroomopening in het hoofdlichaam ingericht voor het daaruit stromen van vloeistof in een uitstroomrichting; en
- een splitter, die in de uitstroomrichting gezien in een verlengde van de uitstroomopening op een verspreidingspositie is geplaatst,

**met het kenmerk, dat** de splitter in de uitstroomrichting verplaatsbaar is tussen de genoemde verspreidingspositie, waarin de splitter de uitstroomopening vrijgeeft, en een gesloten positie, waarin de splitter de uitstroomopening afsluit.

2. Brandbeveiligingssprinklerkop volgens conclusie 1, waarbij de brandbeveiligingssprinklerkop is voorzien van voorspanmiddelen voor het naar de gesloten positie voorspannen van de splitter.

3. Brandbeveiligingssprinklerkop volgens conclusie 2, waarbij de voorspanmiddelen een veer omvatten.

4. Brandbeveiligingssprinklerkop volgens één der voorgaande conclusies, waarbij de splitter op een pen is bevestigd, die zich in het verlengde van de uitstroomopening uitstrekt, waarbij de pen ten opzichte van de uitstroomopening in zijn lengterichting verplaatsbaar is bevestigd door middel van een geleider.

5. Brandbeveiligingssprinklerkop volgens conclusie 4, waarbij de geleider door middel van ten minste één arm aan het hoofdlichaam bevestigd is en zich aan een tegenover het hoofdlichaam gelegen zijde van de splitter bevindt.

6. Brandbeveiligingssprinklerkop volgens één der voorgaande conclusies, waaronder ten minste conclusies 3 en 4, waarbij de veer een helixvormige veer is, die coaxiaal om de pen heen is aangebracht.

7. Brandbeveiligingssprinklerkop volgens conclusie 6, waarbij de veer een drukveer is die tussen de splitter en de geleider is aangebracht.

8. Brandbeveiligingssprinklerkop volgens één der conclusies 2 - 7, waaronder ten minste conclusie 2, waarbij een kracht waarmee de voorspanmiddelen de splitter naar de gesloten positie voorspannen instelbaar is.

9. Brandbeveiligingssprinklerkop volgens conclusie 8, verder voorzien van een stelschroef voor het instellen van de voornoemde kracht.

10. Brandbeveiligingssprinklerkop volgens één der conclusies 2 – 9, waaronder ten minste conclusie 2, waarbij een of de kracht waarmee de voorspanmiddelen de splitter naar de gesloten positie voorspannen overeenkomt met een overdruk bij de uitstroomopening van 0,5 bar, 1,5 bar, of eenieder welke tussengelegen waarde in stappen van 0,1 bar.

11. Brandbeveiligingssprinklerkop volgens één der voorgaande conclusies, waarbij de splitter kunststof of rubber omvat.

12. Brandbeveiligingssprinklerkop volgens één der voorgaande conclusies, waarbij de splitter van een uv- en/of hitte- en/of koudebestendig materiaal is vervaardigd.

13. Brandbeveiligingssprinklerkop volgens één der voorgaande conclusies, waarbij de splitter in hoofdzaak conusvormig is, waarbij een apex van de conusvorm naar de uitstroomopening is gericht.

14. Brandbeveiligingssprinklerkop volgens één der voorgaande conclusies, waarbij het hoofdlichaam over de omtrek van de uitstroomopening is voorzien van een afdichting waartegen de splitter de uitstroomopening afdicht in zijn gesloten positie.

15. Brandpreventie- en/of brandblusinstallatie, omvattende:

- een systeem van leidingen;
- een met het systeem van leidingen verbonden vloeistoftoevoer die in- en uitschakelbaar is;
- een detectiesysteem dat is ingericht om de vloeistoftoevoer in te schakelen in reactie op het detecteren van een brand of brandgevaar;
- ten minste één met het systeem van leidingen verbonden brandbeveiligingssprinklerkop volgens één der voorgaande conclusies; en

- een met het systeem van leidingen verbonden toevoer van inert gas en/of corrosie-inhibitor en/of biocide, voor het althans gedeeltelijk met het inerte gas en/of de corrosie-inhibitor en/of de biocide vullen van het systeem van leidingen.

16. Brandpreventie- en/of brandblusinstallatie volgens conclusie 15, waarbij tussen de toevoer van het inerte gas en/of de corrosie-inhibitor en/of biocide en het systeem van leidingen een inrichting is aangebracht voor het aanpassen van een gasdruk in het systeem van leidingen.

17. Brandpreventie- en/of brandblusinstallatie volgens conclusie 15 of 16, verder voorzien van een met het systeem van leidingen verbonden gasaflaatinrichting voor het continu aflaten van een vooraf ingestelde hoeveelheid gas per tijdseenheid.

18. Werkwijze voor het tegen corrosie beschermen van een brandpreventie- en/of brandblusinstallatie, omvattende stappen van:

a) het van ten minste één afsluitbare brandbeveiligingssprinklerkop, bijvoorbeeld volgens één der conclusies 1 – 14, voorzien van een systeem van leidingen van de brandpreventie- en/of brandblusinstallatie, waarbij de afsluitbare brandbeveiligingssprinklerkop is afgesloten en opent bij een bepaalde overdruk; en

b) het althans gedeeltelijk met een inert gas en/of een corrosie-inhibitor en/of biocide vullen van het systeem van leidingen.

19. Werkwijze volgens conclusie 18, verder omvattende een stap van:

c) het continu tot een vooraf bepaalde minimumdruk aanvullen van het inerte gas en/of de corrosie-inhibitor en/of de biocide in het systeem van leidingen, waarbij de voornoemde minimumdruk onder de bepaalde overdruk ligt.

20. Werkwijze volgens conclusie 19, verder omvattende een stap van:

d) het continu aflaten van een vooraf bepaalde hoeveelheid gas per tijdseenheid.

21. Werkwijze volgens één der conclusies 18 – 20, waarbij vóór stap b) het systeem van leidingen wordt gespoeld met zoet water, en/of omgevingslucht, en/of een breedspectrumcorrosieinhibitor, in willekeurig welke geschikte volgorde.

22. Werkwijze volgens één der conclusies 18 - 21, waarbij in stap b) tijdelijk inert gas en/of corrosie inhibitor en/of biocide aan het systeem van leidingen toe wordt gevoegd met een druk die hoger is dan de bepaalde overdruk.

**Abstract**

The invention relates to a fire safety sprinkler head for preventing and/or extinguishing fire, comprising a main body through which liquid can flow, an outflow opening in the main body for the flowing out of liquid thereof in an outflow direction, and a splitter, disposed in an extension of the outflow opening as seen in the outflow direction at a splitting position, wherein the splitter is moveable in the outflow direction between said splitting position, in which the splitter leaves free the outflow opening, and a sealed position, in which the splitter seals the outflow opening. The invention also relates to a fire prevention and/or extinguishing installation comprising such a fire safety sprinkler head and a method for preventing corrosion in such an installation.