

DESCRIPTION

[0001] The present invention refers to a control system and process against an occlusion for fog-generating device.

[0002] Fog-generating devices are known in the art, adapted to deliver thermal energy to a fog-generating liquid, typically based on glycols, in order to make this latter one quickly change its phase and afterwards condensate it into droplets which are sufficiently fine as not to be deposited and sufficiently big as to create scattering under visible radiation.

[0003] Such known fog-generating devices, and in particular those whose function is preventing robberies, can incur in the intentional occlusion of their outlet nozzle: in this case it is therefore impossible for the device to emit fog in case of need, lacking its operation.

[0004] Currently, the only possible solution to verify the correct operation of the nozzle and the absence of possible occlusions (intentional or accidental) which could impair or even prevent the correct operation of the related fog-generating device is a periodic visual check of the presence of clogging before arming the device itself (with direct vision, videocameras or other): however, this solution is uncomfortable and unreliable, since the clogging could be pushed downwards inside the nozzle, consequently resulting invisible. In this case, the tampering could be pointed out only by performing a test shoot and verifying the results, thing which is clearly not feasible.

[0005] Object of the present invention is solving the above prior art problems, by providing a system and a control process against an occlusion for fog-generating device adapted to allow at least detecting, and signaling, in an automatic way, the presence of possible occlusions, for example present in the fog delivery circuit and/or in the nozzle of the device itself, which could impair the correct fog delivery operation. While such a system and control process against an occlusion in fog generating devices is principally known from DE 196 00 359 C1, another object of the present invention is providing a system and a control process against an occlusion for fog-generating device adapted to allow the automatic removal of the detected occlusion.

[0006] The above and other objects and advantages of the present invention, as will result from the following description, are obtained with a control system against an occlusion for fog-generating device as claimed in claim 1.

[0007] Moreover, the above and other objects and advantages of the invention are obtained with a control process against an occlusion for fog-generating device as claimed in claim 9.

[0008] Preferred embodiments and non-trivial variations of the present invention are the subject matter of the dependent claims.

[0009] It is intended that all enclosed claims are an integral part of the present description.

[0010] It will be immediately obvious that numerous variations and modifications (for example related to shape, sizes, arrangements and parts with equivalent functionalities) could be made to what is described, without departing from the scope of the invention as appears from the enclosed claims.

[0011] The present invention will be better described by some preferred embodiments thereof, provided as a non-limiting example, with reference to the enclosed drawings, in which:

- Figure 1 shows a general schematic view of the example combinations of the components possibly present in some preferred embodiments of the control system against an occlusion according to the present invention;
- Figure 2 shows a schematic view of a first preferred embodiment of the control system against an occlusion according to the present invention;
- Figure 3 shows a schematic view of a second preferred embodiment of the control system against an occlusion according to the present invention;
- Figure 4 shows a schematic view of a third preferred embodiment of the control system against an occlusion according to the present invention; and
- Figure 5 shows a schematic view of a fourth preferred embodiment of the control system against an occlusion according to the present invention.

[0012] In order to shorten the description, obviously descriptions related to common parts and components with the prior art fog-generating devices and necessary for the basic operation of the devices themselves will not be dealt with, since they are deemed widely known in the art, such as for example electric supply systems, managing systems, gas compressing and channeling systems, boilers, containers of the pressurized fog-generating fluid, thermal accumulators, etc., to describe in particular detail the aspects and the components characterizing the system and the control process against an occlusion 1 according to the present invention.

[0013] With reference then to the Figures, it is possible to note some possible and preferred embodiments of the control system against an occlusion 1, total or partial one, for a fog-generating device. In particular, it is functionally useful to point out, for the purposes of describing the control system against an occlusion 1 according to the present invention, that such fog-generating device, like those substantially known in the art, can comprise at least one container 3a, 3b containing therein at least one fog-generating fluid, possibly pressurized, such fluid being of a substantially known type in the art, at least one thermal energy exchanger 5 (possibly adapted to accumulate energy in thermal form) adapted to generate a phase passage of at least one of such fog-generating fluids coming from one or more of such containers 3a, 3b in a fog-generating gas, and at least one delivery nozzle to the external environment of such fog-generating gas from such thermal energy exchanger 5.

[0014] If, as known, the fog-generating fluid is pressurized inside its related container 3b, as

shown for example in particular in Figures 1, 4 and 5, this latter one can be connected to at least one thermal energy exchanger 5 by interposing at least one first valve means 11 (composed, for example, of at least one check valve) adapted to be driven when opening, for example through an electric or mechanic drive, in order to allow the passage of the fog-generating fluid from the related container 3b to at least one thermal energy exchanger 5, for example through a related duct 13.

[0015] Alternatively, if, as known, the fog-generating fluid is not pressurized inside the related container 3a, as shown for example in particular in Figures 1, 2 and 3, this latter one can be connected to at least one thermal energy exchanger 5 by interposing at least one first pumping means 15 whose operation is driven, for example through an electric or mechanic drive, in order to allow pumping with adequate pressure the fog-generating fluid from its related container 3a to at least one thermal energy exchanger 5, for example through such duct 13.

[0016] In general, the system and the control process against an occlusion according to the present invention, as can be described below in more detail, allow verifying the presence of possible occlusions, total or partial ones, which impair or prevent the delivery of fog-generating gas 9 through the nozzle 7 pressurizing one or more thermal energy accumulators 5, such as for example a boiler, present in the related fog-generating device, by introducing a compressed control fluid, composed for example of at least one compressed gas or of a liquid with boiling temperature sufficiently low to be able to create a steam which pressurizes such thermal energy accumulators 5, and, through at least one pressure measuring means, measure the pressure inside the thermal energy exchanger 5: if the pressure inside such thermal energy exchanger 5 rises over an established threshold value, and substantially the pressure value present in case of flow of fog-generating gas 9 with completely free nozzle 7, one is able to detect the presence of at least one total or partial occlusion.

[0017] Advantageously, therefore, the control system against an occlusion 1 according to the present invention comprises:

- at least one pressurizing means 17 of at least one control fluid adapted to be inserted compressed in at least one such thermal energy exchanger 5, such pressurizing means 17 being adapted to internally generate for such thermal energy exchanger 5 a control compression through such control fluid;
- at least one measuring means 19 of at least one pressure control value P_c of such control compression generated by such control fluid inside at least one of such thermal energy exchangers 5;
- at least one comparing means (not shown) between such pressure control value P_c and at least one normal pressure threshold value P_s adapted to verify if $P_c > P_s$; and
- at least one signaling means (not shown) adapted to emit at least one alert signal for a present occlusion if such comparing means detects at least that $P_c > P_s$, for example through one or more optical systems and/or acoustic systems and/or through remotizing through electric connection and/or telematic network connection and/or cellular network.

[0018] With reference to the Figures, it is possible to note that the mode for making such pressurizing means 17 can be multiple. As an example, herein below some variations of such means 17 will be described, taking into account that the skilled person in the art could make other functionally equivalent means, without therefore departing from the scope of the present invention.

[0019] Therefore, with particular reference to Figures 1, 2 and 3, it is possible to note that such control fluid can be any non-pressurized fluid, such as for example a gas (preferably inert gas), ambient air, a liquid (preferably water or any other liquid having a boiling temperature lower than the operating temperature of the thermal energy exchanger 5, so that the following passage of the control fluid to the vapor state generates the pressurization of the thermal energy exchanger 5 itself and the generation therein of the control compression) and such pressurizing means 17 can comprise at least one related pumping means for gas 21 or at least one related pumping means for liquids 23, such pumping means 21, 23 being composed, for example, of one or more volumetric pumps, which are speed-controlled or not.

[0020] In particular, with reference to Figures 1 and 2, it is possible to note that the pressurizing means 17 comprise at least one pumping means for gas 21 adapted to compress the non-pressurized control fluid in gaseous form coming from a related container (not shown) or taken by the external environment, such as for example ambient air, and to pump it inside the thermal energy exchanger 5, for example through the same duct 13.

[0021] Alternatively, with reference to Figures 1 and 3, it is possible to note that the pressurizing means 17 comprise at least one pumping means for liquids 23 adapted to compress the non-pressurized control fluid in liquid form, for example water, contained in a related container of the control fluid 25 and to pump it inside the thermal energy exchanger 5, for example through the same duct 13.

[0022] With particular reference instead to Figures 1, 4 and 5, it is possible to note that, as further alternative, such control fluid can be any pressurized fluid, such as for example a gas, a liquid, a gas/liquid mixture, contained in at least one related pressurized container or bottle 27 and such pressurizing means 17 can comprise at least one related control valve means 29 interposed between such pressurized container or bottle 27 and the thermal energy exchanger 5, such control valve means 29 being composed, for example, by one or more proportional valves or not (if one is not interested in checking the amount of flow of the control fluid).

[0023] In particular, with reference to Figures 1 and 4, it is possible to note that the pressurizing means 17 comprise at least one control valve means 29 adapted to be opened to allow the pressurized control fluid as gas/liquid mixture contained in the related pressurized container or bottle 27 to reach the thermal energy exchanger 5, for example through the same duct 13.

[0024] Alternatively, with particular reference to Figures 1 and 5, it is possible to note that the pressurizing means 17 comprise at least one control valve means 29 adapted to be opened to allow the compressed control fluid as gas contained in the related pressurized container or bottle 27 to reach the thermal energy exchanger 5, for example through the same duct 13.

[0025] Advantageously, the measuring means 19 can indifferently be of the analogue or digital type.

[0026] In case of measuring means 19 of the analogue type, the output signal given by the pressure control value P_c could be fetched by suitable processing means of such signal (not shown) which, depending on the occlusion amount detected by the comparing means adapted to compare such pressure control value P_c with the normal pressure threshold value P_s , could identify even partial occlusions.

[0027] In case of measuring means 19 of the digital type (composed, for example, by a mechanical pressure switch), the identified occlusion level will depend on the calibration of the pressure switch and on the flow of control fluid inserted in the thermal energy exchanger 5. Moreover, in case of measuring means 19 of the digital type, the presence of signal processing means could be not necessary, but the signal itself could be directly applied, by interposing the comparing means, to the signaling means composed, for example, through such one or more optical and/or acoustic systems or directly remotized.

[0028] Moreover, the control system against an occlusion 1 according to the present invention can cooperate with the managing system of the emission of fog-generating gas of the related fog-generating device in such a way that, if the comparing means detects that $P_c > P_s$, the control system against an occlusion 1 is adapted to drive such managing system for delivering in the external environment, from the fog-generating device, at least one emission of fog-generating gas in order to try and free the detected occlusion.

[0029] The present invention further refers to at least one control process against a total or partial occlusion, for a fog-generating device comprising, for example, at least one container 3a, 3b containing therein at least one fog-generating fluid, possibly pressurized, such fluid being of a substantially known type in the art, at least one thermal energy exchanger 5 (possibly adapted to accumulate energy in thermal form) adapted to generate a phase passage of at least one fog-generating fluid coming from one or more containers 3a, 3b in a fog-generating gas, and at least one delivery nozzle in the external environment of such fog-generating gas from such thermal energy exchanger 5. Preferably, such fog-generating device further comprises at least one control system against an occlusion 1 like the previously described one, such control system against an occlusion 1 then comprising:

- at least one pressurizing means 17 of at least one control fluid adapted to be inserted compressed in at least one thermal energy exchanger 5, such pressurizing means 17 being adapted to internally generate to such thermal energy exchanger 5 a control compression through such control fluid;

- at least one measuring means 19 of at least one pressure control value P_c of such control compression generated by such control fluid inside at least one thermal energy exchanger 5;
- at least one comparing means (not shown) between such pressure control value P_c and at least one normal pressure threshold value P_s ; and
- at least one signaling means (not shown) adapted to emit at least one alert signal if such comparing means detect at least that $P_c > P_s$.

[0030] The process according to the present invention further comprises the steps of:

- providing at least one normal pressure threshold value P_s , substantially equal to the pressure value present inside such thermal energy exchanger 5 in case of flow of fog-generating gas with completely free nozzle;
- introducing at least one compressed control fluid inside such thermal energy exchanger 5, for example through at least one of such pressurizing means 17, for generating internally to such thermal energy exchanger 5 a control compression through such control fluid;
- detecting, for example through such measuring means 19, at least one pressure control value P_c of such control compression generated by such control fluid inside at least one of such thermal energy exchangers 5;
- comparing, for example through such comparing means, such pressure control value P_c with such normal pressure threshold value P_s ;
- if $P_c > P_s$, (acoustically, visually and/or through remotizing) emitting at least one alert signal for a present occlusion, for example through such signaling means.

[0031] Obviously, the above steps can be performed at any time and/or cyclically. The process according to the present invention further comprises the step, if $P_c > P_s$, of delivering at least one emission of fog-generating gas by such fog-generating device in order to try and free the detected occlusion.

[0032] Preferably, the flow of compressed control fluid should remain at least inside the thermal energy exchanger 5 for the whole time for which it is desired to protect the fog-generating device from a possible tampering.

[0033] The check of the presence of occlusions, in particular inside the nozzle 7, through the system and the process according to the present invention, should be preferably performed at all those times in which the fog-generating device can be vulnerable to an intruder or anyway before the device itself can start operating.

[0034] The vulnerability conditions which can cause a lack of efficiency are substantially of two

types:

- upon arming the device: in this case, implementing the process according to the present invention through the related control system against an occlusion 1 is used to detect the possible occlusion while there is personnel that activates the device itself and avoid that, in case of alarm (if the device has been tampered with) the device itself is inefficient;
- immediately after a delivery of fog-generating gas 9 because, depending on room sizes and delivery power, the fog-generating gas is projected away from the fog-generating device and, typically, above the areas to be protected with priority, for which, next to the machine, a visibility space remains for a certain time (variable from a few minutes to even a quarter of an hour if the room is very big), which can allow a possible intruder to approach and occlude the nozzle of the device with the purpose of coming back after some time, for example once the control people have passed, who could not be aware of the problem (above all if the "plug" is deeply inserted in the nozzle itself) and finish his theft without the protection of the fog-generating device: this is deemed as the time in which the fog-generating device is more vulnerable, because it is without surveillance and with the intruder present.

[0035] It is now possible to distinguish two further possible operating conditions of the fog-generating device on which different behaviours of the system and of the process according to the present invention have effects:

- case of activated and armed fog-generating device: in this case, it is assumed that the room in which such device resides is free of people and that the responsible personnel cannot quickly intervene and that the device itself is under such operating conditions that no operator is authorized to approach it. In this case, the system and the process can command the device, after an adequate acoustic and optical signaling, to take care by itself to perform a delivery of fog-generating gas lasting a few seconds with the purpose of trying and freeing the occlusion and, anyway, protect the room even if it has not received the anti-theft unit alarm, because, if there has been a way to occlude the nozzle, it can be assumed that there has also been a way to tamper with the system sensors and the occlusion-detecting signal can be considered by the system as alarming signal.
- case of activated and unarmed fog-generating device: if, during a routine check during the day, the system and process according to the present invention detect an occlusion, they provide for an optical, acoustic and/or remotized signaling, but do not conclude the attempt of freeing the fog-generating device from the occlusion itself, since it is assumed that there is personnel who can be immediately aware of the signaling and adequately intervene and, moreover, presumably this is an opening time of the protected room and there could be unprepared public that could get afraid with risks for the health of all people present. This latter case, however, does not form part of the present invention.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE19600359C1 [0005]

PATENTKRAV

1. Styringssystem mod en fuld eller delvis tilstopning (1) for en tågegenereringsanordning, hvilket system omfatter mindst én varmeenergigiveksler (5), eventuelt tilpasset til at akkumulere energi i varmeform, hvor varmeenergigiveksleren (5) er tilpasset til at generere en fasepassage af mindst ét tågegenererende fluid i en tågegenererende gas, hvilket system (1) endvidere omfatter:

mindst ét middel til tryksætning (17) af mindst ét styringsfluid, der er tilpasset til at blive indsat komprimeret i mindst én af varmeenergigivekslerne (5), hvilket tryksætningsmiddel (17) er tilpasset til internt at generere i varmeenergigiveksleren (5) en styringskompression via styringsfluidet; mindst ét målemiddel (19) af mindst én trykstyringsværdi P_c af styringskompressionen genereret af styringsfluidet inde i varmeenergigiveksleren (5); mindst ét sammenligningsmiddel mellem trykstyringsværdien P_c og mindst én normal tryktærskelværdi P_s tilpasset til at kontrollere, om $P_c > P_s$; og

mindst ét signaleringsmiddel tilpasset til at udsende mindst ét alarmsignal for en tilstedeværende tilstopning, hvis sammenligningsmidlet detekterer mindst, at $P_c > P_s$; kendetegnet ved, at styringssystemet er tilpasset til at samvirke med et system til håndtering af en emission af den tågegenererende gas fra tågegenereringsanordningen, således, hvis sammenligningsmidlet detekterer, at $P_c > P_s$, at styringssystemet mod antilstopning (1) tilpasses til at foranledige håndteringssystemet til at levere, i et eksternt miljø i forhold til tågegenereringsanordningen, mindst én udsendelse af den tågegenererende gas.

2. Styringssystem mod en tilstopning (1) ifølge det foregående krav, kendetegnet ved, at styringsfluidet er et fluid, der ikke er under tryk, og ved, at tryksætningsmidlet (17) omfatter mindst ét pumpemiddel (21; 23) tilpasset til at komprimere og pumpe styringsfluidet ind i varmeenergigiveksleren (5).

3. Styringssystem mod en tilstopning (1) ifølge det foregående krav, kendetegnet ved, at styringsfluidet, der ikke er under tryk, er udvalgt blandt gas, omgivende luft, væske, vand, væske med en kogetemperatur, der er lavere end en driftstemperatur for varmeenergigiveksleren (5).

4. Styringssystem mod en tilstopning (1) ifølge krav 1, kendetegnet ved, at styringsfluidet er et fluid under tryk, der er indeholdt i mindst én tilsvarende beholder eller flaske (27) under tryk, og tryksætningsmidlet (17) omfatter mindst ét styringsventilmiddel (29) indsat mellem

beholderen eller flasken (27) under tryk og varmeenergivesleren (5), hvor styringsventilmidlet (29) er tilpasset til at blive åbnet for at gøre det muligt for styringsfluidet under tryk at nå varmeenergivesleren (5).

5 5. Styringssystem mod en tilstopning (1) ifølge det foregående krav, kendetegnet ved, at styringsfluidet under tryk er udvalgt blandt gas, væske, gas/væskeblanding.

6. Styringssystem mod en tilstopning (1) ifølge krav 1, kendetegnet ved, at målemidlet (19) er af en analog eller digital type.

10

7. Styringssystem mod en tilstopning (1) ifølge krav 1, kendetegnet ved, at signaleringsmidlet er tilpasset til at fjernstyre alarmsignalet for en tilstedeværende tilstopning via en elektrisk forbindelse og/eller telematisk netværksforbindelse og/eller mobilt netværk.

15 8. Fremgangsmåde til styring mod en, hel eller delvis tilstopning, fortrinsvis via mindst ét styringssystem mod en tilstopning (1) ifølge et hvilket som helst af de foregående krav, for en tågegenereringsanordning, der omfatter mindst én varmeenergivesler (5) tilpasset til at generere en fasepassage af mindst ét tågegenererende fluid i en tågegenererende gas, der omfatter følgende trin:

20 tilvejebringelse af mindst én normal tryktærskelværdi P_s ;
introduktion af mindst ét komprimeret styringsfluid i varmeenergivesleren (5) for at generere, internt i forhold til varmeenergivesleren (5), en styringskompression via styringsfluidet;
detektering af mindst én trykstyringsværdi P_c for styringskompressionen genereret af styringsfluidet inde i varmeenergivesleren (5);

25 sammenligning af trykstyringsværdien P_c med den normale tryktærskelværdi P_s ; hvis $P_c > P_s$, udsendelse af mindst ét alarmsignal for en tilstedeværende tilstopning;
kendetegnet ved, at den endvidere omfatter trinnet med levering af mindst én udsendelse af den tågegenererende gas ved hjælp af tågegenereringsanordningen, hvis $P_c > P_s$.