Fire suppression system

Field of the invention

The present invention relates to a fire suppression system.

Background to the invention

There is a longstanding need for fire suppression apparatus in many sectors and environments. A key challenge is to provide fire suppression systems and apparatus which are appropriate for their context. For example while it is relatively straightforward to include fire suppression systems at the design stage of a new building development, it is not so straightforward to provide such systems in existing buildings – sometimes referred to as retro-fitting.

In other fields there may be different physical constraints in a particular context. For example in a wind turbine installation, it may be difficult to store sufficient fluid to suppress a fire, or it may be difficult to direct fluid from where it is stored to where it is needed.

Summary of invention

The present inventive concept provides a fire suppression system comprising fluid spray nozzles which are each in fluid communication with a pumping means, the pumping means being supplied with fluid by a reservoir, wherein flow through each spray nozzle is controlled by a control element.

The reservoir may be selectably in fluid communication with an external fluid source.

On activation, the system relies on fluid present in the reservoir. The reservoir may be supplemented with fluid from an external fluid source. Thus, when active, the system can supply more fluid through the nozzles than the initial volume stored in the reservoir.

The control element may comprise a frangible bulb. A frangible bulb is a known control element and a suitable bulb may be selected so as to break to allow fluid flow through the nozzle when a pre-determined temperature is reached. Alternatively a sprung arrangement may be used as a control element. Yet alternatively an open nozzle arrangement may be used wherein the control element controls the provision of fluid to the spray nozzle.

In a first envisaged application of the inventive concept, the fire suppression system is adapted for use in a domestic situation which comprises one or more zones, wherein each zone is provided with one or two fluid spray nozzles / heads which are each in fluid communication with a pumping means, the pumping means being supplied with fluid by a reservoir, wherein flow through each spray nozzle is controlled by a control element. The reservoir may be common to all zones, i.e. there may be only a single reservoir which supplies all zones.

This first envisaged application is aimed at the domestic fire suppression context. Especially, the first envisaged application is to a retro-fitted arrangement for existing domestic premises. One of the constraints on a retro-fitted domestic fire suppression system is the limit on water supplied to domestic premises. Whereas new-build development can ensure a broad supply of water for an in-built fire suppression system, a retro-fitted system must use the supply typical for existing homes. Thus, such a system must be provided with features in addition to a known system in order to address the aforementioned constraints.

In this first envisaged application the fire suppression system further comprises a pumping means capable of producing a water pressure of approximately 100 bar (10^7 Pa) at a flow rate of at least 24 litres per min (l/min). Preferably, the pumping means is capable of producing that pressure at a flow rate of approximately 28 l/min. This provides for head room, or small losses due to the configuration of the system.

The fluid spray nozzles are adapted to distribute substantially water, and are each adapted to distribute approximately 12 l/min.

Thus, the pumping means is adapted to supply up to two nozzles with 12 l/min each at approximately 100 bar.

As mentioned, such a fire suppression system addresses constraints set by the context. Thus whilst in an idealised setup there would be sufficient water supply to provide for a large number of nozzles to be active simultaneously, the present envisaged application provides for a situation in which only a domestic water supply and a limited reservoir is available. Furthermore, a pumping means suitable for suppling a large flow rate of water at the pressures mentioned is likely to be large, demanding of energy and expensive. Thus, in this first envisaged application of the inventive concept, we seek to address a situation in which a pumping means suitable for installation in a domestic premises can be used.

Thus, in this first envisaged application the fire suppression system may further comprise a control circuit and on or more valves connected to the control circuit to manage the flow of fluid from the reservoir to each fluid spray nozzle. The control circuit may thus manage a situation in which more than one zone is active simultaneously. This is believed to be unlikely, however, as domestic fires generally have a single source and therefore it will usually be possible to suppress such a single source within a single zone.

Each fluid spray nozzle may be arranged in co-operation with a respective diversion valve adapted to limit the flow of fluid to the nozzle. Thus, if the fluid pressure is such that otherwise the flow rate of fluid is likely to exceed a nominal flow rate, then excess pressure may be diverted back towards the reservoir. In this way, the flow rate through each nozzle may be maintained relatively consistently and the pumping means does not need to adapt in real time to the flow rate required by the one or two nozzles according to whether one or two are active.

The pumping means may be a multi-chamber pump. Preferably the pumping means is a six-chamber pump.

The pump may be electrically-powered. The pump may be connected to a domestic electricity supply via a phase converter. The pump may comprise a three-phase alternating current motor. A pump with a three-phase motor can switch between an idle or low-level operating mode and an active or high-level operating mode quickly. Therefore providing substantial instantaneous power for driving the pump, thereby pressurising the fluid from maintaining a holding pressure, to a fire suppression pressure.

In use, the fire suppression system of the first envisaged application maintains a holding fluid pressure in the region of the nozzle of approximately 20 bar when there is no flow through the nozzles in any zone. This pressure is monitored by a pressure sensor which is connected to the control circuit.

In the case when a fire breaks out, when a pre-determined threshold temperature is reached in the vicinity of a first fluid spray nozzle, a glass bulb – an exemplary control element - breaks. A suitable glass bulb is selected as the control element in accordance with the desired threshold temperature. The nozzle is said to be activated.

Once the control element no longer encumbers fluid flow through the nozzle, fluid begins to flow through the nozzle. The fluid pressure will then tend to fall as fluid flows into the environment. If the fluid pressure drops by a certain pre-determined amount for a pre-determined period, the pressure sensor transmits a signal to the control circuit. In response to that signal the pump increases to raise the fluid pressure to approximately 100 bar.

The pre-determined period may be approximately ten seconds.

The control means and/or the pumping means may be adapted to maintain the desired pressure. Alternatively or in addition a diversion valve may be provided to ensure that the flow rate and pressure are maintained.

If the fire is not suppressed by the fluid being sprayed by one nozzle, it may spread. If a pre-determined threshold temperature is reached in the vicinity of a second fluid spray nozzle, a glass bulb – similarly – breaks. In the situation where a second nozzle is activated, the fluid pressure may again drop. As a result the control means and pumping means may react to increase the flow rate. Alternatively or in addition, the diversion valve may cease diverting part of the flow back to the reservoir.

The reservoir is selected to be of a volume so that the fire suppression system can meet current standards, especially with regard to the length of time the suppression system can maintain operation while the fire brigade arrive. Currently, it is envisaged that the fire suppression system should be able to maintain the flow to two nozzles in a single zone for at least 30 minutes from activation.

A common domestic water supply flow rate is approximately 12 l/min. Thus, to maintain two nozzles each distributing approximately 12 l/min the reservoir would need to store approximately at least 360 l of water, preferably at least 400 l.

Once the reservoir is depleted, the available flow rate will naturally fall to that which is supplied solely by the domestic water supply, i.e. around 12 l/min. At that stage the control circuit may be adapted to reduce the flow rate to one or both nozzles, to reduce the required flow rate to the same as or even slightly below the available flow rate.

The control circuit may be adapted to continue to operate the pumping means irrespective of whether it is able to successfully pump fluid through the nozzle or nozzles. This may be referred to as operation to destruction.

The control circuit may comprise a control panel including electronic circuitry for directing one or more behaviours of the system. For example, the control panel may comprise an emergency stop button, which a user can activate to cease the pumping means. Thus, a user can stop fluid flow through one or more nozzles if the system is activated inadvertently or if the system successfully suppresses a fire.

The control circuit may comprise a self-testing circuit for testing whether one or more components – such as a pressure sensor – are operating within normal parameters.

Although references have been made to the fluid being water, the reservoir may initially also comprise further substances in solution to aid fire suppression.

In a second envisaged application of the inventive concept, the fire suppression system is adapted for use in an industrial situation, wherein the system comprises at least two fluid spray nozzles which are each in fluid communication with a pumping means, the pumping means being supplied with fluid by a reservoir, wherein flow through each spray nozzle is controlled by a control element.

One example of a suitable industrial situation is to provide the fire suppression system as part of an offshore electricity-generating wind turbine installation.

Preferably, the fluid provided in the reservoir is water, i.e. non-saline water. The water may additionally comprise further substances in solution to aid fire suppression.

Preferably, the external fluid source in such fire suppression system is the sea in which the turbine installation is located.

The reservoir in this second envisaged application may be located that the base of a wind turbine installation. Usually, where turbine installations are provided with fire suppression systems, any reservoir is located near the turbine mechanism itself, i.e at or near the top of a turbine column. This makes sense in that fluid required for fire suppression needs little further pumping to reach the required location – as generally fires take place within the mechanism of the turbine. However, there are natural restrictions on the volume of fluid which may be kept at or near the top of a turbine column due to its weight and volume.

The present inventive concept allows for a much larger volume of fluid to be provided. Furthermore, given that the external fluid source is the sea, the available volume of fluid for fire suppression is effectively unlimited.

The pump is preferably located towards the bottom of the turbine column.

Thus, in this second envisaged application the fire suppression system may further comprise a control circuit and on or more valves connected to the control circuit to manage the flow of fluid from the reservoir to each fluid spray nozzle.

Each fluid spray nozzle may be arranged in co-operation with a respective diversion valve adapted to limit the flow of fluid to the nozzle. Thus, if the fluid pressure is such that otherwise the flow rate of fluid is likely to exceed a nominal flow rate, then excess pressure may be diverted back towards the reservoir. In this way, the flow rate through each nozzle may be maintained relatively consistently and the pumping means does not need to adapt in real time to the flow rate required by the one or more nozzles according to whether one or more are active.

The pumping means may be a multi-chamber pump. Preferably the pumping means is a six-chamber pump.

The pump may be electrically-powered. The pump may comprise a three-phase alternating current motor. A pump with a three-phase motor can switch between an idle or low-level operating mode and an active or high-level operating mode quickly.

An electrical supply to the pump may be provided by a grid to which the wind turbine installation is connected.

A coarse filter may be provided to prevent ingress of large objects from the sea into the fire suppression system. One or more finer filters may be provided.

Detailed description of the invention

Certain examples of possible parts of the inventive concept will now be described with respect to the accompanying drawings, in which:

Figure 1 shows an electrical block diagram of a possible electrical arrangement of a motor for a pumping means;

The motor is a three phase motor, which is typically by a three phase 415 V AC electrical supply, which originates from a 4.0 Kilowatt [KW] invertor device. The invertor is supplied by a single phase 24 V AC electrical supply, which originates from a step down mains transformer device [not shown]. The transformer is supplied from a 230V AC single phase electrical supply. The single phase 24 V AC supply also comprises an in-line electrical filter, which prevents the communication of any electrical noise generated by the invertor device, back into the 24 V AC single phase supply. A 4KW invertor will typically draw in the region of eight amps from a 230 V AC single phase mains supply. Therefore, the 230 V AC supply may be provided by plugged 13 amp socket in an electrical ring-main circuit. If a larger 3 phase a motor is required to drive the pump, a larger 5 KW invertor may be required which will draw in the region of 32 amps from a 230 V AC single phase mains supply. Therefore, the 230 V AC supply may be provided by an electrical spur which is connected to an electrical fuse board.

When system is functioning the maintenance mode, the invertor provides a 50 hertz [HZ] three phase supply to the three phase motor connected to the pump, which in use pressurises the fluid within the system to 20 bar. When the system is functioning in the Fire mode, the invertor provides a 80 hertz [HZ] three phase supply to the three phase motor connected to the pump, which in use pressurises the fluid within the system to 100 bar.

Therefore, the invertor device provides effect of allowing a 3 phase motor to be supplied from a single phase mains supply within a residential/domestic property.

Figures 2 and 3 show floor plans of a domestic premises to which the present inventive concept may be applied;

Figure 4 shows a side elevation of a wind turbine installation to which the present inventive concept is applied;

Figure 5 shows a side section of a wind turbine head to which the present inventive concept is applied;

Figure 6 shows a side section of a wind turbine base to which the present inventive concept is applied; and

Figures 7 and 8 show schematically a possible configuration of the present inventive concept as applied to a wind turbine installation.

Figure 1 shows an electrical block diagram showing how a three-phase motor 10 could be connected to a single-phase domestic electrical supply via a phase converter 12.

Figures 2 and 3 show floors plan 20, 20' of a domestic premises to which a domestic fire suppression system is to be retro-fitted. Each dot represents a location of a fluid spray nozzle. A single dot 22 is labelled, but the skilled reader will appreciate that each dot represents a nozzle. Nozzles are arranged in zones, as described above. In use, if the system detects a fire, via the rupturing of any fire detection bulbs and/or other fire sensors within a given zone, the nozzles/heads associated to that zone will be activated. The system can dispense 12 litres per minute for a maximum of two nozzles/heads. If more than two heads are activated, the dispensing pressure will drop accordingly.

Figure 4 shows a wind turbine installation 40 having a base portion 42, a column 44 and a top portion 46. Between the base portion 42 and the top portion 46 run pipes 48 within the column 44.

Figure 5 shows an enlarged view of the top portion 46 of the wind turbine installation shown in Figure 4. Within the top portion 46 are two sets 50, 52 of nozzles 54. Respective sets 50, 52 are supplied by supply lines 56, 58 which are in turn supplied by the pipes of the installation (48 of Figure 4).

Figure 6 shows an enlarged view of the base portion 42 of the wind turbine installation shown in Figure 4. Within the base portion 42 is located a pump 60 in fluid communication with a reservoir 62. The reservoir fees pipes 66, 68 which supplied the pipes of the installation (48 of Figure 4). There is further a pump 66 for supplying the reservoir from an external source (such as the sea), which may be activated if the amount of fluid in the reservoir falls below a pre-determined level.

Figure 7 shows a possible configuration of pumps, pipework, valves and nozzles etc.. Starting at the base there is a high pressure pump for supplying water from a reservoir (not shown) to a substantially vertical supply line. There is also a low pressure pump configured to supply the reservoir from an external source, such as the sea. The supply line may be a 50mm stainless steel pipe. That supply line connects to a free moving rotary valve which in turn feeds a 25 mm feed pipe which terminates in a manifold and one or more pressure diverter valves. Diverter valves distribute fluid to sets of nozzles.

Figure 8 shows a network of pipes and valves which could form a possible configuration. It is implicit that this network is supplied by a pump and reservoir as described.