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(54) Benævnelse: **Indretning til at forhindre tilbagestrømning i ventilationskanaler som indgår i ventilationssystemer**

(56) Fremdragne publikationer:
FR-A1- 2 598 197
GB-A- 395 994
SE-C2- 518 899
US-A- 5 421 127
US-A- 5 970 670

DESCRIPTION

[0001] The present invention concerns a device for preventing backflow in ventilation ducts in ventilation system and further propagation of fire and fire gases through said ventilation systems.

[0002] According to existing building standards in Sweden as well as internationally, a larger building shall be divided into different so called fire cells. As a definition a fire cell is a room or a group of connected rooms within which a fire may develop but not propagate to other fire cells. This means that the structures that surrounds a fire cell, such as walls, framing of joists and so on, must have a certain predetermined resistivity against fire. Examples of fire cells are residential flats, different offices, meeting halls, care departments in hospitals and so on.

[0003] To provide surrounding structures, such as walls and framing of joists and also doors with sufficient resistivity against fire is fairly easy. A more often considerable problem is to prevent fire and fire gas propagation through the ventilation systems of the building. Different more or less safe and more or less expensive ways are available to prevent or render more difficult fire and fire gas propagation through the ventilation system.

[0004] A safe way is to provide fully separate ventilation systems for each fire cell. Regarding the requirements of today on airflows and so on, this solution means many bulky ventilation ducts and a lot of expensive air treatment apparatuses. Said solution is thus normally only used for buildings with a few large fire cells. Therefore, most often the whole or parts of the ventilation system are common for different fire cells. A common solution is that common air treatment apparatuses and common so called collection ducts and/or so called distribution ducts are used for different fire cells. From these collection ducts and/or distribution ducts separate connection ducts are lead to the different fire cells. Then there is a risk that fire gases will come into the common collection ducts and/or distribution ducts when a fire occurs in a fire cell and from there propagate to adjacent fire cells through the connection ducts.

[0005] One way to prevent fire gases to propagate into collection ducts is to provide each connection duct to a collection duct and/or distribution duct with motor controlled valves which has a sufficient air tightness and resistivity against fire and fire gases and which automatically close at the occurrence of fire. This means often great costs and also requires quick and secure detection of a fire and also requires an automatic check of the function of the valves.

[0006] Up to now another common method to make fire gas propagation through a common ventilation system more difficult is to allow fire gases to propagate into the common collection ducts and/or distribution ducts but take special measures in order to minimize the risk of fire gas propagation to other fire cells. One way of doing so is to make sure that the pressure drop relation between the pressure drop in the part of the duct system that serves only one fire cell and the part of the system which constitute common ventilation duct is larger than 5:1. In order to achieve this it is generally required that the fans are turned off and pressure release valves are opened to free air. The method means that fire gases that propagate into the ventilation system shall pass more easily out to free air than into another fire cell. The method requires detection of fire so that the fans will be turned off and the valves will be opened. The method is unsecure. It does not guarantee that any gases do not propagate to other fire cells, only that the amount of fire gases which propagate will become less due to the size of the pressure drop relation.

[0007] The method is also impossible or very difficult to apply to horizontal collection ducts due to the fact that the necessary pressure drop relation is then difficult to achieve. Experiences from fires also show that the detection and opening of the pressure release valves mean a great unsecurity. Often the fans are turned off in, for example, a office building at night and weekends in order to save energy. A detector provided in collection with the outlet air fan, which is the most common way, will then never detect fire gases and open the valves until fire gases already have propagated to other fire cells. The method is also complicated to apply at air treatment apparatuses in the basement since this requires special ventilation chimneys up through the outer roof of the building.

[0008] In more recent time possibilities to prevent fire gas propagation with fans operating have started to be used. By means of having the outlet air fan in operation all the outlet air ducts have a subpressure which prevents fire gas propagation to other fire cells connected to the ventilation system. In order not to let fire gas propagation to occur the capacity of the outlet air fan may be increased so that a larger air volume flow arise, which is sufficient to prevent fire gas propagation through the outlet air system. The temperature through the fan depends inter alia on the number of connected fire cells. The more fire cells that are connected to a collection duct the lower the temperature will become through the fan since the fire gases then will be diluted with cold air from all the other fire cells. The temperature through the fan also depends on the pressure increase which occurs in the fire cell having a fire. The greater pressure increase the greater amount of fire gases will be forced into the system.

[0009] Applying the method with fans in operation is further more complicated on the inlet air side. Since the over pressure in the inlet air system of the is limited there is a great risk that the over pressure due to the fire will force fire gases backwards into the inlet air system. When fire gases have been forced back to the closest branch point to the next fire cell, the inlet air fan will then quickly aid the fire gases to propagate into this fire cell. One way of solving this problem is to convert, in case of fire, the inlet air system to an outlet air system. This can be done by, in case of fire, connecting the inlet air system with the outlet air system through a valve. An alternative way may be to connect a separate fire gas fan to the inlet air system, which only starts in case of fire.

[0010] The disadvantages with converting the inlet air system into an outlet air system in case of fire are although several. A secure detection is required, which automatically convert the system, which together with required connections and valves means costs. Another disadvantage is the risk of unbalance in the system. The conversion means that a severe subpressure may arise in the adjacent fire cells since there is only outlet air present and no inlet air. The subpressure may itself cause problem by opening doors etc. It will also increase the risk of fire gas propagation through cracks and drafts in walls and doors and so on between the fire cell having a fire and the closest adjacent fire cells. This is due to the fact that the fire cell having a fire will be under over pressure while the adjacent fire cells by means of the conversion will be given a subpressure.

[0011] A further disadvantage in a converted inlet air system is the problem after a fire has occurred. Before the duct system may be used for inlet air again an extensive and costly sanitation may be required.

[0012] SE 518 899 C2 discloses a valve for depressurising a ventilation system. Known devices for preventing the backflow in ventilation ducts by means of tubes are disclosed in US 5 421 127 A, GB 395 994 A, FR 2 598 197 A1 and US 5 970 670 A.

[0013] The object of the present invention is to provide a device by means of which the risk of propagation of fire and fire gases through a ventilation system will be eliminated, whereby a backflow is prevented in the ventilation ducts of the ventilation system.

[0014] The characterising features of the invention is given in the following claims.

[0015] The invention will be described in greater detail by means of a preferred embodiment referring to the enclosed drawings, in which:

Fig. 1
: illustrates a sketch of principles of known art of a common ventilation system for a number of fire cells,

Fig. 2
: illustrates in a known way overpressure arising in the starting stage in the fire cell having a fire,

Fig. 3
: illustrates in a known way the overpressure in the same fire cell after bursting of windows,

Fig. 4
: illustrates in a known way principles of preventing backflow in ventilation ducts,

Fig. 5
: illustrates a view along a device which according to the invention prevents backflow of primarily fire gases in ventilation ducts,

Fig. 6
: illustrates an end view of the device of Fig. 5, and

Fig. 7
: illustrates an example of connection of ventilation ducts by means of a device in accordance with the invention, as a prefabricated piece.

[0016] Referring to Fig. 1 a fire occurring in a fire cell 1 is shown. The rest of the shown fire cells are numbered 2, 3 and 4, respectively. The fire cells 1, 2, 3 and 4 are connected with a common outlet air duct 5 and a common inlet air duct 6, respectively. Connecting ducts 7,7', 7" and 7"' are present in each fire cell from the outlet air duct 5. Connecting ducts 8, 8', 8" and 8"' are present in each fire cell to the inlet air duct 6.

[0017] A fire results in an overpressure 9 in the fire cell 1. This overpressure is present because of the fact that the fire heats the air up and because of the fire gases in the fire cell 1. The temperature increase in turn makes the air and fire gases expanding in volume. The faster the temperature increase is and the denser the connecting structures of the fire cell are the greater this overpressure becomes. When the overpressure in the fire cell exceeds the pressure drop in the connecting duct 8 with its inlet air devices, fire gases will propagate into the common inlet air duct 6. The inlet air fan then quickly will spread the fire gases to, at first hand, fire cell 3 through the connecting duct 8". Depending on the size of the overpressure and the overpressure in the inlet air system "upstream" there is a risk of the fire gases to also propagate into fire cell 2 and 4 through connecting ducts 8' and 8"', respectively.

[0018] Regarding the outlet air system, it is not as vulnerable since the overpressure will make that a greater added amount of air and fire gases will be forced into the outlet air system but this increase will generally not influence the fire gas propagation since the outlet air fan is capable of handling this volume increase, wherefore fire gases will not propagate into any of the other fire cells 2, 3 and 4 through the connecting ducts 7', 7" and 7"'.

[0019] In Fig. 2 the fire cell 1 is shown and also a typical overpressure 9 in the starting stage of the fire. Theoretical calculations as well as tests show that an overpressure of 200-600 Pa quickly may occur within the fire cell. Normal pressure drops over the connecting ducts are about 50-100 Pa. This means according to the description above that a larger amount of air and fire gases will be forced into the outlet air system and that fire gases will pass backwards into the inlet air system. At larger overpressures than about 600 Pa generally a quick pressure release will occur within the fire cell by means of the bursting of one or several windows. The windows may also burst at lower pressure due to high temperatures and thus bring a pressure release. Typical overpressures 9 due to the fire after a window burst is about, according to Fig. 3 in the region of 10-20 Pa. After a burst of the windows the overpressure thus is generally lower than the pressure drop over the connecting ducts and therefore the risk of fire gas propagation in this stage through the ventilation system eliminated with the inlet and outlet air fans in operation. The critical stage is thus before windows have burst either due to high pressure or due to high temperatures. During this early critical stage large amounts fire gases may have time to spread to other fire cells through the common ventilation system.

[0020] In Fig. 4 it is shown in a known way a method of preventing back flow in ventilation ducts with so called back valves 10. The back valves comprise of one or more lamellae which due to its own weight or by means of spring force close when the flow in the ventilation duct changes direction. This back valves are not used in fire technical contexts since their reliability is not considered satisfactory and that the leakage over a closed valve is great. Further, these back valves are position dependent horizontally or vertically, and pressure drop and required opening pressure are relatively great in normal operation.

[0021] The device according to the invention on the other hand prevents effectively a back flow in ventilation ducts and give very high sealing at changed direction of air, position independent and with its design a low pressure drop is achieved at the same time as only a small opening pressure is required at normal direction of air.

[0022] Referring to Fig. 5 a preferred embodiment of the device according to the invention is shown, designed as a prefabricated piece and which is formed by a distance means 11 in the form of a net 11', preferably of steel sheet material and a tube form 12 of a flexible material, which is open in both ends and which preferably is made of a flame proof textile. The left part of Fig. 5 shows the prefabricated piece in its active, operative position with open through flow area along all of its length while the right part of Fig. 5 shows an embodiment where the tube form 12 collapse and start its abutment against the net 11" forming the distance means 11. The prefabricated piece according to the invention is thus easily mounted in a ventilation duct 13 of a ventilation system. Alternatively, the distance means 11 and its connected tube form 12 may naturally alse be mounted to each other directly in a ventilation duct 13 in question and therefore does not need to be comprised as a separate prefabricated piece.

[0023] The distance means 11 in itself corresponds mainly to the area of the ventilation duct 13 and is attached from the downstream side and extends as a tube 12' of the tube form 12 a predetermined length and which is open in its free end 15. The length and the circumference of the tube 12' is adapted so that when a air flow is stopped or not occur the tube 12' collapse and when back flow occur the tube 12' is forced, thanks to its flexible material, in the direction towards the net 11', whereby a sealing delimiting wall is achieved.

[0024] In the shown example the distance means 11 is comprised of a net 11' with a tube 12' of a flame proof textile but the distance means 11 may of course be comprised of any other suitable means that let air pass. The tube 12' along the periphery at the distance means 11, which show a length which in this shown example at least corresponds the diameter of the ventilation duct 13. Further, the tube 12' is here conically tapering in its length direction towards its free end 15. In the case the net 11' shows a centrally provided cover plate the length of the tube 12' may of course be shorter, i.e. the length of the tube 12' needs only be sufficiently long in order to allow a covering of the duct in case of back flow.

[0025] The temperature resistance of the tube 12' is adapted to the temperature arisen in the fire cell in question and its position in relation to the fire cell.

[0026] In Fig. 7 an example of connection of a prefabricated piece according to the invention is shown in a ventilation duct 13 of a ventilation system, where a rubber ring connection 14 is used for sealingly abutment against the distance means 11 and then suitably in connection with a joint of two ventilation ducts 13 to each other. The net 11' may be attached in a flange 16, which has the form of a pipe socket, which in the shown example is connection means between the both adjacent ventilation ducts 13.

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- SE518699C2 [0012]
- US5421127A [0012]
- GB395994A [0012]
- FR2598197A1 [0012]
- US5970670A [0012]

Patentkrav

1. Indretning til at forhindre tilbagestrømning i ventilationskanaler i ventilationssystemer og yderligere spredning af brand og brandgasser gennem ventilationssystemet, omfattende et afstandsorgan (11) i form af et net (11') tilvejebragt med en flange (16) monterbar i en ventilationskanal (13) og dækkende dens gennemstrømningsområde, til hvilket afstandsorgan (11) en rørform (12) er forbundet, som har en forlængelse af længden i retningen af pågældende strøm og som består af et rør (12') fastgjort ved omkredsen på afstandsorganet (11) og hvilken rørform (12) omfatter et fleksibelt materiale og er åben i dens frie ende (15) og har en længde som er tilstrækkelig når den falder sammen i tilfælde af tilbagestrømning for at dække afsnitsområdet i ventilationskanalen (13) til at danne en forseglet støtte mod afstandsorganet (11).

2. Indretning ifølge krav 1, **kendetegnet ved at** afstandsorganet (11) og rørformen (12) forbundet dermed er fremstillet som et præfabrikeret stykke.

3. Indretning ifølge krav 1, **kendetegnet ved at** rørformen (12) er helt eller delvist skåret i dens længderetning.

4. Indretning ifølge krav 1, **kendetegnet ved at** røret (12') er konisk tilspidset i retningen mod dets frie ende (15).

DRAWINGS

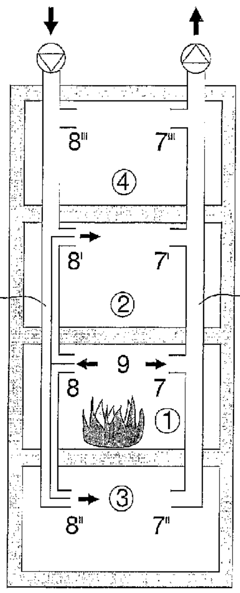

Fig 1 (Prior Art)

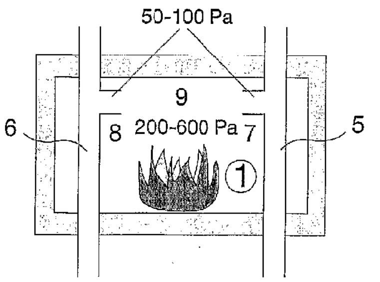

Fig 2

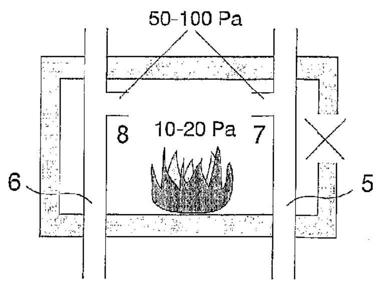

Fig 3

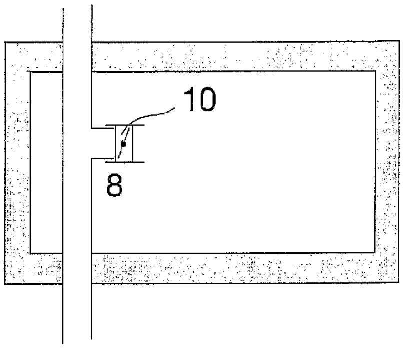

Fig 4 (Prior Art)

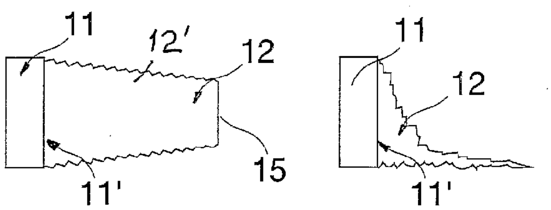

Fig 5

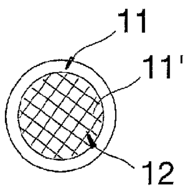

Fig 6

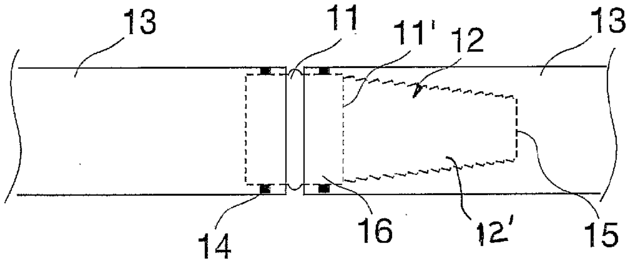

Fig 7