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- (54) Benævnelse: **Termisk udløsningsindretning til at udløse en automatisk lukning af en brandbeskyttelsesklap i en luftkanal**
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Description

Thermal trip device for triggering the automatic closing of a fire damper in an air duct

The invention relates to a thermal trip device for triggering an automatic closing of a fire damper in an air duct. Such an air duct is provided for instance for the air conditioning of a building or for smoke extraction of a building in the event of fire. The fire damper can be closed by means of an actuator when a predeterminable duct air temperature limit value inside the air duct is exceeded. The duct air temperature limit value lies in particular in a temperature range of 65°C to 120°C, preferably in a range of 72°C to 95°C. Such an actuator is also referred to as a fire damper drive.

Fire damper drives according to EN standard 15650 require a thermal trip device, which triggers the closing of the fire damper with an increased temperature, typically in the event of a fire, in the air duct or outside of the air duct. Such a thermal trip device is verified according to EN standard 10294-4 and in the future according to international standard ISO 21925-1, Annex B, C, D. To this end, a thermal fuse is typically used in the embodiment as a fuse or a "bimetal", which interrupts the power supply to the actuator in the case of an increased temperature. The power supply to the actuator is then guided by way of the known thermal trip devices (see also FIG 1). The actuator then drives the fire damper automatically into the secure closed position, such as e.g. with the aid of mechanical energy stored in the actuator (spring energy store) or with the aid of stored electrical energy (capacitor, accumulator).

A thermal trip device of this type is known from the European patent application EP3104518A1 (see paragraph [0050]) or from the International patent application WO2010/099630A1 (see paragraph on page 11).

The known thermal trip devices have the following disadvantages:

A thermal trip device, known as a thermal fuse, realised as a fuse, has the property that it interrupts the power supply to the actuator at a predetermined limit temperature. Such a thermal fuse cannot be reset. Two thermal fuses of this type are typically connected in series, wherein the first thermal fuse is then positioned inside the air duct and the second thermal fuse is positioned in the environment outside of the air duct. If one of the thermal fuses reaches its respective limit temperature, the power supply to the actuator is interrupted as a result or in other words the safety loop is opened.

A further disadvantage is that thermal fuses with different triggering limit temperatures must be kept available for different fields of application and/or according to national standard requirements. A further disadvantage is that thermal fuses can already trigger during transportation or during storage when the limit temperature is reached. The storage temperature of the fuse is often restricted by the manufacturer in the data specification.

Moreover, in the embodiment of a thermal trip device as a fuse, the production in SMD construction is not possible since the fuse would already fuse upon soldering or during the

soldering process (reflow soldering process, surge soldering process).

The thermal trip device considered here is embodied for attachment to the air duct and is designed to interrupt a trip line of the actuator which is connected through by way of the thermal trip device. The connected-through trip line fulfils the function of a safety loop. In the simplest case, the power supply to the actuator is interrupted by the trip device.

Furthermore, the thermal trip device can have an electronic control unit, a first temperature sensor connected to the control unit for in particular continuously detecting a duct air temperature value inside the air duct, a second temperature sensor connected to the control unit for in particular continuously detecting an ambient air temperature value outside the air duct and an electrically actuatable switching element downstream of the control unit for interrupting the power supply to the actuator when the duct air temperature limit value or a predeterminable ambient air temperature limit value is exceeded.

The electrically actuatable switching element for interrupting the power supply to the actuator is in particular a transistor, in particular a switching transistor, preferably a MOSFET, a mono- or bistable relay.

Based on the prior art cited in the introduction, it is an object of the invention to specify a thermal trip device which can be used more flexibly.

The object of the invention is achieved with the features of the main claim. Advantageous embodiments are cited in the dependent claims.

In accordance with the invention, the thermal trip device has a housing and an (integrally formed) circuit carrier accommodated at least partially in the housing. The circuit carrier is e.g. a printed circuit board (board). The first temperature sensor is arranged on a first circuit carrier portion and the second temperature sensor is arranged on a second circuit carrier portion. When the thermal trip device is correctly attached to the air duct, the first temperature sensor is arranged inside the air duct and the second temperature sensor is arranged outside the air duct.

The advantage of the invention lies in the realisation of a thermal trip device which is extremely simple in terms of circuitry and is at the same time compact. Since, upon correct attachment to the air duct, the circuit carrier extends both inside the air duct and through the opening in the air duct into the environment outside the air duct, all required components including the two temperature sensors and the electronic control unit can be applied to a single circuit carrier. The electronic control unit is preferably a microcontroller. A separate wiring of the two sensors as in the prior art is not required.

The first and second temperature sensor is in particular a thermistor, in other words a temperature-dependent electrical resistor. Such a thermistor preferably has what is known as PT100, PT500 or PT1000 as a platinum measuring resistor. The previously cited platinum measuring resistors here advantageously have a linear resistance curve which depends on

the temperature. Alternatively, the thermistor can be what is known as an NTC (Negative Temperature Coefficient) or a PTC (Positive Temperature Coefficient).

The first and second temperature sensor is thus not a temperature switch, as is the case in the prior art with thermal fuses or bimetal switches. It is instead embodied to provide an electrical resistance value assigned to the detected temperature. Alternatively, the temperature sensor can be a digital temperature sensor, which outputs a digital value assigned to the detected temperature as an electrical signal.

The duct air temperature limit value and the ambient air temperature limit value, in other words the respective trip temperature, can be set variably, for instance. The duct air temperature limit value and the ambient air temperature limit value can be stored in the electronic control unit in the form of a data byte, for instance. As a result, the same hardware can be configured for different applications and the product variety can thus be reduced.

The housing is preferably produced from a temperature-resistant plastic, i.e. from a plastic which is mechanically stable for temperatures up to 150°C. The circuit carrier is preferably a printed circuit board, such as e.g. a printed circuit board made from FR4 material.

According to one embodiment of the thermal trip device, the housing has a sensor opening for leading the first circuit carrier portion out of the housing. By leading the first temperature sensor out of the housing, it is advantageously possible to design a thermal trip device which is structurally

particularly simple. This simultaneously ensures a rapid response of the first temperature sensor to temperature changes in the air duct. For instance, after the circuit carrier is introduced into the housing, the sensor opening can be sealed using an adhesive or a silicon, to prevent the penetration of dirt.

According to one embodiment, the electronic control unit is designed or programmed to actuate the switching element in an opening manner, if a temperature increase rate of the respectively detected temperature value, in other words of the duct air temperature value and the ambient air temperature value, exceeds an associated predeterminable minimum temperature increase rate, in particular an associated predeterminable minimum temperature increase rate of $10^{\circ}/\text{min}$, in particular of $20^{\circ}/\text{min}$, preferably of $25^{\circ}/\text{min}$.

According to a particularly advantageous embodiment, the electronic control unit is a microcontroller. The microcontroller is arranged on the second circuit carrier portion. With correct attachment of the trip device to the air duct, the microcontroller is therefore disposed on the second circuit carrier portion which lies outside the air duct. The second temperature sensor is (already) integrated in the microcontroller, preferably on the chip pad, the so-called "die" of the microcontroller. The microcontroller is programmed in particular to detect an ambient air temperature value continuously.

The microcontroller is a processor-assisted electronic processing unit. Suitable program steps which can be executed by the microcontroller or by its processor are loaded or can be loaded on the microcontroller. The microcontroller has a

preferably non-volatile electronic memory, such as e.g. a Flash memory, in which the executable program routines are stored. In addition to the electronic memory, the processor and a RAM memory, the microcontroller typically has at least one of the subsequently cited integrated hardware functional unit: analogue/digital converter, digital/analogue converter, digital input/output unit, serial bus interface, timer, signal processor, watchdog and temperature sensor.

The particular advantage here is that it is possible to dispense with a separate temperature sensor as a component for detecting the ambient temperature. This simplifies the circuit arrangement of the inventive thermal trip device.

In particular, the housing surrounds the circuit carrier, essentially in a flush manner with a maximum housing depth of 4 cm, in particular of 2.5 cm, except for the first circuit carrier portion which is not led out of the housing. This results in an extremely compact design of the inventive trip device. In particular, the housing hermetically encloses the circuit carrier. The corresponding openings in the housing for the electrical terminal of the trip line, for the leading out of the portion with the first temperature sensor and for the manually activatable switch are preferably sealed or closed in a preferably dust or moisture-tight fashion.

The trip device can be snap-fitted or locked into an opening of the air duct, for instance. With correct attachment of the thermal trip device, part of this projects into the inside of the air duct. The other part of the thermal trip device points away from the opening into the environment outside the air duct. The opening is preferably slot-shaped or rectangular. In the longitudinal extent it has a dimension in the range of 3

cm to 10 cm, preferably in the range of 4 cm to 7 cm. Moreover, the opening in the transverse extent can have a dimension in the range of 1 cm to 4 cm, preferably in the range of 2 cm to 3 cm.

The thermal trip device can alternatively or in addition be screwed, riveted or glued to the air duct in the region of the opening of the air duct. The thermal trip device or the housing surrounding the same is preferably embodied so that after correct attachment of the thermal trip device, the opening in the air duct is sealed so that no air in the air duct can pass through the opening into the environment outside the air duct.

Furthermore, according to a further embodiment of the thermal trip device, two external snap-fit elements which face one another are arranged on or moulded to the housing. The snap-fit elements are configured such that with the introduction of the thermal trip device into a slot-shaped opening matched geometrically thereto, these lock in the air duct with the slot-shaped opening. The two snap-fit elements are arranged or moulded so that these lock with the inner edges of the slot-shaped opening which are disposed furthest from one another. As a result, a particularly simple and at the same time mechanically stable fastening of the inventive trip device to the air duct, i.e. to a wall of the air duct, is possible.

According to a further embodiment, the electronic control unit is designed to actuate the switching element in an opening manner, if a temperature increase rate of the respectively detected temperature value exceeds an associated predeterminable minimum temperature increase rate of 10°/min, in particular of 20°/min.

Evaluating the respective temporal temperature increase advantageously renders a quicker triggering possible, since as expected it is then possible to compute the impending exceeding of the duct air temperature limit value or the ambient air temperature limit value. This enables a prediction to be made about the further temperature curve and a prompt triggering with a significantly increasing temperature in the event of fire.

According to a further embodiment, the microcontroller has a chip housing, preferably a plastic or ceramic housing. The chip housing is connected to the housing of the thermal trip device in a heat conductive, in particular heat conductive with contact, manner. The chip housing can rest directly on the housing of the trip device, for instance. For improved heat transfer, e.g. a thermally conductive paste can be introduced between the chip housing and the housing of the trip device, similarly to the improved heat discharge in a heat sink.

According to a particularly advantageous embodiment, the thermal trip device has a manually activatable switch, in particular a button, connected electrically to the control unit. The binary switching state of the switch can then be read in by means of the control unit. The switch can be manually activated by a user from the outside of the housing of the thermal trip device.

The electronic control unit can be designed or programmed, in the tripped state of the thermal trip device, i.e., after the switching element has been closed, and after activating the switch to actuate the switching element again in a closing

manner to re-establish the power supply to the actuator. As a result, a reset of the thermal trip device is possible in a particularly simple manner.

Alternatively or in addition, in the non-triggered state of the thermal trip device and after activating the switch, the electronic control unit can be designed to actuate the switching element in an opening manner in order to interrupt the power supply to the actuator. The electronic control unit can additionally be designed to actuate the switching element again in a closing manner after a further activation of the switch. As a result, it is easily possible to test the thermal trip device for its functionality.

According to a further embodiment, the trip device has an optical display element, in particular an LED. The optical display element can be actuated at least indirectly by the electronic control unit. The electronic control unit is designed or programmed to actuate the optical display in the triggered state of the thermal trip device in a permanently lit or flashing manner. Alternatively, the electronic control unit can be designed to actuate the optical display in the non-triggered state in a permanently lit manner. This makes possible a direct status output to the thermal trip device.

According to a further embodiment, the trip device has two switching elements which are connected in series and can be actuated electrically separately by the electronic control unit. As a result, with a technical failure of a switching element (breakdown), an interruption of the trip line is possible.

According to one embodiment, the thermal trip device has a modulator and/or demodulator (modulator/demodulator) which acts electrically on the trip line. The modulator and/or demodulator is or are connected via signalling to the electronic control unit. The modulator and the demodulator can be separate physical units or a combined physical unit. The modulator can be designed to inject electrical signals into the trip line in a modulating manner using inductive, capacitive or ohmic means, such as e.g. in the sense of a Powerline modem. Correspondingly, the demodulator can be designed to couple electrical signals out of the trip line and to demodulate the same using inductive, capacitive or ohmic means.

The electronic control unit can be designed or programmed to output a current duct air temperature value and/or current ambient air temperature value and/or possibly the switching state of the switch connected to the electronic control unit as data, i.e., in the form of a digital sequence, via signals or data to the modulator to modulate this data onto the trip line.

In this way, an actuator designed to receive this modulated data and connected to the inventive thermal trip device by way of the trip line can forward this data via a network connection further to a higher-level control device, e.g. for further possible evaluation.

Alternatively or in addition, the electronic control unit is designed to receive demodulated data received from the trip line by means of the demodulator. The data includes an updated duct air temperature limit value and/or an updated ambient air temperature limit value and/or an updated minimum temperature

increase rate of the first and/or second temperature sensor and/or possibly an illumination state to be output to the optical display element by means of the electronic control unit. The latter can comprise e.g. a permanent lit state, a non-lit dark state, a flashing state with a brief flashing sequence or a flashing state with a long flashing sequence.

In this way, an actuator, which is designed to receive this data from a higher-level control unit by way of a network terminal, can forward this data by means of modulation further via the trip line to the connected inventive thermal trip device for possible further processing by the electronic control unit of the trip device.

Furthermore, the electronic control unit is designed or programmed to replace the duct air temperature limit value stored in the electronic control unit or in a connected external memory and/or the ambient air temperature limit value and/or the minimum temperature increase rate of the first and/or second temperature sensor in each case with the updated duct air temperature limit value, with the updated ambient air temperature limit value and/or with the updated minimum temperature increase rate of the first and/or second temperature sensor. As a result, a changed parameterisation of the inventive thermal trip device is advantageously possible.

Furthermore, the electronic control unit of the thermal trip device can be designed to receive and as such to identify a temporal sequence of activation phases (button pushed) input by way of the manually activatable switch and non-activation phases (switch released), which encodes an actuator parameter from a plurality of possible actuator parameters. The electronic control unit can moreover be designed to then

output these actuator parameters to a modulator which acts electrically on the trip line, and which is connected via signal to the electronic control unit. An actuator parameter can e.g. be a parameter for the maximum actuator torque, for the delay angle range, for the maximum motor speed of the actuator and suchlike. The electronic control unit can moreover be designed to acknowledge a respectively input temporal sequence by actuating the optical display in a suitable manner.

The afore-described properties, features and advantages of this invention and the manner in which these are achieved will become clearer and more intelligible in conjunction with the following description of the exemplary embodiments, which are explained in more detail in conjunction with the drawings. The drawings show schematically here:

FIG 1 an example of a thermal trip device with two thermal fuses connected in series according to the prior art for interrupting the power supply to an actuator,

FIG 2 an example of an inventive thermal trip device with an electronic control unit, two temperature sensors and a switching element for interrupting the power supply,

FIG 3 an exemplary embodiment of the thermal trip device with a data transmission possibility to the actuator according to the invention,

FIG 4 a sectional representation through an exemplary thermal trip device according to the invention at right angles to the flow direction in an air duct, and

FIG 5 a sectional representation through the thermal trip device according to FIG 4 along the viewing direction plotted in FIG 4.

FIG 1 shows a known thermal trip device 10 with two thermal fuses 6, 7 connected in series for interrupting the power supply to an actuator 1. The reference character 8 refers to a trip line which, in the form of a cable, connects the trip device 10 to the actuator 1 via its electrical terminal 3. It is apparent from FIG 1 that when one of the thermal fuses 6, 7 is tripped, the power supply to the actuator 1 along the path power supply terminal 2, control unit SE of the actuator 1, trip line 8, both thermal fuses 6, 7, trip line 8, electric motor M of the actuator 1, control unit SE and back to the power supply terminal 2 is interrupted. An input voltage present there is referred to with V_{IN} . The actuator 1 acts in a known manner on a fire damper 4 in an air duct 5, to automatically close this after triggering. ϑ_a refers here to an ambient air temperature outside the air duct 5 and ϑ_i refers to a duct air temperature inside the air duct 5 shown.

FIG 2 shows an example of an inventive thermal trip device 10. The latter comprises an electronic control unit 14 referred to as "logic", preferably a microcontroller. Furthermore, the trip device 14 already has two temperature sensors 16, 17 connected to the control unit 14 and a switching element S which can be actuated electrically at least indirectly by means of the control unit 14 to interrupt the power supply to the actuator 1. The power supply is interrupted by means of an electrical separation of a safety loop formed by the trip line 8. A line as a reference potential (mass) referred to with BP and a return line RL to the electric motor M is guided parallel to the trip line 8 or in a shared connecting cable

with the trip line 8. The reference potential BP can be a common mass, for instance. VS refers to a supply voltage, which is provided inter alia also to electrically supply the thermal trip device 10.

The control unit 14 is designed according to the invention to continuously detect a duct air temperature value θ_i detected by the first temperature sensor 16 and to actuate the switching element S in an opening manner if a currently detected duct air temperature value θ_i exceeds a predeterminable duct air temperature limit value θ_{Gi} . In the example in FIG 1, the control unit 14 is moreover already designed to continuously detect an ambient air temperature value θ_a by means of the second temperature sensor 17 and to control the switching element S in an opening manner, if a currently detected ambient air temperature value θ_a exceeds a predeterminable ambient air temperature limit value θ_{Ga} .

In the simplest case, the control unit 14 logically reproduces a series circuit of the two temperature sensors 16, 17, as described in FIG 1. It is therefore triggered if the detected air duct temperature value θ_i exceeds the predeterminable duct air temperature limit value θ_{Gi} OR if the detected ambient air temperature value θ_a exceeds the predeterminable ambient air temperature limit value θ_{Ga} .

Alternatively, the control unit 14 can be designed to control the switching element S in an opening manner as a function of a combination of the detected ambient air temperature value θ_a and of the detected duct air temperature value θ_i , such as for instance when the sum of the two temperature values θ_i , θ_a exceeds a total temperature limit value.

In the example in FIG 2, the control unit 14 is additionally designed preferably to actuate the switching element S, independently of the sum of the detected temperature values θ_i , θ_a , if a predeterminable minimum temperature increase rate θ'_{Gi} , θ'_{Ga} of $10^\circ/\text{min}$, in particular of $20^\circ/\text{min}$, of the respective detected temperature value θ_i , θ_a is detected, in order to interrupt the power supply to the actuator 1.

Further alternatively, the control unit 14 can be designed to actuate the switching element S in an opening manner when the detected duct air temperature value θ_i exceeds the predeterminable duct air temperature limit value θ_{Gi} AND the predeterminable minimum temperature increase rate θ'_{Gi} for the duct air temperature ϑ_i OR when the detected ambient air temperature θ_a exceeds the predeterminable ambient air temperature limit value θ_{Ga} AND the predeterminable minimum temperature increase rate θ'_{Gi} for the ambient air temperature ϑ_a in order to interrupt the power supply to the actuator 1.

With "OR" the Boolean OR or the logical OR and with "AND" the Boolean AND or the logical AND are meant.

The cited temperature limit values θ_{Gi} , θ_{Ga} and minimum temperature rates θ'_{Gi} , θ'_{Ga} can be stored electronically in the microcontroller 14, e.g. as a variable of the float datatype.

Furthermore, the inventive thermal trip device 10 has a manually activatable switch 15 connected electrically to the control unit 14. This is preferably a button. The control unit 14 is moreover designed, in the triggered state of the thermal trip device 10, in other words with an opened switching element S, and after activating the switch 15, to actuate this switching element S in the context of a reset of the trip

device 10 again in a closing manner to re-establish the power supply to the actuator 1. The control unit 14 can moreover be designed, in the corresponding non-triggered state of the thermal trip device 10 and after activating the switch 15, to actuate the switching element S in an opening manner to interrupt the power supply to the actuator 1. In this way, a function test of the inventive thermal trip device 14 is possible. A light-emitting diode (LED) referred to with LED as an optical display unit can be actuated accordingly in a permanently lit or flashing manner to display the operating status of the trip device 10. Alternatively, a sounder, a beeper or a vibration element can be used. In the present example, the optical display unit LED and the switch 15 are combined to form a separate functional unit HMI. This human-machine interface HMI which is realised in a particularly simple manner communicates internally with the microcontroller 14. The detection of the switching state of the switch 15 and the electrical actuation of the optical display unit LED are thus carried out indirectly with respect to the microcontroller 14.

FIG 3 shows an exemplary embodiment of the thermal trip device 10 with a data transmission possibility to the actuator 1 according to the invention. Compared with the previous FIG 2, the trip device 10 has a modulator/demodulator M/D, to transmit data DAT, which is stored in the control unit 10 or can be read in externally by this, to the actuator 1 by means of modulation by the modulator of the modulator/demodulator M/D and by way of the trip line 8. In the example in FIG 3, the data DAT in the return line RL is modulated onto the electric motor M. For demodulation, the actuator 1 has a demodulation unit symbolised by a diode and by a capacitor. The received data DAT can be evaluated by the control device

SE of the actuator 1 to parameterise the actuator 1 and possibly forwarded to a higher-level control device by way of a network interface, not shown in more detail. The same also applies to the converse manner, i.e. from the higher-level control device or from the control device SE of the actuator 1 to the control unit 14 of the inventive thermal trip device 10.

FIG 4 shows a sectional representation through an exemplary thermal trip device 10 according to the invention at right angles to the flow direction in an air duct 5. As FIG 4 shows, the trip device 10 has a housing 12, which encloses a circuit carrier 11 (see also FIG 5). Two snap-fit elements 18 are moulded to the housing 12, so that in the correctly inserted state of the thermal trip device 10 shown, the housing 12 with a slot-shaped opening SL matched geometrically thereto can lock in a wall of the air duct 5 in a mechanically stable manner. A first temperature sensor 16, in particular a PT1000, is applied to the "lower" portion 19-1 of the circuit carrier 11 shown. This circuit carrier portion 19 projects out of an opening OF in the housing 12 and is therefore circulated directly by the duct air in the air duct 5. A microcontroller 14, a switch 15 embodied as a button, a switching element S realised as a MOSFET, an optical display unit realised as an LED and a second temperature sensor 18 are arranged on the circuit carrier 11. The latter can also already be integrated in the microcontroller 14 shown. The last-mentioned components S, 15, LED, 17 are connected electrically with the microcontroller 14. The microcontroller 14 is arranged on the two "upper" circuit carriers 19-2, with the integrated second temperature sensor 17, lying outside of the air duct 5.

In the left part of FIG 4, a cable sleeve KT is moulded to the housing 12, for example. A trip line 8 embodied as a connection cable is guided through this cable sleeve KT through a further housing opening KO or cable sleeve opening. Its electrical individual conductors contact in each case a contacting surface 13 on the circuit carrier 11. The MOSFET as a switching element S closes the two upper individual conductors in the non-trip case of the trip device 10. In the trip case, the MOSFET is controlled in a closing manner by the microcontroller 14.

A housing width is referred to with B, but without the cable sleeve KT shown. The housing width B preferably lies in the range 4 to 8 cm.

FIG 5 shows a sectional representation through the thermal trip device 10 according to FIG 4 along the viewing direction V shown in FIG 4. In this representation, the particularly compact design of the inventive thermal trip device 10 can be seen. L refers here to a housing length and T to a housing depth. The housing length L preferably lies in the range 8 to 15 cm. The housing depth L preferably lies in the range 1.5 to 4 cm. A sensor length referred to with SL describes the length of the circuit carrier portion 19 led out of the housing 12, with the first temperature sensor 16 applied thereto. The sensor length SL lies in particular in the range 0.2 to 5 cm, preferably in the range 0.3 to 1.5 cm.

As FIG 5 shows further, the light-emitting diode LED illuminates through a transparent window in the housing 12. The button 15 can be activated manually from the outside of the housing 12. The entire housing 12 preferably closes the

circuit carrier 11 in a dust and moisture-tight manner, in particular in a hermetically tight manner.

List of reference characters

1	Actuator
2	Power supply terminal, voltage supply terminal
3	Electrical terminal, socket
4	Flap, fire damper
5	Air duct, smoke extraction duct
6	First thermal fuse
7	First thermal fuse
8	Connection line, line cable
10	Thermal trip device
11	Circuit carrier, printed circuit board
12	Housing
13	Contacting surfaces
14	Electronic control unit, microcontroller
15	Button, switching element
16	First temperature sensor, thermistor, NTC
17	Second temperature sensor, thermistor, NTC
18	Snap-fit hook, locking hook
19	First circuit carrier portion
19-2	Second circuit carrier portion
B	Housing width
BP	Reference potential, mass
DAT	Data
D/M	Demodulator/modulator
HMI	Human-machine interface
KO	Housing opening
KT	Cable sleeve
L	Housing length
LED	Optical display unit, LED
LS	Sensor length

M	Motor, electric motor
OF	Housing opening
RL	Return line, return line to the electric motor
S	Switching element, relay, FET, MOSFET
SE	Control device
SL	Slot, slot opening, opening in the air duct
T	Housing depth
V_{IN}	Input voltage
VS	Supply voltage
θ_{Ga}	Ambient air temperature limit value
θ_{Gi}	Duct air temperature limit value
θ'_{Ga}	First minimum temperature increase rate
θ'_{Gi}	Second minimum temperature increase rate
θ_a	Duct air temperature value
θ_i	Ambient air temperature value
ϑ_a	Ambient air temperature
ϑ_i	Duct air temperature

P a t e n t k r a v

1. Termisk udløsningsindretning (10) til at udløse en automatisk lukning af en brandbeskyttelsesklap (4) i en luftkanal (5), hvor brandbeskyttelsesklappen (4) ved overskridelse af en forudbestemmelig kanallufttemperaturgrænseværdi (θ_{Gi}) i luftkanalens (5) indre kan lukkes ved hjælp af et indstillingsdrev (1), hvor den termiske udløsningsindretning (10) er udformet til anbringelse på luftkanalen (5) og indrettet til afbrydelse af en udløsningsledning (8) af indstillingsdrevet (1), der er gennemsløjet via den termiske udløsningsindretning (10), hvor den termiske udløsningsindretning (10) omfatter en elektronisk styreenhed (14), en første temperatursensor (16), der er tilsluttet til styreenheden (14), til fortløbende registrering af en kanallufttemperaturværdi (θ_i) i luftkanalens (5) indre, en anden temperatursensor (17), der er tilsluttet til styreenheden (14), til fortløbende registrering af en omgivelseslufttemperaturværdi (θ_a) uden for luftkanalen (5) og et elektrisk styrbart koblingselement (S), der er efterkoblet styreenheden (14), til afbrydelse af strømforsyningen af indstillingsdrevet (1) ved overskridelse af kanallufttemperaturgrænseværdien (θ_{Gi}) eller en forudbestemmelig omgivelseslufttemperaturgrænseværdi (θ_{Ga}), hvor den termiske udløsningsindretning (10) omfatter et hus (12) og en kredsløbsbærer (11), der i det mindste delvist er optaget i huset (12), hvor den første temperatursensor (16) er anbragt på et første kredsløbsbærerseksnit (19-1), og den anden temperatursensor (17) er anbragt på et andet kredsløbsbærerseksnit (19-2), og hvor den første temperatursensor (16) ved korrekt anbringelse af den termiske udløsningsindretning (10) på luftkanalen (5) er anbragt i luftkanalens (5) indre, og den anden temperatursensor (17) er anbragt uden for luftkanalen (5).

2. Termisk udløsningsindretning (10) ifølge krav 1, hvor huset (12) har en sensoråbning (OF) til at føre det første kredsløbsbærerseksnit (19-1) ud af huset (12).

3. Termisk udløsningsindretning (10) ifølge krav 1 eller 2, hvor styreenheden (14) er en mikrocontroller, hvor mikrocontrolleren (14) er anbragt på det andet kredsløbsbærerseksnit (19-2), hvor den anden temperatursensor (17) er integreret i mikrocontrolleren (14), og hvor mikrocontrolleren (14) er programmeret

til fortløbende at registrere en omgivelseslufttemperaturgrænseværdi (θ_a).

5 **4.** Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor huset (12) undtagen det første kredsløbsbærerabsnit (19-1), der ikke er ført ud af huset (12), i det væsentlige omgiver kredsløbsbæreren (11) fladt og med en maksimal husdybde (T) på 4 cm, især på 2,5 cm.

10 **5.** Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor der på huset (12) af den termiske udløsningsindretning (10) er anbragt eller udformet to udvendigt liggende modsat beliggende snapelementer (18), hvor snapelementerne (18) er udformet på en sådan måde, at de ved indføring af den termiske udløsningsindretning (10) i en spalteformet åbning (SL), der er tilpasset geometrisk dertil, i luftkanalen (5) går i indgreb med den spalteformede åbning (SL).

15 **6.** Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor styreenheden (14) er indrettet til at styre koblingselementet (S) åbnende, hvis en temperaturstigningshastighed af den pågældende registrerede temperaturværdi (θ_i , θ_a) overskrider en tilhørende forudbestemmelig minimumstemperaturstigningshastighed (θ'_{Gi} , θ'_{Ga}) på 10°/min, især på 20°/min.

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7. Termisk udløsningsindretning (10) ifølge et af kravene 3 til 6, hvor mikrocontrolleren (14) omfatter et chiphus, og hvor chiphuset er forbundet varmeledende, især kontaktbehæftet varmeledende, med huset (12) af den termiske udløsningsindretning (10).

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8. Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor udløsningsindretningen (10) omfatter en manuelt betjenelig kontakt (15), især en knap, der er forbundet elektrisk med styreenheden (14),

30 - hvor styreenheden (14) er indrettet til i udløst tilstand af den termiske udløsningsindretning (10) og efter betjening af kontakten (15) at styre koblingselementet (S) lukkende igen til genetablering af indstillingsdrevets (1) strømforsyning, eller

- hvor styreenheden (14) er indrettet til i ikke-udløst tilstand af den termiske udløsningsindretning (10) og efter betjening af kontakten (15) at styre koblingselementet (S) åbnende til fortrinsvis testvis afbrydelse af indstillingsdrevets (1) strømforsyning.

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9. Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor udløsningsindretningen (10) omfatter et optisk visningselement (LED), især en LED, hvor det optiske visningselement (LED) i det mindste indirekte kan styres ved hjælp af styreenheden (14), og hvor styreenheden (14) er indrettet til at styre det optiske visningselement (LED) permanent lysende eller blinkende i udløst tilstand af den termiske udløsningsindretning (10) eller er indrettet til at styre det optiske visningselement (LED) permanent lysende i ikke-udløst tilstand af den termiske udløsningsindretning (10).

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10. Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor den termiske udløsningsindretning (10) omfatter en modulator og/eller demodulator (M/D), der indvirker elektrisk på udløsningsindretningen (8) og er forbundet signalteknisk med styreenheden (14),

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- hvor styreenheden (14) er indrettet til at afgive en aktuel kanallufttemperaturværdi (θ_i) og/eller en aktuel omgivelseslufttemperaturgrænseværdi (θ_a) og/eller eventuelt koblingstilstanden for kontakten (15), der er forbundet med styreenheden (14), som data (DAT) signal-/eller datateknisk til modulatoren (M/D) til opmodulering af disse data (DAT) til udløsningsledningen (8), og/eller

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- hvor styreenheden (14) er indrettet til at

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- modtage demodulerede data (DAT), der opnås fra udløsningsledningen (8), ved hjælp af modulatoren og/eller demodulatoren (M/D), hvor dataene (DAT) omfatter en aktualiseret kanallufttemperaturgrænseværdi (θ_{Gi}), en aktualiseret omgivelseslufttemperaturgrænseværdi (θ_{Ga}), aktualiserede minimumstemperaturstigningshastigheder (θ'_i , θ'_a) og/eller eventuelt en lystilstand, der afgives til det optiske visningselement (LED) ved hjælp af styreenheden (14), og

- erstatte den i styreenheden (10) gemte kanallufttemperaturgrænseværdi (θ_{Gi}), omgivelseslufttemperaturgrænseværdien (θ_{Ga}) og/eller minimumstemperaturstigningshastighederne (θ'_i , θ'_a) med den aktualiserede kanallufttempera-

turgrænseværdi (θ_{Gi}), med den aktualiserede omgivelseslufttemperaturgrænseværdi (θ_{Ga}) og/eller med de aktualiserede minimumstemperaturstigningshastigheder (θ'_i , θ'_a).

- 5 **11.** Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor den pågældende temperatursensor (16, 17) omfatter en termistor, især en PT100 eller PT1000.
- 10 **12.** Termisk udløsningsindretning (10) ifølge et af de foregående krav, hvor det elektrisk styrbare koblingselement (S) er en transistor, især en MOSFET, et monostabilt relæ eller et bistabilt relæ.

FIG 1

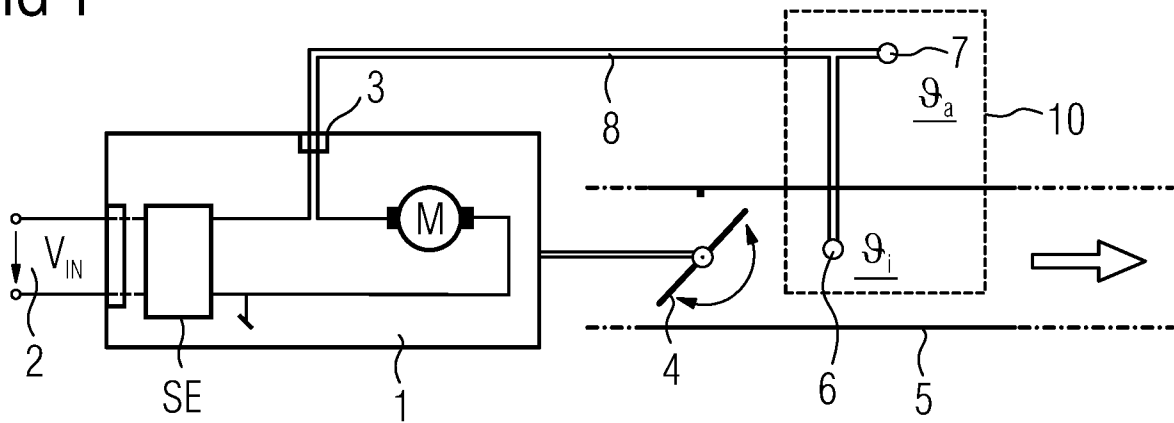


FIG 2

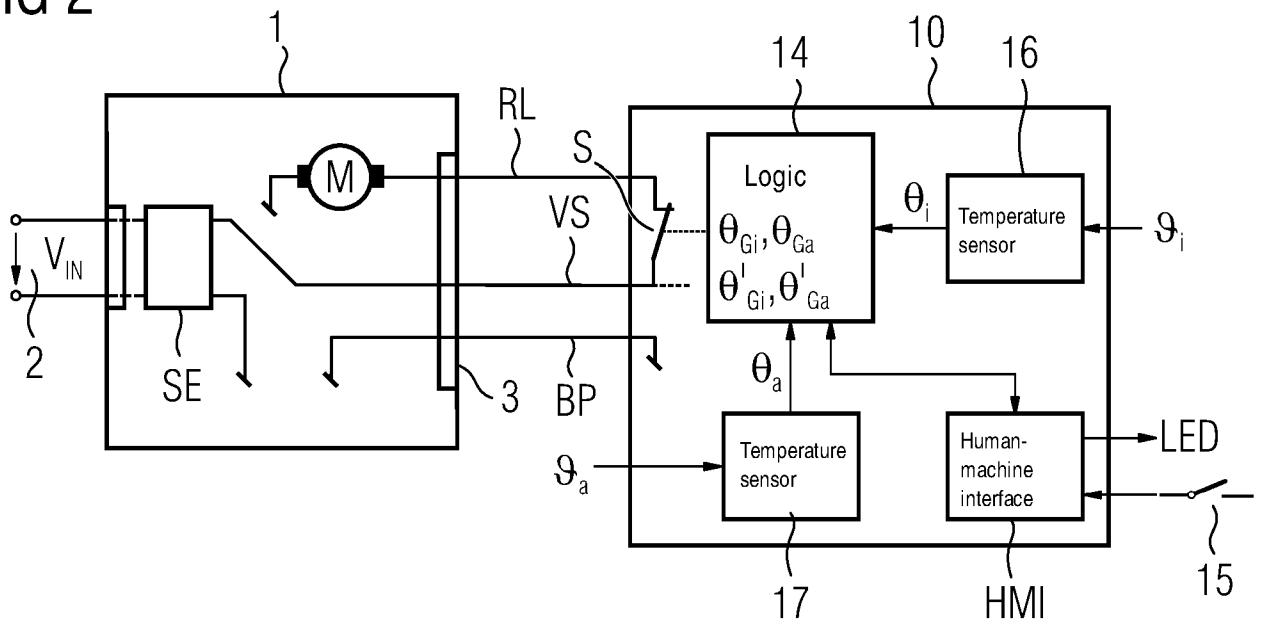


FIG 3

