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THERMAL FIRE PROTECTIVE SYSTEM

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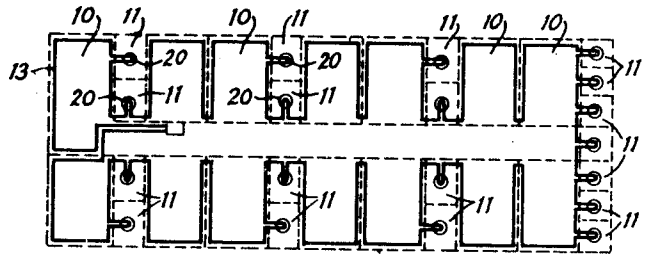


Fig. 1

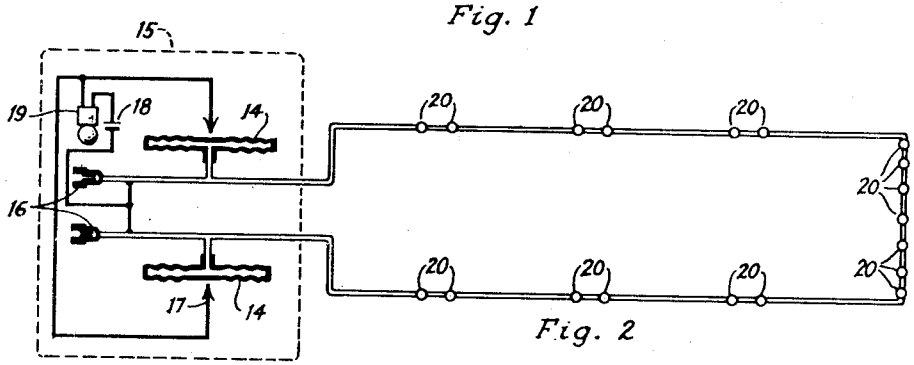


Fig. 2

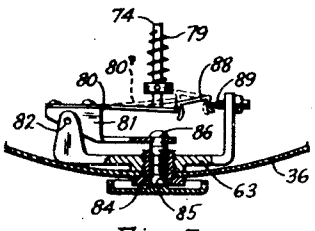


Fig. 5

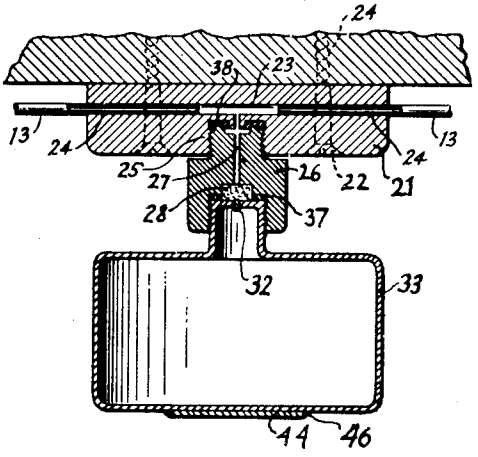


Fig. 3

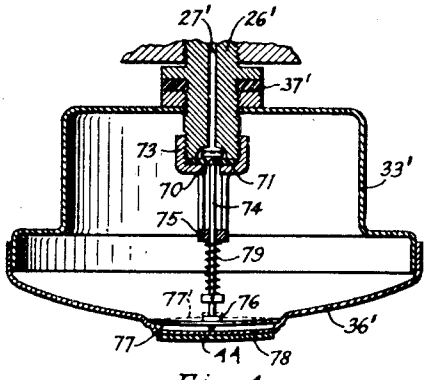


Fig. 4

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THERMAL FIRE PROTECTIVE SYSTEM

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4 Claims. (Cl. 177—355)

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This application is a continuation-in-part of application Serial No. 222,178, filed July 30, 1938.

This invention relates to thermal protective systems and more particularly to thermo-responsive pneumatic air tube systems for giving an alarm if an abnormal temperature is caused by a fire or similar abnormal temperature rise.

Among the objects of the invention is an air tube thermal protective system combining with the usual "rate of rise" features of such system, novel means for starting the alarm in response to a predetermined abnormal temperature condition in one or more selected parts of the protected system without impairing the efficiency of the rate of rise protection given by the system.

The foregoing and other features of the invention will be best understood from the following description of exemplifications thereof reference being had to the accompanying drawings wherein

Fig. 1 is a diagram showing the layout of a fire alarm system exemplifying the invention as applied to a building installation;

Fig. 2 is a diagrammatic view of the fire alarm system of Fig. 1;

Fig. 3 is a vertical cross sectional view of a fixed temperature detector unit, used in the system of Fig. 2;

Fig. 4 is a view similar to Fig. 3 of a modified form of temperature detector unit; and

Fig. 5 is a view similar to Fig. 4 showing the bottom part thereof equipped with a modified form of thermostat mechanism.

Fig. 1 illustrates a floor arrangement of a building which is to be protected by a fire alarm system of the invention. It comprises a plurality of rooms 10, and associated closets or small compartments 11, for storage or the like. The spaces are protected by a "rate of rise" pneumatic air-tube fire-alarm system comprising a small bore air tubing 13, about $\frac{1}{16}$ of an inch in diameter, running along the ceilings of the different spaces 10 and 11. The two ends of the tubing 13 are connected to an alarm starting device in the form of expansive diaphragm chambers 14 mounted in a suitable casing 15. Each diaphragm chamber 14 is shown connected through a conventional air leak unit 16 to the external atmosphere so as to equalize slight variations in the air pressure by slow leakage of the

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air between the space within the tubing 13 and the external atmosphere, and to normally maintain the air in the tubing 13 at the pressure of surrounding atmosphere.

With this arrangement a fire occurring in one of the protected spaces 10 will heat up the air layer near the ceiling including the air in tubing 13 and bring about an abnormal rapid rise of the pressure of the air confined in the tubing length located in the affected space. The abnormal rise of the air pressure in the affected portion of the tubing is instantly propagated to the diaphragm chambers 14 and causes them to expand and actuate contacts of an electric alarm circuit indicated conventionally by contacts 17 of an alarm circuit including a battery 18 and an alarm bell 19.

In such fire alarm systems, the alarm is started only in case of an abnormal rate of rise of the temperature regardless of the slow variations of the temperature which takes place, for instance, between day and night, and the operation of such system is not affected by gradual changes. Such tube arrangement will protect spaces, such as rooms 10 against a sudden rise of temperature, but will not give alarm if the temperature in the room rises gradually.

In order to secure satisfactory operation of such rate of rise fire alarm systems, they must meet certain requirements. Among these requirements is that each tube circuit must consist of a single continuous length of tubing not exceeding one thousand feet in length without branches or alternative path; that not less than a certain minimum length of tubing, and at least 5% of the total length of the tubing circuit must be placed in every enclosed space or separate room; and that no point of the ceiling shall be more than a certain minimum distance away from the nearest point of the tubing.

Such systems are not affected by slow or gradual variations in the temperature in the protected spaces. Thus in case of a slow smouldering fire, originating for instance, from compact slow burning material, or in closely confined spaces, such as a packed closet, where the air supply is limited, the temperature of the air will rise only gradually and the rate of rise of the temperature caused by such fire would not be sufficient to actuate the alarm in a rate of rise air tube protec-

tive system. Such places require protection both in case of a sudden temperature rise, and also against an abnormal dangerous maximum slow temperature rise.

There are also special applications, such as furnace installations, wherein a sudden temperature rise is not dangerous, and should not start the alarm, but wherein the alarm should be started upon an abnormal maximum temperature rise.

Such special protective requirements complicate the design of rate of rise protective systems. In the past, various makeshift arrangements have been resorted to in order to meet such special requirements. Thus, a relatively large length of air tubing wound into a coil, usually designated as a "rosette," has heretofore been used for protecting small closet spaces.

The invention overcomes these and other difficulties encountered in the available systems by combining with a rate of rise air tubing protective system, novel abnormal temperature detector units, which are normally disconnected from the air tubing system and are so arranged in locations exposed to special operating conditions that at a predetermined abnormal temperature they are automatically connected to the air tubing system and bring about a rapid rise of the pressure in air tubing system sufficient to set the alarm into operation.

In Fig. 3 is shown one form of such fixed temperature detector unit **20** designed for mounting on the ceilings of the closets **11** as a part of the air tube protective system shown in Figs. 1 and 2. It comprises a junction plate **21** which may be affixed to the ceiling by screws **22**. The plate has an air bore **23** in the ends of which are sealed adjacent section ends **24** of the continuous air tubing circuit **13** extending through the rooms of the building so as to maintain its continuity. Within a threaded hole **25** of the junction plate **21** is mounted an inlet nipple member **26** having a bore **27** providing an air circuit connection between the junction plate air tubing bore **23** and a small inlet cavity **28** formed at the lower end of the nipple **26**. The lower end of the inlet nipple **26** forms an enlarged threaded opening for receiving the neck of a detector vessel **33** of material, such as metal, having high heat conductivity, and containing a sealed-in cavity of air or gas which is released into the nipple bore **27** and the air tubing circuit **13** upon the melting of its meltable sealing drop **32** of solder or similar substance, which is chosen to melt at a predetermined fixed temperature at which the detector vessel **33** should start the alarm.

Gaskets **37**, **38** assure gas-tight connection between the detector vessel **33** and the nipple **26**, and between the nipple **26** and the air tubing circuit **13**, respectively.

In an installation of the type shown in Figs. 1 and 2, such detector units **20** are placed in the individual closets in lieu of about 50 feet of rosette tubing heretofore required for protecting such spaces. In such application, the air volume of the casing is made about equal to the air volume contained in about 50 feet of tubing, or about two cubic inches. The casing **33** has, for instance, sealed therein a volume of air at atmospheric pressure at a temperature of about 70° F. This air is normally segregated from the air confined in the circuit of the air tubing **13**, and the air tubing circuit **13** functions to give the rate of rise fire protection just as if the fixed detector units **20** did not form a part of the protective system.

The seal **32** which seals the air confined in the detector casing **33** is made of a substance which melts at the desired maximum abnormal temperature at which the fire alarm should be given.

The volume of the air in the fire detector casing **33** is so chosen that when the casing temperature approaches the abnormal temperature at which the vessel seal **32** melts, and opens the connection of the vessel **33** to the air tubing **13**, the pressure of the air confined in the casing **13** will be sufficiently high so as to cause a propagation of the pressure wave along the bore of the air tubing **13** to the diaphragm chambers **14** for starting the alarm.

In a practical design of such air tubing protective systems, having a detector casing **33** holding about two cubic inches of air at the temperature of 70° F. and a solder seal **32** arranged to melt at a temperature of 160° F., the confined air will have risen in pressure about 1.7 pounds per square inch, sufficient to bring about the propagation of the pressure wave through the air confined in the tubing **13** for actuating the expansion chambers **14** and start the alarm.

In order to prevent a molten solder seal drop **32** from blocking the connection to the air tubing **13**, the nipple cavity **28** adjoining the solder seal **32** is filled with a fluffy porous substance, such as fluffy cotton or glass wool, which traps the molten solder drops and vapor and prevents them from blocking up the inlet in the nipple bore **27**.

The vessel **33** with its seal **32** is designed to have small heat capacity and the connector nipple **26** is made from heat insulating material, and they are so proportioned and arranged that the connector **26** serves as a heat insulating support, which impedes flow of heat from the vessel **33** and assures that its temperature rises substantially as fast as the temperature of the space to which it is exposed.

The temperature detector unit **20** with its air chamber **33** is also provided with indicating means for indicating to observer that it was called upon to perform its protective duty and that its seal to the air tube **13** has been opened by an abnormal temperature rise.

Such indicating means may be formed of a metal plate **44** shaped to fit into a depression on the bottom wall **36** of the air casing **33**. The plate **44** is shown held in place by one or more drops **46** of solder which melts at a temperature correlated to the melting temperature of the solder seal **32** so as to assure that the indicator **44** operates when the solder seal **32** opens. The portion of the closure wall **36** underlying the indicator plate **44** may have a different color than the exposed portions of the casing walls **33** and **36** so as to indicate at a glance that a given detector unit **20** has performed its protective function and should be replaced by another unit.

In order to assure at all times positive functioning of the alarm system upon the melting of the solder drop seal **32**, the pressure of the air or other normally non-condensing gas with which the chamber **33** is originally filled may be of considerably higher than atmospheric pressure.

Such abnormal maximum temperature detector unit may be used not only as a substitute for rosette tubing ordinarily required for small closet spaces, but it is also of great value in designing air tube protective systems which are required to protect spaces which are exposed to sudden temperature rises which are not dangerous, but require protection against abnormal tem-

perature rises above a maximum temperature value, for instance, in furnace installation.

In Fig. 4 is shown a modified abnormal temperature detector unit of the invention. It comprises a connecting nipple 26' associated with an air chamber casing 33', as in Fig. 3, which is shown abnormally sealed by a valve member 70 pressed against a valve seat 71, which is held in place by a closure wall 73 of the valve chamber. The valve 70 is actuated by a valve stem 74, led by a guide ring 75 into engagement with a bimetallic temperature responsive snap disc 77 located in a depression 78 in the bottom closure wall 36' of the air chamber casing 33'. The valve member 70 is normally held in the closed position against the valve seat 71 by a spring 79. Upon an abnormal rise of the temperature to a predetermined value, the bimetallic disc which is normally in its downward position will snap to its dotted line upper position 77', and push the valve stem upwardly to open the valve 70 and release the confined heated air in the air vessel 33' into the air tubing 13 for actuating an expansion chamber 14 and start the alarm, as in the arrangements of Figs. 3 and 4. This arrangement brings about automatic resealing of the air in the detector vessel 33' as soon as the temperature drops to a predetermined lower value at which the bimetallic disc 77 snaps back to its normal position, and permits the spring 79 to close the valve 70 and seal the air in the vessel 33'.

In Fig. 5 is shown a modified thermo-responsive control device for actuating the valve stem 79 of a valve 70 from its normal closed position to the open position in which it releases the heated air of higher pressure confined in the air chamber 33 into the air duct of the air tubing 13 for starting the alarm. The temperature control device of Fig. 5 comprises a bimetallic bar 80 carried by a carrier 81 which is pivoted at 82 on a supporting member 83 held clamped to the bottom wall 36 by a threaded collar 84 extending through the bottom wall 36 of the air casing 35. A control screw 85 threadedly mounted in the collar 84 has at its upper end an abutment 86 engaging an arm extending from the carrier 81. At normal lower temperatures the free end of the bimetallic bar 80 is held in its downward position shown in Fig. 5 by a U-shaped spring 88 seated on a knife edge of the free end of the bimetallic bar 80 and on the adjusting screw 89 mounted on an uptsanding arm of the supporting member 63. The bimetallic bar is normally in its lower position shown in Fig. 5, and permits the valve spring 79 to keep the valve 70 in the normal closed position. Upon an abnormal temperature rise to a predetermined maximum value, the bimetallic bar 80 will bend in upward direction until, after reaching its neutral position, it will be snapped over by the pressure of the spring 88 in upward direction to dotted line position 80' so as to lift the valve stem 74 and open the valve 70 for releasing the compressed heated air confined in the chamber casing 33 into the air tubing 13 and start the alarm.

The valve will automatically reseal the air in the detector vessel 33 as soon as the temperature drops down to a predetermined minimum value at which the reverse bending motion of the bimetallic bar 80 passes its neutral position and is snapped back by the spring 88 to the lower position, and permits the valve spring 79 to close the valve 70. By rotating the control screw 85 the temperatures at which the thermostat bar acts to operate the switch from the open to the closed position and vice versa may be controlled. In addition, the mounting of the adjustment screw 89 controlling the pressure exerted by the spring 88 on the thermostat bar 80 enables the control of the range between the maximum and minimum temperatures at which the thermostatic bar is actuated from the downward position to the upper position and from the upper position to the downward position.

In rate of rise air tube systems of the type described above, all the advantageous features of the continuous tubing circuit for starting a protective action in response to a sudden rise of the temperature are fully retained, without requiring the utilization of great lengths of the tubing circuit for giving protection in spaces such as small closets, or furnace locations, which require protection that responds to an excessive temperature rise to a predetermined maximum value. It combines a fluid tubing circuit that is substantially throughout its entire length effective to secure rate of rise protection for spaces requiring such protection, with excessive temperature protection by temperature responsive normally sealed fluid discharge vessels in spaces requiring such protection into an ever effective and easily maintained and supervised unitary protective system.

In the system of the invention, the excess temperature detector vessels are normally sealed against the main tubing circuit, and are actuated by an excessive temperature to release a volume of compressed heated air confined in the vessel into the main tubing circuit for actuating the alarm, without adversely affecting the sensitivity of the normal rate of rise protection of the main tubing circuit by introducing additional volume in areas not directly exposed to the fire.

The system of the invention is also of great value in locations, such as those heated by unit blower heaters, which are exposed to rapid temperature changes, which might give a false alarm if protected by the main rate of rise tubing. In accordance with the invention, the main rate of rise tubing extending such locations is shielded by heat insulation to decrease its sensitivity, and effective protection is secured by a sealed off air vessel which releases an air pressure wave into the main tubing upon an abnormal temperature rise to a maximum dangerous value. Such normally sealed temperature responsive air pressure release units are also useful in giving additional excess temperature protection to spaces equipped with rate of rise tubing as protection against sudden dangerous rises of temperature as well as against dangerous excessive temperatures. Depending on the conditions, the detector units may be designed for operation at different air release temperatures ranging between about 160° F. to 250° F.

In installations, in which a sealed off air release vessel is located near the expansion diaphragm chamber, the inlet nipple bore 27 or 27' may be made very small, for instance, of capilliary size, so as to reduce the pressure pulse in the circuit portion leading to the nearby expansion chamber and prevent abnormal deformation of the chamber.

The practical value of combining a rate of rise tubing system with fixed excess temperature air release devices of the invention is illustrated by the following typical conditions:

Assume a space to be protected to have a floor area of 1200 sq. ft. including eight fully enclosed closet spaces. The rules under which the tubing would be installed would require 10% of the tub-

ing in the open room and 5% in each of the closets, which would consume 50% of the tubing circuit.

If the fixed temperature devices were used in the installation about four devices would be installed in the room and one device in each of the closets, in lieu of the 5% of tubing. With this arrangement only 10% to 12% of the tubing would be used in covering this space, leaving 90% to be used in adjacent locations, thus effecting an economy in the installation of the service.

In the event of a fast fire originating from loosely packed combustibles such as waste paper, scrap wood, excelsior or highly inflammable liquids such as gasoline, cleaning fluids or paints, the rate-of-rise tubing would promptly function and give an alarm within ten to thirty seconds after the fire had started.

A very slow fire, originating from compact slow burning materials or in closely confined spaces such as small well packed closets where the air supply is limited, would not operate the rate-of-rise tubing as promptly as a fire producing a fast rate of temperature rise. In cases where the fire progresses very slowly, it may fail to function until conflagration condition exists in the space due to a gradual build up in temperature in the room by a slow, steady condition. The temperature at which this condition takes place is around 350 degrees F. With the normally sealed off fixed temperature device of the invention installed in the tubing circuit the fire condition will be detected in the early stages, at which time the fire can be easily controlled and extinguished.

However, since the new excess temperature air release detector units are very small and inconspicuous, each space protected by a rate-of-rise air tubing section may also be equipped with one or more such excess temperature detector units as protection against excessive temperature rise in addition to the rate of rise protection given by the air tubing section.

The exemplifications of the invention described above will suggest to those skilled in the art other modifications thereof. It is accordingly desired that the appended claims be given a broad construction with the scope of the invention within the art.

We claim:

1. In a control arrangement for an abnormal temperature protective gas tube system remaining inactive upon a gradual increase of the internal tube pressure operative to exert a protective action upon a sudden rise of said pressure, and having a tube portion connected to said system and located adjacent to a space exposed to abnormal excessive temperatures, a gas discharge vessel containing a charge of normally non-condensible gas and a sealing element located between said discharge vessel and said tube portions for normally maintaining said vessel disconnected from the tube system and operative at a predetermined excessive temperature to connect said vessel to said tube portion for suddenly increasing the pressure in said tube portion and thereby actuate said system, the major portion of said vessel being of a material having high heat conductivity, and a connector element of heat insulating material having a gas passage connecting said vessel and said tube portion and constituting the sole supporting connection supporting said vessel in its operative position so as to effectively impede flow of heat from said vessel.

2. In a control arrangement for an abnormal temperature protective gas tube system remaining inactive upon a gradual increase of the internal tube pressure operative to exert a protective action upon a sudden rise of said pressure, and having a tube portion connected to said system and located adjacent to a space exposed to abnormal excessive temperatures, a gas discharge vessel containing a charge of normally non-condensible gas and a sealing element located between said discharge vessel and said tube portion for normally maintaining said vessel disconnected from the tube system and operative at a predetermined excessive temperature to connect said vessel to said tube portion for suddenly increasing the pressure in said tube portion and thereby actuate said system, the major portion of said vessel being of a material having high heat conductivity, indicating means including an element located in a normal position on the exterior of said vessel and operative to be released from said normal position upon a predetermined rise of temperature for indicating the operative condition of said vessel, and a connector element of heat insulating material having a gas passage connecting said vessel and said tube portion and constituting the sole supporting connection supporting said vessel in its operative position so as to effectively impede flow of heat from said vessel.

3. In a control arrangement for an abnormal temperature protective gas tube system remaining inactive upon a gradual increase of the internal tube pressure operative to exert a protective action upon a sudden rise of said pressure, and having a tube portion connected to said system and located adjacent to a space exposed to abnormal excessive temperatures, a gas discharge vessel containing a charge of normally non-condensible gas, a sealing element for maintaining said vessel normally disconnected from the tube system and operative at a predetermined excessive temperature to connect said vessel to said tube system for suddenly increasing the pressure in said tube portion for actuating said system, the major portion of said vessel being of a material having high heat conductivity, and a connector element of heat insulating material having a gas passage connecting said vessel and said tube portion and constituting the sole supporting connection supporting said vessel in its operative position so as to effectively impede flow of heat from said vessel.

4. In a control arrangement for an abnormal temperature protective gas tube system remaining inactive upon a gradual increase of the internal tube pressure operative to exert a protective action upon a sudden rise of said pressure, and having a tube portion connected to said system and located adjacent to a space exposed to abnormal excessive temperatures, a gas discharge vessel containing a charge of normally non-condensible gas, a sealing element for maintaining said vessel normally disconnected from the tube system and operative at a predetermined excessive temperature to connect said vessel to said tube system for suddenly increasing the pressure in said tube portion for actuating said system, the major portion of said vessel being of a material having high heat conductivity, the tube portion in the area of normal sudden temperature rise having heat insulation rendering it insensitive to said normal temperature

rises, and a connector element of heat insulating material having a gas passage connecting said vessel and said tube portion and constituting the sole supporting connection supporting said vessel in its operative position so as to effectively impede flow of heat from said vessel.

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