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 [33] **Japan**
 [31] **43/102655 and 43/102656**

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[54] **HEAT DETECTION UNIT**
3 Claims, 9 Drawing Figs.
 [52] U.S. Cl. 337/380,
 236/101, 337/377
 [51] Int. Cl. H01h 37/04,
 H01h 37/52
 [50] Field of Search 236/101;
 337/354, 365, 372, 373, 376, 377, 380

ABSTRACT: A heat detection unit including in a sealed block a contact assembly connected to an electric driving circuit for fire alarm or extinguisher apparatus and adapted to be closed by self-turning or deforming action of an associated heat-sensitive bimetal element. The bimetal element is arranged to be thermally close contact with a sealing metal cap of the block having a heat-collecting plate member provided with a plurality of holes adapted to have circumferential heat collected at both surfaces of the plate and transmitted to the cap through the shortest distance.

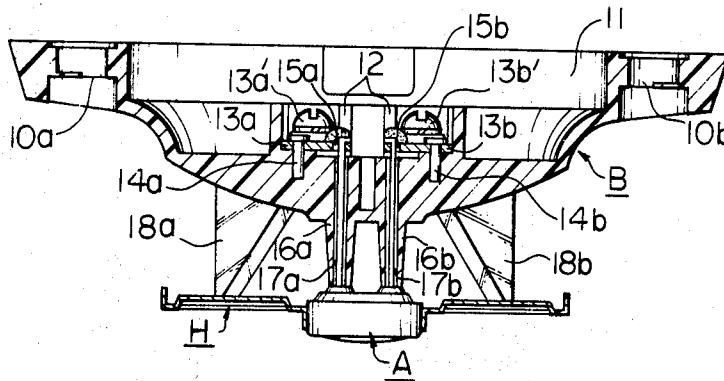


Fig. 1

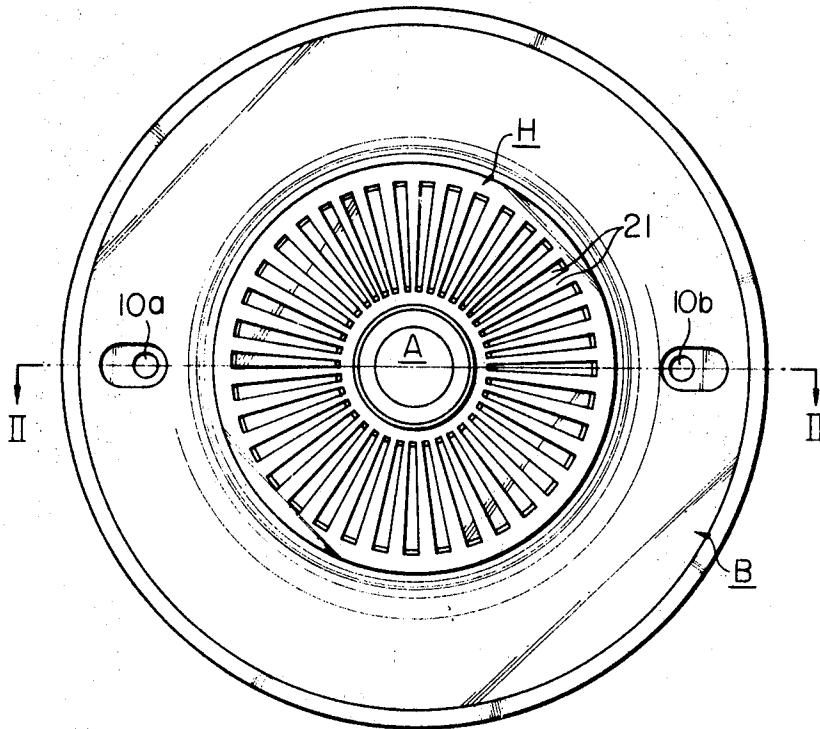
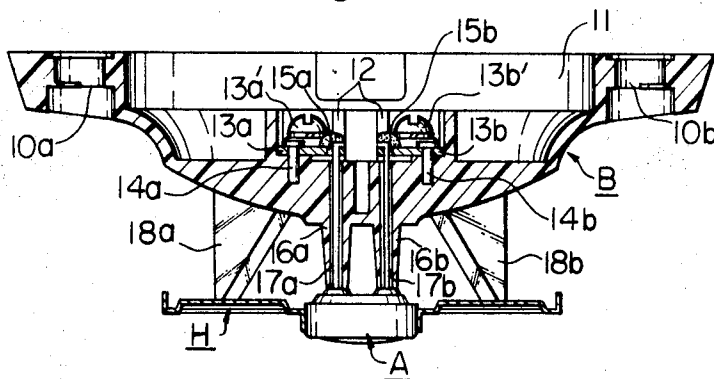


Fig. 2



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Fig. 3

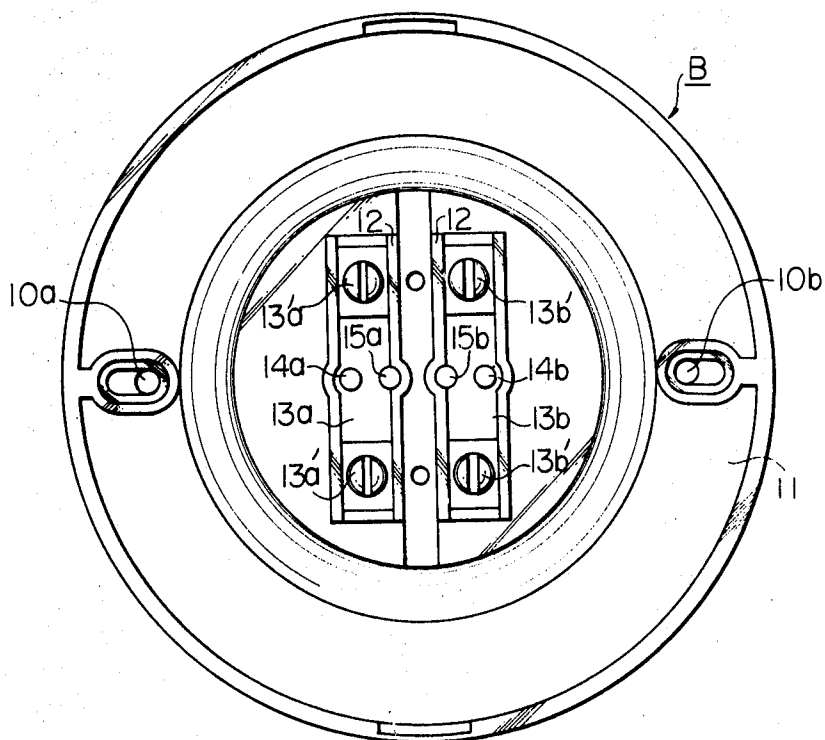
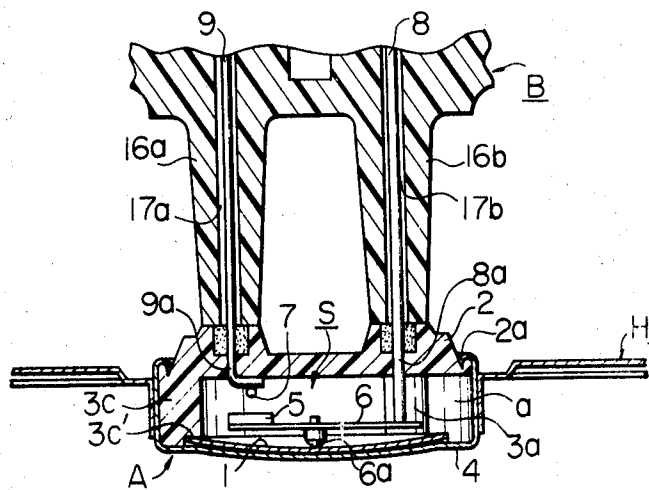


Fig. 4



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Fig. 5

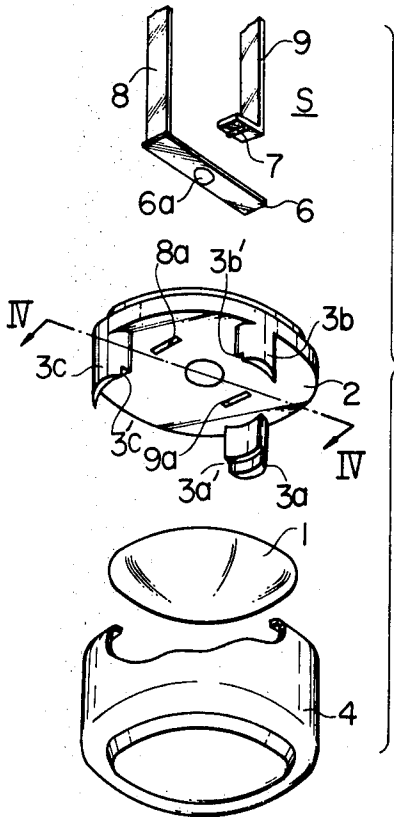


Fig. 6A

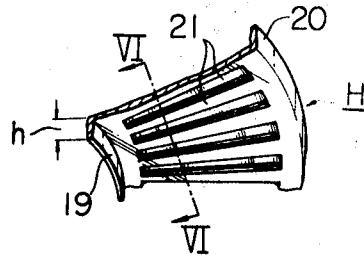


Fig. 6B

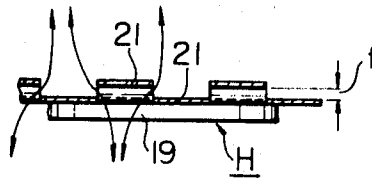


Fig. 7

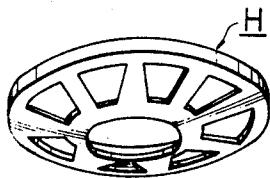
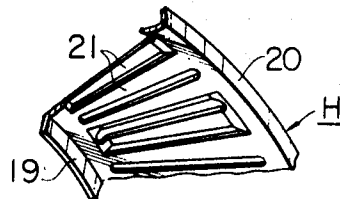


Fig. 8



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HEAT DETECTION UNIT

This invention relates in general to extraordinary heat or fire detection unit adapted to close contacts in electric circuit for driving fire alarm devices, fire extinguishing devices or the like devices upon detecting a state of fire occurrence or immediate before such occurrence.

More specifically, it relates to a heat detection unit provided with a heat collector element which is capable of having the highest heat receptivity in spite of its occupying smallest heat-receiving surface area.

For the heat detection unit of the type as referred to, there have been suggested various types of unit including, for example, a type in which such heat-sensitive element as a bimetal, thermistor or the like is made to be enclosed in a porous guard member, and a type in which similar heat-sensitive element is held in a metal case of a high thermal conductivity so as to be brought into close contact with the latter.

However, such conventional types of heat detection unit have been inherently involving several defects. In the case of the first one of the two types as referred to in the above, the guard member enclosing the heat-sensitive element is not effective in thermal function at all and even obstructs the passage of heated air currents to the heat-sensitive element due to its insufficient ventilation. In addition, since normally the heat-receptive surface area of the heat-sensitive element has been remarkably small, the unit of this type has been faulty in that the same could have been only raised to required or predetermined operating temperature finally at the time when the fire has reached a certain large scale.

In the case of the second type of the conventional unit as referred to in the above, while effective heat-receiving surface area could be enlarged by means of the metal case as compared with that of the first one of the types, the heat-sensitive element has not been placed in position for direct contact with the heated air current and, thus, the heat receptivity of the element has been forced to be deteriorated. If a metal case of larger dimension would be utilized in this second type of the unit for the purpose of compensating the above fault, such a larger dimension would result only in a useless increase in the thermal capacity of the unit so that the fire could grow to a large scale before the air temperature inside the metal case would be raised to the predetermined temperature level at which the heat-sensitive element could be actuated.

A principal object of the present invention is, therefore, to provide a heat detection unit in which the heat-sensitive element can be raised in an extremely short time period while the same occupies an extremely small space.

A further object of the present invention is to provide a heat detection unit which is constructed in such manner that the heat received at respective parts of the unit will be effectively converged into the heat-sensitive element so as not to be dispersed to other parts.

Other objects and advantages of the invention will become clear upon reading the following disclosures set forth with reference to the accompanying drawings, in which:

FIG. 1 is a front side plan view of the heat detection unit according to the present invention.

FIG. 2 is a vertically sectioned view taken along a line II—II in FIG. 1.

FIG. 3 is a reverse side plan view of the unit shown in FIG. 1.

FIG. 4 is a detailed vertical section of main part of the unit of FIG. 1, shown in an enlarged scale and, specifically, taken along a line IV—IV in FIG. 5.

FIG. 5 is a perspective view of the main part shown in FIG. 4 as disassembled.

FIG. 6A is a perspective view of a heat-collecting member of the present invention, which is shown here fragmentarily.

FIG. 6B is a vertical sectioned view of the heat-collecting member along VI—VI line in FIG. 6A.

FIG. 7 is a perspective view of another embodiment of the heat-collecting member.

FIG. 8 is an enlarged fragmentary perspective of the heat-collecting member of FIG. 7.

Referring now to FIGS. 1 and 2, the heat detection unit comprises in general a sealed block A containing the heat-sensitive element therein, a heat collector rim or plate H mounted around said block A for collecting and transferring the heat of circumferential air to the block A, and a base member B to which the block A is secured. The unit will be normally fixed to ceiling surface of a room at the part of said base member B.

The heat-sensitive element employed in the unit according to the present invention comprises a disc- or saucer-shaped bimetal 1, which is, as will be best seen in FIGS. 4 and 5, placed inside a space *a* of the sealed block A formed with a receptacle 2 made of a synthetic resin and a metal cap 4, in such manner that peripheral edge of the bimetal 1 will be engaged in respective steps 3*a'*, 3*b'* and 3*c'* of supporting columns 3*a*, 3*b* and 3*c* projected along peripheral edge of the receptacle 2. Said sealed block A is performed by squeezing end edge of the metal cap 4 into a peripheral groove 2*a* provided on reverse side of the receptacle 2. The saucer-shaped bimetal 1 is so arranged as to contact with inner surface of the metal cap 4 at its convex side in the normal or fixed temperature.

In the space *a* of the above mentioned sealed block A, there is further contained a contact assembly S in addition to the disk-shaped bimetal also in the sealed state. Said contact assembly S comprises a movable contact 5 secured on a movable contact arm 6 and a fixed contact 7. Said contact arm 6 is in turn secured at an end to an extending end of a rod-shaped lead 8 inserted through a small hole 8*a* made in the receptacle 2, so as to oppose to concave side at the time of the fixed temperature of the bimetal 1. At the center of the movable contact arm 6, there is provided an actuating button 6*a*, which is brought substantially into the disk-shaped bimetal 1 so that self-turning movement of the bimetal 1 at the time when the same detects an excess heat over the fixed temperature will be transmitted to the arm 6. The fixed contact 7 is provided at a position opposed to said movable contact 5 as spaced by a proper distance, and is fixed to an end of another rod-shaped lead 9 inserted through a small hole 9*a* made in the receptacle 2.

The sealed block A containing the disk-shaped bimetal and the contact assembly S is held by the base member B which will be set forth in detail in the following.

Referring again to FIGS. 1 and 2 and to FIG. 3, the base member B is provided with mounting holes 10*a* and 10*b* for mounting the unit to ceiling surface, and is formed as a whole in a streamline shape projecting downwardly, so that heated air current will be smoothly led along the base member surface toward the sealed block A containing the heat sensor bimetal 1. At the mounting side of the base member B to the ceiling, there is provided a hollow room 11, in which terminal plates 13*a* and 13*b* separated by separating walls 12 are fixed to the base B by means of self-tapping screws, and wire fastening screws 13*a'* and 13*b'* are screwed to the terminal plates 13*a* and 13*b*, respectively. Adjacent to said terminal plates 13*a* and 13*b*, holes 15*a* and 15*b* are provided in such manner that they will be aligned with holes 17*a* and 17*b* respectively made through each of two projections 16*a* and 16*b* projecting out of the base B, so as to be a pair of continuous holes 15*a*—17*a* and 15*b*—17*b*, through which said leads 8 and 9 are inserted, respectively. Upper ends of these leads 8 and 9 are fixed to a part of the terminal plates 13*a* and 13*b* by means of soldering, respectively. Therefore, the sealed block A referred to in the above will be fixed to the base member B by means of the leads 8 and 9. The base member B is further provided, in addition to the above mentioned projections 16*a* and 16*b*, with ribs 18*a* and 18*b* likely projected out of the base member B in downward direction. These ribs 18*a* and 18*b* are formed for the purpose of protecting the heat collector H, which will now be explained in the following.

The heat collector H is a member to be brought into close contact thermally with the sealed block A for the purpose of transmitting the generated heat rapidly from circumferential air to the bimetal 1 contained in the sealed block A.

For this purpose, the heat collector H is formed in a disc shape and is provided at its central part a cylindrical portion 19 having a height h and formed in a squeezing process, as shown in FIG. 6A. Inner diameter of the cylindrical portion 19 is made to substantially coincide with outside diameter of the sealed block A, so that the heat collector H is mounted around the sealed block A with the cylindrical portion 19 as engaged at outside periphery of the block A and adhered thereto by means of a proper bonding agent, thereby the collector H and block A will be mechanically and thermally bound together.

Along outer periphery of the heat collector H, there is provided a raised rib 20 formed by a squeezing process for increasing mechanical strength of the collector H.

The heat collector H according to the present invention is further provided with a plurality of bridge portions 21 respectively separated at longitudinal sides from each other by a plurality of clearances or slits made radially on the disk. Such clearances will be established, for example by depressing every one of adjacent two of the bridge portions 21, as shown in FIGS. 6A and 6B, so that the portions 21 will be alternately stepped from adjacent ones and, thus, a plurality of clearances t in vertical direction sufficient for passing air current therethrough will be provided between each of the adjacent stepped bridge portions 21.

Since the heat detection unit according to the present invention is formed in such structure as above with such components as detailed in the above, when any fire occurs or any extraordinary temperature rise which will cause such fire to occur is present nearby the position at which the heat detection unit is installed, possible heated air current due to the above will go up toward the unit so as to have the bimetal piece 1 in the unit heated through the metal cap 4 and, thus, urged to be bent upward. When the curvature of the saucer-type bimetal 1 is thus turned upward with its own snap action due to the heat, the movable contact arm 6 will be pushed up through the actuating button 6a, so that the movable contact 5 and fixed contact 7 are closed. By this closing of the both contacts, the terminal plates 13a and 13b are brought into short-circuited condition so as to close an electric driving circuit for an associated alarm device or fire extinguishing system.

As will be readily appreciated from the foregoing, the feature of the present invention resides in that the highest heat receptivity will be obtained at the heat collector means with the smallest surface area, and that the above-mentioned structure of the unit of the present invention is greatly contributing to such feature due to the following phenomena caused by the particular structure.

That is, since the heat-collecting plate H according to the present invention is provided with a plurality of radial bridge portions 21 respectively separated by a vertical clearance t from each other as alternately stepped or depressed, the heated air current coming up will not only flow into reverse side of the heat collecting plate H through the clearances of t , but also will collide with the respective bridge portions 21 so as to cause a turbulent or eddy current of the heated air to be generated over the entire surface area at both surfaces of the plate H, so that all of the bridge portions 21 and, consequently, the whole of the heat-collecting plate will be highly and effectively heated from its both of front and reverse sides.

Further, as the lower or front surface of the heat-collecting plate H is made to be on a different level from that of lower surface of the metal cap 4 of the block A by a height of h , i.e., by the height corresponding to that of the cylindrical portion 19 of the plate H, the heat-collecting surface area of the unit according to the present invention is enlarged by an area obtained by multiplying the height h with circumferential length of the cylindrical portion 19.

The heat of collector H thus heated up to a higher temperature will then be conveyed to the metal cap 4, which is kept at a lower temperature than the collector H because it is relatively hard to be heated comparing with the collector H. Therefore, the temperature of saucer-shape bimetal 1 which is arranged thermally integral with the metal cap 4 will be quickly raised to a degree substantially identical to the temperature of the heat collector H.

In the above case, it will be appreciated that the particular arrangement of the respective bridge portions 21 formed radially so as to be directed to the center of the circular disc plate H will be effective in transmitting the heat collected by the plate H to the metal cap 4 through the shortest distance and, also, in making the temperature rise of the saucer-shaped bimetal 1 to be much faster. Further, the radially extending bridge portions 21 are also making the heat-collecting plate H to be stronger against any external force given in horizontal direction.

Further in the present invention, it will be seen that the saucer-shape bimetal 1 is supported only by the supporting columns 3a, 3b and 3c, except the metal cap 4 covering the same. This fact is specifically effective in preventing the heat transmitted to the bimetal 1 from the heat-collecting plate H through the cap 4 from being dispersed to other parts of lower temperature and consequently the temperature rise in the bimetal 1 will be effectively made to be quicker.

It will be understood that, in carrying out the present invention, the bridge portions 21 of the heat collecting plate H should not necessarily be formed in radial arrangement or in stepped relation to each adjacent ones. It will be possible to have the hot air current led to both of the front and reverse sides of plate H simply by providing many holes or slots in the plate H as, for example, shown in FIG. 7 so as to be able to make the heat receptivity much higher than in the case of conventional types of the unit. It should be also understood that the effects are obtained by so forming the heat collector as to be stepped, for example, at every two adjacent portions as shown in FIG. 8, instead of being stepped at every one alternately.

What I claim is:

1. A heat detection comprising a sealed block including a heat-conductive metal cap, a base member for holding said sealed block, a heat-sensitive bimetal element contained in said sealed block in such manner that its convex side surface at lower temperature will be thermally related to said metal cap of the sealed block, a contact assembly having a movable contact and a fixed contact and contained in the sealed block together with said bimetal element, said contact assembly being positioned adjacent said bimetal element so as to be operated upon self-deformation of the bimetal in response to presented heat thereto, and a heat-collecting plate member of a heat-conductive material brought into thermally close contact with the metal cap of sealed block, said heat-collecting plate member being formed in a disk-shape and provided with a plurality of bridge portions respectively separated from each other by a plurality of vertical slits with respect to the plane of the disk so as to be stepped alternately, so that heat-collecting surface area of the plate member will be increased and the plate will be heated from its both front and reverse sides simultaneously.

2. The heat detection unit as set forth in claim 1, wherein said sealed block comprises said metal cap and an insulative receptacle member having a plurality of supporting columns, and said bimetal element is held between said columns and metal cap, thereby possible dispersion of collected heat from the bimetal element will be restricted to be minimum.

3. A heat detection unit comprising a sealed block including a heat-conductive metal cap, a base member for holding said sealed block, a heat-sensitive bimetal element contained in said sealed block in such manner that its convex side surface at lower temperatures will be thermally related to said metal cap of the sealed block, a contact assembly having a movable contact and a fixed contact and contained in the sealed block together with said bimetal element, said contact assembly being positioned adjacent said bimetal element so as to be operated upon self-deformation of the bimetal in response to presented heat thereto, and a heat-collecting plate member of a heat-conductive material brought into thermally close contact with the metal cap of sealed block, said heat-collecting plate member being provided with a plurality of holes for allowing heated air current to be passed therethrough so as to have the heat-collecting plate heated simultaneously from its

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both surfaces, said heat-collecting plate member also being coupled with said metal cap of the sealed block in such manner that the horizontal plane of the plate member is spaced above the bottom surface of the cap, said plate

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member including a depending peripheral flange in heat-conducting engagement with said metal cap so that the heat-collecting surface area of the unit will be enlarged.

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