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(54) SOCKET-MOUNTED FIRE SENSORS

(71) We, CERBERUS AG., a Swiss corporate body of Mannedorf, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to fire-sensing devices, and more particularly to fire sensors which are adapted for connection to a socket, and to be removable from the socket.

Fire sensors are arranged to sense ambient conditions indicative of a fire, and many include a sensing element which provides an electrical output signal so that an electrical circuit can provide a fire alarm, upon sensing of fire conditions. The sensing elements frequently require connection to electrical circuit elements which have very high resistances. Typical fire sensors may include ionization chambers or photoelectric cells. The evaluation circuits connected to such sensors include amplifiers which also may have high input resistances, such as highly sensitive field effect transistors. The fire sensor or detector requires insulation paths which are of extremely high resistance, and which should be as free from creep paths as possible.

Fire-sensing elements can be manufactured to have extremely high insulation resistances; they must be protected from casual or intentional contact, however. Fire sensors preferably are made in various parts, including one socket element, for example adapted for attachment to, or recessing into a wall or ceiling of the space to be supervised, and a sensing element or fire detector portion itself which is removably connected to the socket. The various electrical connections and components of the detector or sensing portion become accessible upon removal of the detector portion from the socket; the sensitive sensing or detector elements may

therefore be damaged, for example by mishandling.

Ionization-type fire sensors or detectors use radio-active substances. If the detector or sensing unit is removed from the socket, contamination by radioactive substances cannot be entirely excluded, which may result in hazards to the health of unskilled persons handling the ionization-type detector.

It is an object of the present invention to prevent unauthorized separation of the fire sensor or detector portion or unit from the associated socket by unauthorized persons, and preferably by persons not having access to specific removal tools. Such tools should be simple, and removal of the sensor unit or element from the socket should still be simple, without requiring direct handling of the sensing unit or element itself. The use of safety screws or special holding screws to secure the sensing unit to the socket thus is not suitable.

According to the present invention there is provided a fire sensor including a socket element suitable for mounting on a support, and a sensor element including fire sensing means, removably securable to the socket element, and further including a movable locking member located in one of said elements to cooperate with a recess located on the other of said elements, said locking member engaging in said recess means upon relative engaging movement of said elements and preventing disengaging movement of said elements upon engagement of said movable locking member in said recess.

In accordance with a feature of the invention, a removal tool is provided which can engage in a space between the socket portion and the sensor or detector portion and release the catch, while at the same time surrounding and shielding the detector portion, to permit removal of the detector portion from the socket while simultaneously protecting the sensor

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element or detector portion and not requiring handling thereof, directly, during the removal operation.

5 The invention will be described by way of example with reference to the accompanying drawings, wherein:

Figure 1 illustrates, in exploded view, a fire sensor socket, detector, and removal tool;

10 Figure 1a is a fragmentary detailed view of a modification of the catch element assembly of Figure 1;

Figure 2 is an exploded view of another embodiment of a fire sensor, and a removal tool, and to a reduced scale;

15 and Figure 3 is an exploded side view, partly in section, of another type of fire sensor, and removal tool.

20 The fire sensor construction illustrated in Figure 1, shows the various elements. A socket portion or socket element A is secured to a support surface, for example the ceiling of a room or other space which is to be supervised for fire detection purposes. 25 The actual sensor or detector element B is attached to the socket element A by means of interlocking bayonet fastening members 1, 2 which permit connection of element B with element A upon relative rotation of the 30 two elements, in this case rotation of element B with respect to element A, secured to the ceiling. The detector element B may be any type of known fire detector, such as an ionization-type fire 35 sensor, a smoke detector, a flame detector, or the like, or may contain other sensing elements which are sensitive to the consequences of a fire.

40 Socket portion or socket element A includes a housing 3 which is formed with a space 4 within which a plug 5 is movable. Plug 5 can slide in the vertical direction. Plug 5, preferably, is T-shaped in cross section, round or polygonal in plan, and 45 formed with an enlarged head portion 5'. The element 5 normally lies with its head portion 5' against the bottom wall of housing 3, being held there by its own weight.

50 The detector element B has a housing 6, preferably slightly conical, which includes the sensing elements responding to the consequences of a fire, as well as the electronic evaluation circuitry. The housing 55 6 is formed with an opening 7, through which air and smoke or gases may enter into the interior of the housing 6. The upper edge portion of the housing 6 is formed with a narrow upwardly open aperture or slot 8, which is dimensioned so that the lower 60 portion of the plug 5 fits into the slit. The slit is so located with respect to the bayonet fastener parts that, when elements A and B are assembled together, slit 8 is exactly 65 beneath the plug 5.

Assembly: upon pushing the detector or sensor element B against socket A, the upper edge portion of the housing 6 will press plug 5 into the recessed space 11 70 thereabove. Upon subsequent rotation of the element B, to engage the bayonet fastener or catch, plug 5 will, when the bayonet fastener and catches are fully engaged, drop into the slit-like opening 8, 75 located directly beneath plug 5. Plug 5, after having dropped into the slit-like opening 8, prevents reverse rotation of the sensor element B, so that removal of the sensor element from the socket becomes 80 impossible. Electrical connections between the socket element A and the sensor element B have been omitted from the drawing; they may be formed, for example, by spring contacts, pigtail wires, separable 85 connectors and the like.

Disassembly: by use of a tool as shown as element C in Figure 1, sensor element B can be removed from the socket element A. 90 The removal tool element C comprises a sleeve 9 which can be pushed over the element B. There is clearance, between the head 5' of plug 5 and an internally projecting shoulder which upwardly bounds space 11, so that the upper edge of the 95 sleeve 9 can engage the plug 5, pushing plug 5 upwardly and releasing the plug from the slit 8. Alternatively, plug 5 can be so arranged that its width projects laterally over the edge of the slit 8, so that the upper edge of the sleeve 9 of the removal tool will 100 engage against the lower edge of plug 5, thus pushing plug 5 upwardly. The inside of sleeve 9 has a rubber or foam or similar insert 10 at the lower edge thereof, which 105 resiliently clamps the sensor element B so that, upon subsequent rotation of the removal tool C, the sensor element B is also rotated, thereby disengaging the bayonet catches 1, 2. The sleeve 9 is attached to a 110 handle which, for example, may be a long rod, only the upper portion of which is shown, so that the detector or sensor element B can be removed by service 115 personnel without resorting to ladders or the like. It is then merely necessary to push the removal tool element C against the socket element B, and twist. The socket element, upon removal, will be retained by the resilient holder 10 within the cup-shaped removal tool element C, so that the 120 sensitive element B need not be handled or touched.

The invention is not limited to interlocking or interengaging catch elements operating by their own weight. 125 For example, and referring to Figure 1a, plug 5 can be pressed downwardly by a spring 11' located within the space 11. A spiral spring is suitable. Positive engagement of the plug

5 with the slit-like aperture 8 of the sensor element B is ensured.

The fire sensor and removal tool of Figure 2, has a catch or lock which is magnetically retained. Socket 3 is here formed with an auxiliary chamber in which is located a plug 15 made of magnetic material, the poles of which are schematically indicated by + and - signs. Plug 15 is a permanent magnet, and is signed upwardly by a spiral spring 13. A light may be provided on the socket element A, adapted to be illuminated when the sensor responds. The sensor element B is slightly conical; its housing 6' is formed with lateral air entrance slits 7'. A magnetically responsive element 12 is located on the detector element B; this magnetically responsive element may be a permanent magnet, polarized as shown, or a soft-iron plug, and is located close to the slit 8. If element 12 is a permanent magnet, the polarization is opposite that of the plug 15, so that opposite poles will be adjacent each other.

For assembly, and upon rotary engagement of the bayonet catches 1, 2 of elements B and A, permanent magnet plug 5 is attracted by the opposite pole of the plug 12 (or by a soft-iron plug in the detector element B), thus positively ensuring seating of the magnetic plug 15 within the slit 8, and preventing subsequent rotation of the detector element B, and thus removal from the socket element A. The removal tool C may be similar to that of the tool of Figure 1. The plug 15 is pressed upwardly by the upper edge of sleeve 9 of the tool, releasing the magnetic attraction, and permitting rotation of the sensor element B' upon engagement with the resilient insert 10 in the removal tool.

In the embodiment of Figure 3, the sensor element B" is formed with connecting plugs 20, adapted to engage in matching sockets in the socket element A". Socket element A" is of the recessed type, to be mounted flush with a ceiling structure, for example. The locking member is a wedge-shaped plug 21, having a downwardly inclined surface, and pressed into an engaging position by means of a resilient element, such as a leaf-spring 22, a spiral spring, foam padding, or the like. The sensor element B" has an essentially cylindrical housing 6, in which grid-like openings 7" are provided to permit ingress of air and gases.

Assembly: the upper edge 24 of the detector element B", upon vertical movement of the element B", engages the wedge-shaped surface of the plug 21, and presses the plug 21 radially outwardly. As soon as detector element B" is completely seated, the locking plug 21 snaps into an

opening 23 formed in the housing of the sensor element B", so that the sensor element can no longer be removed downwardly.

Removal: a removal tool which merely may include a sleeve 9 is used, the sleeve fitting over the housing of the sensor element B", and engaging the slanting surface of plug 21, pressing the plug 21 outwardly and holding it in outwardly pressed direction, permitting removal of the sensor element B" downwardly. The diameter of the sleeve 9 of the removal tool C" may be just slightly greater than that of the sensor B". The sleeve 9 may, additionally, be formed with a resilient, inwardly extending bulge, punch, or the like, or be slit longitudinally to provide an inwardly extending springy region, for engagement of the sleeve 9 with the element B" in the direction of removal. Alternatively, a yielding resilient edge may be secured to the upper end of the sleeve 9, for example formed of plastic material, and integral with the sleeve 9 which, likewise, may be of plastic.

The direction of movement of the locking element, or locking catch 5 (Figure 1), 15 (Figure 2), 21 (Figure 3) is at right angles to the direction of movement of the sensor element, when the sensor, or detector element and the socket element are being engaged. This difference in direction of movement provides for reliable locking engagement of the parts with respect to each other. Locating the locking catch or plug in such a manner that it is shielded, or shrouded by the housing of the socket itself prevents unauthorized removal and, ordinarily, removal without use of a tool adapted for the specific purpose.

Various changes and modifications may be made, and embodiments described in connection with any one of the drawings may be used with any one of the others, within the inventive concept. Preferably, the direction of motion of the safety catch is to be so selected that it differs from the direction of motion required to assemble (or disassemble) the socket and sensor elements.

WHAT WE CLAIM IS:—

1. A fire sensor including a socket element suitable for mounting on a support, and a sensor element including fire sensing means, removably securable to the socket element, and further including a movable locking member located in one of said elements to cooperate with a recess located on the other of said elements, said locking member engaging in said recess upon relative engaging movement of said elements and preventing disengaging movement of said elements upon

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5 with the slit-like aperture 8 of the sensor element B is ensured.

The fire sensor and removal tool of Figure 2, has a catch or lock which is magnetically retained. Socket 3 is here formed with an auxiliary chamber in which is located a plug 15 made of magnetic material, the poles of which are schematically indicated by + and - signs. Plug 15 is a permanent magnet, and is signed upwardly by a spiral spring 13. A light may be provided on the socket element A, adapted to be illuminated when the sensor responds. The sensor element B is slightly conical; its housing 6' is formed with lateral air entrance slits 7'. A magnetically responsive element 12 is located on the detector element B; this magnetically responsive element may be a permanent magnet, polarized as shown, or a soft-iron plug, and is located close to the slit 8. If element 12 is a permanent magnet, the polarization is opposite that of the plug 15, so that opposite poles will be adjacent each other.

For assembly, and upon rotary engagement of the bayonet catches 1, 2 of elements B and A, permanent magnet plug 5 is attracted by the opposite pole of the plug 12 (or by a soft-iron plug in the detector element B), thus positively ensuring seating of the magnetic plug 15 within the slit 8, and preventing subsequent rotation of the detector element B, and thus removal from the socket element A. The removal tool C may be similar to that of the tool of Figure 1. The plug 15 is pressed upwardly by the upper edge of sleeve 9 of the tool, releasing the magnetic attraction, and permitting rotation of the sensor element B' upon engagement with the resilient insert 10 in the removal tool.

In the embodiment of Figure 3, the sensor element B" is formed with connecting plugs 20, adapted to engage in matching sockets in the socket element A". Socket element A" is of the recessed type, to be mounted flush with a ceiling structure, for example. The locking member is a wedge-shaped plug 21, having a downwardly inclined surface, and pressed into an engaging position by means of a resilient element, such as a leaf-spring 22, a spiral spring, foam padding, or the like. The sensor element B" has an essentially cylindrical housing 6, in which grid-like openings 7" are provided to permit ingress of air and gases.

Assembly: the upper edge 24 of the detector element B", upon vertical movement of the element B", engages the wedge-shaped surface of the plug 21, and presses the plug 21 radially outwardly. As soon as detector element B" is completely seated, the locking plug 21 snaps into an

opening 23 formed in the housing of the sensor element B", so that the sensor element can no longer be removed downwardly.

Removal: a removal tool which merely may include a sleeve 9 is used, the sleeve fitting over the housing of the sensor element B", and engaging the slanting surface of plug 21, pressing the plug 21 outwardly and holding it in outwardly pressed direction, permitting removal of the sensor element B" downwardly. The diameter of the sleeve 9 of the removal tool C" may be just slightly greater than that of the sensor B". The sleeve 9 may, additionally, be formed with a resilient, inwardly extending bulge, punch, or the like, or be slit longitudinally to provide an inwardly extending springy region, for engagement of the sleeve 9 with the element B" in the direction of removal. Alternatively, a yielding resilient edge may be secured to the upper end of the sleeve 9, for example formed of plastic material, and integral with the sleeve 9 which, likewise, may be of plastic.

The direction of movement of the locking element, or locking catch 5 (Figure 1), 15 (Figure 2), 21 (Figure 3) is at right angles to the direction of movement of the sensor element, when the sensor, or detector element and the socket element are being engaged. This difference in direction of movement provides for reliable locking engagement of the parts with respect to each other. Locating the locking catch or plug in such a manner that it is shielded, or shrouded by the housing of the socket itself prevents unauthorized removal and, ordinarily, removal without use of a tool adapted for the specific purpose.

Various changes and modifications may be made, and embodiments described in connection with any one of the drawings may be used with any one of the others, within the inventive concept. Preferably, the direction of motion of the safety catch is to be so selected that it differs from the direction of motion required to assemble (or disassemble) the socket and sensor elements.

WHAT WE CLAIM IS:—

1. A fire sensor including a socket element suitable for mounting on a support, and a sensor element including fire sensing means, removably securable to the socket element, and further including a movable locking member located in one of said elements to cooperate with a recess located on the other of said elements, said locking member engaging in said recess upon relative engaging movement of said elements and preventing disengaging movement of said elements upon



engagement of said movable locking member in said recess.

2. A fire sensor in accordance with claim 1, wherein the locking member is located in the socket element and the recess is located on the sensor element.

3. A fire sensor in accordance with claim 1 or claim 2, wherein the movement of said locking member upon engagement with said recess is in a direction approximately at right angles to the direction of relative movement of said elements upon engagement with each other.

4. A fire sensor in accordance with any one of claims 1—3, wherein the socket element is formed with a downwardly facing opening, and wherein the locking member comprises a plug extending through said opening.

5. A fire sensor in accordance with any of claims 1—4 wherein the sensor element has a housing with an upwardly projecting edge portion, and the recess comprises a slit-shaped gap in the upper edge of the housing, the locking member engaging in the slit-shaped gap, and wherein the relative engaging movement of said elements is in a sliding direction aligning said gap with said locking means.

6. A fire sensor in accordance with claim 5, wherein the socket element and the sensor element include bayonet-type engagement means, and the locking means comprises a plug located in alignment with said slit-shaped gap when the elements are engaged together.

7. A fire sensor in accordance with claim 5, wherein the locking means comprises a plug so located with respect to the sleeve-shaped housing of the sensor element when engaged with the socket element so that a portion thereof extends laterally beyond the outer surface of the sleeve-shaped housing to permit engagement of said portion with a removal tool.

8. A fire sensor in accordance with any one of claims 1—4, wherein the locking means comprises a vertically movable plug means engageable, by vertical sliding movement under the force of its own weight, with said engagement recess means.

9. A fire sensor in accordance with any of claims 1—4, wherein the movable locking means comprises an engagement catch, located to engage the matching engagement recess and spring means are provided to urge said catch in a locking direction.

10. A fire sensor in accordance with any

of claims 1—4, wherein said movable locking means comprises magnetically active material, and magnetically responsive material is located adjacent said engagement recess means, said locking means, engaging in said recess means, and being maintained in said recess means by magnetic force.

11. A fire sensor in accordance with claim 1, wherein the socket element and the sensor element are connectable by means of plug-and-socket means, the direction of engaging movement being in alignment with the plug means, and wherein said locking means comprises a locking catch movable in a direction other than the direction of said plug means, the movable catch being spring-biased to move in engagement with said recess means and engage therein upon engagement of said plug means in said socket means.

12. A fire sensor in accordance with claim 11, wherein the catch is wedge-shaped, having a slanting surface engaged by the sensor element upon engaging movement with respect to said socket element, the slanting surface forming a camming surface and moving the catch, against its bias force, until engagement of the sensor element in said socket element, the recess being formed in said socket element and permitting return of said catch, and engagement in said recess means upon such engagement of said elements.

13. A fire sensor in accordance with any one of claims 1—12, wherein said elements each include, an outer housing and wherein said locking means is located interiorly of the respective housing and, upon locking engagement of said elements, are manually inaccessible.

14. A fire sensor in accordance with claim 13, in combination with a removal tool (C), said removal tool comprising a narrow strip-like projection fitting between said elements and of sufficient length to engage said locking means within the respective housing, said tool further comprising resilient gripping means shaped to surround said sensor element, and engageable with said sensor element upon engagement of said strip-like projection, so that, upon disengagement of said locking means from said recess means and movement of said sensor element in disengaging direction, the sensor element will be resiliently gripped by said removal



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tool and, upon removal from the socket element, will be protected thereby.

15. A fire sensor substantially as herein described with reference to the accompanying drawing.

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