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3,104,060

FIRE EXTINGUISHING SYSTEM AND APPARATUS

Filed Dec. 7, 1960

3 Sheets-Sheet 1

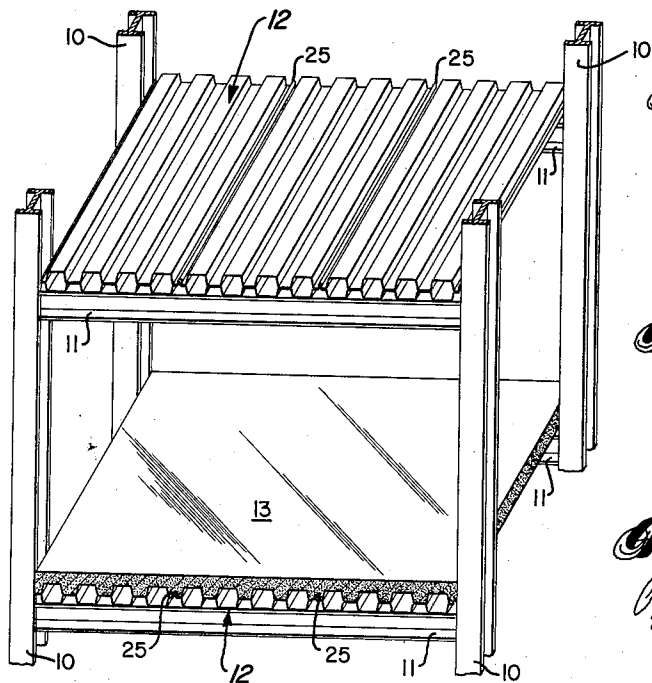


Fig. 1

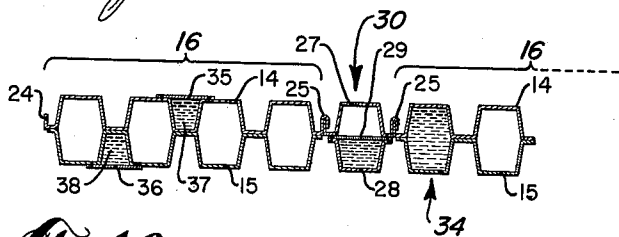


Fig. 10

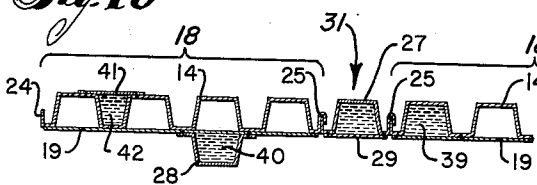


Fig. 11

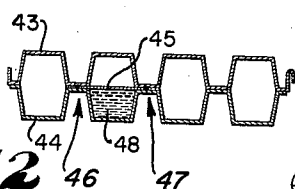


Fig. 12

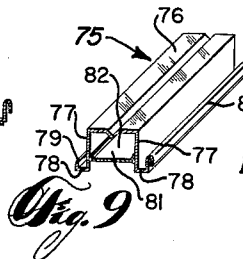
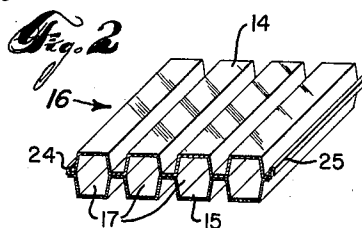
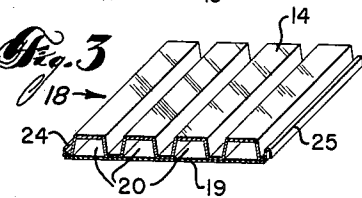
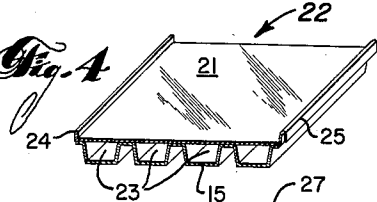
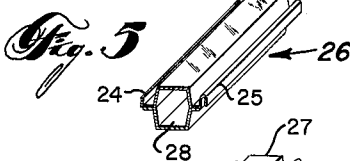
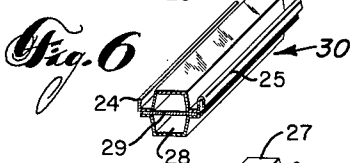
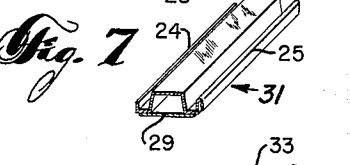
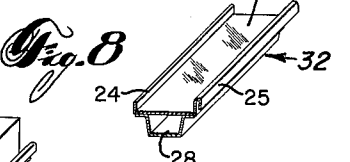
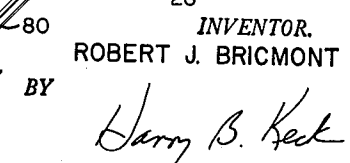


Fig. 9



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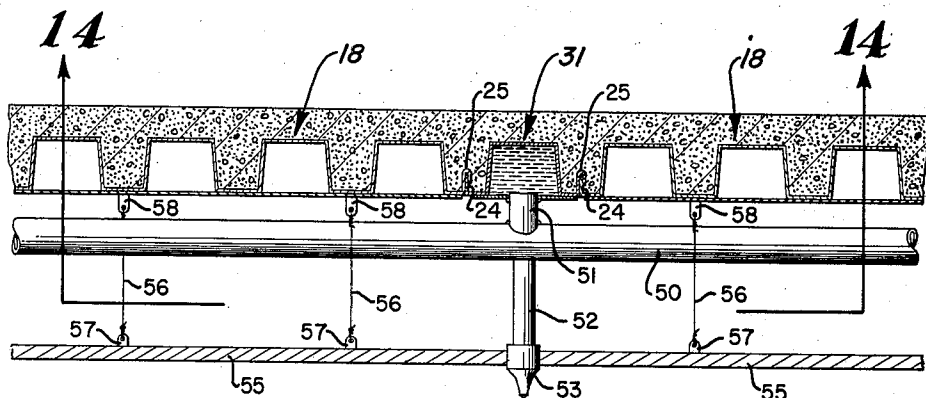


Fig. 13

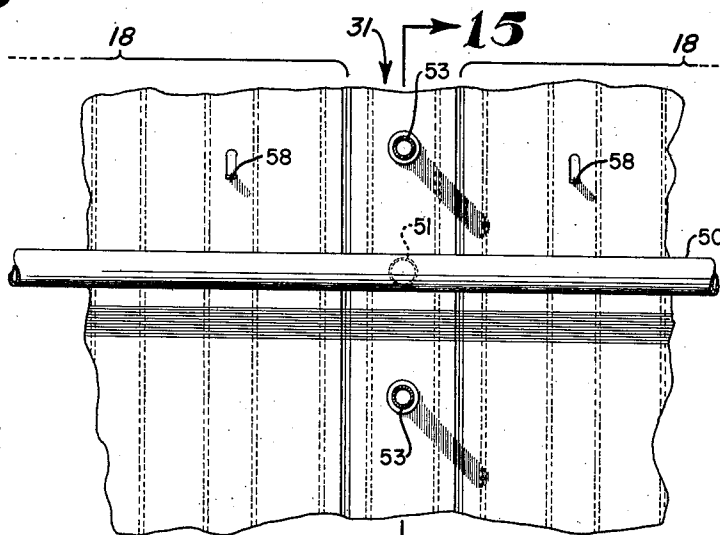


Fig. 14

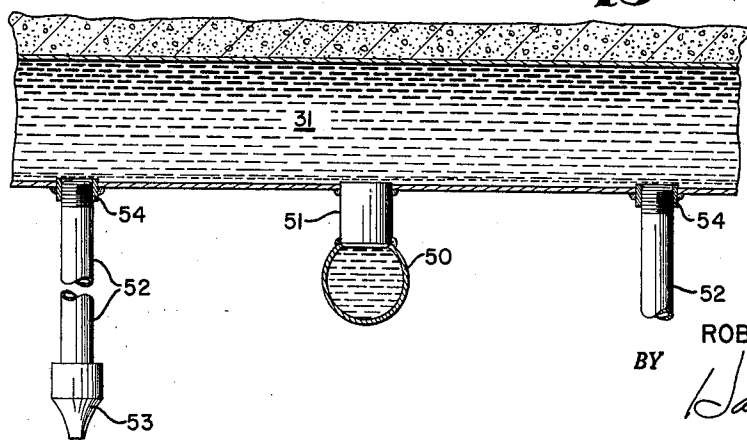


Fig. 15

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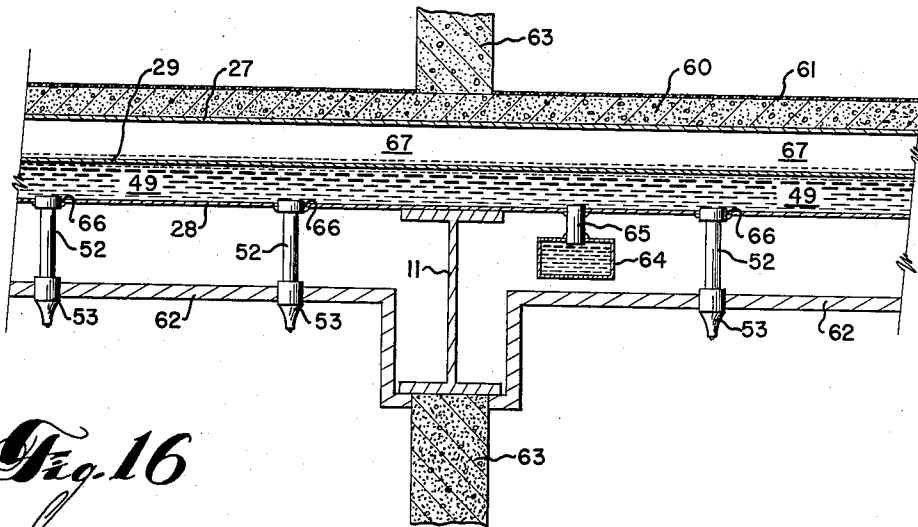


Fig. 16

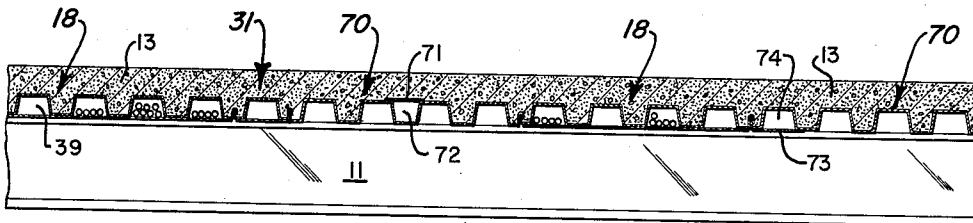


Fig. 17

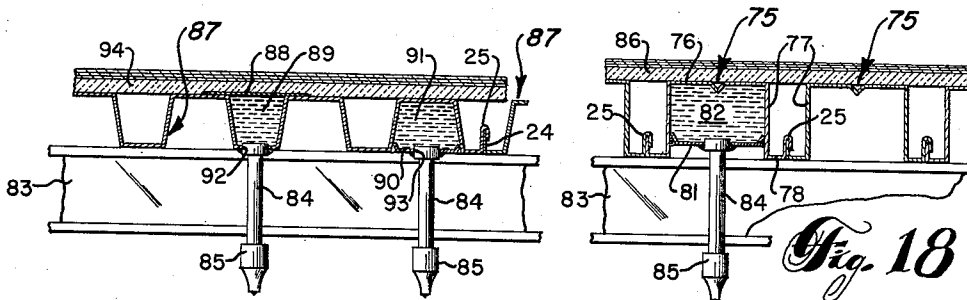


Fig. 19

Fig. 18

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3,104,060

FIRE EXTINGUISHING SYSTEM AND APPARATUS

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8 Claims. (Cl. 239—209)

The present invention relates to building construction and more particularly to fire extinguishing systems for use in building construction and cellular metal floor sections useful in such fire extinguishing systems.

Cellular metal floor is widely employed in the building industry to serve dual functions: firstly, the cellular metal floor is an integral load bearing beam or element in the building; secondly, the cells of the cellular metal flooring are employed as conduits for electrical wiring, piping and air distribution. See U.S. Patents 2,680,775 and 2,883,111.

Many modern buildings incorporate fire extinguishing systems which comprise a network of conduits for distributing fire extinguishing fluids, usually water, throughout a building beneath every floor thereof. Spray nozzles extend downwardly from the fluid distributing conduits at selected locations in the subjacent ceilings to provide a desirable sprinkling distribution pattern in the event of fire. Usually the nozzles are provided with fusible metal elements which permit automatic activation of the nozzles in response to the heat generated by a fire in the building.

The installation of a distribution network of fire extinguishing conduits is a substantial expense which is justified by considerations of safety to personnel and property and further justified by the significantly reduced fire insurance rates which are available for buildings so equipped. In addition to the initial expense of the fire extinguishing system, there are construction scheduling problems associated with such installations. That is, frequently it is necessary to provide special purpose tradesmen to install the fire extinguishing system and its components. These special purpose tradesmen cannot commence their work until certain preliminary portions of the construction have been completed by other tradesmen. The work of the special purpose tradesmen must be completed before subsequent portions of the construction can be commenced. The attendant scheduling problems frequently result in unnecessary delays in the completion of a building.

An object of this invention is to employ cellular metal floor and corrugated roof deck—which are primarily load supporting elements of a building—as essential elements in a fire extinguishing system.

Another object of this invention is to provide special purpose cellular metal flooring sections peculiarly adapted to use in fire extinguishing systems.

Another object of this invention is to provide a building construction having relatively inexpensive fire extinguishing systems.

A further object of this invention is to provide a building construction having a fire extinguishing system which can be quickly installed in combination with other essential building elements.

According to the present invention, in one embodiment, the cells of the metal cellular flooring are employed as transversely extending conduits for fire extinguishing fluids such as water. In an alternative embodiment, certain outside walls of the metal cellular flooring are employed in combination with flat ribbons or channel sections of metal to form transversely extending conduits for fire extinguishing fluids. Fluid carrying header conduits extend transversely across the generally parallel cells of the metal cellular flooring to provide connections to a source of a fire extinguishing fluid. Plural fire nozzles com-

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municate with the fluid cells at selected locations within the building and extend downwardly through suspended ceilings in spraying relation with the rooms and corridors of the subjacent floor.

In a further embodiment of the present invention, corrugated roof deck may be employed as walls of a fluid cell in combination with a ribbon or channel of metal to form a conduit for fire extinguishing fluids.

Frequently composite cellular flooring is provided in modern buildings which employs sections of cellular metal flooring interposed in assembly with corrugated metal roof deck sections. Only the cellular metal flooring is available for use as electrical raceways, ventilating conduits and the like. The engageable roof deck sections merely serve as structural elements of the building. In such composite floor assemblies, the corrugated roof deck sections can be adapted according to this invention for use as fire extinguishing conduits.

Thus structural elements, otherwise required in the construction of a building, are employed, according to the present invention, in the fabrication of a fire extinguishing system for the building. Since the essential elements of the system are normally specified as structural features of the building, there is not significant increased expense associated with the fire extinguishing system.

The objects and advantages of the present invention will become apparent from the following detailed description by reference to the accompanying drawings in which:

FIGURE 1 is a perspective illustration of a fragmentary portion of a typical building illustrating the conventional utilization of cellular metal flooring;

FIGURES 2, 3 and 4 are perspective illustrations of typical sections of metal cellular flooring;

FIGURES 5, 6, 7 and 8 are perspective illustrations of special purpose cellular metal flooring sections particularly adapted to utilization in fire extinguishing systems;

FIGURE 9 is a perspective illustration of a typical "hat section" roof deck element adapted for use in a fire extinguishing system;

FIGURES 10 and 11 are cross-section illustrations of various alternative embodiments of the present invention showing typical cellular metal flooring sections including specifically those illustrated in FIGURES 2, 3, 6 and 7;

FIGURE 12 is a cross-section illustration of a special purpose cellular metal flooring section particularly adapted to utilization in fire extinguishing systems;

FIGURE 13 is a cross-section illustration of a floor and subjacent ceiling embodying the present fire extinguishing system as illustrated in FIGURE 11;

FIGURE 14 is a fragmentary bottom plan view of the floor shown in FIGURE 13 taken along the line 14—14;

FIGURE 15 is a cross-section illustration of the same fire extinguishing system taken along the line 15—15 of FIGURE 14;

FIGURE 16 is a cross-sectional illustration similar to FIGURE 15 showing the utilization of a fire extinguishing system according to this invention embodying the cellular metal floor section shown in FIGURE 6;

FIGURE 17 is a cross-section illustration similar to FIGURE 15 illustrating a preferred embodiment of the present invention utilizing the cellular metal flooring section shown in FIGURE 11 along the line 17—17;

FIGURE 18 is a cross-section illustration of a roof deck fire extinguishing system employing the modified roof deck elements shown in FIGURE 9; and

FIGURE 19 is a cross-section illustration of a typical roof deck fire extinguishing system according to this invention.

The environment of the present invention will be described by reference to FIGURE 1. A typical building is constructed of vertical columns 10 and horizontal beams 11. A metal cellular sub floor 12 extends across

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the horizontal beams 11 to serve as a base for a subsequently poured concrete covering layer 13. The cellular metal floor 12 is formed from repeating sections of metal cellular flooring of the types illustrated in FIGURES 2, 3 and 4. As shown in FIGURE 2, a pair of corrugated metal sheets 14, 15 are welded together to form a metal cellular flooring section identified by the numeral 16. The correlative corrugations of the metal sheets 14, 15 form individual longitudinal cells 17 which heretofore have been used for the electrical wiring and air distribution in a building.

The flooring section of FIGURE 3 is identified by the numeral 18 and includes an upper corrugated element 14 and a lower flat element 19. The corrugations of the metal sheet 14 combine with the flat sheet 19 to form a plurality of longitudinal cells 20 which functionally correspond to the longitudinal cells 17 of FIGURE 2.

As shown in FIGURE 4 a flat upper sheet 21 and a corrugated lower sheet 15 are fastened together to form a metal cellular flooring section 22. The corrugations of the lower sheet 15 combine with the flat sheet 21 to form longitudinal cells 23 which correspond in function to the longitudinal cells 17 of FIGURE 2.

It will be observed that each of the flooring sections 16, 18 and 22 has a male lip 24 and a female lip 25 along its edges for interlocking adjacent sections to form a cellular metal flooring installation.

In general, the cellular metal flooring sections 16, 18 and 22 are provided with a plurality of individual cells, there being four such cells illustrated in each of the FIGURES 2, 3 and 4.

For the purposes of the present invention, one or more of the individual cells or portions of the individual cells is utilized as a fluid conduit for a fire extinguishing distribution system. Any cell so selected must have watertight seams along its edges. Since watertight seams are not essential in the fabrication of conventional cellular metal flooring sections, it may be preferable in many instances to fabricate the special purpose individual cell sections as shown in FIGURES 5, 6, 7 and 8. The individual cell 26 of FIGURE 5 corresponds in profile to the cells shown in FIGURE 2 and includes a male and female lip 24, 25 respectively for interlocking the cell into a flooring system. A channel shaped upper element 27 and a channel shaped lower element 28 are welded along their contiguous portions in a watertight, continuous manner.

As shown in FIGURE 6, an additional horizontal plate 29 is positioned between the upper channel 27 and the lower channel 28 to form a divided cell 30 having watertight continuous welds along contiguous portions of the horizontal metal sheet 29. In one aspect, the cell of FIGURE 6 corresponds to the individual cells of FIGURE 2 with the addition of an intermediate dividing horizontal plate 29. In another aspect, the section 30 of FIGURE 6 corresponds to the individual cells of FIGURE 3 with an additional channel member 28 attached to the bottom surface. In a further aspect, the divided cell 30 of a FIGURE 6 corresponds to the cells of FIGURE 4 with an additional channel element 27 attached to the upper surface.

As shown in FIGURE 7, an individual cell 31 may be fabricated from an upper channel 27 and a horizontal plate 29. The individual cell 31 corresponds to the cells heretofore shown in FIGURE 3.

As shown in FIGURE 8, a special cell 32 can be formed from an upper flat sheet 33 and a lower channel 28. The individual cell 32 corresponds to the cellular metal flooring sections shown in FIGURE 4.

According to the present invention, the cells of the cellular metal flooring sections or their components are employed as conduits for the distribution of fire extinguishing fluids throughout a building.

Referring to FIGURE 10, conventional cellular metal flooring sections 16 are shown in assembled relation with a special purpose individual cell 30. Four available fluid

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conduits are illustrated in FIGURE 10. One entire cell 34 of a conventional metal cellular flooring section 16 may be sealed along its edges by means of a continuous weld to provide a watertight seam. Alternatively a special individual cell 30 may be sealed along its edge to provide a conduit for fire extinguishing fluids either in the upper portion (above the horizontal sheet 29) or in the lower portion (below the horizontal sheet 29—as shown).

It is further possible to employ the outer surfaces of the corrugated elements 14, 15 as essential components of conduit walls by affixing a flat sheet metal strip 35 or 36 to the upper sheet 14 or to the lower sheet 15 respectively. The additional sheets of metal 35, 36 are sealed in a continuous, watertight manner to provide conduits 37, 38 for utilization as fire extinguishing fluid conduits.

FIGURE 11 illustrates a cellular metal floor assembly employing floor sections 18 and a special purpose individual cell 31. As shown, one of the individual cells 39 of a flooring section 18 may be sealed by means of a continuous weld along its edges to serve as a fluid conduit. Alternatively a special purpose individual cell 31 having sealed edges may be employed as a conduit. As a further alternative, a channel 28 may be welded continuously along its edges to the bottom of the flat sheet 19 to serve as a fluid conduit 40. As a further alternative, a flat sheet 41 may be continuously welded along its edges to adjacent crests of the corrugated element 14 to provide a fluid conduit 42.

FIGURE 12 illustrates a further special purpose metal flooring section which may be employed in the present fire extinguishing system. As shown in FIGURE 12, a corrugated upper element 43 and a corrugated lower element 44 are welded together along contiguous portions to form a typical metal cellular flooring section. A flat sheet of metal 45 is positioned between the corrugated elements 43, 44, and a continuous, watertight weld is provided along the contiguous portions 46, 47 of the two corrugated elements 43, 44 on each side of the selected cell having the horizontal plate 45. The resultant watertight cell 48 is available for use as a fluid conduit.

The means for introducing fire extinguishing fluids into the selected cells and for withdrawing the fluid from the selected cells are illustrated in FIGURES 13 through 19.

Referring to FIGURES 13, 14 and 15 there is illustrated a typical building floor assembly having cellular metal flooring sections 18 and a special purpose individual cell 31 assembled by means of interlocking lateral flanges 24, 25. The individual cell 31 in this example is selected as the fluid conduit. A transverse fluid header 50 communicates with the interior of the selected cell 31 by means of a connecting pipe 51. The header 50 is disposed beneath the floor. At selected locations along the selected cell 31, a plurality of depending conduits 52, terminating in spray nozzles 53, communicate with the interior of the selected cell 31 through openings 54 cut in a wall thereof for that purpose.

A suspended ceiling 55 is positioned below the cellular metal floor by means of suitable suspension elements such as wires 56 secured to the ceiling by means of tabs 57 and secured to the cellular metal floor by means of tabs 58. The tabs 58 are more fully described in copending application S.N. 745,699, filed June 30, 1958 and assigned to the assignee of the present invention. It will be observed that the spray nozzles 53 extend through the suspended ceiling 55 in order to discharge fire extinguishing fluids into a subjacent room or corridor of the building below the suspended ceiling 55.

The header conduit 50, the selected fluid cell 31 and the connecting pipe 52 may be maintained filled with fire extinguishing fluids at all times if desired. Alternatively the fire extinguishing system may operate on the so-called "dry principle" wherein water is supplied to the header conduit 50 and thence through the selected cell 31 to the distribution pipe 52 and spray nozzle 53 only in response to the appearance of a fire hazard in the building. Under

normal conditions, the headers and cells are filled with air maintained at predetermined pressure.

While water is the preferred fire extinguishing fluid, other fluids may be employed where, for example, the possibility of chemical or electrical fires precludes the use of water as a fire extinguishing fluid. When the fire extinguishing system is maintaining filled with fire extinguishing fluid such as water, it may be advisable to include certain corrosion inhibiting compounds in the fluid inventory maintained within the building to inhibit deterioration of the system and permit the use of relatively inexpensive fabrication materials such as ordinary carbon steel. Such inhibitors are well known in the corrosion art and may include sodium chromate, sodium hexameta-phosphate, combinations of the two, sodium sulfite, et cetera.

A fire extinguishing system utilizing the cellular floor sections of FIGURE 6 is set forth in FIGURE 16 as a preferred embodiment. The metal cellular flooring section having an upper corrugated member 27 and a lower corrugated member 28 includes a central horizontal plate 29. A layer of concrete 60 and a decorative floor covering 61 thereover is provided above the cellular metal flooring in conventional practice. The cellular metal flooring is supported on a horizontal beam 11. A suspended ceiling 62 is disposed beneath the cellular metal floor in any suitable manner. Normally room partitions 63 are provided in the building above and below the horizontal beams 11. A fluid header in FIGURE 16 is illustrated in the form of a rectangular conduit 64 which communicates with the interior of a fluid carrying floor cell 49 by means of a connecting pipe 65. At spaced locations along the length of the fluid conduit 49, there are openings 66 provided for the installation of depending pipes 52 terminating in spray nozzles 53. It will be observed that the upper portion of the cellular metal flooring 67 above the flat horizontal plate 29 remains available for utilization as a conduit for electrical conductors or other suitable purposes.

A further embodiment of this invention is illustrated in FIGURE 17 wherein a "composite floor" is shown in cross-section. The composite floor comprises sections of cellular metal flooring 18 of the type shown in FIGURE 3, and corrugated metal sections which are normally employed as roof deck sections. Also shown in FIGURE 17 is a special purpose cellular flooring section 31 of the type shown in FIGURE 7.

Supported on a horizontal beam 11, from left to right are a cellular metal flooring section 18, a special purpose cellular metal flooring section 31, a roof deck section 70, a cellular metal flooring section 18, and a roof deck section 70. A concrete fill 13 is poured above the interlocked sections 18, 31, 70. It will be observed that all of the sections 18, 31, 70 have lateral male and female lips for interlocked assembly. Various alternatives are shown in FIGURE 17 for fire extinguishing systems. Preferably, the special purpose metal cellular flooring cell 31 is selected for use as the fire extinguishing fluid conduit. Alternatively, one of the metal cells 39 (as shown in FIGURE 11) may be selected as the conduit. Alternatively, a roof deck section 70 may be provided with a flat, horizontal plate 71 which is continuously welded to the top of the section between adjacent crests to form a conduit 72. As a still further alternative, a flat horizontal plate 73 may be continuously welded to the bottom of a roof deck section 70 to provide a fluid conduit 74.

Such composite floors as shown in FIGURE 17 are frequently provided in buildings which do not require the electrical capacity and versatility which can be achieved through utilization of metal cellular flooring throughout the building.

The foregoing description has concerned principally the utilization of cellular metal flooring in a fire extinguishing system. It is a further part of this invention to employ corrugated roof deck as a portion of a fire

extinguishing fluid conduit in a similar manner. Reference should be had to FIGURES 9, 18 and 19.

Referring to FIGURE 9, there is illustrated a typical "hat section" roof deck element 75 having an upper flange 76, vertical legs 77, and lower flanges 78 which terminate in a male lip 79 and a female lip 80 for interlocking assembly. An additional closure strip 81 is continuously welded along the vertical leg 77 to provide a watertight channel 82 in combination with the contiguous vertical legs 77 and upper flange 76. Utilization of the roof deck section of FIGURE 9 in a fire extinguishing system is illustrated in FIGURE 18 wherein adjacent roof deck sections 75 are interlocked and positioned above a generally horizontal beam 83 which is a roof supporting structure in a building. One or more of the roof deck sections 75 is adapted as a fluid carrying conduit by the continuously welded insert plate 81. A plurality of depending nozzle pipes 84 terminating in spray nozzles 85 is provided in communication with the interior of the fluid conduit 82. One or more transverse fluid headers (not shown in FIGURE 18) is provided to introduce fluid into the fluid conduit 82. A suitable weather proofing roof surface 86 is applied to the upper surfaces of the upper flanges 76 in conventional manner.

In addition to the hat section profile of roof deck illustrated in FIGURES 9 and 18, it is conventional to provide other forms of sheet metal roof deck. One popular form of roof deck is a so-called V-beam corrugation which corresponds to the upper element 14 of FIGURE 2 by itself. Such roof deck sections also appear in the composite floor of FIGURE 17 as the element 70. Such roof deck, as shown in FIGURE 19, is provided in sections 87 having interlocking male and female lips 24, 25 along their edges. The V-beam corrugated sections 87 rest upon a beam 83 which forms the structural roof supporting element. In one embodiment, a horizontal flat sheet of metal 88 may be continuously welded between the upper surfaces of adjacent corrugations to provide an enclosed cell 89 for use as a fire extinguishing fluid conduit. Alternatively a horizontal closure plate 90 may be welded between adjacent corrugations along its edges to provide an enclosed cell 91 serving as a fire extinguishing fluid conduit. Suitable pipes 84 terminating in spray nozzles 85 communicate through openings 92 in the valley of a roof deck section wall or openings 93 in the horizontal closure plate. As before, a suitable transverse fire extinguishing fluid header extends beneath the longitudinal cells created in the roof deck to supply fire extinguishing fluids to the enclosed cells 89, 91 created in accordance with this invention. A suitable weatherproof roof covering 94 is provided over the upper surfaces of the roof deck sections 87 in a conventional manner.

General

Thus, according to the present invention, it is possible to provide a relatively inexpensive fire extinguishing system in a modern building employing metal cellular floors or roof deck by employing the individual metal cells and/or portions of the cell walls and/or portions of the roof deck walls as longitudinal conduits for suitable fire extinguishing fluids. Downwardly depending spray nozzles communicate with the fluid conduits to distribute the fluids where required in the event of fire. Transversely extending fluid headers are provided which communicate with each of the individual fluid carrying cells thus created to supply the necessary fluid.

It will be observed upon reflection that abutting sections of cellular metal flooring and roof deck must be provided with a watertight, continuous peripheral seam in those cells which are selected as fire extinguishing fluid conduits. Suitable methods for providing airtight (hence watertight) seams between abutting floor cells are disclosed in U.S. Patents 2,849,942 and 2,916,110 assigned to the assignee of the present invention.

According to the provisions of the patent statutes, I

have explained the principle, preferred embodiment and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In a building having a structural framework and cellular metal flooring secured to said framework, said cellular metal flooring being assembled in sections and serving as a load-supporting element of the said building, each of said sections being formed from two correlative sheets of metal, corrugations in at least one of said two sheets of metal, the said two sheets of metal being secured together along spaced contiguous portions corresponding to the said corrugations whereby longitudinal cells are formed between the two said sheets of metal, the combination therewith of:

a flat strip of metal being secured along its edges by a watertight seam to a corrugated sheet of the said two metal sheets along the outer surface of a pair of adjacent cells, said strip of metal combining with the intervening portions of the said corrugated sheet to define a fluid conduit,

at least one outlet depending downwardly from said conduit intermediate its ends for discharging fluid from said conduit, each said outlet being connected to a fluid distributing nozzle positioned in spraying relation with the subjacent floor space, a fluid supply pipe extending transversely of said conduit, and fluid connections between the said supply pipe and the said conduit.

2. The combination of claim 1 wherein each said conduit is closed at each end of said section.

3. The combination of claim 1 wherein each said conduit is linearly aligned with a corresponding conduit of an abutting one of said sections and each said conduit communicates with an abutting aligned conduit at at least one of its ends.

4. In a building having a structural framework and cellular metal flooring secured to said framework, said cellular metal flooring being assembled in sections and serving as a load-supporting element of the said building, each of said sections being formed from two correlative sheets of metal, corrugations in at least one of said two sheets of metal, the said two sheets of metal being secured together along spaced contiguous portions corresponding to the said corrugations whereby longitudinal cells are formed between the two said sheets of metal, the combination therewith of:

at least one of said sections being assembled as a fluid conduit from said two sheets of metal with a single cell defined by an upper metal sheet and a lower metal sheet, at least one of the said upper and lower sheets having a U-shaped configuration with a horizontal base, vertical legs and outwardly extended flanges, the said upper and lower sheets being secured along the said flanges by a water-tight seam to define the said single cell corresponding in vertical dimensions with the said longitudinal cells of the said sections, the said fluid conduit being assembled in the said building between the said flooring sections as a load supporting element of the said building, at least one outlet depending downwardly from the said fluid conduit intermediate its ends for discharging fluid from said conduit, each said outlet being connected to a fluid distributing nozzle positioned in spraying relation with the subjacent floor space, a fluid supply pipe extending transversely of the said conduit, and fluid connections between the said supply pipe and the said conduit.

5. In a building having a structural framework and cellular metal flooring secured to said framework, said

cellular metal flooring being assembled in sections, each of said sections being formed from two correlative sheets of metal, the upper one of said two sheets of metal being corrugated and the lower one of said two sheets of metal being substantially flat, the said two sheets of metal being secured together along spaced contiguous portions corresponding to the said corrugations whereby longitudinal cells are formed between the said two sheets of metal, the combination therewith of:

a generally U-shaped metal channel having a horizontal base, upright vertical legs and outwardly extended horizontal flanges at the upper ends of the said legs, said channel being secured to the said lower one of the said two sheets of metal by a watertight seam along the said flanges, the said channel combining with the flat undersurface of the said lower one of the said two sheets to define a fluid conduit parallel to the said cells,

at least one outlet depending downwardly from said fluid conduit intermediate its ends for discharging fluid from said conduit, each said outlet being connected to a fluid distributing nozzle positioned in spraying relation with the subject floor space, a fluid supply pipe extending transversely of said conduit, and fluid connections between the said supply pipe and the said conduit.

6. The combination of claim 5 wherein each said conduit is closed at each end of said section.

7. The combination of claim 5 wherein each said conduit is linearly aligned with a corresponding conduit of an abutting one of said sections and each said conduit communicates with an abutting aligned conduit at at least one of its ends.

8. In a building having a structural framework and cellular metal flooring secured to said framework, said cellular metal flooring being assembled in sections, each said section being formed from two correlative sheets of metal, corrugations in at least one of said two sheets of metal, the said two sheets of metal being secured together along spaced contiguous portions corresponding to the said corrugations whereby longitudinal cells are formed between the two said sheets of metal, the combination therewith of:

fluid conduits associated with the said cellular metal flooring, said fluid conduits extending longitudinally parallel with the said cells and having watertight seams, said fluid conduits being defined by an enclosed metal periphery, at least a part of which comprises the walls of at least one of the said two metal sheets,

at least one outlet depending downwardly from the said conduit intermediate its ends for discharging fluid from said conduit, each said outlet being connected to a fluid distributing nozzle positioned in spraying relation with the subjacent floor space, a fluid supply pipe extending transversely of said conduit, and fluid connections between the said supply pipe and the said conduit.

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