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[54] **STORAGE RACK AND SPRINKLER ARRANGEMENT**

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[52] **U.S. Cl.** ..... **169/2 R**, 239/209

[51] **Int. Cl.** **A62c 3/00**

[58] **Field of Search** ..... 169/1 R, 1 A, 1 B, 169/2 R, 5, 37; 239/208, 209

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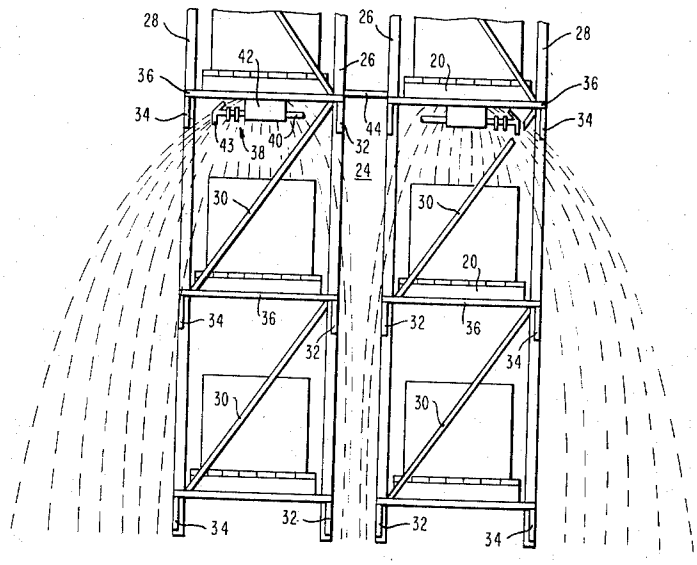
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[57] **ABSTRACT**

A storage rack and sprinkler arrangement wherein two rows of storage racks are arranged in spaced relation so that a narrow flue space exists between the rows. Each rack has a plurality of horizontal shelves arranged in a vertical tier and upright support members supporting the shelves and spaced to separate the tier of shelves into bays. At least one sprinkler head with a heat actuated device which initiates the water flow is mounted on the underside of each alternate shelf in each bay. A heat deflecting means, typically a plate of fire resistant material is associated with the shelf immediately above each sprinkling head which closes the flue space. The sprinkler heads are arranged to provide a spray when actuated over the shelf beneath the head, the aisle and the flue space.

9 Claims, 3 Drawing Figures



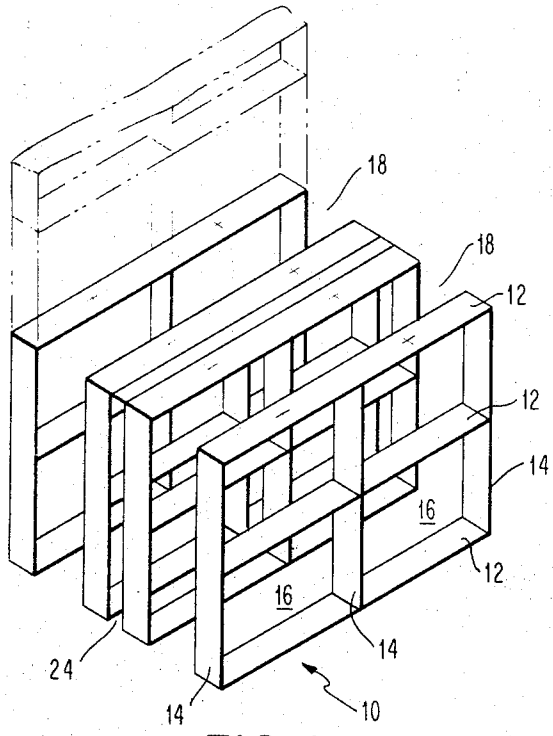


FIG. 1

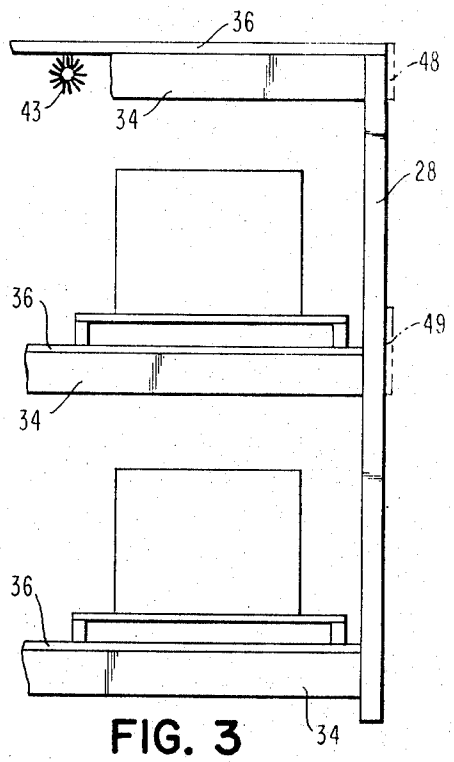


FIG. 3

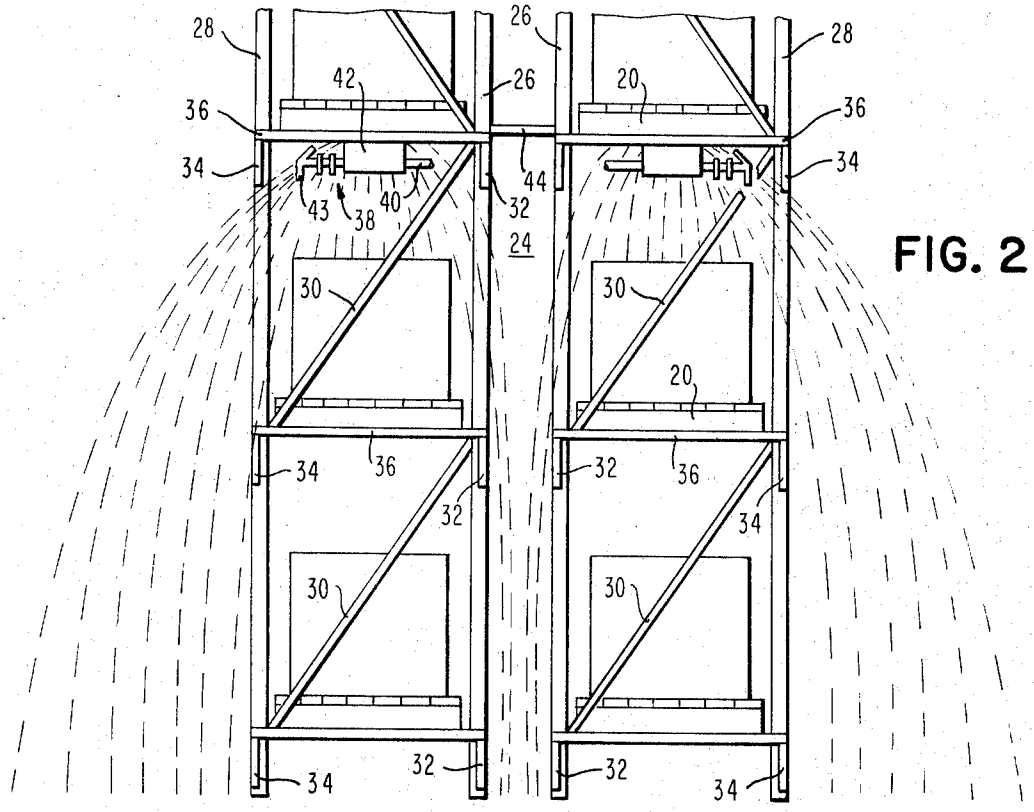


FIG. 2

STORAGE RACK AND SPRINKLER ARRANGEMENT

FIELD OF THE INVENTION

This invention relates to fire prevention in warehouse and storage areas, and more particularly to a novel storage rack and sprinkler arrangement wherein a fire in articles or stock on the rack is detected controlled and confined to the local area.

BACKGROUND OF INVENTION

Material handling equipment, principally forklift trucks, have been developed which will stack or store materials at very high levels. By utilizing such equipment storage facilities can be used with increasingly high ceilings, which permit material to be stored at increasingly higher elevations in storage racks. The cost of warehousing can be significantly reduced since the cost of a building is greatly reduced when only a single floor is provided. This type facility replaces warehouses having two or three floors.

It is felt by most in the fire protection field that very serious problems exist in providing fire protection in shelves extending to higher levels. One indication of this is born out in reports that several firms have been forced to scrap plans for high-rise warehousing because of demands of insurance carriers to install fire protection systems that carry prohibitively high price tags. Thus, in the present situation the savings that are potentially possible using high storage racks are more than off-set by the lack of effective fire prevention and control and also increased insurance rates.

Fire sprinkler systems are usually required by law to be installed in warehouses and other similar article storage areas. Conventional sprinkling systems are generally installed in the ceiling of the building and consist of separate sprinkling elements with heat actuated closures which open only at temperatures well above the normal, which normally would be caused only by a fire. The sprinklers spray water in the area of the fire to either control and/or extinguish the fire. However, in storage areas utilizing racks a fire which breaks out on a lower rack is protected from the spray eminating from the ceiling sprinkler. The situation is significantly aggravated as the number of shelves is increased. In situations where the ceiling of the warehouse is very high and many shelves in tiers are provided to store material, conventional sprinkling systems fail to fulfill their originally intended protective function. Since the sprinkling elements are located high in the ceiling a fire in the lower shelves may not actuate the heating actuated sensing element in sufficient time to provide an effective control of the flame. Further even when the sprinkling system is actuated the fire on the lower shelves is protected from the spray by the upper shelves and the fire can spread upwardly until it is out of control.

It has been suggested that overhead or roof sprinkler systems be supplemented by intermediate levels of sprinklers, as for example, sprinklers mounted within the storage racks, and also within the aisle. This arrangement was not generally satisfactory because consistent, timely, and dependable detection and sprinkler actuation was not achievable. Consequently, greater damage to stored material, and greater risk to material being stored and the building structure prevented widespread use of high storage facilities.

Fire protection using foam systems have been suggested for use in high-rise storage facilities. This system in general has a foam generator coupled with a suitable sensing system which is capable of filling the entire building volume with a light foam. Single generators capable of producing as much as 2,000 cubic foot per minute of foam are available. The time required for filling the building varies but in general ranges from 2 to 8 minutes. Such systems are not completely satisfactory since the foam may damage goods within the warehouse. Also when the fire occurs at a high elevation the foam may not reach the level for some time permitting the fire to spread to the roof or ceiling and become out-of-control. Further the system is relatively expensive requires large quantities of water, requires a great deal of maintenance, and the generators which are heavy and normally mounted on the roof may result in structural damage if sufficient reinforcement is not provided. Removal of the foam from the warehouse after the fire is out is a major problem.

SUMMARY OF THE INVENTION

An object of this invention is to provide a new and improved storage rack and sprinkler arrangement for improved fire protection.

Another object of this invention is to provide a new storage rack and sprinkler arrangement adapted for more effective fire protection in high rise storage racks.

The storage rack and sprinkler arrangement consists of a pair of adjacent storage racks arranged in back-to-back relation with a space between constituting a flue space. Sprinkler heads are mounted on the underside of alternate shelves and positioned to provide a spray when actuated which is directed over the shelf beneath the sprinkler and the aisle. The heating deflecting means is provided to block the flue space at an elevation approximate to the sprinkler head. The deflecting means holds and directs the heat from a fire from one of the underlying shelves to the sprinkler head to cause its actuation. Actuation of the sprinkler head, in this arrangement, brings the materials under the head level into direct exposure to the discharge water. The materials below the shelf are under effective indirect control by the discharge water.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the invention will become more apparent from the more particular description of the preferred embodiments as illustrated in the accompanying drawings.

IN THE DRAWINGS

FIG. 1 is an isometric view illustrating the storage rack arrangement for practicing the invention.

FIG. 2 is a side elevational view of a pair of storage racks illustrating the specific elements thereof and the spray pattern of an actuated water sprinkler.

FIG. 3 is a front elevational view in broken section showing a frontal view of the storage rack and sprinkler combination of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings there is depicted schematically an arrangement of storage racks for carrying out the purpose and objectives of the invention. Each storage rack 10 has a plurality of shelves

12 arranged in a vertical tier. Upright supports elements 14 support shelves 12 and divide the rack up into bays 16. For purposes of explanation a bay is considered to be the space between two upright supports 14 and extends from the floor to the uppermost shelf. Racks 10 can consist of any suitable number of shelves arranged vertically in tiers to meet the requirements of any particular application. In warehouses having relatively high ceilings the height of the racks can extend from the floor to nearly the ceiling and range in number from 2 to 20. Racks 10 are arranged in back-to-back relation and spaced from each other. Access to the shelves is normally made from aisle 18 illustrated in FIG. 1. Suitable material handling apparatus, typically forklift trucks and/or travel cranes convey the material to the desired racks and elevate it to the suitable shelf. The material is normally maintained for ease of handling on pallets 20 shown in FIG. 2. As illustrated in FIG. 1 two rows of racks are positioned with the backsides spaced to form a flue space 24. The reason and nature of flue space will be explained in more detail in the descriptions that follows.

Referring now to FIG. 2 and 3 there is illustrated a more specific rack structure and the relationship of the sprinkling system. The upright members normally consist of upright corners members 26 and 28 located at the rear and the front of the racks. Members 26 and 28 can be angle iron, channel iron, or other types of structural elements that provide sufficient strength to support the structure. Diagonal members 30 may be provided for stability. The shelves consists of longitudinally extending members 32 and 34 which span each bay and provide support for the horizontal shelf member 36. The shelves can be any suitable distance apart. In general the shelf spacing in a typical warehouse is on the order of five feet. As most clearly illustrated in FIG. 2 sprinklers are provided on the underside of every other shelf in each bay. The shelves below sprinkler heads can be solid or open type, consisting of cross members joined to the horizontal members 32 and 34. The sprinkler head 38 is preferably located behind horizontal member 34 in order to protect it during loading and unloading of the shelves. Sprinkler 38 is mounted on the end of a supply conduit 40 connected to a suitable source of water. Preferably the supply conduit is attached to the underside of shelf 36 as for example, by a bracket 42. The supply conduits are conveniently located in the flue space and serve the sprinklers in both rows of adjacent racks. However, other arrangements can be provided, as for example, locating the vertical conduits within the upright members 26 and 28. Sprinkler 38 is preferably of the type having a heat actuated device covering an orifice. A preferred type of sprinkler employs a quartz cylinder filled with a liquid which is held in place over an orifice. When a predetermined rise in temperature occurs which would happen normally only in the event of a fire the liquid within the cylinder expands breaking the cylinder and opening the orifice. This allows water to flow outwardly which is broken up into a spray by a suitable type baffle element 43 illustrated in FIG. 3. As most clearly illustrated in FIG. 2 the pattern of the spray is such that approximately one-third falls on the shelf and into the flue space 24 while approximately two-thirds is directed into the aisle and across the bay length. The placement and nature of the sprinkling system is selected so that the combined action of the baffle 43 and spray directed from member 34 directs the spray in the aforementioned manner. The spray directed toward the aisle forms a curtain of water which prevents the flame from spreading and controls the heat release of the fire. Normally a suitable alarm is associated with the conduit system supplying water to the sprinklers which provides an indication of their actuation. The spray pattern must be sufficiently large to cover the entire longitudinal length of bay, i.e., between the upright members. Any suitable type of heat actuated sprinkler head can be used in the practice of this invention. A type of sprinkler head found to be effective and one which is preferred for practice of this invention is the Grinnel sidewall quartzoid sprinkler mounted horizontally. Preferably the reflectors of the Grinnel sprinkler is positioned approximately 4 inches back of rack support member 34. With this type of sprinkler head a nozzle pressure of 40 pounds per square inch will produce a flow of approximately 35 gallons per minute. In general the flow of water from the sprinkler per cubic foot of protected shelf volume is in the range of 0.06 to 0.2 gal/min/ft^3. The protected shelf volume is considered the volume between the sprinkler heads, or between the lower sprinkler head and floor in a single bay. The preferred rate is 0.12 gal/min/ft^3.

In operation, a fire, as for example on the lower shelf in FIG. 2 would produce heat which would travel upwardly through flue 24 until blocked by the closure 44. When a sufficient amount of heat builds up the sprinkler 38 would be actuated producing a spray. This spray will confine the fire to the specific area and at the same time prevent the structural members of the rack from heat which might otherwise result in their collapse. As can be readily appreciated the stability of the racks can be affected by a fire which would seriously jeopardize the lives and safety of persons investigating and fighting the fire. The hazards of topling racks and their heavy loads on personnel is believed obvious. In some instances it may be desirable to provide additional paneling or sheets on the upright members of each rack that separate the bays which further confine the heat produced by a fire in a specific area to insure the actuation of the particular sprinkler involved, and limit horizontal fire spread. This sheet or paneling can be of any suitable type of non-combustible material as for example steel sheets. If desired the sheet can extend only to cover the space between the uprights on the upper shelf enclosing the sprinkler or alternately can extend the entire length.

Preferably the panels cover the entire area between uprights 32 and 34. However, as an alternate arrangement, a panel 48 can be provided which extends downwardly from the shelf over the sprinkler to a point approximately even with span members 34 as shown in FIG. 3. The panel 48 aids in retaining heat in the location of the sprinkler in the event of a fire which results in an earlier actuation. A second panel 49 which extends above and below the shelf under the sprinkler by about one foot aids in directing heat from the lower shelf to the sprinkler. Ordinarily there is a space provided between the end of the shelf and panel 49.

Another embodiment of the storage rack and sprinkler arrangement also has a tier of shelves separated into bays with a sprinkler beneath a solid shelf spaced from the floor or another solid shelf and sprinkler. This embodiment differs from the previously described embodiment in that more than a single shelf can be pro-

vided beneath a sprinkler provided that the shelves are open shelves. Such shelves permit heat to rise and actuate the sprinkler in the event of a fire. The same flue arrangement, heat deflecting plate **44**, water spray pattern, and baffle **48** are provided for the reasons discussed previously. The solid shelf and underlying sprinkler are spaced to suit the particular conditions. If the fire loading is great, and/or there is a large number of open shelves, the distance between is less. In general, the sprinkler shelves are vertically spaced in the range of 7 to 12 feet. The primary considerations in designing the rack and sprinkler arrangement is assuring of early fire detection by providing as clear path for heat to travel to the sprinkler head, and subsequently producing a spray pattern that is localized but is effective in confining and controlling any fire in the zone protected by the individual sprinkler.

With the rack and sprinkler arrangement of this invention early detection of a fire in a storage rack is possible since the sprinkler will be actuated much sooner than a sprinkler on the ceiling would normally be actuated. Since the sprinkling actuations takes place at an earlier time control and isolation of the fire is assured. With the sprinklers in the racks, sprinkler heads with a lower actuation temperature can be used. This would also provide earlier action necessary for effective fire control. Still further, since the sprinkling action is localized to only the fire location, water damage to merchandise outside the area is minimized. The use of this system eliminates the alternate forms of deluge protection namely use of foam which necessitates a difficult and tedious clean up operation.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a storage rack and sprinkler arrangement having at least one pair of adjacent storage racks, each rack having a plurality of horizontal shelves arranged in a vertical tier, and upright support members supporting the shelves and spaced to form the tiers of shelves into bays, the improvement comprising,

said adjacent rows of storage racks spaced to provide a vertical flue space,

a sprinkler head provided with a heat actuatable closure mounted on the underside of each alternate shelf in each bay, at least said shelf above said sprinkler head being solid,

a heat deflecting means associated with the shelf immediately above said sprinkler head which closes said flue space,

said sprinkler head arranged to provide a spray of water when actuated over the shelf beneath the head, the aisle, and the flue space,

said heat deflecting means adapted to hold and to direct heat to said heat actuatable closure of said sprinkler head from a fire on either of the shelves beneath the sprinkler head to cause actuation and subsequent water spray to control the fire.

2. The storage rack and sprinkler arrangement of claim **1** wherein said sprinkler head is arranged to distribute approximately one-third of the spray to the shelf and flue and two-thirds to the aisle.

3. The storage rack and sprinkler arrangement of claim **1** wherein said head deflecting means is an impervious plate of non-combustible material spanning the adjacent shelves across the flue space.

4. The storage rack and sprinkler arrangement of claim **3** wherein said heat deflecting means is a metal plate.

5. The storage rack and sprinkler arrangement of claim **1** wherein heat baffle means is provided on said upright supports for enclosing at least partially the ends of said bays.

6. The storage rack and sprinkler arrangement of claim **5** wherein said heat baffle means is a vertical metal sheet on said supports transverse to the shelves.

7. The storage rack and sprinkler arrangement of claim **1** wherein the width of said flue space is in the range of 4 to 12 inches.

8. The storage rack and sprinkler arrangement of claim **1** wherein the flow of the spray per sprinkler is in the range of 0.06 to 0.2 gallons per minute/cubic foot of protected shelf space.

9. In a storage rack and sprinkler arrangement having at least one pair of adjacent storage racks, each rack having a plurality of horizontal shelves arranged in a vertical tier, and upright support members supporting the shelves and spaced to from the tiers of shelves into bays, the improvement comprising,

said adjacent rows of storage racks spaced to provide a vertical flue space,

at least one of said shelves impervious,

a sprinkler head provided with a heat actuatable closure mounted on the underside of said impervious shelf,

a heat deflecting means associated with the shelf associated with the said shelf immediately above said sprinkler head which closes said flue space,

at least one pervious shelf beneath said sprinkler head,

said sprinkler head arranged to provide a spray of water when actuated over the shelf beneath the head, the aisle, and the flue space,

said heat deflecting means adapted to hold and to direct heat to said heat actuatable closure of said sprinkler head from a fire on either of the shelves beneath the sprinkler head to cause actuation and subsequent water spray to control the fire.

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