Heat Dissipation Structure for Factory Building

【FIELD OF THE INVENTION】

【0001】 The invention is related to a heat dissipation structure for a factory building, particularly to one that can be equipped with bridge cranes or other large-scale equipment according to needs, and can effectively eliminate the heat in the factory building.

【DESCRIPTION OF THE RELATED ART】

【0002】 For small and medium-sized factory buildings with a height less than 6 m, in order to enhance the heat dissipation effect, a plurality of spinning fans are generally installed on the roof of the factory to discharge hot air and keep out the rain; or a series of fans are hung above the workers in the work area of the factory or placed below the height of the person to anticipate discharging the hot air and blowing the person to dissipate heat. For a large factory building, such as a factory building with a height of 15 m, a width of 50 m, and a length of 200 m, the natural ventilation used is usually a raised monitor roof on the factory building, and two sides of the monitor roof are equipped with open side windows, the work area below has side windows for air inlet, and the roof of the factory building is especially raised to reduce the impact of radiant heat from the roof.

【0003】 However, because the details of fluid flow are not dealt with in the traditional heat dissipation method, it is easy to form large areas of recirculation and/or low-speed areas in the room, and the concentration of pollutants in these areas

is higher. Because the worker is prone to feel almost no wind and stuffy heat, it is intuitive to increase the air volume or increase the number of fans, but the effect is not good, which consumes energy and increases the noise, and the worker hit by high-velocity airflow in a long time is uncomfortable. Furthermore, due to insufficient opening area or poor distribution of the side windows of the monitor roof or the spin fans of the roof, most of the hot air in the factory building cannot be effectively removed, and large recirculation bubbles will be formed inside the factory building, which will roll the hot air from the top to the lower work area, causing the temperature of the work area to rise. At this time, the air outside the factory building is pulled by the buoyancy of the hot air inside the factory building. After entering the side windows on both sides of the lower part of the factory building, the air will quickly turn upward due to the influence of the large recirculation bubble. Therefore, except the workers in a short distance near the windows on both sides feel a little cool, most of the interior of the factory building is stuffy. Even if a large number of fans are used to blow, the hot air is only sucked from the back of the fan, and then blown out from the front of the fan, which still cannot solve the problem that the temperature of most of the work areas below rises, which causes the discomfort of the workers and reduces the work efficiency thereof, and even occupational injuries are generated.

【0004】 Therefore, Taiwan Patent No. I659145 “Heat Dissipation Structure for Factory Building” proposes a solution, in which four lateral walls are constructed under a roof with an air outlet, and the first and the second platforms are configured in the factory building. The first and the second lateral walls of the four lateral walls

are parallel to each other, and the lower half of the first and the second lateral walls are respectively provided with air inlets. A first end of the first platform connects with the first lateral wall to separate an interior space of the factory building to a first upper recirculation area and a first lower work area; a first end of the second platform connects with the second lateral wall to separate the interior space of the factory building to a second upper recirculation area and a second lower work area; and a second end of the first platform and a second end of the second platform form an interval therebetween. Thereby, the air outside the factory building can enter into the first and the second lower working areas through the two opposite air inlets respectively, and then the hot air can flow upward through the gap between the two platforms by thermal buoyancy and discharge from the air outlet to dissipate heat.

【SUMMARY OF THE INVENTION】

【0005】 However, the factory building structure in which the interval is formed between two opposite platforms, and the lower half of the two lateral walls connected to the two opposite platforms are respectively provided with air inlets. Although it is possible to input air at the two air inlets at the same time, and achieve heat dissipation by thermal buoyancy, the structure of this “dual platform” is more complicated, and due to the small interval between the two platforms, for bridge cranes or other large-scale equipment with a height greater than the height of the “dual platform”, the number and position of their placement will be greatly restricted. The traditional way of increasing the air volume or increasing the number of fans for heat dissipation inside the factory building is ineffective, consumes

energy, and increases noise. In view of this, in order to provide a structure that is different from the conventional technology and improve the above-mentioned shortcomings, the inventor has accumulated many years of experience and continuous research and development, so this invention came into being.

【0006】 The purpose of the present invention is to provide a heat dissipation structure for a factory building in order to solve the problem that the overhead bridge crane or other large-scale equipment cannot be installed in the required position in the conventional factory building; the problem that the temperature of most work areas rises, causing the worker to feel uncomfortable, thus reducing the work efficiency and even causing occupational injuries; and the problem that increasing the air volume or increasing the number of fans consumes energy and increases noise. An effective heat dissipation structure is provided, so that the bridge crane or other large-scale equipment can be configured according to the actual needs of the factory building to improve the work efficiency; the temperature of the work area can be greatly reduced, so that the workers can work in a cool and comfortable environment in the work area, thereby increasing the work efficiency and avoiding the occupational injury due to the high-temperature environment; and the heat dissipating air flow can flow smoothly to reduce power consumption and noise generation, thereby improving the quality of the working environment.

【0007】 To achieve the above-mentioned purpose, the factory building of the present invention comprises a roof, and a first lateral wall, a third lateral wall, a second lateral wall, and a forth lateral wall constructed sequentially and continuously under the roof; the roof and each of the lateral walls together surround

an interior space, and the first lateral wall is parallel to the second lateral wall. The heat dissipation structure for a factory building of the present invention mainly comprises a first platform, at least one air inlet and at least one air outlet. The first platform is located in the interior space of the factory building, wherein the first platform has a first end and a second end opposite to the first end, the first end of the first platform connects with an inner wall surface of the first lateral wall so as to separate the interior space of the factory building to an upper recirculation area and a lower work area, and the second end of the first platform and an inner wall surface of the second lateral wall have a first interval therebetween. The at least one air inlet is disposed and transversely spaced in a lower half of the first lateral wall below the first platform. The at least one air outlet is disposed and transversely spaced in a lower half of the second lateral wall, wherein an exhaust center of the at least one air outlet is located at a vertical position between a center position and a top position of the at least one air inlet, so that cold air is input through the at least one air inlet and hot air is exhausted through the at least one air outlet. A partition is positioned between the roof and the first platform, wherein the partition has a first end and a second end opposite to the first end, the first end of the partition connects with the inner wall surface of the first lateral wall, a length of the partition is larger than or equal to one half of a distance between the first and the second lateral walls, the partition has at least one rectangular trough, any one of a long side of the rectangular trough is parallel to the first lateral wall, the rectangular trough has a height H and a width L, and $H \geqq 0.1L$.

【0008】 In an implementation, the first platform has a third end and a forth end opposite to the third end, the third end connects with an inner wall surface of the third lateral wall, and the forth end connects with an inner wall surface of the forth lateral wall.

【0009】 In an implementation, the present invention further comprises a plurality of vents disposed between the partition and the roof to exhaust the hot air between the partition and the roof, wherein the partition has a first end and a second end opposite to the first end, the first end of the partition connects with the inner wall surface of the first lateral wall, and the second end of the partition connects with the inner wall surface of the second lateral wall.

【0010】 In an implementation, the partition has a first end and a second end opposite to the first end, the first end of the partition connects with the inner wall surface of the first lateral wall, the second end of the partition and the inner wall surface of the second lateral wall have a second interval therebetween, and a length of the second interval is smaller than a length of the first interval.

【0011】 In an implementation, the partition has a third end and a forth end opposite to the third end, the third end of the partition connects with an inner wall surface of the third lateral wall, and the forth end of the partition connects with an inner wall surface of the forth lateral wall.

【0012】 In order to further understand the present invention, preferred embodiments are given below, and the specific contents and the effects achieved of the present invention are described in detail as follows in conjunction with the drawings and drawing numbers.

【BRIEF DESCRIPTION OF THE DRAWINGS】

【0013】

Fig. 1 is a schematic of three-dimensional appearance of the first embodiment in the present invention.

Fig. 2 is a longitudinal sectional view of Fig. 1.

Fig. 3 is a diagram of the height (H) vs. the width (L) of the rectangular trough in the present invention.

Fig. 4 is a diagram of the velocity vector vs. streamline distribution at the x-z section which uses CFD computer program to analyze and calculate the results in the first embodiment of the present invention.

Fig. 5 is a longitudinal sectional view of the second embodiment of the present invention.

【DETAILED DESCRIPTION OF THE INVENTION】

【0014】 Please refer to Figs. 1 and 2 which show a heat dissipation structure for a factory building 1 of the first embodiment of the present invention for installation inside a factory building 2 and on each wall thereof. The factory building 2 includes a roof 21, and a first lateral wall 22, a third lateral wall 23, a second lateral wall 24 and a forth lateral wall 25 constructed sequentially and continuously under the roof 21. The four lateral walls frame a rectangle, and together with the roof 21 surround an interior space 26, the first lateral wall 22 is parallel to the second lateral wall 24, and the third lateral wall 23 is parallel to the forth lateral wall 25.

【0015】 The heat dissipation structure for a factory building 1 in the present invention mainly includes a first platform 3, a plurality of air inlets 4, a plurality of air outlets 5 and a partition 6. The first platform 3 is horizontally suspended in the interior space 26 of the factory building 2, and the first platform 3 has a first end 31, a second end 32 opposite to the first end 31, a third end 33, and an fourth end 34 opposite to the third end 33. The first end 31 of the first platform 3 connects with an inner wall surface of the first lateral wall 22, the second end 32 and an inner wall surface of the second lateral wall 24 have a first interval W1 therebetween, the third end 33 connects with an inner wall surface of the third lateral wall 23, and the fourth end 34 connects with an inner wall surface of the forth lateral wall 25 so as to separate the partial interior space 26 to an upper recirculation area 35 and a lower work area 36. The upper recirculation area 35 is disposed between a bottom of the partition 6 and a top of the first platform 3.

【0016】 A plurality of air inlets 4 extend laterally in a rectangular array on the lower half of the first lateral wall 22 below the first platform 3, and the plurality of air inlets 4 are openable windows, so that the air outside the factory building 2 can enter the lower work area 36 of the factory building 2. In an implementation, the plurality of air inlets 4 can also be a single horizontal row of windows or an upper and a lower horizontal rows of windows, which can also allow the air outside the factory building 2 to enter the interior space 26 of the factory building 2. A plurality of air outlets 5 disposed and transversely spaced in a lower half of the second lateral wall 24, and the plurality of air outlets 5 are fans. In an implementation, the plurality of air outlets 5 can also be a horizontal row of air outlets connected to the air

extraction equipment. An exhaust center of the plurality of air outlets 5 of height H1 is between a center position of the plurality of air inlets 4 of height H2 and a top position of the plurality of air inlets 4 of height H3. In other words, the height H1 of the exhaust center of the plurality of air outlets 5 needs to be higher than the height H2 of the center position of the plurality of air inlets 4 and lower than the height H3 of the top position of the plurality of air inlets 4 at the same time.

【0017】 The partition 6 is positioned between the roof 21 and the first platform 3. The partition 6 has a first end 61, a second end 62 opposite to the first end 61, a third end 63, and a fourth end 64 opposite to the third end 63. The first end 61 of the partition 6 connects with the inner wall surface of the first lateral wall 22, the second end 62 connects with the inner wall surface of the second lateral wall 24, the third end 63 connects with the inner wall surface of the third lateral wall 23, and the fourth end 64 connects with the inner wall surface of the forth lateral wall 25. In an implementation, the partition 6 is a ceiling with a high thermal insulation coefficient, so as to block the radiant heat radiated downward from the roof 21, so that the temperature of the lower work area 36 under the partition 6 will not rise. The lateral walls between the roof 21 and the partition 6 are provided with plural vents for exhausting the hot air between the roof 21 and the partition 6.

【0018】 The partition 6 has a rectangular trough 65, the height of the rectangular trough 65 is H, the width of the rectangular trough 65 is L, and $H \geqq 0.1L$, and a long side of the rectangular trough 65 is parallel to the first lateral wall 22 and the second lateral wall 24. In this way, when the top of the bridge crane is accommodated or installed in the rectangular trough 65, the suspending chain of the

bridge crane can move horizontally along the long side of the rectangular trough 65, and the operating range of the above-mentioned bridge crane is limited to a single area in the factory building 2. In an implementation, a plurality of rectangular troughs 65 can also be arranged on the partition 6 according to actual needs and parallel to the first lateral wall 22 and the second lateral wall 24 as well.

【0019】Thereby, when workers or machines that generate heat are distributed in the lower work area 36, the cold air outside the factory building 2 is input into the interior space 26 through the plurality of air inlets 4, and the hot air in the interior space 26 is exhausted through the plurality of air outlets 5. Because the air flow speed generated in the lower work area 36 below the first platform 3 is greater than that of the upper recirculation area 35 above the first platform 3, a high-speed area and a low-speed area are respectively formed. A fan-shaped expanded mixed layer is formed at the boundary between the high-speed area and the low-speed area. The mixed layer is blocked by the first platform 3, allowing the hot air above the first platform 3 to form recirculation bubbles in the upper recirculation area 35, and most of the recirculation bubbles are limited within the upper recirculation area 35. A small part of the hot air above the first platform 3 and most of the hot air in the lower work area 36 will be exhausted outside the factory building 2 along the direction from the first lateral wall 22 to the second lateral wall 24 by rapid flow of the air in the high-speed area to reduce the temperature of the lower work area 36. As shown in Figs. 2 and 3, due to the limitation of the height H and the width L of the rectangular trough 65 of the partition 6, i.e. to meet the restriction condition of $H \geq 0.1L$, the length of the recirculation bubble is approximately equal

to the width L in the rectangular trough 65, so that the airflow will not deflect into the rectangular trough 65 too much, and the airflow speed of the working area below the rectangular trough 65 will not be excessively reduced.

【0020】 Based on the structure of the above-mentioned first embodiment, the present invention is simulated and tested with the following parameters in a factory building with a height of 15 m, a width of 36 m and a length of 108 m, and is analyzed and calculated by the computer program of Computational Fluid Dynamics (CFD).

Total number of windows (air inlets): 24, 1 row

Distance between upper and lower edges of windows (a plurality of air inlets): 1.8 m

Window (air inlet) inlet wind speed: 2.48 m/s

Length of the first platform: 5 m

Total number of fans (air outlet): 18, 1 row

Air volume of a single fan (air outlet): 700 CMM

Axial wind speed at the outlet of a single fan (air outlet): 10.3 m/s

Total air volume of a plurality of fans (air outlet): 12600 CMM

Height of rectangular trough (H): 6 m, 7 m, 8 m

Width of rectangular trough (L): 50 m

【0021】 After analyzing the calculation results by CFD computer program, the velocity vector and streamline distribution diagram are shown in the x-z section in Fig. 4. The arrow represents the velocity vector, and the curve along the tangent of the velocity vector represents the streamline. The velocity vectors and streamlines

of the lower work area 36 show almost parallel flow from left to right and no recirculation area or low-speed area is created. Therefore, when the roof 21 is designated a temperature of 60℃, the temperature inside the roof 21 is designated as 60℃, and the temperature of the atmosphere is designated as 29℃, the high temperature air in the rectangular trough 65 can be prevented from rolling downward to the lower work area 36 by the above-mentioned distribution of the velocity vector and the streamline to maintain the high-speed airflow of the lower work area 36, and let the airflow temperature of the lower work area 36 below 3 meters be approximately equal to the atmospheric temperature, so as to effectively reduce the temperature in the lower work area 36.

【0022】 As shown in Fig. 5, which is a second embodiment of the heat dissipation structure for a factory building 1 of the present invention, the difference from the first embodiment is that the first end 61 of the partition 6 connects with the inner wall surface of the first lateral wall 22, the second end 62 of the partition 6 and the inner wall surface of the second lateral wall 24 have a second interval W2 therebetween, and the second interval W2 is smaller than the first interval W1. The length of the partition 6 L1 is greater than or equal to one half of the distance L2 between the first lateral wall 22 and the second lateral wall 24, that is, L1 $\geqq$ 1/2 L2. In an implementation, the length of the partition 6 L1 is preferably $\geqq$ 3/4 of the distance L2 between the first lateral wall 22 and the second lateral wall 24. In addition, the interior space 26 between the roof 21 and the partition 6 is a closed space that does not allow outdoor air to enter, that is, the factory building above the partition 6 cannot have an opening to prevent the fan from sucking air from the

opening above the partition 6, resulting in less air inlet from the window below the partition 6.

【0023】 In this way, a small part of the hot air above the partition 6 and most of the hot air in the lower work area 36 will flow outside the factory building 2 along the direction from the first lateral wall 22 to the second lateral wall 24 through the fast and smooth flow of the cooling air to reduce the temperature of the lower work area 36.

【0024】 Therefore, the present invention has the following advantages:

1. The present invention can avoid the hot air in the upper part of the factory building from rolling down to the lower working area through a gentle and smooth airflow, so that the temperature of the lower working area can be greatly reduced. Therefore, it can not only reduce the speed of the exhaust fan to reduce power consumption and noise generation to improve the quality of the working environment, but also enable the workers in the lower working area to work in a cool and comfortable environment to improve work efficiency and avoid occupational injury caused by high temperature environment.

2. The present invention can use the rectangular trough of the partition to accommodate or install the top of the bridge crane or other large-scale equipment, which can effectively increase the usable space in the factory building. Because a plurality of rectangular troughs can be configured on the partition, the bridge crane or other large-scale equipment can be configured separately according to the actual needs, so as to improve the work efficiency. Furthermore, because the height of the rectangular trough and the width of the rectangular trough are limited within a

certain ratio, it can effectively accommodate the recirculation bubbles generated by the airflow below the partition entering the rectangular trough, so as not to allow the airflow to deflect into the rectangular trough too much, and it can let the airflow under the partition smoothly pass the recirculation bubbles in the rectangular trough without excessively reducing the airflow speed, so as to maintain effective ventilation and heat dissipation.

3. For the high-rise factory building, through the limitation of the effective length of the partition, in addition to accommodating and placing taller large-scale equipment through the open space of the second interval in order to increase the usable space, the exchange of the air flow above and under the partition is avoid to prevent the hot air above from rolling down to the lower working area, and the ventilation and heat dissipation effect of the lower working area can be effectively maintained.

【0025】 In conclusion, according to the content disclosed above, the present invention can indeed achieve the expected purpose to provide a heat dissipation structure for a factory building which effectively reduces the temperature of the work area where the machines are placed and the workers operate, save the power, decrease the noise, and increase the usable space in the factory building. Therefore, the present invention has industrial utility and is filed accordingly.

【SYMBOL DESCRIPTION】

【0026】

1 heat dissipation structure for a factory building

2 factory building

21 roof	22 first lateral wall
23 third lateral wall	24 second lateral wall
25 forth lateral wall	26 interior space

3 first platform

31, 61 first end	32, 62 second end
33, 63 third end	34, 64 fourth end
W1 first interval	W2 second interval
35 upper recirculation area	36 lower work area
4 air inlet	5 air outlet

H1 height of the exhaust center of the plurality of air outlets

H2 height of the center position of the plurality of air inlets

H3 height of the top position of the plurality of air inlets

6 partition	65 rectangular trough
H height of the rectangular trough	L width of the rectangular trough

L1 length of the partition

L2 distance between the first lateral wall and the second lateral wall

WHAT IS CLAIMED IS:

1. A heat dissipation structure for a factory building, wherein the factory building comprises a roof, and a first lateral wall, a third lateral wall, a second lateral wall, and a forth lateral wall constructed sequentially and continuously under the roof; the roof, the first lateral wall, the third lateral wall, the second lateral wall, and the forth lateral wall together surround an interior space, and the first lateral wall is parallel to the second lateral wall; the heat dissipation structure for a factory building including:

a first platform located in the interior space of the factory building, wherein the first platform has a first end and a second end opposite to the first end, the first end of the first platform connects with an inner wall surface of the first lateral wall so as to separate the interior space of the factory building to an upper recirculation area and a lower work area, and the second end of the first platform and an inner wall surface of the second lateral wall have a first interval therebetween;

at least one air inlet disposed and transversely spaced in a lower half of the first lateral wall below the first platform;

at least one air outlet disposed and transversely spaced in a lower half of the second lateral wall, wherein an exhaust center of the at least one air outlet is located at a vertical position between a center position and a top position of the at least one air inlet, so that cold air is input through the at least one air inlet and hot air is exhausted through the at least one air outlet; and

a partition positioned between the roof and the first platform, wherein the partition has a first end and a second end opposite to the first end, the first end of the partition connects with the inner wall surface of the first lateral wall, a length of the partition is larger than or equal to one half of a distance between the first and the second lateral walls, the partition has at least one rectangular trough, any one of a long side of the rectangular trough is parallel to the first lateral wall, the rectangular trough has a height H and a width L, and $H \geqq 0.1L$.

2. The heat dissipation structure for a factory building according to Claim 1, wherein the first platform has a third end and a forth end opposite to the third end, the third end connects with an inner wall surface of the third lateral wall, and the forth end connects with an inner wall surface of the forth lateral wall.

3. The heat dissipation structure for a factory building according to Claim 1, further comprising a plurality of vents disposed between the partition and the roof to exhaust the hot air between the partition and the roof, wherein the partition has a first end and a second end opposite to the first end, the first end of the partition connects with the inner wall surface of the first lateral wall, and the second end of the partition connects with the inner wall surface of the second lateral wall.

4. The heat dissipation structure for a factory building according to Claim 1, wherein the partition has a first end and a second end opposite to the first end, the first end of the partition connects with the inner wall surface of the first lateral wall, the second end of the partition and the inner wall surface of the second lateral wall have a second interval therebetween, and a length of the second interval is smaller than a length of the first interval.

5. The heat dissipation structure for a factory building according to Claim 3 or 4, wherein the partition has a third end and a forth end opposite to the third end, the third end of the partition connects with an inner wall surface of the third lateral wall, and the forth end of the partition connects with an inner wall surface of the forth lateral wall.