

FAN STRUCTURE FOR MOUNTING IN A LIGHT STEEL

STRUCTURE OF A CEILING

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a fan structure and more particularly, to such a fan structure suitable for mounting in a light steel structure of a ceiling.

2. Description of the Related Art:

A light steel structure may be installed in a ceiling inside a room of a building to provide frame sashes for the mounting of ceiling panels or lighting fixtures. Further, a fan structure may be installed in one frame sash of a light steel structure in a ceiling for causing currents of air.

Many light steel structure mountable fan structure designs have been disclosed and have appeared on the market. Exemplars are seen in Taiwan patent number M251939 entitled "IMPROVED FAN STRUCTURE FOR MOUNTING IN A LIGHT STEEL STRUCTURE" and M322475, entitled "IMPROVED FAN STRUCTURE FOR MOUNTING IN A LIGHT STEEL STRUCTURE". These two prior art designs commonly have an enclosed base disposed at the top side to prevent suction of dust from the space above the ceiling into the indoor space. However, these two prior art designs commonly have a bottom cover suspending below the elevation of the ceiling that obstructs the planar sense of beauty of the ceiling. According to

these two prior art designs, outside air goes into the fan structure from gaps around the periphery of the bottom cover. Therefore, the fan blade must be disposed below the elevation of the ceiling at a certain distance so that sufficient air can be sucked into the fan structure. Except the problem of sense of beauty, this installation design will cause noise. In case of shortening the elevational distance between the fan blade and the ceiling, the amount of suction air will be greatly reduced, lowering the performance of the fan structure.

Therefore, it is desirable to provide a fan structure that eliminates the aforesaid drawbacks.

SUMMARY OF THE INVENTION

The present invention has been accomplished to provide a fan structure suitable for mounting in a light steel structure of a ceiling that eliminates the aforesaid drawbacks.

According to the present invention, the fan structure comprises a fan holder, a bottom cover frame and a grille. The fan holder comprises a top cover shell, a fan motor mounted in the bottom side of the top cover shell, and a fan blade coupled to the output shaft of the fan motor and rotatable by the fan motor to cause currents of air. The bottom cover frame comprises a smoothly arched bottom wall curving smoothly downwards, a horizontal mounting flange extending around the smoothly arched bottom wall and mountable in one frame sash of a light steel structure of a ceiling, a

vertical connection flange upwardly extending from the connection between the smoothly arched bottom wall and the horizontal mounting flange and connected to the top cover shell of the fan holder, a circular center opening cut through the smoothly arched bottom wall at the center corresponding to the fan blade, a plurality of ventilation holes cut through the smoothly arched bottom wall around the circular center opening, and a fence disposed above the circular center opening and surrounding the fan blade. The fence has a top edge defining with the top cover shell of the fan holder a space for causing a gate effect during rotation of the fan blade. The grille is mounted in the circular center opening of the bottom cover frame for output of currents of air caused by the fan blade. When the fan blade is rotated by the fan motor to cause currents of air, the currents of air go from the outside of the fan structure into the inside of the bottom cover frame through the ventilation holes over the fence and then go toward the outside of the fan structure through open spaces in the grille.

After installation of the fan structure in the light steel structure of a ceiling, only the smoothly arched bottom wall slightly protrudes over the bottom side of the ceiling. Therefore, the installation of the fan structure in the light steel structure of the ceiling does not obstruct the sense of beauty of the ceiling. Further, the design of the fence enables the fan structure to cause currents of air efficiently. Further, the enclosed structural design of the fan

structure prevents suction of dust from the space above the ceiling into the indoor space during operation of the fan structure.

Further, a fan duct may be used and connected to an air conditioning system to guide regulated cold or hot air from the air conditioning system to the inside of the fan structure for sending into the indoor space.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an oblique bottom elevation of a fan structure in accordance with a first embodiment of the present invention.

FIG. 2 is an exploded view of the fan structure in accordance with the first embodiment of the present invention.

FIG. 3 is a cutaway view of the fan structure in accordance with the first embodiment of the present invention.

FIG. 4 is a schematic sectional view of the first embodiment of the present invention, showing the flowing passage of air during operation of the fan structure.

FIG. 5 is an applied view of the first embodiment of the present invention, showing the fan structure installed in the light steel structure of a ceiling.

FIG. 6 is an exploded view of a fan structure in accordance with a second embodiment of the present invention.

FIG. 7 is a cutaway view of the fan structure in accordance with the second embodiment of the present invention.

FIG. 8 is a schematic sectional view of the second

embodiment of the present invention, showing the flowing passage of air during operation of the fan structure.

FIG. 9 is an applied view of the second embodiment of the present invention, showing the fan structure installed in the light steel structure of a ceiling.

FIG. 10 is an exploded view of a fan structure in accordance with a third embodiment of the present invention.

FIG. 11 is an exploded view of a fan structure in accordance with a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 5, a fan structure **1** is shown mounted in one frame sash of a light steel structure **2** of a ceiling **3**. The fan structure **1** in accordance with a first embodiment of the present invention, as shown in FIGS. 1~3, is comprised of a fan holder **11**, a bottom cover frame **12**, and a grille **13**.

The fan holder **11** comprises a top cover shell **111**, a fan motor **112** mounted in the bottom side of the top cover shell **111**, and a fan blade **113** coupled to the output shaft of the fan motor **112** and rotatable by the fan motor **112** to cause currents of air.

The bottom cover frame **12** comprises a smoothly arched bottom wall **122** curving smoothly downwards, a horizontal mounting flange **121** extending around the smoothly arched bottom wall **122** to facilitate installation of the fan structure **1** in one frame sash of the light steel structure **2** of the ceiling **3**, a vertical

connection flange 123 upwardly extending from the connection between the smoothly arched bottom wall 122 and the horizontal mounting flange 121 for connection to the fan holder 11, a circular center opening 124 cut through the bottom wall 122 at the center corresponding to the fan blade 113, and a plurality of ventilation holes 125 cut through the smoothly arched bottom wall 122 around the circular center opening 124. The ventilation holes 125 are formed in the four corners of the smoothly arched bottom wall 122 and a midpoint of each of the four sides between two corners. The grille 13 is mounted in the circular center opening 124, having longitudinally and transversely aligned open spaces for output of currents of air caused by the fan blade 113.

Further, a fence 126 is provided at the top side of the smoothly arched bottom wall 122 around the circular center opening 124. The fence 126 surrounds the fan blade 113 in such a manner that a space S is defined between the fan holder 11 and the topmost edge of the fence 126 to provide a gate effect (see FIG. 4).

Referring to FIG. 4, when the fan motor 112 is electrically connected to rotate the fan blade 113, currents of air (see flow lines in the drawing) are produced to go from the outside into the inside of the bottom cover frame 12 through the ventilation holes 125 over the fence 126 and then to go toward the outside of the bottom cover frame 12 through the open spaces in the grille 13.

It is to be understood that the design of the bottom cover

frame **12** enables the fan blade **113** to be kept at an elevation above the ceiling **3**. After installation, as shown in FIG. 5, only the smoothly arched bottom wall **122** slightly protrudes over the bottom side of the ceiling **3**. Therefore, the installation of the fan structure **1** in the light steel structure **2** of the ceiling **3** does not obstruct the sense of beauty of the ceiling **3**. Further, the design of the fence **126** enables the fan structure **1** to cause currents of air efficiently.

According to this embodiment, the fence **126** is directly upwardly extended from the smoothly arched bottom wall **122** around the circular center opening **124**.

Obviously, the aforesaid first embodiment of the present invention has the following advantages:

1) The smoothly arched bottom wall **122** curves smoothly downwards along the inner side of the horizontal mounting flange **121**. After installation of the fan structure **1** in one frame sash of the light steel structure **2** of the ceiling **3**, only a small part of the fan structure **1** protrudes over the bottom side of the ceiling **3**. Therefore, the installation of the fan structure **1** in the ceiling **3** does not obstruct the sense of beauty of the ceiling fan **3**.

2) The ventilation holes **125** of the smoothly arched bottom wall **122** are through holes, avoiding accumulation of dust.

3) The fan holder **11** and the bottom cover frame **12** form an enclosed structure above the light steel structure **2** of the ceiling **3**, avoiding suction of dust from the space above the ceiling **3** into the

inside of the fan structure 1 during rotation of the fan blade 113 and assuring output of cleaning currents of air.

4) The installation of the fan structure is easy.

Further, a fan structure 1 may be connected with a fan duct 4 for connection to the air conditioning system of the building to guide regulated cold or hot air from the air conditioning system into the indoor space, as shown in FIG. 9).

FIGS. 6~8 show a fan structure in accordance with a second embodiment of the present invention. The fan structure 1 according to this second embodiment is substantially similar to the aforesaid first embodiment with the exception that the top cover shell 111 of the fan holder 11 has an opening 114 at the center and a mounting flange 114a protruded from the top side of the top cover shell 111 and extending around the opening 114 for the connection of a fan duct 4.

Referring to FIG. 8, when the fan motor 112 of the fan structure 1 according to this second embodiment is electrically connected to rotate the fan blade 113, currents of air (see flow lines in the drawing) are produced to go from the outside into the inside of the bottom cover frame 12 through the ventilation holes 125 of the smoothly arched bottom wall 122 over the fence 126 and then to go toward the outside of the bottom cover frame 12 through the open spaces in the grille 13. At the same time, regulated cold air or hot air is continuously delivered out of the fan duct 4 and moved with

the currents of air caused by the fan blade **113** through the grille **13** toward the indoor space.

FIG. 10 shows a fan structure in accordance with a third embodiment of the present invention. This third embodiment is substantially similar to the aforesaid second embodiment with the exception that the top cover shell **111** of the fan holder **11** of this third embodiment eliminates the aforesaid mounting flange **114a** and has a fan duct connector **115** fastened to the opening **114** for the connection of a fan duct **4**.

FIG. 11 shows a fan structure in accordance with a fourth embodiment of the present invention. According to this fourth embodiment, the bottom cover frame **12** has a support structure **128** suspending in the circular center opening **124** to support the fan motor **112** at the top side and a synchronizing motor **127** at the bottom side. The synchronizing motor **127** has a grille connector **131** affixed to the output shaft thereof. A cap **132** is affixed to the output shaft of the synchronizing motor **127** to secure the grille **13** to the grille connector **131** and to block the connection between the grille **13** and the grille connector **131**, allowing rotation of the grille **13** with the output shaft of the synchronizing motor **127**. Further, an electric box **126a** is mounted in the bottom cover frame **12** outside the fence **126** and covered with a cover **129** for accommodating a fan control circuit board (not shown).

Although particular embodiments of the invention have

been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

What the invention claimed is:

1. A fan structure mountable in one frame sash of a light steel structure of a ceiling, comprising:

a fan holder, said fan holder comprising a top cover shell, a fan motor mounted in a bottom side of said top cover shell, and a fan blade coupled to an output shaft of said fan motor and rotatable by said fan motor to cause currents of air;

a bottom cover frame, said bottom cover frame comprising a smoothly arched bottom wall curving smoothly downwards, a horizontal mounting flange extending around said smoothly arched bottom wall and mounted in one frame sash of a light steel structure of a ceiling, a vertical connection flange upwardly extending from the connection between said smoothly arched bottom wall and said horizontal mounting flange and connected to said top cover shell of said fan holder, a circular center opening cut through said smoothly arched bottom wall at the center corresponding to said fan blade, a plurality of ventilation holes cut through said smoothly arched bottom wall around said circular center opening, and a fence disposed above said circular center opening and surrounding said fan blade, said fence having a top edge defining with said top cover shell of said fan holder a space for causing a gate effect during rotation of said fan blade; and

a grille mounted in said circular center opening of said bottom cover frame for output of currents of air caused by said fan

blade;

wherein when said fan blade is rotated by said fan motor to cause currents of air, said currents of air go from the outside of the fan structure into the inside of said bottom cover frame through said ventilation holes over said fence and then go toward the outside of the fan structure through open spaces in said grille.

2. The fan structure as claimed in claim 1, wherein said fence protrudes upwards from said smoothly arched bottom wall and extends around said circular center opening.

3. The fan structure as claimed in claim 1, wherein said ventilation holes are respectively disposed in four corners of said smoothly arched bottom wall and at the midpoint at each of four sides between each two corners of said four corners.

4. The fan structure as claimed in claim 1, wherein said top cover shell of said fan holder has an opening and a fan duct connecting the opening of said top cover shell of said fan holder to an air conditioning system for guiding regulated air from said air conditioning system into the fan structure.

5. The fan structure as claimed in claim 4, wherein the opening of said top cover shell of said fan holder is located on the center of said top cover shell of said fan holder, and said top cover shell of said fan holder comprises a mounting flange extending around the opening thereof for the mounting of said fan duct.

6. The fan structure as claimed in claim 4, wherein the

opening of said top cover shell of said fan holder is located on the center of said top cover shell of said fan holder, and has a fan duct connector affixed thereto for the connection of said fan duct.

7. The fan structure as claimed in claim 4, further comprising a synchronizing motor mounted in said bottom cover frame, a grille connector affixed to an output shaft of said synchronizing motor to secure said grille for allowing rotation of said grille in said circular center opening of said bottom cover frame by said synchronizing motor.

8. The fan structure as claimed in claim 7, wherein said bottom cover frame comprises a support structure suspending in said circular center opening, said support structure supporting said synchronizing motor at a bottom side thereof.

9. The fan structure as claimed in claim 8, wherein said fan motor is affixed to the center of a top side of said support structure.

10. The fan structure as claimed in claim 7, further comprising a cap fastened to a bottom side of said grille to block the connection between said grille and said grille connector.

11. The fan structure as claimed in claim 4, further comprising an electric box mounted in said bottom cover frame outside said fence and covered with a cover for receiving a fan control circuit board.