Sept. 26, 1967 YOSHITOSHI SOHDA ETAL 3,343,474

BUILDING WITH A VENT DEVICE

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Fig. 1.

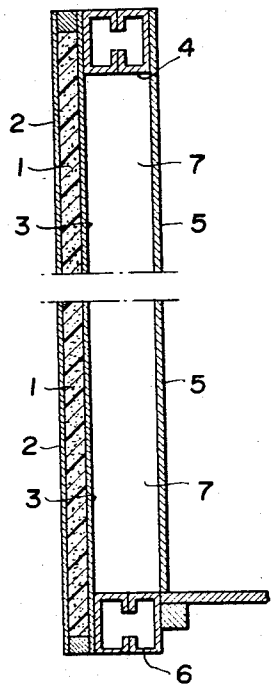


Fig. 2.

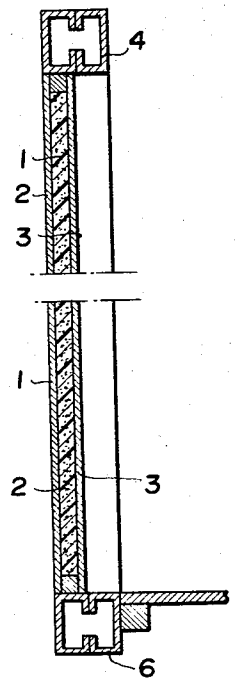
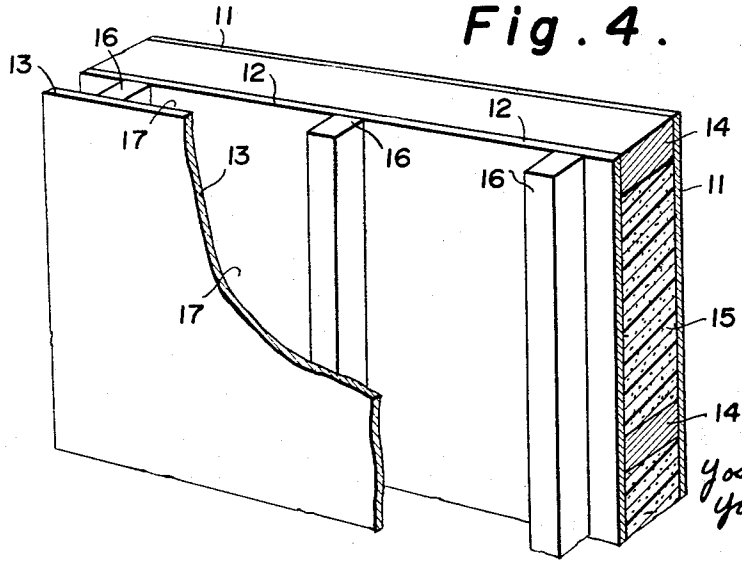


Fig. 4.



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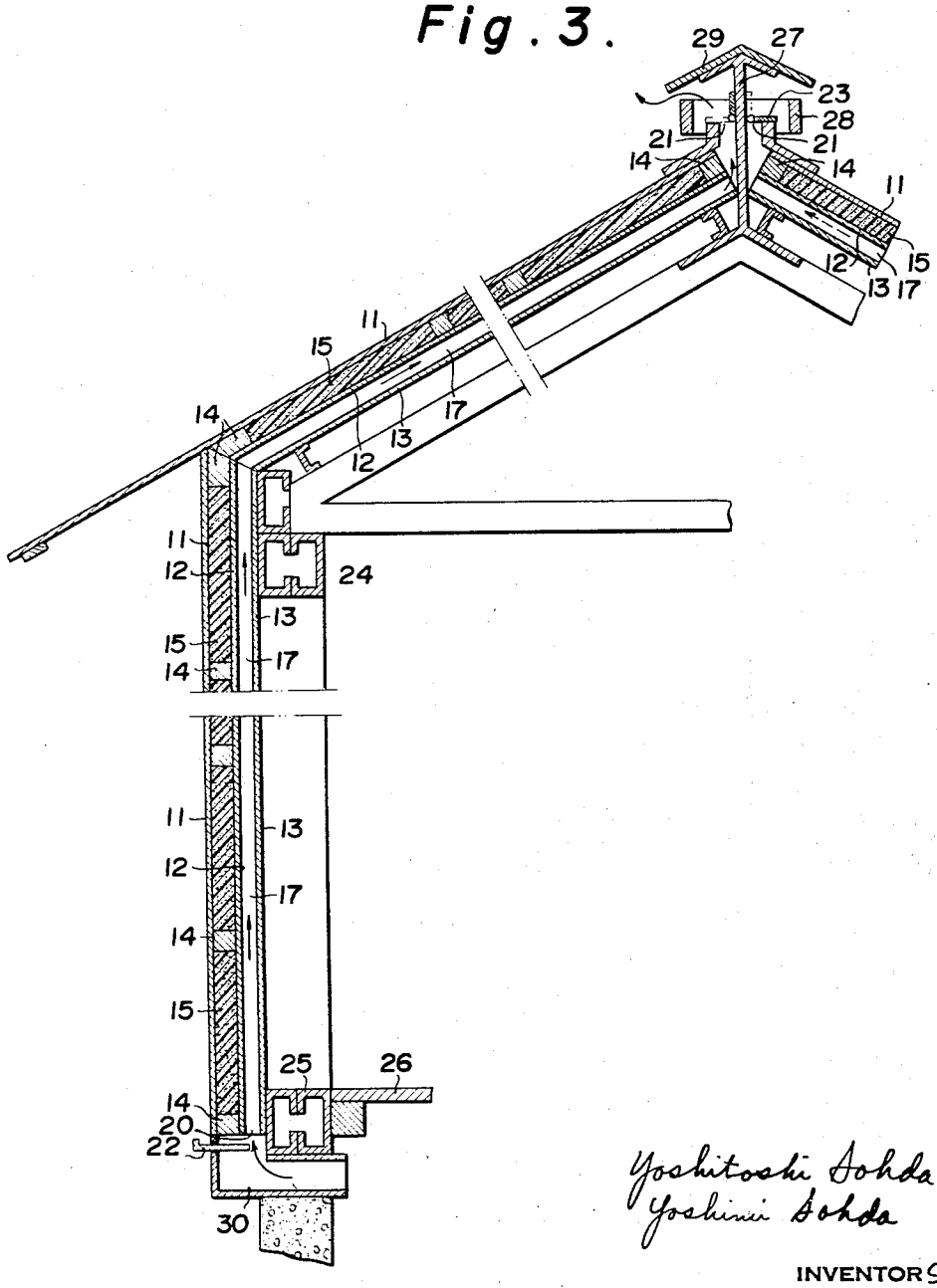
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Fig. 3.



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BUILDING WITH A VENT DEVICE

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Fig. 5.

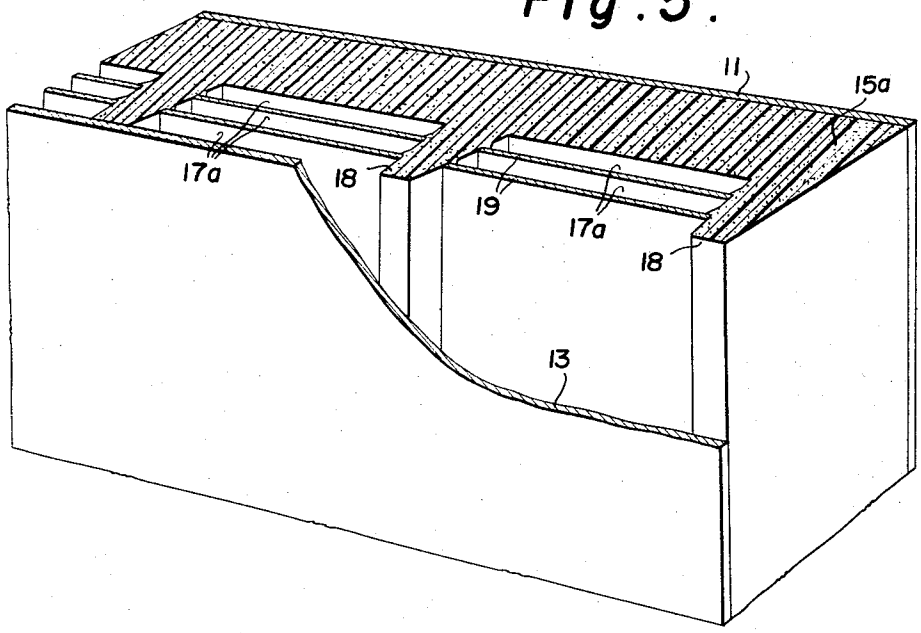
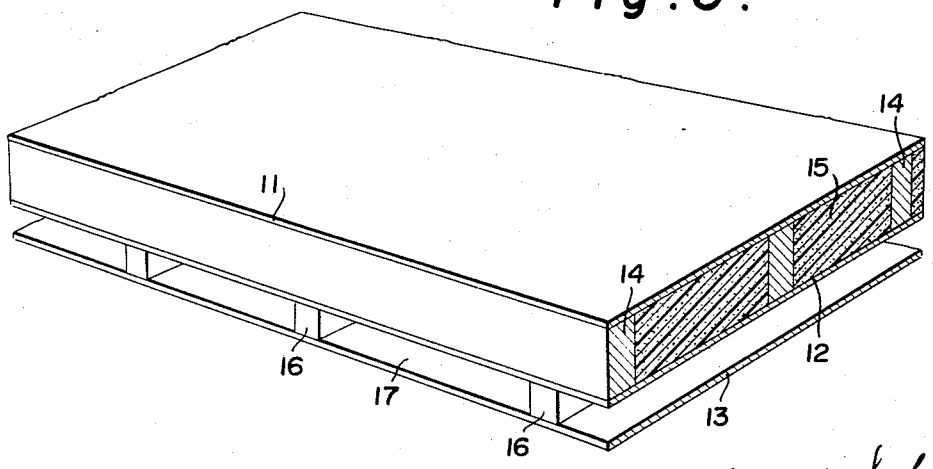


Fig. 6.



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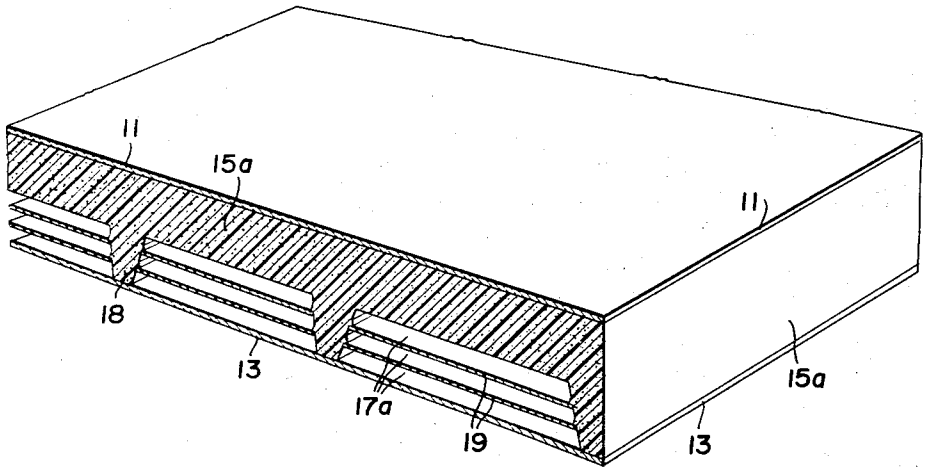
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BUILDING WITH A VENT DEVICE

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Fig. 7.



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3,343,474

BUILDING WITH A VENT DEVICE

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1 Claim. (Cl. 98—31)

ABSTRACT OF THE DISCLOSURE

A building having wall and roof contained ventilation channels, and consisting essentially of a foundation, a framework, a prefabricated wall structure and a prefabricated roof structure thereon, each structure comprising an exterior board, an interior board, a layer of heat insulating material against the inner surface of said exterior board, and a plurality of layers between said insulating material and said interior board and each layer having a plurality of side by side air passages extending from the lower end to the upper end of said wall structure and from the edge to the center of said roof structure; controlling plates at the lower ends of said air passages in said wall structure and controlling plates at the central ends of said air passages in said roof structure, said controlling plates being mounted on said structure for opening and closing, and the air passages in said wall structure being in communication with the air passages in said roof structure at the juncture of said structures.

This invention relates to construction materials and prefabricated structural members made therefrom, and more particularly to such structural members having a ventilation device which may be readily used as wall or roof members for the construction of modern buildings. The present invention further includes novel wall or roof structures fabricated with the above construction materials.

The outdoor temperature varies constantly with radiation of heat, direct or indirect, from the sun which, so to speak, rotates round the earth on a cycle of twenty-four hours, and the temperature is, therefore, in the so-called "unstationary state."

It is the object of the present invention to eliminate the defects relating to heating and cooling in conventional buildings and provide a building which is cool in the daytime in summer, warm in winter and, particularly, cool in the period from evening to midnight in summer, and having a vent device which is capable of adjusting the indoor temperatures to sudden changes in outdoor temperature conditions, such as hot in the daytime and cold in the night, occurring frequently in the transitional periods of seasons from spring to summer and summer to autumn.

The construction of a building with a vent device of the present invention will now be described in reference to the embodiments illustrated in the accompanying drawings, in which:

FIGS. 1 and 2 are side views, partially cross-sectional, of conventional building wall structures including a layer of heat insulating material.

FIG. 3 is a partially cross-sectional side view of a building with vent device embodying the present invention.

FIG. 4 is a perspective view of one form of the heat insulating wall structure with an air vent used in the present invention, with parts taken away to show its inside.

FIG. 5 is a perspective view of another form of the air vent and heat insulating wall structure, with parts taken away to show its inside.

FIG. 6 is a perspective view of one form of the heat insulating roof structure with air vent used in the present invention, with parts taken away to show its inside.

FIG. 7 is a perspective view of another form of the heat insulating roof structure with air vent, with parts taken away to show its inside.

There is known a building which has a wall or roof structure which comprises a layer of heat insulating material such as, for example, a foam plastic with an exterior board **2** and an interior board **3** cemented on respective sides thereof, as illustrated in FIGS. 1 and 2. The structure shown in FIG. 1 has an interior wall lining **5** applied to the interior side of wall plate **4** to form with the interior board **3** an air-tight hollow section. This hollow section has its upper part secured to the wall plate **4** and its lower part to the sill **6** so that it is completely closed and allows no passage of air. On the other hand, the heat insulating material normally has a considerable heat capacity. In such a structure, therefore, the outdoor and indoor temperatures are in the following relationship.

(a) The mean value of outdoor temperature is almost equal to the indoor temperatures.

(b) There is a delay in the time at which the highest temperature occurs and also in the time of the lowest temperature, the indoor temperature always occurring later than the outdoor temperature.

(c) At temperatures higher than the average temperature, the indoor temperature is lower than the outdoor temperature, and at temperatures lower than the average temperature, the indoor temperature is always higher than the outdoor temperature (through comparison of the same phases of time).

Further, with varying heat capacity of the adiabatic material, the following results.

(A) The greater the heat capacity, the higher the lowest indoor temperature.

(B) The greater the heat capacity, the greater the delay in time.

(C) The greater the heat capacity, the greater the difference between the outdoor and indoor temperatures.

According to the results of experiments, when the heat insulating material was used in an amount which provided a sufficient insulating effect in the daytime in summer, the said delay in time was a little less than five hours. The outdoor temperature became highest at about 14:00 while the indoor temperature was the highest at about 17:00. The indoor temperature at bedtime of 21:00 to 22:00 was equal to the outdoor temperature at 16:00 to 17:00, the lowest indoor temperature occurring at about 07:00 the next morning.

In other words, the indoors becomes hottest in the early part of the evening and the heat continues until about midnight.

The conventional buildings using an insulating material are cool to a certain extent in the daytime in summer, and are warm to a certain extent in winter. However, they have the detrimental defect of being hot in the evening (particularly from early in the evening to bedtime) during the summer season.

The air circulating and heat insulating wall structure for building in accordance with the present invention has the construction shown in FIGS. 4 and 5. The similar roof structure of the invention is of the construction shown in FIGS. 6 and 7. The wall structure shown in FIG. 4 and the roof structure shown in FIG. 6 comprise respectively an exterior board **11**, an inner board **12** and an interior board **13**, with a plurality of rails **14** inserted between the exterior board **11** and the inner board **12**, a heat insulating material **5** filling the space formed by the rails **14**, and a plurality of vertical rails **16** disposed at a predetermined distance between the inner board **12** and the interior board **13** to thereby form a space allowing passage of air.

In another embodiment of the wall structure and the roof structure shown in FIGS. 5 and 7, respectively, there are a plurality of layers of side by side air passages. Between the exterior board **11** and the interior board **13** is provided a layer of heat insulating material **15***a* consisting of a rigid cellular plastic the lower side of which is partly removed to leave a plurality of leg portions **18**, thereby forming a plurality of air passing sections **17***a*. In each of the air passing sections **17***a* are provided one or more partitions (two in the illustration) parallel to the interior board **13** so that the air passing section **17***a* is divided into several air passages.

In constructing a building having a vent device with such a wall structure (illustrated in FIG. 4) and a roof structure (illustrated in FIG. 6), there are provided air inlet openings **20** on the lower edge of the wall for connection directly to outdoor air or through an air inlet frame structure **30** to the air under the floor, and air outlet openings **21** on the upper edge of the roof structure, said air inlet openings **20** having an air passage control plate **22** which is free to open and close and said air outlet openings **21** having a plate **23** for free opening and closing rotatably mounted thereon so that the control of air can be easily achieved, as illustrated in FIG. 3.

Referring further to FIG. 3, designated at **24** is a wall plate; **25** is a sill; and **26** is a floor board. The roof structure has its interior board **13** partly cut off so that the air passage **17** is connected with that of the wall structure at the upper edge of the wall structure, has an outlet opening cover plate **23** hinged thereto at the top thereof, and has a partitioning plate **27** and rain shelters **28** and inclined plates **29** provided at the ridge pole.

In the building of the foregoing construction according to the present invention, all the controlling plates **22** and **23** are opened in summer. Thus, depending on the thickness of the heat insulating layer, some of the solar heat radiated during the daytime is conducted to the inner side of the heat insulating material **15**. The temperature of the heat insulating material **15** on the interior side is, therefore, higher than that of the outside atmosphere at the places where the solar heat is directly or indirectly intercepted. The air within the air passage absorbs the heat, expands and generates an upward current, taking the heat from the inside surface of the heat insulating layer **15** and dissipating the same into the atmosphere continuously. Thus, conductance of heat into the room is prevented.

As the evening approaches, the solar heat applied to the surface of the heat insulating layer **15** gradually decreases until there is no more further application of heat. Then the temperature on the external side of the heat insulating layer drops gradually.

However, the decline of the temperature on the internal side of the heat insulating layer occurs after a time delay as mentioned previously. The upward flow of air in the passage **17** still continues. This moderates the otherwise unavoidable heat within the room in the evening during the summer season.

In the early stage of night, while the upward flow of air continues until its temperature approximates the temperature on the internal side of the heat insulating layer, its upward velocity decreases gradually. As a result, the indoor atmosphere becomes cool. The outdoor temperature declines further to the lowest point at about 02:00 of the next day. When the outdoor temperature becomes lower than that indoors, the upward current of air in the air passage **17** picks up the heat from indoors through the interior board **13** so that the indoor temperature drops somewhat and has the effect of providing coolness in the room.

In the seasons of spring and autumn, the controlling plates **22** and **23** may be opened or closed as appropriate to the weather conditions of the areas concerned. During the transitional period of seasons from spring to summer or summer to autumn, there is often experienced a day which is abnormally hot in the daytime and cold in the night. On such an occasion, the controlling plates **22** and **23** may be opened or closed as desired so that the room temperaure can be adjusted.

In the winter season, all the controlling plates are closed. Thus the air passage encloses a closed column of air which, together with the adjacent layer of heat insulating material **15**, improves the heat insulating effect and prevents heat in the warm atmosphere in the room from escaping through the wall and the roof into the outside atmosphere.

Thus, in accordance with the present invention, the indoor temperature is controlled freely by the simple operation of opening or closing the controlling plates **22** and **23** so that there is economically provided a building which is valuable from the point of view of health.

It will be obvious to those skilled in the art that various modifications and changes can be made in the specific construction herein described, without departing from the inventive concept of this invention set forth in the appended claim.

What is claimed is:

A building consisting essentially of a foundation, a framework, a prefabricated wall structure and a prefabricated roof structure thereon, each structure comprising an exterior board, an interior board, a layer of heat insulating material against the inner surface of said exterior board, and a plurality of layers between said insulating material and said interior board and each layer having a plurality of side by side air passages extending from the lower end to the upper end of said wall structure and from the edge to the center of said roof structure; controlling plates at the lower ends of said air passages in said wall structure and controlling plates at the central ends of said air passages in said roof structure, said controlling plates being mounted on said structure for opening and closing, and the air passages in said wall structure being in communication with the air passages in said roof structure at the juncture of said structures.

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