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(54) Title: SPACE DELIMITING STRUCTURE FOR UTILISING LOW-TEMPERATURE HEAT-CARRYING AGENTS

(57) Abstract: A delimiting structure for utilising low-temperature heat-carrying agents, which comprises an internal member (1) made of a thermal insulator, an external member (3) also made of a thermal insulator, and distance pieces (4) inserted between the internal member (1) and the external member (3), so that the internal member (1) and the external member (3) are separated from each other by a gap (6) with the help of the distance pieces (4), and the gap (6) between the internal member (1) and the external member (3) is filled up at least partly with a subsequently hardening building material (2). The characteristic feature of the invention is that the overall heat transfer rate of the internal member (1) of the space delimiting structure (8) facing the closed internal space (8a) is lower than the overall heat transfer rate of the external member (3), and a pipe (5) constructed from pipe sections (5a) suitable for forwarding a heat transfer agent is embedded in the subsequently hardening building material (2) filling the gap (6) at least partly, the pipe (5) has an entrance stub (5b) and an exit stub (5c), and a heat-carrying agent circulating part-unit (7) heated by a renewable energy source is inserted between the exit stub (5c) and the entrance stub (5b).
Space delimiting structure for utilising low-temperature heat-carrying agents

The subject of the invention relates to a delimiting structure for utilising low-temperature heat-carrying agents, which comprises an internal member made of a thermal insulator, an external member also made of a thermal insulator, and distance pieces inserted between the internal member and the external member, so that the internal member and the external member are separated from each other by a gap with the help of the distance pieces, and the gap between the internal member and the external member is filled up at least partly with a subsequently hardening building material.

In building industry several solutions have become known for the construction of space delimiting wall structures, the aim of which is to reduce the construction time of the wall structure and improve its insulation and strength characteristics. There are some building construction solutions, in the case of which two layers of EPS are joined by plastic or steel bridges, and between the two delimiting EPS layers there is a gap determined by distance pieces. From these building units building blocks of different sizes and shapes are created, the wall structure of the building is constructed from these blocks, and finally the central free space between the EPS layers is filled with concrete. The internal side of such structures is formed by a thinner and the external side is formed by a thicker heat-insulating layer to improve the thermal insulation value of the wall. Such a solution is described for example in utility model specifications no. HU 3.317 and no. HU 3.408.

The undoubted advantage of these solutions is that they reduce the time needed for the construction of the wall structure and even for providing it with heat insulation, but the disadvantage of this "passive" heat-insulation arrangement is that it significantly increases the thickness of the structure; while the heat loss of the building still depends on the difference between the external and internal temperature both in the summer and in the winter.

Patent application no. HU P 89 06126 describes a solution where the delimiting members of buildings have a pipe coil and heat distribution layer arranged on their side
facing the internal space, and a heat transfer agent flows in the pipe coil to heat/cool the
surface of the internal space. However, only one side of the wall structure is provided with
a heat-insulating layer. The disadvantage of this solution is that both it has significant
investment and operating costs, and this construction cannot be regarded as a solution for
the active heat-insulation of the walls of the building, but rather as air-conditioning
equipment integrated in the wall.

The building structure with active heat insulation according to patent specification no.
HU 227.029 is aimed at minimising the disadvantages of passive heat insulation, and it is
based on that liquid of soil temperature is circulated in the pipe coil placed in the external
concrete layer of a multi-layered wall structure, by this realising active heat insulation, as a
result of which the heat loss of the building can be kept at a permanently low level,
independently from the external temperature.

However, the disadvantage of this solution is that due to the characteristics of the
structure the thickness of the thermal insulator core is restricted, the steel rods connecting
the external concrete layer and the internal wall structure, passing through the thermal
insulator layer encased by them and joining the two rigid wall structures act as a thermal
bridge reducing by this the thermal insulation ability of the structure.

A further disadvantage is that the building structure described in the patent specification
can only be used in the case of newly built engineering structures.

With the space delimiting structure according to the invention our aim is to overcome
the deficiencies of the known constructions and to create a version, which can be
constructed in a quick and simple way and, even besides a smaller insulation thickness,
makes it possible to keep the heat loss of the building at a permanently low level
independently from the changes of the external temperature, and ensures the active heat
insulation of the building so that it uses a low-temperature agent heated by the renewable
energy of the Earth and the Sun to save significant amounts of heating/cooling energy.

The space delimiting structure according to the invention was based on the recognition
that if the internal space of a building to be protected can be separated from the external
environment with a layer of a basically permanent temperature, then with this intermediate layer of a basically permanent temperature the temperature difference between the two spaces can be reduced. In accordance with this, if the internal space formed by a gap between the two delimiting plates - having different overall heat transfer rates - of building elements known in themselves and generally made of a thermal insulator material is provided with a pipe suitable for forwarding a heat transfer agent before filling it up with a load-bearing subsequently hardening material - unlike it is normally done -, then after the subsequently hardening material hardens it can act as a thermal battery between the appropriately positioned external plate and internal plate made of a thermal insulator material, and by evenly distributing the amount of heat transferred by the agent of a lower temperature entered through the pipe it practically forms a layer of a permanent temperature, which, despite its small structural thickness, realises the active heat insulation of the space delimiting structure, and so the task can be solved.

In accordance with the set aim, the 'space delimiting structure according to the invention for utilising low-temperature heat-carrying agents - which comprises an internal member made of a thermal insulator, an external member also made of a thermal insulator, and distance pieces inserted between the internal member and the external member, so that the internal member and the external member are separated from each other by a gap with the help of the distance pieces, and the gap between the internal member and the external member is filled up at least partly with a subsequently hardening building material -, is constructed in such a way that the overall heat transfer rate of the internal member of the space delimiting structure facing the closed internal space is lower than the overall heat transfer rate of the external member, and a pipe constructed from pipe sections suitable for forwarding a heat transfer agent is embedded in the subsequently hardening building material filling the gap at least partly, the pipe has an entrance stub and an exit stub, and a heat-carrying agent circulating part-unit heated by a renewable energy source is inserted between the exit stub and the entrance stub.

A further criterion of the space delimiting structure according to the invention may be that at least a part of the internal member made of a thermal insulator is formed by an arranged group of smaller internal basic bodies fitting each other, while at least a part of
the external member made of a thermal insulator is formed by an arranged group of smaller external basic bodies fitting each other.

From the aspect of the sample it may be favourable, if the heat-carrying agent circulating part-unit has a circulating pump and an expansion tank.

In the case of a possible version of the building structure element the heat-carrying agent circulating part-unit has a tube collector sunk into the ground, suitable for collecting ground source heat energy.

In the case of a further different realisation of the invention the heat-carrying agent circulating part-unit has a solar collector suitable for collecting solar energy.

The delimiting structure according to the invention has numerous favourable characteristics. The most important one of these is that due to the pipe placed in the concrete block between the two insulating layers a space delimiting structure can be constructed in a quick and simple way, which, besides having a static - that is load-bearing task, has significantly more favourable thermal insulation characteristics, even despite its smaller structural thickness, because the subsequently hardening material layer acts as a low-temperature heat battery and forms by this the active heat-insulating insert of the building structure, as a result of which besides reducing the costs and time demand of construction, due to the more favourable winter and summer insulation characteristics it also reduces the energy consumption needed for the appropriate air-conditioning of the internal protected space, which results in the reduction of the operating expenses too.

Another advantage is that due to the structural construction according to the invention, besides the significantly smaller insulation thickness the heat loss of the building can be kept at a practically permanent low level, independently from the changes of the external temperature. For active heat insulation and for cooling during the summer the surface of the entire external delimiting structure of the building is available, which enables a significant amount of heat exchange without any noise or draft even besides a relatively low temperature difference, as the overheating of the internal space can be hindered without any air movement, using the low-temperature layer - as compared to the external...
ambient temperature in the summer - in the walls, which has an effect blocking the external heat amount from getting onto the internal side of the wall structure.

It can also be regarded as an advantage of the space delimiting structure according to the invention that in the case of a suitably chosen construction there are no heat bridges between the active heat insulating layer and the internal space, which may enhance the heat insulating effect even more.

From the aspect of environmental protection it can be regarded as an advantage that the agent of a lower temperature heated by the renewable energy of the Earth and the Sun can be used for heat insulation, that is for keeping the space delimiting structure warm in the winter and cool in the summer, which, besides saving a significant amount of heating/cooling energy, does not represent a load on the environment. Consequently the heat insulation realised with the space delimiting structure according to the invention is completely environment friendly.

It is important to emphasise another favourable effect, namely that the solution according to the invention makes it possible to increase significantly the utilisation of the capacity of the solar collectors possibly used in the case of the building, because the energy stored in the low-temperature heat transfer agent - of a temperature between 10-30 °C - obtained by the solar collectors can also be used in the structure with active heat insulation, as earlier only the energy stored in the heat transfer agent of a temperature above 30 °C collected by the solar collectors was used for producing hot water or for supporting heating. Due to the construction of the space delimiting structure according to the invention it is possible to use heat transfer agents within a lower temperature range too.

Below the space delimiting structure according to the invention is described in detail in connection with construction examples, on the basis of a drawing. In the drawing

figure 1 is the longitudinal view of a version of the space delimiting structure according to the invention,
Figure 2 is the schematic view of a method of using the space delimiting structure according to the invention, showing the section of a part of the space delimiting structure,

Figure 3 is the schematic view of another method of using the space delimiting structure according to the invention, showing the front view of a part of the space delimiting structure, partly in section.

Figure 1 shows a version of the space delimiting structure 8 according to the invention, where the subsequently hardening material 2 between the internal member 1 and the external member 3 is concrete. It can be seen that in the present construction example the thicker internal member 1, having a lower heat transfer ability, faces the internal space 8a of the space delimiting structure 8, while the thinner external member 3, with a higher heat transfer ability, faces the external environment. The internal member 1 and the external member 3 are joined together by distance pieces 4, so that there is a gap 6 between them. In the gap 6, besides the distance pieces 4, there is a subsequently hardening material 2 with a bent pipe 5 constructed from pipe sections 5a embedded in it. In the case of this construction example the pipe sections 5a are attached to the distance pieces 4 joining the internal member 1 and the external member 3 to each other, and in this way they are in a fixed position in the gap 6 until the gap 6 is filled with a subsequently hardening material 2.

Figure 2 shows another construction of the space delimiting structure 8. It can be seen here that the internal member 1 comprises internal basic body 1a and internal basic body 1b, while the external member 3 comprises external basic body 3a and external basic body 3b. It is not a requirement to construct the internal member 1 and the external member 3 "from pieces", but it significantly simplifies the construction of the space delimiting structure 8. In the case of this version of the space delimiting structure 8 too, there are distance pieces 4 and also pipe sections 5a, from which the pipe 5 is constructed.

It can also be seen in figure 2 that here a heat-carrying agent circulating part-unit 7 containing a circulating pump 7a, an expansion tank 7b and a tube collector 7c is connected to the pipe 5. In the case of the given version the tube collector 7c is placed in the ground 9, practically at a depth of 1.5-5 m.
When using the space delimiting structure according to figure 2, first internal member 1 must be constructed from internal basic bodies 1a and internal basic bodies 1b, as well as the structural elements containing the subsequently hardening material 2 in such a way that the internal member 1 is situated on the side of the space delimiting structure 8 facing the internal space 8a. In the following the pipe 5 must be constructed from the pipe sections 5a, and it must be placed appropriately in the gap 6 between the internal member 1 and the external member 3 and fixed for example to the distance piece 4. Finally the gap 6 is filled with subsequently hardening material 2, e.g. concrete, which is left to harden under the ordinary technological conditions to realise the space delimiting structure 8.

During this period the heat-carrying agent circulating part-unit 7 can also be installed in such a way that the tube collector 7c is placed at such a depth in the ground 9, where it is surrounded by an even temperature.

Finally the heat-carrying agent circulating part-unit 7 can be connected to the pipe 5, and then the entire system can be filled with a suitably chosen anti-freezing heat transfer liquid, and so the space delimiting structure 8 with completely active heat insulation becomes operable.

During operation in the winter, the heat transfer agent circulating in the tube collector 7c placed at an appropriate depth in the ground 9 assumes the temperature of the ground 9, so it has a temperature of about 8-10 °C, which is warmer than the external environment. The heat transfer agent flowing back in the subsequently hardening material 2 from the ground 9 creates a layer between the internal member 1 and the external member 3, the temperature of which layer is lower than the temperature of the internal space 8a delimited by the space delimiting structure 8, but it is basically permanent. However, the temperature of the layer having a basically permanent temperature inside the subsequently hardening material 2 is higher than the ambient temperature outside the external member 3 of the space delimiting structure 8. The temperature inside the subsequently hardening material 2 of the space delimiting structure 8 is basically permanent, because the amount of heat conducted as a result of the difference between the temperature of the subsequently hardening material 2 and the temperature of the external member 3 of the space delimiting
structure 8 facing the external space is provided by the amount of heat passing through the internal member 1 of the space delimiting structure 8 from the protected internal structure 8a on the one part, and on the other part by the amount of heat carried by the heat transfer agent circulating in the pipe 5 embedded in the subsequently hardening material 2, even continuously, controlled by the heat-carrying agent circulating part-unit 7. Due to this operation the space delimiting structure 8, as an active heat-insulating structure, reduces the heat loss of the internal space of the building.

During operation in the summer, the heat transfer agent circulating in the tube collector 7c placed at an appropriate depth in the ground 9 assumes the temperature of the ground 9, so it has a temperature of about 8-10 °C, which is significantly lower than the temperature of the external environment. In this case, in the subsequently hardening material 2 a layer of a lower temperature is created, the heat transfer agent circulating in the pipe 5 assumes the heat flowing from the external member 3 of the space delimiting structure 8 towards the internal member 1 and the heat passing through the internal member 1 of the space delimiting structure 8 from the direction of the internal space 8a into the subsequently hardening material 2, returns it to the ground 9, and after passing through the tube collectors 7c it returns, cooled down again, to the subsequently hardening material 2 placed in the gap 6.

In the solution according to figure 2 the heat transfer agent circulating in the pipe 5 assumes its heat directly from the ground 9 or transfers its heat directly to the ground 9, and so the space delimiting structure 8 is able to perform the active heat insulation task without a separate heating or cooling equipment. In order to operate the system only the energy of the circulating pump 7a circulating the heat transfer agent is needed, which is supposed to overcome the flow resistance of the heat transfer agent flowing in the pipe 5.

Figure 3 also shows an arrangement realising active heat insulation containing the space delimiting structure 8 according to the invention. Here again there are the internal basic bodies 1a and the internal basic bodies 1b forming the internal member 1, there is the subsequently hardening material 2, which is covered here and can only be seen in the cut out, and external basic bodies 3a and the external basic bodies 3b forming the external
member 3. In the case of this construction too, the subsequently hardening material 2 includes the pipe 5 constructed from pipe sections 5a. However, the difference is that in this case a heat-carrying agent 7 circulating part-unit is inserted between the entrance stub 5b and the exit stub 5c of the pipe 5, which part-unit also includes a solar collector 7d besides the circulating pump 7a and the expansion tank 7b.

In the case of this version the space delimiting structure 8 is constructed and installed similarly to the one described in figure 2, the only difference is that it is the solar collector's 7d task to heat the heat transfer agent. Consequently, it is obvious that this version is not suitable or only slightly suitable for cooling the subsequently hardening material 2 of the space delimiting structure 8, so this version containing a solar collector 7d can be connected as a supplement to the heat-carrying agent circulating part-unit 7 according to figure 2, in order to enhance the heating of the heat transfer agent circulated in the pipe 5 in the winter period.

The space delimiting structure according to the invention can be favourably used in the case of all buildings to construct wall and floor structure in a quick and simple way and/or to realise their active heat insulation.
List of references

1 internal member                      1a internal basic body
                                         1b internal basic body
2 subsequently hardening material
3 external member                      3a external basic body
                                         3b external basic body
4 distance piece
5 bent pipe                            5a pipe section
                                         5b entrance stub
                                         5c exit stub
6 gap
7 heat-carrying agent circulating part-unit 7a circulating pump
                                         7b expansion tank
                                         7c tube collector
                                         7d solar collector
8 space delimiting structure
9 ground

8a internal space
1. Space delimiting structure for utilising low-temperature heat-carrying agents, which comprises an internal member made of a thermal insulator, an external member also made of a thermal insulator, and distance pieces inserted between the internal member and the external member, so that the internal member and the external member are separated from each other by a gap with the help of the distance pieces, and the gap between the internal member and the external member is filled up at least partly with a subsequently hardening building material, characterised by that the overall heat transfer rate of the internal member (1) of the space delimiting structure (8) facing the closed internal space (8a) is lower than the overall heat transfer rate of the external member (3), and a pipe (5) constructed from pipe sections (5a) suitable for forwarding a heat transfer agent is embedded in the subsequently hardening building material (2) filling the gap (6) at least partly, the pipe (5) has an entrance stub (5b) and an exit stub (5c), and a heat-carrying agent circulating part-unit (7) heated by a renewable energy source is inserted between the exit stub (5c) and the entrance stub (5b).

2. Space delimiting structure as in claim 1, characterised by that at least a part of the internal member (1) made of a thermal insulator is formed by an arranged group of smaller internal basic bodies (la, lb) fitting each other, while at least a part of the external member (3) made of a thermal insulator is formed by an arranged group of smaller external basic bodies (3a, 3b) fitting each other.

3. Space delimiting structure as in claim 2, characterised by that the heat-carrying agent circulating part-unit (7) has a circulating pump (7a) and an expansion tank (7b).

4. Space delimiting structure as in any of claims 1-3, characterised by that the heat-carrying agent circulating part-unit (7) has a tube collector (7c) sunk into the ground (9), suitable for collecting ground source heat energy.
5. Space delimiting structure as in any of claims 1-4, characterised by that the heat-carrying agent circulating part-unit (7) has a solar collector (7d) suitable for collecting solar energy.
INTERNATIONAL SEARCH REPORT

According to International Patent Classification (IPC) or to both national classification and IPC

A. CLASSIFICATION OF SUBJECT MATTER
ADD.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B E04C F24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>DE 195 01 112 Al (ALTMANN WALDEMAR [DE]; FRANZ MICHAEL [DE]) 2 November 1995 (1995-11-02) abstract col umn 4, line 17 - col umn 10, line 49 figures 1-15</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

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Name and mailing address of the ISA/Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax. (+31-70) 340-3016

Beucher, Stefan

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