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HEAT INSULATING STRUCTURAL MEMBER

Original Filed July 27, 1962

2 Sheets—Sheet 2

--- Diagram ---

1. (input material)
   - 8-20 lb./cu. ft. glass wool board

2. (a) Dip in hot asphalt
   - Example: 400 ±20°F for 5 seconds
   - Drain

3. (b) Rapid upset for penetration
   - Example: 3/32" & cool

4. (c) Insert web into bottom channel
   - Then tap on top channel

5. (d) Physical joining

6. (e) Reheat for development of fiber-to-metal bond
   - With inversion for asphalt flow
   - Example: 400°F

7. (f) Cool

8. (g) Package & ship

--- end of diagram ---

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HEAT INSULATING STRUCTURAL MEMBER

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Int. Cl. E04B 1/79

U.S. Cl. 52—309

3 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to structural members to retain and support thermal insulation in cold storage walls, and comprising opposed elongated cap members spaced by an elongated core of light weight and porous fibrous structure, with the cap members held over opposite edges of the core, so that stresses in the core are carried by the spaced cap members.

This application is a continuation of copending application Ser. No. 212,836 filed July 27, 1962, now abandoned.

This invention relates to structural elements and more particularly to heat insulating structural elements and to a method of production. Still more particularly this invention relates to substructural members to retain and support thermal insulation in applications from subzero temperatures to substantially elevated temperatures.

THE PROBLEM

In the prior art it has been a common practice to insulate freezer rooms using wool wall and ceiling joists to hold insulation materials therebetween. It will be apparent to persons skilled in the art that wood provides a substantial fire hazard; a substantial heat transfer path, particularly when wet; is subject to dry rot, or requires treatment to prevent the same, resulting in high costs. Thus, wood is limited in its application to cold storage insulation applications and even then has serious draw-backs; and cannot be used adjacent to a heat source, such as for insulating boilers, ovens, driers, tanks and the like.

Accordingly, an important step forward in the art would be provided by a novel substructural building member operable to retain and support thermal insulation in applications from subzero, that provides the complete exclusion of wood from cold storage wall insulations, provides an increased fire safety factor, reduces costly heat gain characterizing wood members, and eliminates the possibility of dry rot in untreated lumber. Also, a novel substructural member adapted for use in high temperature applications on ovens, driers, tanks and boilers capable of eliminating dangerous surface hot spots and heat loss through conductance, as well as reducing structural insulation supports, would provide a valuable step forward in the art.

Accordingly, it is an important object of the present invention to provide a novel heat-insulating substructural member.

A further object is to provide a novel method for producing substructural members to retain and support thermal insulation in applications from subzero temperatures to well above ambient temperatures.

A further object is to provide novel, substructural members made of glass fibers and a bonding resin, in combination with metal caps, thus increasing fire safety, substantially eliminating heat gain, and having a long service life.

A still further object is to provide a substructural member adapted for use in cold storage applications and also to applications on ovens, driers, tanks and boilers.

Another object is to broadly provide a substructural member utilizing as a web material a substantially non-heat, conductive and fire retardant material of substantial rigidity in combination with metal caps.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIG. 1 is a perspective end view of a first embodiment of the present invention utilizing a web of low heat conductivity material in combination with two flanged cap strips of squared U-shaped section with the closed end of the U extending to either side to form the flanges;

FIG. 2 is an end perspective view similar to FIG. 1 of a second embodiment of the invention wherein the upper cap strip is of squared U-shaped section with flanges extending from and normal to the legs of the U at the free ends of the legs of the U;

FIG. 3 is an end perspective view similar to FIGS. 1 and 2 wherein the caps are of squared U-shaped section without flanges;

FIG. 3a is a fragmentary sectional view taken along line 3b—3c of FIG. 3;

FIG. 4 is an end perspective view of a core construction applicable to use in the invention utilizing reinforcing tension members at the upper and lower edges to resist edge shear;

FIG. 5 is a view similar to FIG. 4 of a laminated core using alternate layers of fibrous mat and woven reinforcement for resistance against edge shear;

FIG. 6 is a composite end perspective view with parts in section illustrating wall structures made in accordance with the present invention with several finish materials and methods of attachment; and

FIG. 7 is a schematic flow diagram of a preferred method of making the structural members of invention.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Briefly, the structural panel of the present invention is a wood-free and thus substantially fire-resistant, beam-like member that can be broadly designated a non-conducting stud or joint wherein thermal insulation material is utilized for the web or core, and can be porous fibrous glass or similar low heat transmission material of sufficient rigidity to perform as a structural member, in combination with metal caps along each edge and joined in assembled relation by means of a suitable bonding procedure.

Also, the present invention relates to a method of manufacturing thermal insulating studs or joints of the present invention wherein the joiner of the core to the edge cap is effected by a series of particular steps utilizing asphalt as a bonding agent.

THE INVENTION

The embodiment of FIG. 1

As shown in FIG. 1, one form of finished substructural member made in accordance with the present invention comprises a heat-insulating core 10 of generally rectangular section. The core 10 will be noted to have opposed major surfaces 12 and opposed longitudinal edges 14.

It is an important aspect of the core 10 that it have
“body,” and accordingly, it is important to the invention that the core have sufficient rigidity to perform in combination with the metal caps to be later described, as a composite structural member.

In the broad sense of the invention, the core 10 may therefore comprise fibrous glass and similar materials. However in a preferred aspect, the present invention utilizes a core 10 of a high-density fibrous glass of the wool or staple type, bonded by a thermosetting resin typified by a phenolic material such as phenol-formaldehyde. One preferred fibrous glass web material comprises 10.5 pound/cu. ft. density bonded wool, 1.5 inches thick.

It is inherent in webs of this density that they are substantially porous and comprise fibers bonded together at their points of contact by cured resin, with interstices between the fibers. These webs are thereby clearly distinguishable from laminates wherein resin fills all spaces between reinforcement fibers.

Also, these webs are clearly distinguishable from wood because of the distinct open porosity and the nature of the fibers.

It is not necessary that the web be continuous throughout the length of the stud, but rather of a convenient length to handle. As is set forth in the following description relating to the method of producing the studs of the present invention, the web segments are abutted into the channel as one step of the operation. It will of course be understood that the density and length are subject to variation within the scope of invention, commensurate with final application.

Referring again to FIG. 1, it will be noted that the depth of the web is as required to accommodate the desired insulation thickness, depending upon an installation sitting.

Also, as shown by reference to FIG. 1, caps 16 of metal or equivalent structural strength material are placed along each of the longitudinal edges 14 of the core 10. The embodiment of FIG. 1 utilizes a cap 16 of squared U-shape wherein the legs 18 of the U embrace the major surfaces 12 of the core 10 adjacent to the longitudinal edges 14. It will be noted that the closed end or bight portion of the U extends to either side to form flanges 20 transverse to the major surfaces 12 of the core 10. Also, it will be noted that the bight of the U and the flanges 20 comprise a substantial surface 22 for attachment of finishing materials as will be described with reference to FIG. 6, hereinafter.

The cap 16 in a preferred embodiment of the invention and for greatest economy, is made of extruded aluminum and thus the unit of FIG. 1 wherein the caps 16 are connected by a web of high density fibrous glass insulation board provides a finished unit weighing less than 2 lbs. per lineal foot, at a web depth of 4 to 8 inches.

The combination structure of the present invention is novel and unexpected because of the light-weight and low strength web. Unexpectedly, the light-weight web, in combination with the structurally strong edge caps, displays high strength. The combination of this invention has met with outstanding commercial success.

Structural strengths based on using 10% lb. density glass fiber mat with an ultimate strength of 50 lbs. per square inch (allowing a safety factor of 3.3 which results in a working shear load of 15 p.s.i.) generally provide the following performance factors:

<table>
<thead>
<tr>
<th>Spans</th>
<th>Load in pounds per square foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'-0.</td>
<td>45.0</td>
</tr>
<tr>
<td>6'-0.</td>
<td>67.0</td>
</tr>
<tr>
<td>8'-0.</td>
<td>90.0</td>
</tr>
<tr>
<td>10'-0.</td>
<td>12.5</td>
</tr>
<tr>
<td>12'-0.</td>
<td>17.0</td>
</tr>
<tr>
<td>14'-0.</td>
<td>22.5</td>
</tr>
<tr>
<td>16'-0.</td>
<td>27.0</td>
</tr>
<tr>
<td>18'-0.</td>
<td>32.0</td>
</tr>
</tbody>
</table>

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As regards the foregoing tabulation, it will of course be understood that where different core materials are utilized, different strengths will be produced. The purpose of the foregoing tabulation is to show a strengthened structural member of adequate strength to support insulation materials is provided in accordance with the present invention.

From the foregoing description it will be understood therefore, that a typical embodiment of the present invention comprises a substructural member to retain and support thermal insulation in applications from subzero temperatures to an upper limit of about 600° F. The upper end of the range is established by the bonding resin and softening point of the metal in the caps. It will be noted that this embodiment of the invention, as well as those to be hereinafter described, provides complete exclusion of wood from either cold storage wall installations or from hot installations thereby increasing fire safety, reducing costly heat gain as through wood members, and eliminating the possibility of dry rot as in untreated lumber. In high temperature applications on ovens, dryers, tanks and boilers, the fibrous glass core in combination with the aluminum or metal caps, provides in structure that, in addition to reducing structural insulation supports, also eliminates dangerous surface hot spots and heat loss due to through conductance.

The embodiment of FIG. 2

The embodiment of FIG. 2 is essentially the same as that of FIG. 1 in the use of a heat insulating core 10 in combination with edge caps, and in this connection it will be noted that one of the caps is designated 16 and thus is of the same configuration as defined for the caps 16 of FIG. 1. However, it will be noted that the upper cap is designated 24 because of its difference of configuration in the placement of the flanges 26. Thus, the cap 24 also consists of a squared U but has the flanges 26 extending from, and normal to, the free edge of the legs 28 of the U. When considered in comparison to the flanges 16 as described with respect to FIG. 1, it will be understood that the broad scope of invention includes placement of the normally extending flanges at any point along the legs of the U.

The embodiment of FIG. 3

The embodiment of FIG. 3 is also basically analogous to the embodiments of FIGS. 1 and 2 but utilizes cap structures 30 that are of more squared U-shaped section without flanges. These can be placed at either edge 14 of the unit in mirror image array as shown in FIG. 3. In accordance with the broad scope of invention, it is to be considered that the caps 16 of FIG. 1, 24 of FIG. 2 and 30 of FIG. 3 can be used singly or in combination.

CONE MODIFICATIONS

The embodiment of FIG. 4

As shown in FIG. 4, a stronger, more expensive core structure which can be used within the broad scope of invention is designated by the reference numeral 32. It will be noted that this core is made up of a series of laminate 34 of generally plate-like configuration and having opposed major surfaces 36 and thinner, squared-off longitudinal edges 38.

It will be noted that adjacent to each of the edges 38, but upon the major surfaces 36, there are provided a plurality of reinforcement members 40, typified by continuous glass fiber rovings of tremendous strength, small metal wires, or the like. It will be noted that the laminate 34 in combination with the reinforcement members 40 in proper position are fastened together utilizing their major surfaces 36. The reinforcement members 40 provide a longitudinal edge section with increased resistance to edge shear where such a problem may arise due to abnormal loadings.
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The core embodiment of FIG. 5 is similar to the core embodiment of FIG. 4 in that it utilizes a plurality of lamina 34 having opposed major surfaces 36 and longitudinal edges 38. However, it is to be noted that the reinforcement material is distinguishable from the longitudinally extending reinforcement members 40 of FIG. 4. Thus, the embodiment of FIG. 5 uses a screen-type material 42, typified by woven cloth of continuous glass strands of tremendous strength. It will be noted that the cloth reinforcement 42 is comprised of warp or lengthwise strands 44 and woof or transverse strands 46. In connection it will be noted that the woof strands 46 are effective to space the warp strands 44 along the width of the major surfaces 36. Production of this type of core is similar to the production of that described in FIG. 4 and comprises the steps of:

(a) laying down a lamina having a major face;
(b) applying a woven membrane having warp and woof strands therein to said major face;
(c) superimposing the major face of a corresponding lamina upon the reinforcement web in aligned relationship to the major face of the first lamina; and
(d) joining the major faces and the reinforcement element in attached relationship.

From the foregoing, it will be understood that the third core structure 48 is greatly reinforced by the screen-like reinforcement 42 and the various laminae all joined as a unitary whole, and thus is highly resistant to edge shear as is the embodiment of FIG. 4.

ILLUSTRATIVE APPLICATIONS OF THE PRESENT INVENTION

By reference to FIG. 6, various embodiments of the invention in combination with a number of different interior finishes are illustrated, along with the attachment to a structural wall.

Common to all aspects of FIG. 6 in a cold storage installation, is the fact that a wall structure 50 of the structural type forms the backing or support for the elements of invention. This can be represented by a concrete wall, a conventional stud wall with a plywood interior or the like. It might also be represented when considering FIG. 6 in its inverted relation, as a ceiling structure with an attachment line representing the bottoms of the joints. With regard to application of the invention, it is to be understood that a vapor barrier will first be applied over the structural wall to which the elements of invention are to be connected as indicated by reference numeral 51.

For attachment, it will be understood that the flanges 20 are secured to the structural wall 50 by means of screws, bolts or the like, 52. By reference to the left half of FIG. 6, it will be noted that studs typified by FIG. 1 and designated 54 are utilized. By reference to the right half of FIG. 6, it will be understood that the embodiment of FIG. 2, designated 56, is utilized.

FIG. 6—Extreme left

By reference now to the extreme left side of FIG. 6, it will be noted that fill insulation of the blanket type and designated 58 is placed in the interior of the wall defined by the opposing major surfaces 22 of the stud 54, as reversing corrugations 60.

The cavity of the blanket fill insulation 58, a refrigeration interior finish board 62 is applied between the exposed stud flanges 20 as the finish material by angular insertion. Though not shown, horizontal joints in the finish material 62 are preferably covered as by aluminum T-strips or the like. Since the fill insulation 58 is compressible, no very exact clearance space beneath the flanges 20 is required for insertion of the refrigeration interior finish board 62. However, it will be understood that where a high-density, substantially non-compressible insulation is provided, proper clearance for insertion of the interior finish board 62 will be maintained.

FIG. 6—Second from left

The foregoing description has related to one typical refrigeration-type installation, and now, by reference to the second from left segment of FIG. 6, an embodiment or application is shown wherein layers of fairly high density board-like insulation, previously referred to are utilized.

It will be noted that the layers 64 of high density glass fiber acoustical board are placed between the cores 10 of the studs 54 and, as mentioned above, a space of about 1 inch thickness is provided at the top or interior to receive the refrigeration finish board 62.

The foregoing discussion has related to two different types of insulation which can be used in accordance with the present invention, and is included for the broad purpose of showing that the invention is not limited to any particular type of insulation; thus the insulation depth between the opposite flanges 20 of the stud can be filled by any suitable insulation material within the broad scope of invention.

FIG. 6—Third from left

This brings the description to the third from left segment of FIG. 6 which illustrates the application of a plaster finish to the interior surface. Of course, it is to be understood that the web depth of the studs 54, 56 will be equal to the specified insulation thickness of the particular application.

In this segment of FIG. 6, fill insulation of the loose type or pouring variety and designated 66 is utilized to fill the insulation space between the web depth of the stud 54 on the left hand and the stud 56 on the right hand. To the flanges 20 and 26 there is applied metal lath 68 by wiring through holes punched in the flanges of the studs or by sheet metal screws with large washers. Thereafter, a plaster layer 70 is applied and this suitably comprises a ¾” scratch coat and about a minimum of ¼” finish coat of portland cement plaster and preferably scored in about 4” squares.

FIG. 6—Right hand segment

Now by reference to the right hand segment of FIG. 6, it will be noted that a plywood layer 72 is applied by screws 52 to the outside surfaces of the flanges 26 of the studs 56. In this embodiment, fill insulation of the pouring type 66 is also illustrated as filling the web depth equal to the specified insulation thickness. Of course, it will be understood that fill insulation is not limiting, but merely illustrative. In vertical installations the board-type material illustrated in the second-from-left segment of FIG. 6 and designated 64 may be preferred to resist settling, whereas loose fill may be desirable for horizontal applications as in ceilings.

It is to be understood that FIG. 6 is merely illustrative and not necessarily meant to designate a floor. It is actually meant to illustrate the types of finishes that can be used for walls and ceilings in the interior of refrigerated rooms wherein the studs comprise part of the structural wall for the purpose of supporting the various insulating materials and the interior finish by attachment to a structural wall 50.

In this regard, it should be pointed out that the primary purpose of the present invention in view of the fact that it is a structural member, is that of erecting walls and ceilings, rather than floors. However, it is to be considered within the scope of invention to include floor applications. Also, while a refrigeration application has been illustrated in FIG. 6, it is to be considered within the scope of invention that application would include walls, ceilings, floors or the like in elevated temperature installations as well. This would include hot applications up to about 600°
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F_, typically established by the phenolic bond of glass and the likely sag point of thin aluminum extrusions. Of course, it will be understood that where high temperature applications are contemplated, the hot side of the wall will be made of a material capable of withstanding the temperatures encountered. However, the cold side can be wood plaster, or finish board, typified by those of FIG. 6, because of the protection provided by the intervening insulation material, reducing thermal transmission to a tolerable low level. Of course, the interior finishes illustrated are not to be considered as limiting upon the invention. Other materials, such as gypsum board, metal sheats and the like could also be employed within the broad scope of invention.

THE METHOD OF INVENTION

By reference to sheet 2 of the drawings and containing FIG. 7, there is shown in diagrammatic form a method for making the studs of invention utilizing extruded aluminum channel caps 16 of FIG. 1, 24 of FIG. 2, or 36 of FIG. 3, in combination with high density, board-like core material made of stapal glass fibers bonded with a thermosetting, phenolic resin. In accordance with a preferred method of producing the studs of invention, it has been found that the use of asphalt in a particular application technique is highly satisfactory. However, at the outset, it is to be understood that other bonding agents which will display processing properties similar to those described in the following process are to be included within the broad scope of invention.

Briefly, the method comprises the steps of:

(a) dipping the core edge in hot asphalt and allowing to drip-drain briefly;
(b) rapidly upsetting the dipped edge for penetration and cooling;
(c) stud assembly comprising inserting web boards butted tightly together into the channel of a cap for the full length of a stud; and forcing the other cap down onto the other, similarly treated edge of the web boards;
(d) providing a physical joinder or clamping between the parts;
(e) reheating to flow the asphalt as a bond between the glass fiber web and the channel;
(f) thereafter cooling to solidify the bond; and
(g) package and ship.

Step (a)—Dip

In the light of the foregoing brief perspective view of the method of invention, a full and complete description of each stage and the coordination of the stages of the process will now be provided. Thus, by reference to FIG. 7, note the step (a) which includes dipping the edges of the boards in hot asphalt to the depth of the channel of a cap member, e.g. 1 1/4" at 400°F, ±20°F for approximately five seconds. The board is dipped vertically into the asphalt and after five seconds is removed and allowed to drip briefly, that is, for about three-to-five seconds. This concludes step (a).

Step (b)—Upset

This step comprises the rapid upsetting to put the asphalt dipped edge up. It has been discovered that a uniform penetration of asphalt of about 3/16" is provided using 10 lb density phenolic bonded wool glass fibers. The foregoing penetration is obtained without drips or sags. In actual production it has been observed that the coated board shall not be shiny. Right after the upsetting operation, the boards are placed on edge to cool with the freshly dipped side up. As soon as one edge is cool to the touch, the other edge can be dipped.

Step (c)—Assembly

Thereafter, the next step of the process follows, namely that of step (c), stud assembly. The studs are assembled by laying the surfaces 22 or the backside of the caps 16, 24 or 30 on a flat supporting surface and inserting the web boards, butted tightly in end-to-end relation into the channel for the full length of the cap of stud to be produced. As previously mentioned, it is not necessary that the web boards be continuous throughout the length of the stud, although this is often desired within the scope of the invention. It has been found more economical and quite satisfactory to use stud web pieces of a length convenient to handle, typified by four-to-six foot sections. It is important, however, to state that the web material should be finished as by sanding to a thickness to snugly fit within the channel of the cap, and thus have a close, embracing relationship with the channel.

The other cap member is then forced down from the top on the other edge of the web boards. Because of the close fit, it was found necessary to tap on the top extrusion with a hammer using a wood block to cushion the blows and prevent damage to the metal to seat both extrusions snugly against the web boards.

Step (d)—Physical joinder

Since there is at this stage of production no reliable bond between the aluminum and the web, the stud cannot be handled further without risk of coming apart. It has been found that by dimpling both the legs 18 of the U of the channel into embracing relationship in against the major surfaces 12 of the core members 10 to a depth of about 3/16" on approximately 6" centers, sufficient mechanical interlock is provided for safe subsequent handling of the studs. This is shown as exemplary at 13 of FIGS. 3 and 3a. Any tool, preferably air or electric powered, capable of being triggered by a single blow which can be controlled and repeated about sixty times per minute would be satisfactory.

Steps (e) and (f)—Reheat to bond; and cool

This brings the description to the next step of the operation of reheating to provide a bond. In order to achieve a continuous adhesive bond between the web and the aluminum cap extrusions and thus develop maximum strength in the stud, the assembled studs are reheated to the point where the asphalt in the web boards will flow onto the aluminum. For this operation an oven capable of developing a temperature of 700°F was utilized. It is very important that during this reheating operation and during the subsequent cooling operation the studs be retained in an accurate assembled alignment. The reason is that when the studs cool from the temperature reached in the reheating oven, they will retain any deformation acquired.

For this reason, the studs are run out on a flat surface at the end of the oven and retained thereon until they have reached a cool, set state. At this point it should be noted that to provide even asphalt flow, the studs are preferably fed through the oven lying on one side, that is, with the core in a horizontal position and as the studs emerge from the oven they are turned over and laid on the flat surface on the other side. This is to encourage asphalt flow to both sides of the channel. Again, it is pointed out that the studs are carefully cooled in a straight, flat condition to avoid any deformation being imparted to them.

Step (g)—Packaging and ship

The next phase of the process comprises packaging and shipment. Although the details of this portion of the process are not to be considered critical to the method, they are supplied to provide a full disclosure. In one typical operation, an order was packaged by bundling ten studs with rayon strapping in four places along the length. Corrugated cartons were placed over the ends of the bundles to protect the stud ends, but this appears to be optional. Wood cleats were placed under the bundle, between the studs and the strapping to allow entry.
with a fork lift and to prevent bending of the flanges by over tensioning of the strapping. As an alternate it is recommended that wood cleats, the width of the bundle, be used. A top and bottom is no longer needed and the sides forming, in effect, an encasing box. Bundles of studs packaged as described were subjected to trucking from point of manufacture to a first destination, unloaded and reloaded, trucked from the first destination to a second destination, unloaded and reloaded, and trucked from the second destination back to the point of manufacture and unloaded in the package. No damage to the studs which would render them unusable.

Thus, the process of the present invention is proven to have commercial utility and capable of producing a novel, functional product.

EXTENDED SCOPE OF INVENTION

While the foregoing disclosure has generally related to a nonconducting stud for use in subzero temperatures as in cold storage applications, the broad scope of invention includes high temperature applications on ovens, driers, tanks, boilers and the like.

Although the foregoing disclosure has more specifically related to a high density glass fiber board as the core member 10 and in combination with extended aluminum caps to provide stud weights of less than about 2 lbs. per lineal foot, it is to be included within the scope of invention that other fibrous materials can be utilized. Aluminum is a practical material for producing the cap members by economical extrusion, but of course it is to be understood that other nonferrous metals such as magnesium, or ferrous materials can also be used and that casting, forging, rolling or other operations can be used in addition to the extrusion process mentioned.

For extremely high temperature applications, as where quartz or aluminum silicate fibers would be used as a core material, the invention would also encompass the use of high silica glass caps, and ceramic and refractory materials for applications as in rocketry and the like.

Within more moderate temperature limits the fiber-resin products also can be employed in making the flanges. These include chopped strand, lofted mat, woven cloth, sisal fiber, etc., as reinforcements in combination with polyester, epoxy and other resins—processed by matched metal molding operations, lay-up techniques and the like.

With respect to the highly desirable glass fiber board webs which have been discussed, it has been mentioned that a preferred material was of about 10.5 lbs./cu. ft. density. This is subject to some latitude and will include such materials in the broad range of about 8 to about 20 lbs./cu. ft.

As mentioned in passing with respect to the description of FIG. 6, a vapor barrier 51 is placed between the structural wall 50 and the substructural refrigeration wall to prevent condensation within the fibrous insulation material, which would reduce efficiency. In accordance with the present invention, it is desirable that all surfaces to receive the vapor barrier shall be thoroughly clean and smooth. The vapor barrier preferably shall be a membrane having a water vapor permeance of not more than about 0.01 perms applied in a solid coating of vapor barrier adhesive. Appropriate edge laps will be provided and sealed with adhesive with a minimum of about 12” of wall vapor barrier extending at top and bottom to permit ceiling to floor and roof vapor barrier, and with a 1” loop left unadhered at all corners and building expansion joints to permit movement. As is shown, the nonconducting studs of invention having a web depth equal to the specified insulation thickness are erected against the vapor barrier covered walls, and spaced as for example on 48” centers.

The foregoing description has not been limited with respect to the precise dimensions of the core members 10 or the cap members 16, 24 or 30. For wall and ceiling members, it will, of course, be understood that the cap members can be of thinner gauge commensurate with the loads encountered also on the flanges. As load conditions are contemplated, a general thickening of all sections commensurate with the loads to be encountered will be provided.

Within the board scope of invention, metal sheets can also be used as equivalents of the refrigeration interior surface board 62, and the plaster 52 will be removed as illustrated in FIG. 6. When using thinner stock, ribs can be provided to resist “oil-canning” effects.

Insulating fibers within the scope of invention would include glass wool, mineral wool, quartz, aluminum silicates and the like. Such fibers are broadly designated siliceous fibers. Thus webs of a material having the quality of low heat transmission and commensurate structural strength for utility can be employed. These materials are of course sharply distinguished from wood because of the latter’s transmissivity, nondurable nature and high structural strength as to be self-supporting. The present novelty hinges on a lightweight, nonconductive core or web in combination with strong caps to provide the unexpected result of a structurally strong, durable and highly functional heat-resistant bridge.

ADVANTAGES OF THE PRESENT INVENTION

While the advantages of the invention have been enumerated throughout the foregoing specification, they will be briefly highlighted as follows:

The stud of the present invention permits the complete exclusion of wood from cold storage wall insulation, increasing fire safety, reducing costly heat gain through wood members, and eliminating the possibility of dry rot in untreated lumber. By comparison, wood has double the conductivity of the glass fiber products of invention from the cold side to the hot side when used as a web. Thus, the unexpected results and superiority of products made in accordance with the present invention are illustrated. In high temperature applications on ovens, driers, tanks and boilers a nonconducting stud of invention, as well as reducing structural insulation supports, eliminates dangerous surface hot spots and heat loss due to through conductance.

The lightweight products of the products of invention has been mentioned hereinbefore as less than 2 lbs. per lineal foot when using aluminum extrusions with a high density glass fiber insulation board web. In short, the unexpected result of the present invention is that the rigidity or strength of long heat transmission materials have been combined into a structural member for the dual purpose of structural stability along with a cold-heat-conducting bridge.

Thus, the present invention envisions an installation that provides great flexibility in depth and fill insulation, in surface treatment of the walls produced, and in variations of installation. It is evident that substantial savings will be provided by the present invention.

Thus, the present invention provides a mechanical support for thermal insulating materials and retains such insulating materials in an intended position. The present invention also provides a base to which various surface finishing and weatherproofing materials can be attached.

Further, by utilizing a design similar to an I-beam in that tensile and flexural stresses in the member are carried by the metallic faces of the member, the forces within the web remain essentially neutral.

We claim:

1. A substructural building element having the general sectional configuration of an I-beam with a web comprised of bonded glass wool fibers and having a density in the range from about 8 lbs. to about 20 lbs. per cubic foot and bonded with thermosetting phenolic resin, said web having a generally rectangular section with
opposed major surfaces and opposed longitudinal edges, and flanged, structurally strong, aluminum cap members attached over said longitudinal edges and bonded thereto and to said opposed major surfaces at areas adjacent to said longitudinal edges by an asphalt adhesive to produce a fiber-to-metal asphalt bond.

2. In a substructural building element having the general sectional configuration of an I-beam, a web comprised of bonded glass wool fibers and having a density in the range from about 8 lbs. to about 20 lbs. per cubic foot bonded with thermosetting phenolic resin, said web having a rectangular section with opposed major surfaces and opposed longitudinal edges, and flanged, structurally strong, aluminum cap members attached over said longitudinal edges and bonded thereto and to said opposed major surfaces at areas adjacent to said longitudinal edges by an asphalt adhesive to produce a fiber-to-metal asphalt bond, and said aluminum cap members comprising a squared U-shaped channel with the legs of the U embracing said opposed major surfaces and having attachment flanges extending outwardly transversely of said legs at a position along the length of the legs.

3. In a substructural building element, a web comprised of bonded glass wool fibers and having a density in the range from about 8 lbs. to about 20 lbs. per cubic foot and bonded with thermosetting phenolic resin, said web having a generally rectangular section with opposed major surfaces and opposed longitudinal edges, and structurally strong, metallic cap members attached over said longitudinal edges and bonded thereto and to said opposed major surfaces at areas adjacent to said longitudinal edges by an asphalt adhesive to produce a fiber-to-metal asphalt bond, and said cap members, comprising a squared U channel with the legs of the U embracing said opposed major surfaces.

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