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(54) **STRUCTURAL BUILDING SYSTEM**

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(57) **ABSTRACT**

A building system comprising a plurality of substantially rigid connectors adapted to form a substantially rigid self-supporting structural skeleton: each said connector having interconnection means and panel securing means; each said connector having an inner and an outer load supporting member and a thermal insulator separating and secured to both said inner and outer load supporting members; and said connectors being adapted to interconnect such that when in position, said thermal insulator provides a substantially complete block against thermal transfer between said inner supporting member and said outer supporting member and said connectors form the substantially rigid self-supporting structural skeleton to which panels can be secured.

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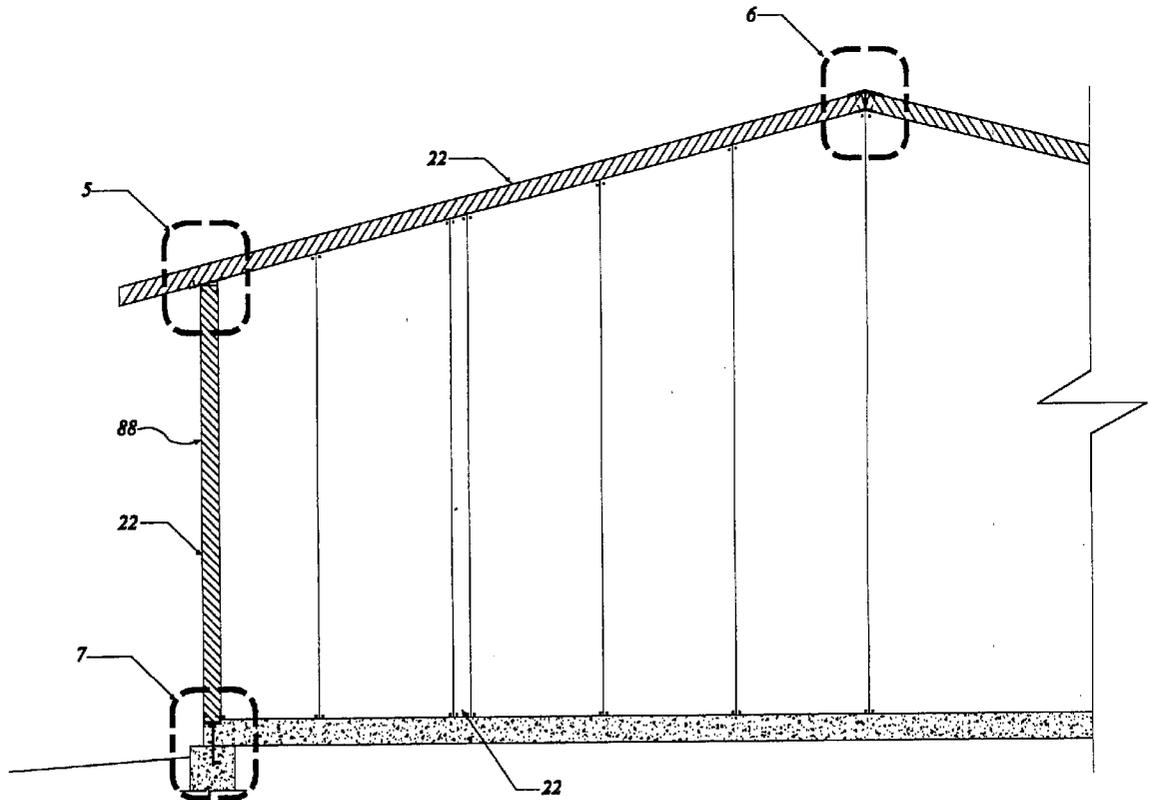
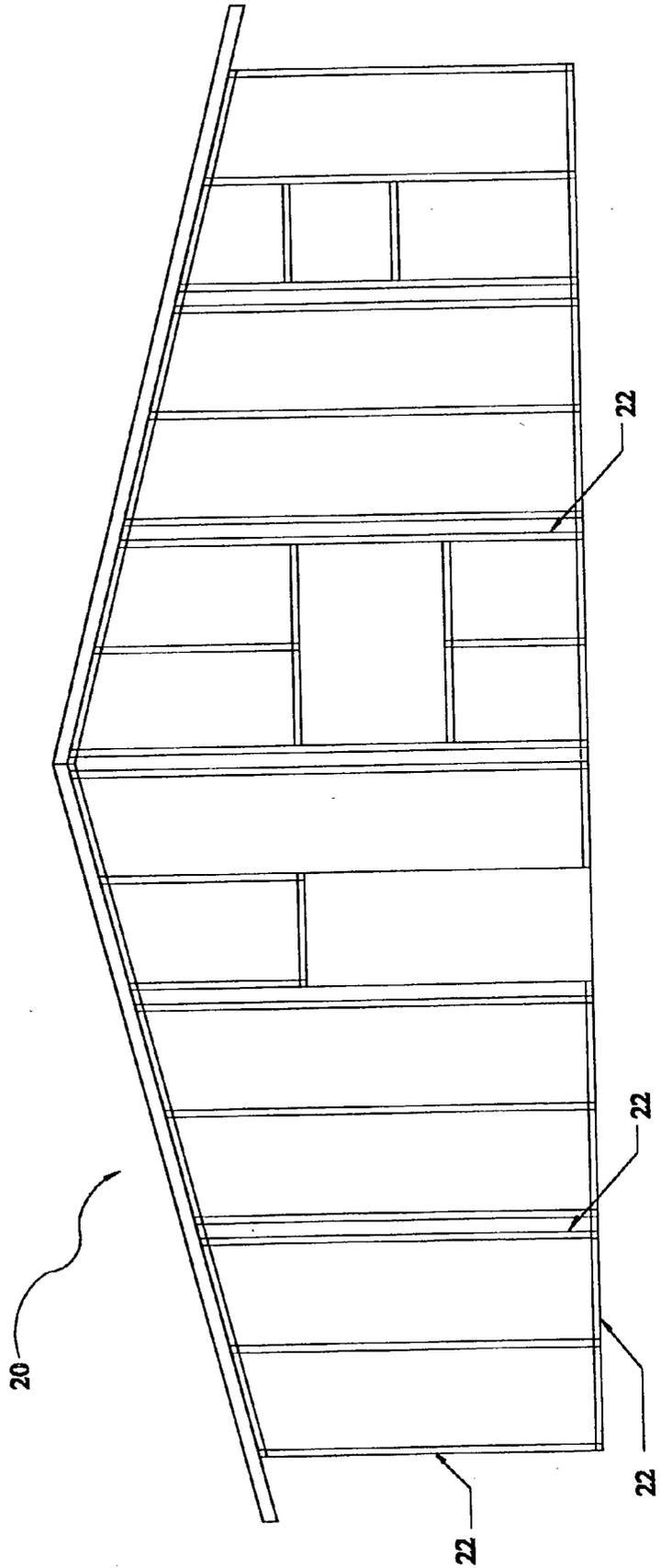
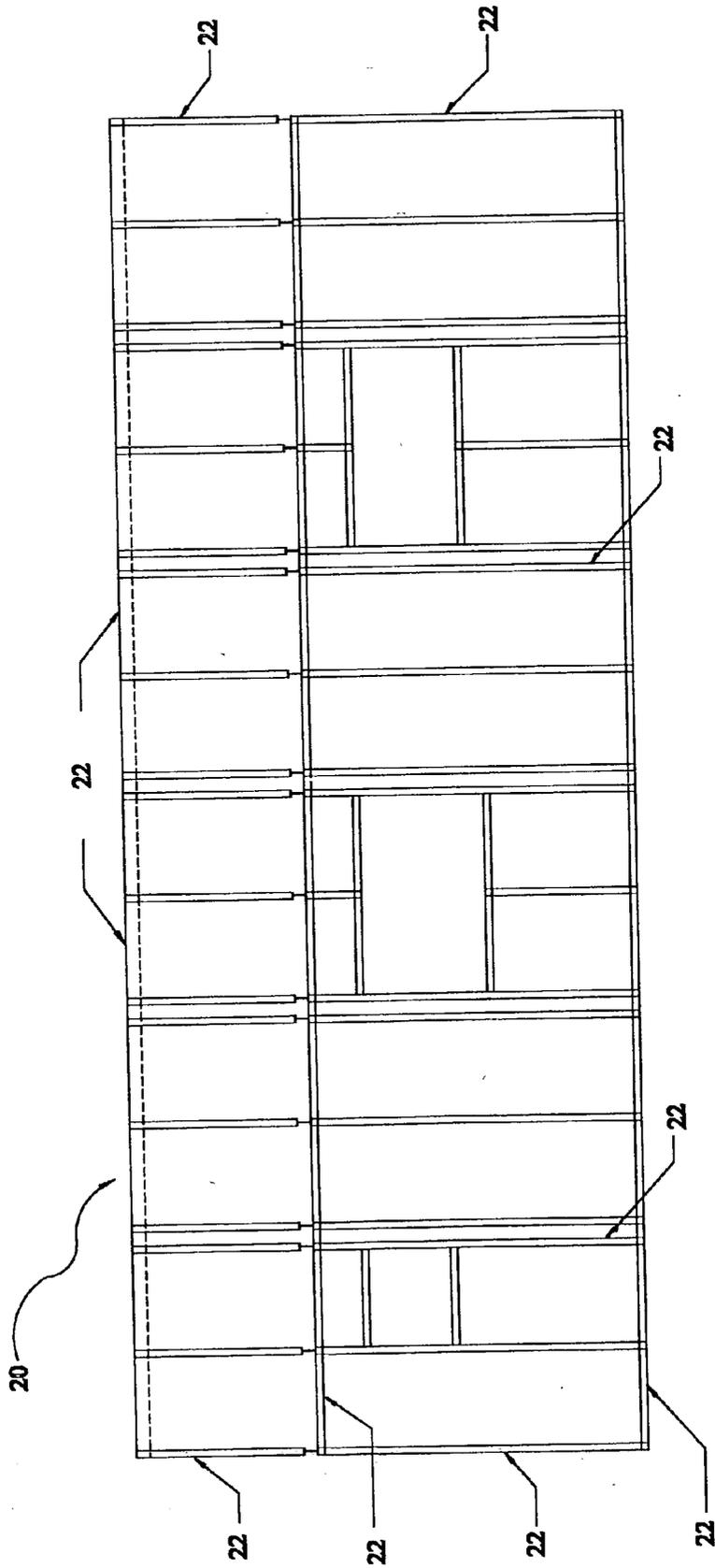


FIGURE 01



TYPICAL FRONT VIEW

FIGURE 02



TYPICAL SIDE VIEW

FIGURE 03

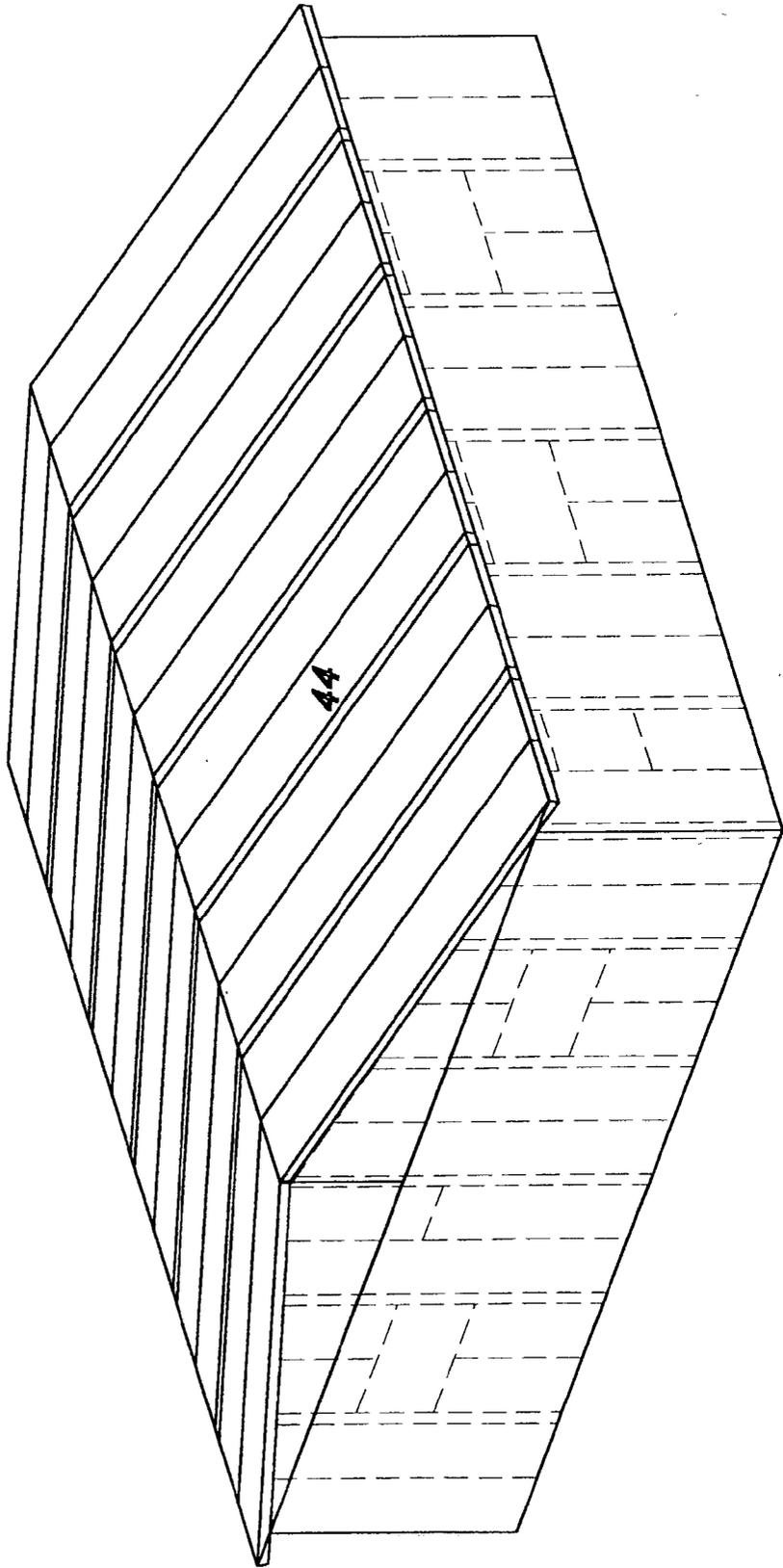


FIGURE 05

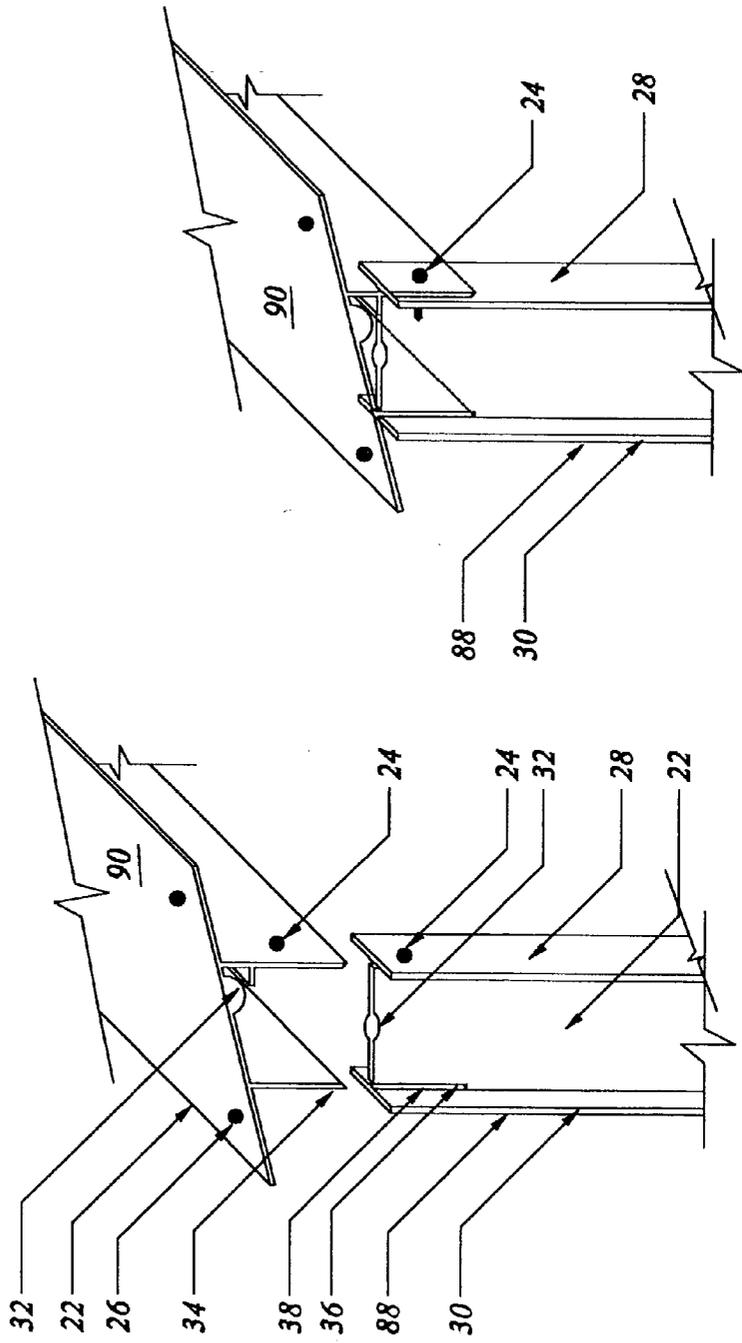


FIGURE 06

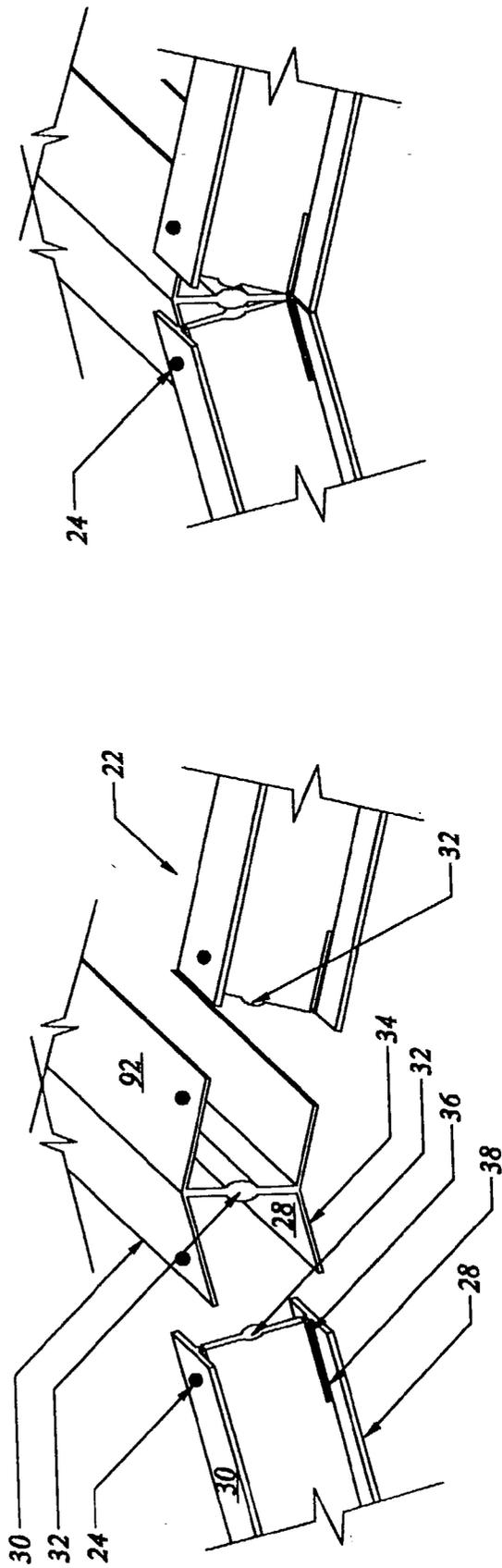


FIGURE 07

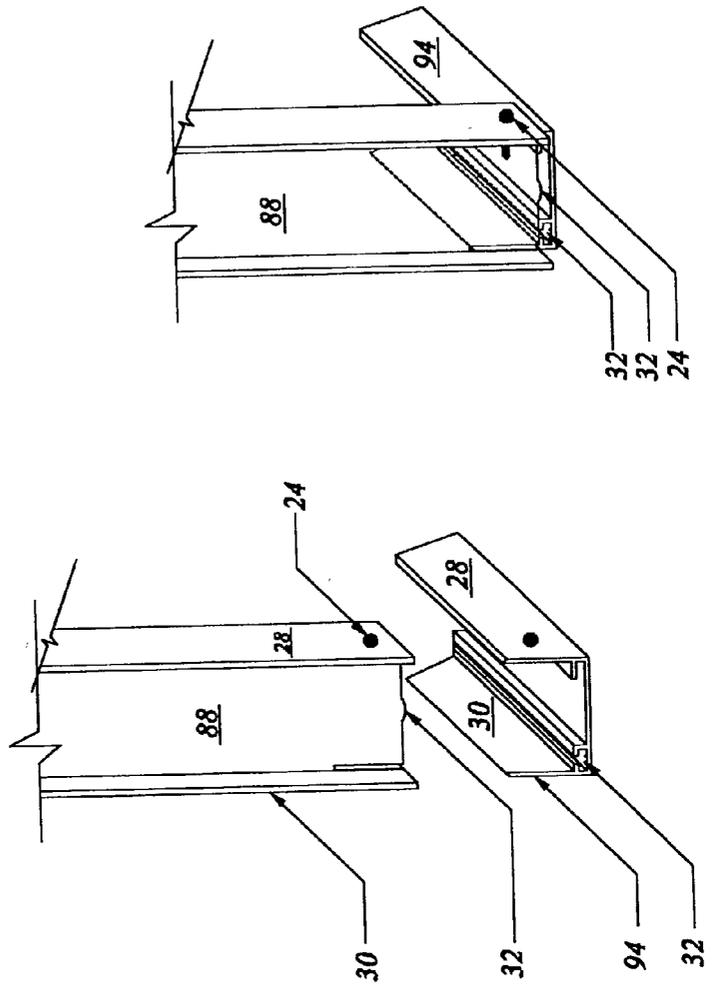


FIGURE 08

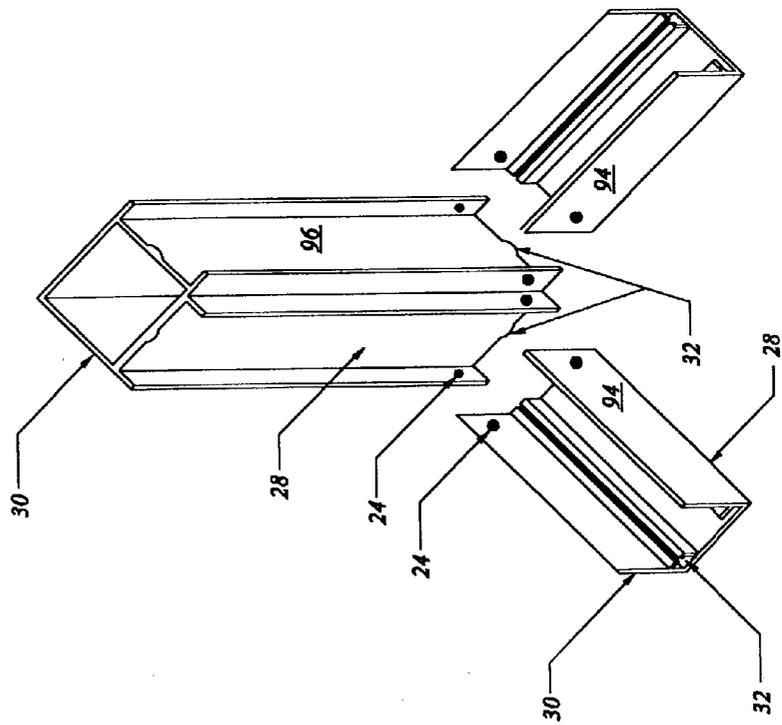
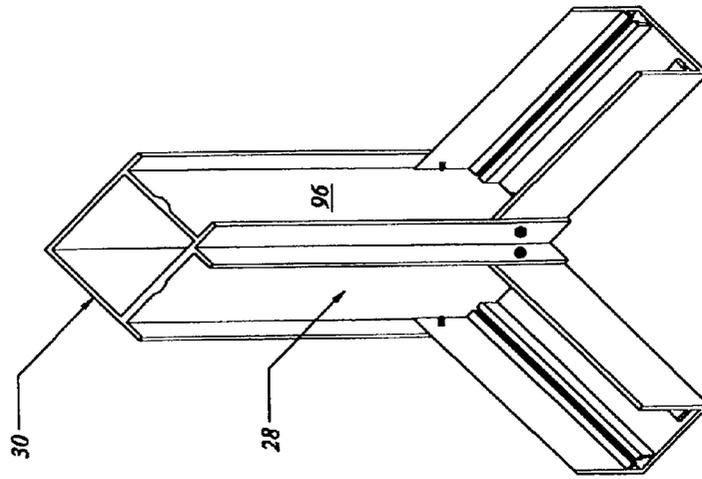


FIGURE 09

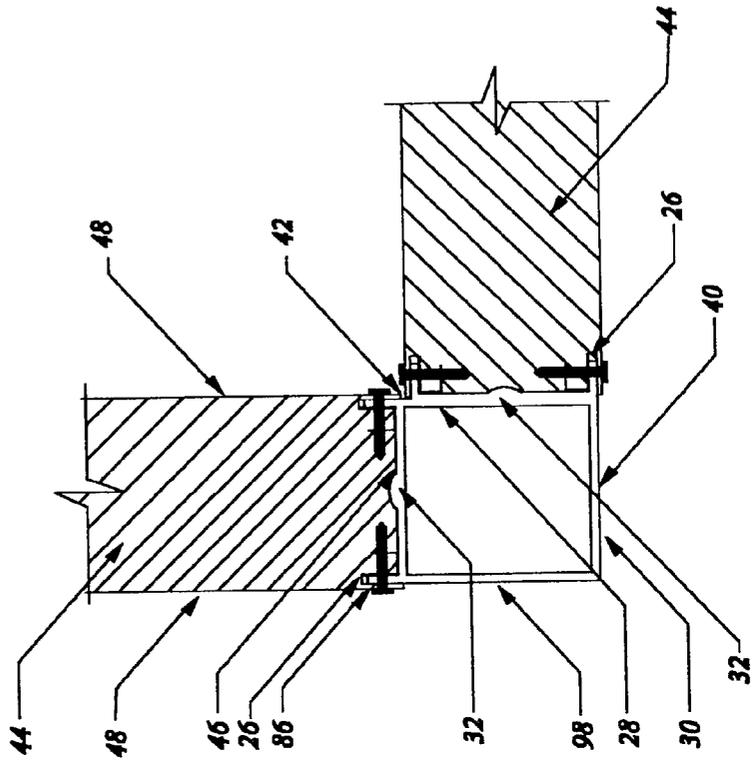


FIGURE 10

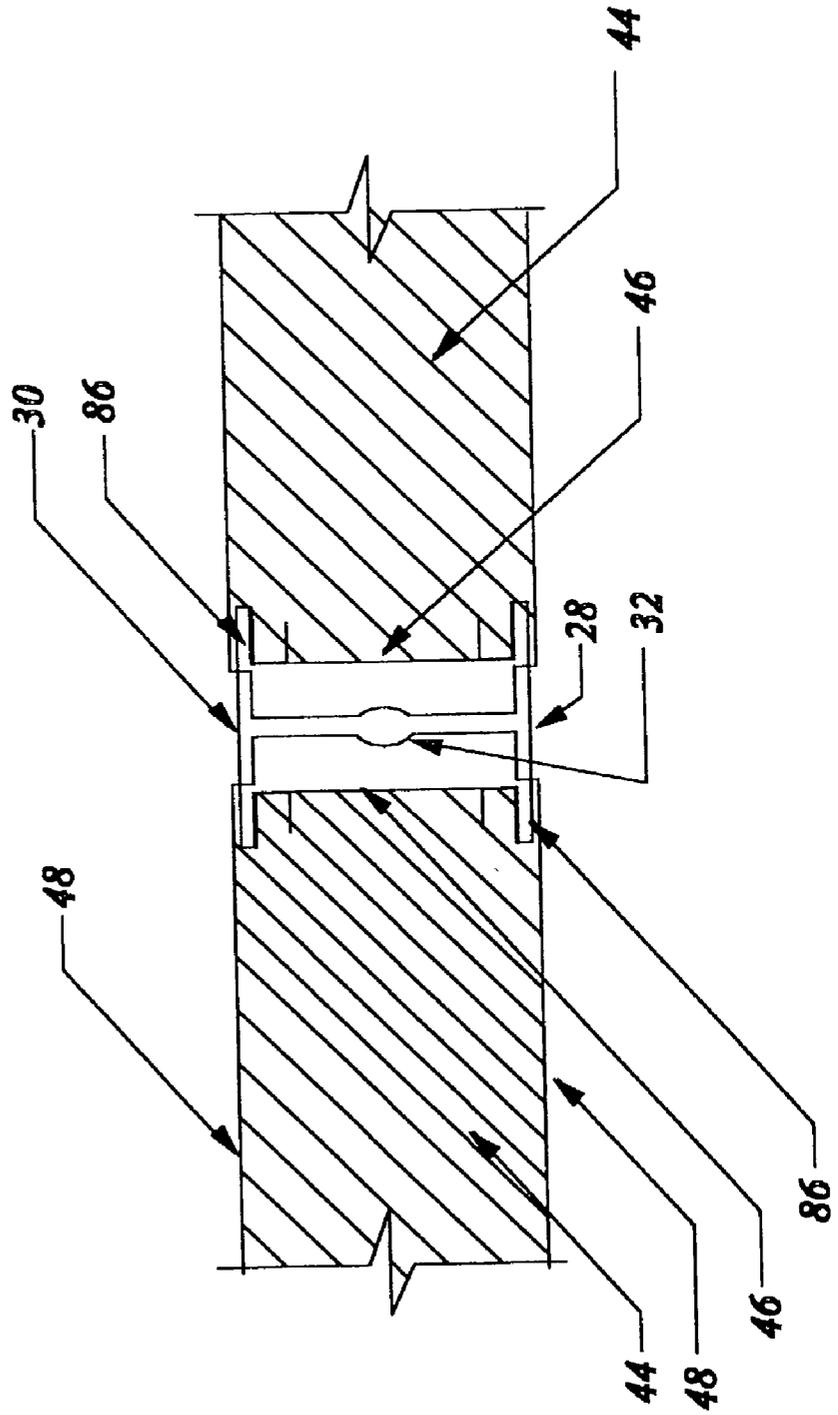


FIGURE 11

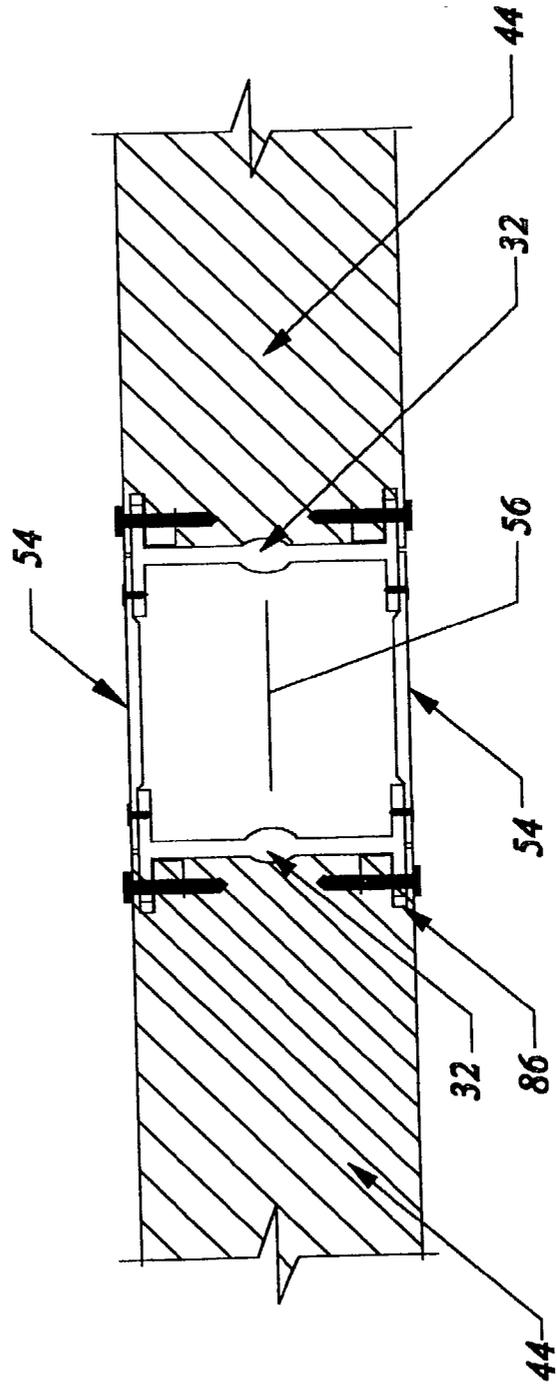


FIGURE 12

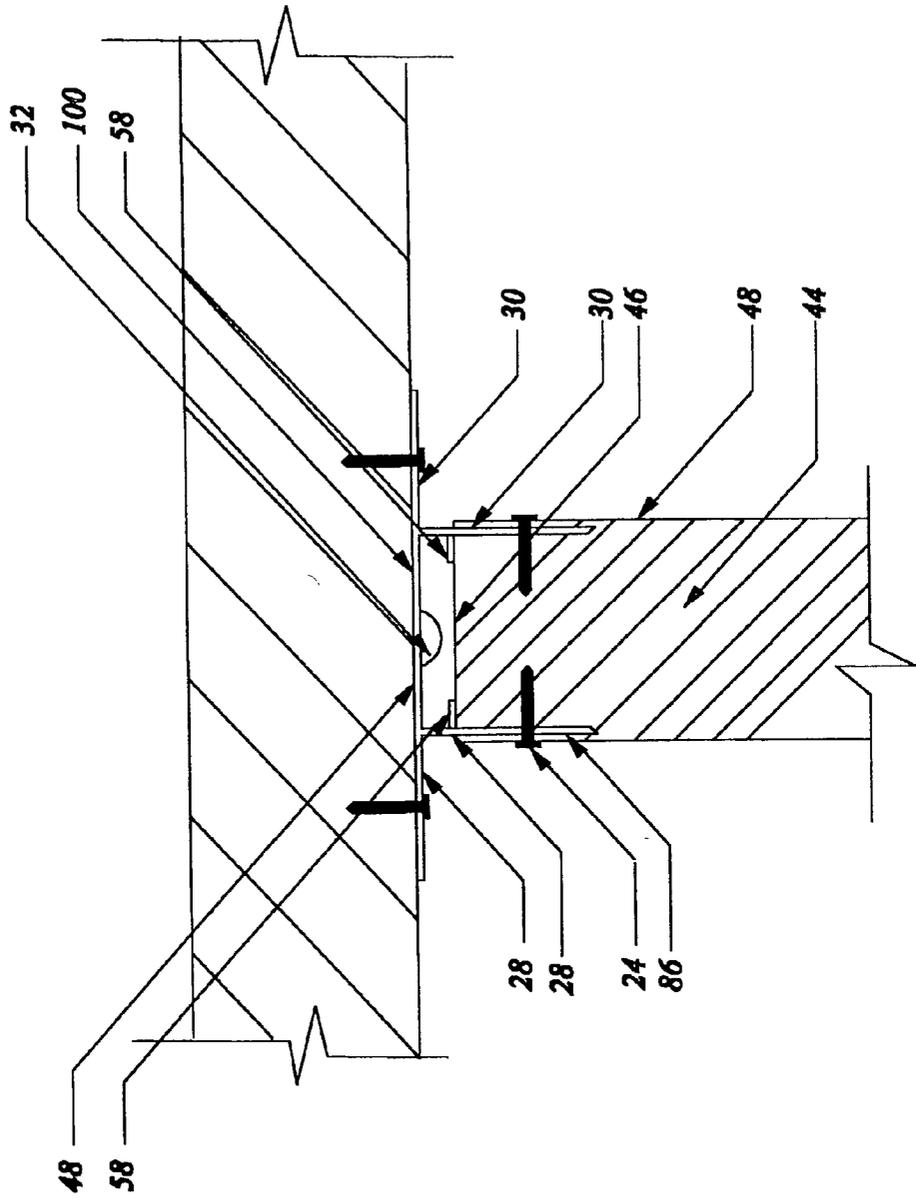


FIGURE 13

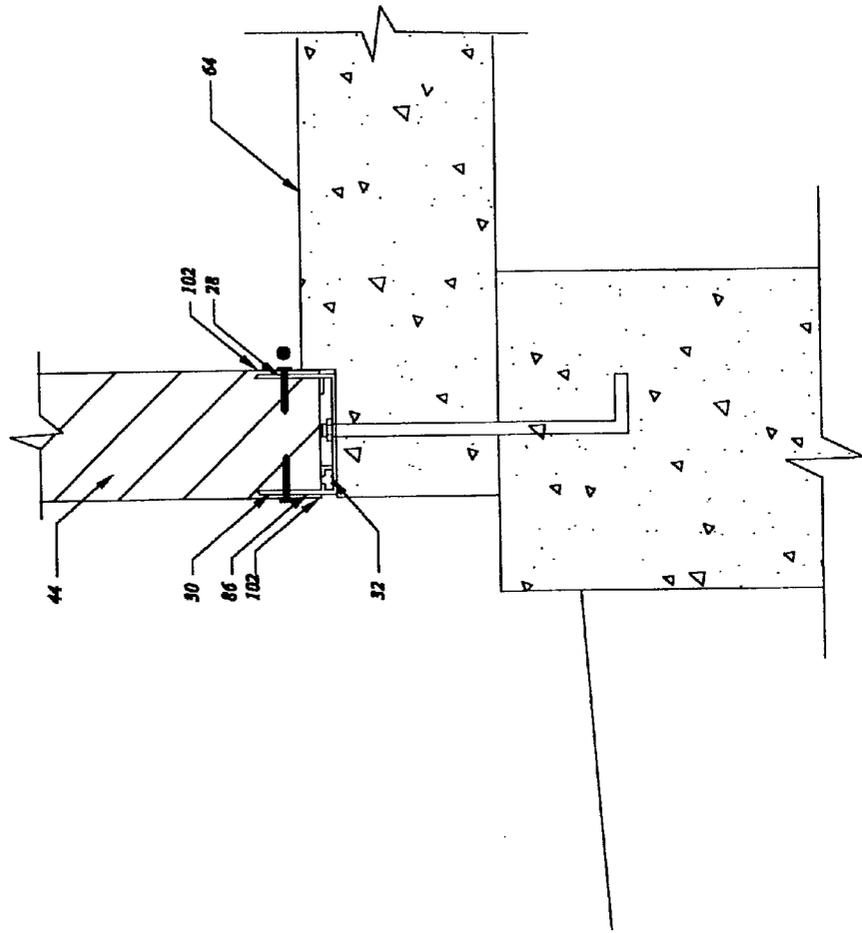


FIGURE 14

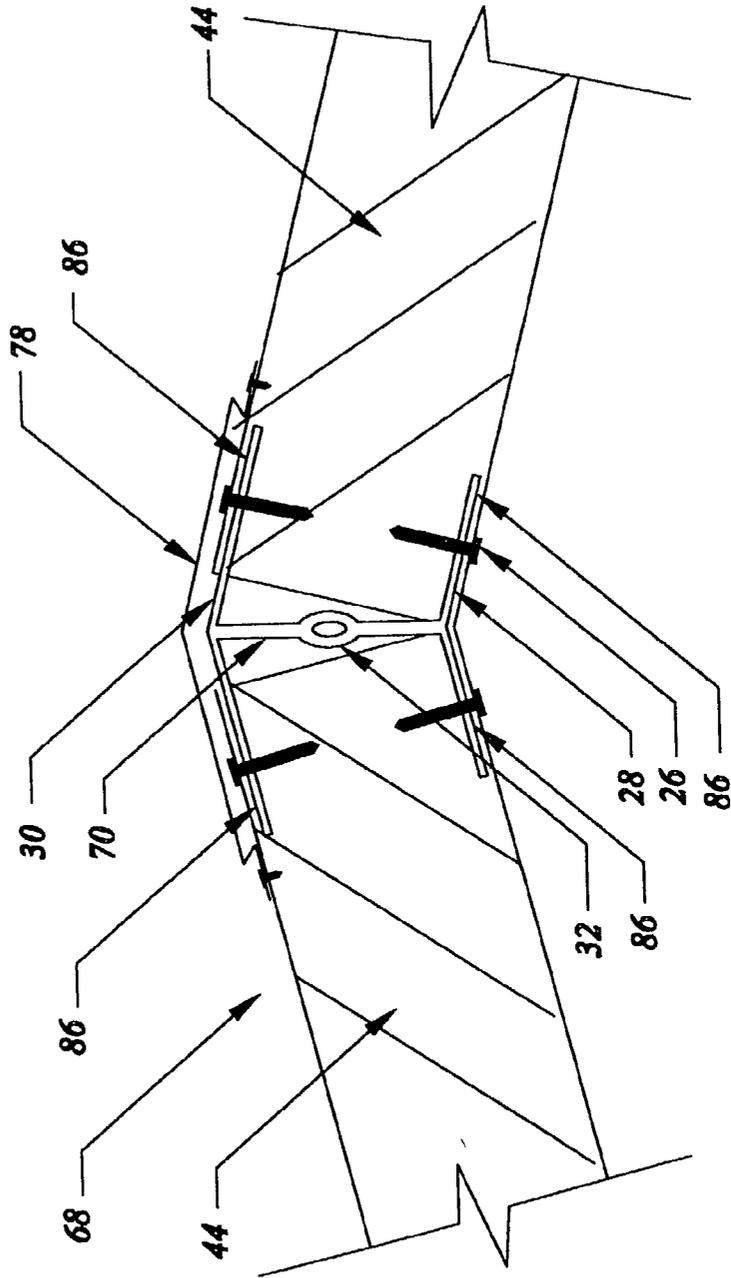
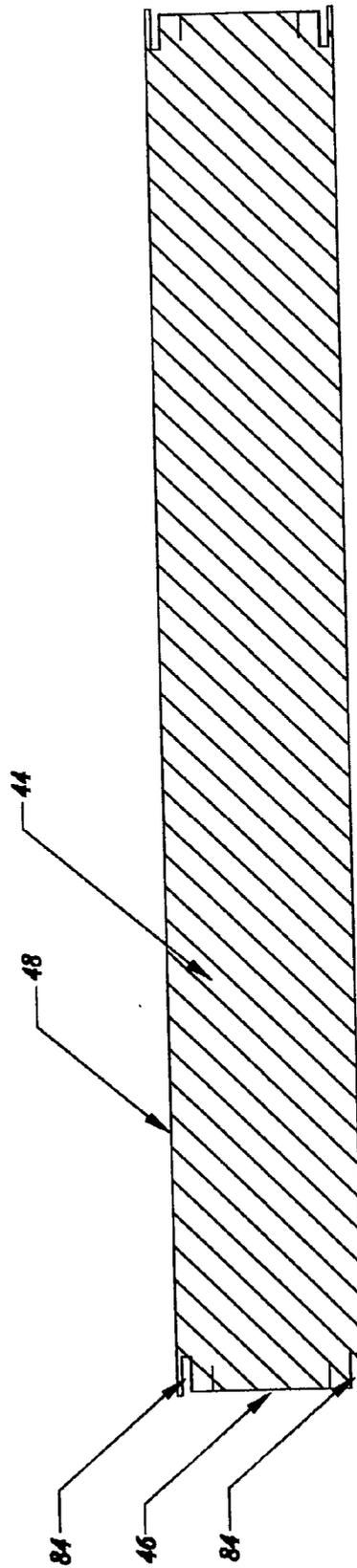


FIGURE 16



STRUCTURAL BUILDING SYSTEM

FIELD OF THE INVENTION

[0001] The invention relates to the field of a building system, and more particularly a building system suitable for use in constructing an insulated structure accommodating building panels.

BACKGROUND OF THE INVENTION

[0002] Building systems employing pre-fabricated panels frequently offer a quick and convenient means of constructing industrial buildings and other structures. A variety of panel-based building systems are known; however, most suffer from poor thermal insulating capability, or fail to provide a truly rigid structure, relying primarily on panels to provide rigidity and strength to the structure. The use of panels to provide structural rigidity and strength to a building system may lead to difficulties in assembling and maintaining the structure when subject to high winds, snow loads, seismic activity and the removal and replacement of damaged panels.

[0003] U.S. Pat. No. 3,667,180 of Tischuk discloses a double-skin building construction panel having a foam core. The panels are adapted to be assembled in lapped fashion without externally visible fasteners wherein the panel provides structural strength to the structure. Panel-based systems such as that of Tischuk typically provide only narrow load-bearing members within the panels, and require complete panel assembly for full strength. Thus, such systems may suffer from a lack of structural strength, particularly in situations of high wind or heavy snow load as well as times when one or more panels are missing, such as during assembly and the replacement of damaged panels. Similar systems with similar limitations are also shown in U.S. Pat. No. 4,575,981, U.S. Pat. No. 3,557,507 and U.S. Pat. No. 4,936,069.

[0004] U.S. Pat. No. 5,509,242 of Rechsteiner discloses a building panel system wherein abutting panels have complementary contoured edges, which intermesh to form a joint between the panels. Reinforcing splines within panel edges, are employed to reduce damage to the panel edges upon connection. This system relies on the panels for strength. While the use of reinforcing splines may provide some additional structural strength to the panels, the building system may not have sufficient strength to withstand high stress, particularly when it is necessary to remove or replace an individual panel in the structure.

[0005] Canadian Patent Application 2,244,568 of Wolfe discloses an adjustable connector assembly for coupling the adjacent lateral edges of construction panels. The connectors are thermally broken, and may reduce heat loss out of the building structure. However, similar to the systems described previously, this system relies upon the panels themselves to provide structural strength, and the connectors are simply present to connect one panel to another.

[0006] Canadian Patent Application 2,280,077 of Meadows discloses a prefabricated building panel including first and second side panel members. Abutting panel members may be interconnected through complementary edge portions and a thermally insulating plug at the end of one panel, to reduce heat transfer through the panel system. The

reliance on panels for structural strength as seen in this system may result in structural failure when the system is placed under stress, as in a wind storm or under heavy snow load.

[0007] Thus, it is an object of the present invention to provide a structural building system adapted to form a substantially rigid self-supporting structural skeleton.

SUMMARY OF THE INVENTION

[0008] Attempts to create panel-based insulated building systems have led to systems in which structural strength has been compromised. In particular, efforts to insulate the interior of the structure from the outside elements have tended to lead to reduced overall structural strength, as high structural strength materials, such as steel, are reduced in an effort to avoid heat transfer through the walls of the system.

[0009] In accordance with the present invention, a building system has been adapted which combines structural strength with thermal insulating capability.

[0010] In one embodiment of the invention there is provided a building system comprising a plurality of substantially rigid connectors adapted to form a substantially rigid self-supporting structural skeleton. Each connector has interconnection means and panel securing means. Each connector has an inner and an outer load supporting member and a thermal insulator separating and secured to both said inner and outer load supporting members. The connectors are adapted to interconnect such that when in position, the thermal insulator provides a substantially complete block against thermal transfer between the inner supporting member and the outer supporting member and the connectors form the substantially rigid self-supporting structural skeleton to which panels can be secured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] These and other advantages of the invention will become apparent upon reading the following detailed description and upon referring to the drawings in which:

[0012] FIG. 1 is a front view of an embodiment of the structural building system of the invention, showing interconnection of the connectors to form a building skeleton.

[0013] FIG. 2 is a side view of an embodiment of the building system of the present invention, showing the connectors interconnected to form a building skeleton.

[0014] FIG. 3 is a perspective view of an embodiment of the building system of the present invention, showing interconnection of the connectors with each other and with panels to form a building.

[0015] FIG. 4 is a cross-sectional view through an embodiment of the structural building system of the present invention, showing interconnection of the connectors to form a building skeleton secured to a base.

[0016] FIG. 5 is a perspective view of an embodiment of two connectors of the present invention, shown in their unconnected (left) and connected (right) states.

[0017] FIG. 6 is a perspective view of another embodiment of two types of connectors of the present invention, shown in their unconnected (left) and connected (right) states.

[0018] FIG. 7 is a perspective view of an embodiment of two connectors of the present invention, shown in their unconnected (left) and connected (right) states.

[0019] FIG. 8 is a perspective view of an embodiment of two connectors of the present invention, shown in their unconnected (left) and connected (right) states.

[0020] FIG. 9 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with building panels.

[0021] FIG. 10 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with two building panels.

[0022] FIG. 11 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with two building panels and a plate.

[0023] FIG. 12 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with two building panels.

[0024] FIG. 13 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with a building panel and structural footings.

[0025] FIG. 14 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with two building panels and a roof cap.

[0026] FIG. 15 is a cross-sectional view of an embodiment of a connector of the present invention, shown in association with two building panels.

[0027] FIG. 16 is a transverse cross-sectional view of an embodiment of a building panel of the present invention.

[0028] While the invention will be described in conjunction with the illustrated embodiments, it will be understood that it is not intended to limit the invention to such embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] In the following description, similar features in the drawings have been given similar reference numerals.

[0030] The present invention provides a building system wherein the connectors interconnect to one another to form a rigid structure, which is self supporting even in the absence of panels. Moreover, the connectors are thermally broken, substantially reducing the transfer of heat through the connectors, and therefore making the connectors suitable for use in the construction of thermally insulated buildings.

[0031] The system is designed to be useful in the construction of a variety of structures. For descriptive purposes, examples of particular structures are described in FIGS. 1-4 herein. However, it will be apparent to one skilled in the art that numerous other structures are contemplated and fall within the scope of the present invention.

[0032] The invention provides a building system 20 having a number of connectors 22. These connectors may be shaped in varying manners for use as vertical, horizontal and

inclined supports. The connectors 22 are preferably substantially rigid. Each connector has interconnection means 24 suitable for connecting the connector 22 to an adjacent connector and panel securing means 26 suitable for securing one or more panels 44 to the connector.

[0033] Each connector 22 has an inner load supporting member 28 and an outer load supporting member 30. The inner 28 and outer 30 load supporting members are separated from one another and secured to each other by a thermal insulator 32. The inner 28 and outer 30 load supporting members are preferably made from a substantially rigid building material such as steel, wood or a structural-strength plastic or nylon material. The thermal insulator 32 is preferably made from a thermally insulating material such as rubber or a similar resilient insulating material.***

[0034] As shown generally in FIGS. 1, 2 and 3, the connectors 22 are adapted to interconnect to form a substantially rigid self-supporting structural skeleton to which other material, such as exterior cladding or panels 44 can be secured. Connectors of the same or different varieties are preferably connected to one another through the interconnection means on each connector. As shown in FIG. 4, interconnections may occur between a wide variety of connectors. For example, an I-beam connector 88 may be secured to a roof edge connector 90, as indicated generally on FIG. 4 in region 5. FIG. 5 depicts in more detail a connection between an I-beam connector 88 and a roof edge connector 90. As will be readily apparent, a variety of interconnection means are possible and within the scope of the invention. One example, as shown in FIG. 5, is a series of holes which align and are adapted to receive a bolt or similar connecting device, thereby securing the two connectors together. The connectors 22 may be aligned so that the end of one connector fits within the end of another, or, as is shown in FIG. 5, the connectors may be adapted so that a portion 34 of one connector fits into a space 36 defined by a receiving portion 38 of another connector.

[0035] Similarly, as shown in FIG. 4 in region 6, and in greater detail in FIG. 6, I-beam connectors 88 aligned for roof support may be connected to a ridge connector 92. Similarly, an I-beam connector 88 vertically aligned as for wall support may be secured to a base connector 94 aligned for floor support as shown in FIG. 4 at region 7, and in more detail in FIG. 7. A corner connector 96 adapted for use in the corner of a structure may be secured to two base connectors 94 adapted for securing to a floor as shown in FIG. 8.

[0036] FIG. 9 depicts a cross-section of a corner connector 96 useful in forming a corner of a structure. The corner connector 96 is preferably used to form a vertical support for a corner, and preferably has an outer corner region 40 and an inner corner region 42. The inner corner region preferably comprises panel securing means 26 adapted to secure two panels 44 at substantially right angles to one another. The panels 44 preferably have ends 46 which are abutted against the inner corner region 42. The inner corner region preferably comprises a portion of the outer load supporting member 30 as well as substantially all of the inner load supporting member 28. The panel 44 is preferably positioned on the inner corner region 42 so that the thermal insulator 32 separating the inner load supporting member 28 and the outer load supporting member 30 is aligned along

the panel end, and away from either panel side 48. In some instances where a substantially right-angled connection of the panels 44 is desired, the corner connector 96 will be substantially square in cross-section, as shown in FIG. 9. However, it will be apparent that various angles between the panels 44 are contemplated and can readily be achieved through the variation of the inner corner region 42 and panel securing means 26 to enable panels to be secured to the connector with the desired angle between the panels.

[0037] FIG. 10 depicts a cross-section of an I-beam connector 88 adapted to be particularly useful as a vertical support or for the support of a roof span. The connector is shown in association with two panels 44. The panel ends 46 are preferably aligned such that the thermal insulator 32 is located along the panel end 46, and spaced apart from either panel side 48. The connector 22 may be secured to panels 44 using panel securing means 26. Panel securing means may take a number of forms. For example, as illustrated in FIG. 10 they may be holes 50 through one or both of the inner load supporting member 28 and/or the outer load supporting member 30, adapted to receive bolts or similar fasteners passing through the holes 50 and entering the panel 44, thereby securing the panel 44 to the connector 22. The bolts 52 preferably pass through only a portion of the panel 44, and in any event do not pass entirely through the panel. It is undesirable to have a continuous thermally conductive link from one side of the panel to another. Thus, bolts 52 and similar connectors should not be permitted to extend fully across the panel, nor should they be permitted to contact any thermally conductive material which itself extends across to the other side of the panel without a thermal break.

[0038] FIG. 11 shows a variation on the I-beam connector 88 arrangement of FIG. 10. As shown in FIG. 11, two I-beam connectors 88 are positioned adjacent to one another, each I-beam connector 88 being secured to a different panel 44, on opposite edges, leaving a gap 56 between the two connectors. A plate 54 is preferably secured to one or both the inner load supporting member or the outer load supporting member of both connectors 22. The gap 56 defined by the two connectors 22 and the plates 54 may be used to run utility wires, plumbing, and similar material up the wall of the structure. It may be desirable in some instances to fill the gap 56 with foam or other insulating material once the wires or other material of interest has been extended through the gap 56.

[0039] FIG. 12 depicts a cross-section through a T-connector 98 useful in connecting the side of a first panel 44 at substantially right angles to the end of a second panel 44. The T-connector 98 includes a main portion 100 having a thermal insulator 32 therein. Two dependant portions 30 depend at a substantially right angle from the main portion 100 on each side of the thermal insulator 32 and are spaced apart to permit a panel 44 to be secured between them. T-connectors of this variety are useful in a range of applications including interior walls and flat roofs. In such a T-connector 98 the panel joined at the end is secured using interconnecting means 24 which preferably penetrate the panel on both panel sides 48, whereas the panel joined at the side is preferably secured using interconnection means 24 which penetrate the panel on only one side 48. In some instances it is desirable to space the two panels apart, and where this is desired, supports 58 are preferably secured to both dependent portions 30 of the T-connector 98. The

supports 58 preferably engage the panel end 46 of a vertical panel, spacing that panel off of a substantially horizontal portion 62 of the connector 22.

[0040] FIG. 13 depicts a cross-section of a base connector 94 adapted to secure a panel 44 to a base 64. The base connector 94 is preferably secured to the base 64 using an anchor bolt 66. The connection between the base connector 94 and the base 64 is preferably filled with caulking compound to further enhance the connection, and reduce the likelihood of unwanted air or water movement. The base connector 94 is preferably a substantially "U"-shaped channel having a thermal insulator 32 extending the length of the channel and creating a thermal break between the channel sides 102. The channel is preferably wide enough to snugly engage a panel 44.

[0041] FIG. 14 is a cross section of a ridge connector 92 adapted to join two panels 44 to form a ridged roof 68. The outer load supporting member 30 includes an outer region 72 which is preferably substantially "arrow"-shaped and has a central downwardly dependent portion 70 secured to an outer region 72 to form the "shaft" of the arrow. The inner load supporting member 28 is secured to the outer load supporting member 30 by the thermal insulator 32. The inner load supporting member 28 preferably comprises a central upwardly extending portion 74 secured at an upper portion to the thermal insulator and secured at a lower portion to an inner region 76 in the shape of an inverted, shallow "V". Preferably, the outer region and inner region are substantially parallel and are each equipped with panel securing means 26. The outer region 72 and the inner region 76 are preferably spaced apart sufficiently to permit the snug insertion of a panel on each side of the central downwardly dependent portion 70 such that the panel ends 46 are adjacent the thermal insulator 32. The connector 22 is preferably covered by a ridge cap 78 which reduces the likelihood of water or other material accumulating on top of the connector, or the panel securing means.

[0042] FIG. 15 is a cross-section through a roof edge connector 90 adapted to connect the end 46 of a first panel 44 with the side 48 of a second panel 44, such as a panel on a ridged roof 68. The connector 22 preferably comprises a main portion 100 and two substantially parallel dependent portions 60. Each dependent portion 60 preferably has a support 58 adapted to engage a panel end 46 on the vertical panel. The dependent portions 60 are fixedly secured to the main portion 100 so that the dependant portions 60 are substantially parallel to each other and form an angle "a" of less than 90° with the main portion. The angle "a" may be selected to provide the roof pitch desired.

[0043] FIG. 16 is a transverse cross-section through a panel 44 adapted for use with the connectors 22 of the present invention. The panel 44 has panel ends 46 and panel sides 48. In some instances, it will be desirable to have a panel 44 having panel ends 46 which are molded to allow insertion of a portion of one or more connectors 22 therein. As shown in FIG. 16, the panel ends 46 may be shaped to include recessed edges 84 adapted to receive panel insertion portions 86 on the connectors 22.

[0044] As shown in FIG. 10, an I-beam connector 88 may be conveniently manufactured using inner 28 and outer 30 load supporting members each of which are substantially T-shaped in cross-section, wherein the inner and outer load

supporting members are secured to one another and separated by a thermal insulator **32** which connects the "base" of each of the "T's".

[0045] In operation, the connectors to be used will be selected based on the size and shape of the structure to be built. Thus, for a typical peaked roof structure, one would ordinarily select base connectors **94** useful to connect to the base **64**, I-beam connectors **88** useful as vertical supports, roof edge connectors **90** useful in supporting each of the roof edges, I-beam connectors **88** useful for supporting the span of the roof, and ridge connectors **92** useful in supporting the roof ridge. These connectors would be interconnected as depicted in the attached figures, or by other suitable means, such as rivets, screws, high strength glue, welding and clamps.

[0046] The present invention differs significantly from the prior art in that it provides a family of connectors which may be connected to one another to form a rigid backbone structure. It will be appreciated by those skilled in the art that a number of different connector shapes may be employed, but so long as the interconnection of thermally broken connectors to one another to form a rigid backbone which still provides thermally insulating properties is provided, such a system, and the connectors going into the formation of that system, will fall within the scope of the present invention.

[0047] Thus, it is apparent that there has been provided in accordance with the invention a structural building system adapted to form a substantially rigid self-supporting structural skeleton. The Structural Building System disclosed herein fully satisfies the objects, aims and advantages set forth above. While the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications and variations as fall within the spirit and broad scope of the invention.

What I claim as my invention:

1. A building system comprising a plurality of substantially rigid connectors adapted to form a substantially rigid self-supporting structural skeleton:

each said connector having interconnection means and panel securing means;

each said connector having an inner and an outer load supporting member and a thermal insulator separating and secured to both said inner and outer load supporting members; and

said connectors being adapted to interconnect such that when in position, said thermal insulator provides a substantially complete block against thermal transfer between said inner supporting member and said outer supporting member and said connectors form the substantially rigid self-supporting structural skeleton to which panels can be secured.

2. The building system of claim 1 wherein the interconnection means and panel securing means are adapted to secure each said connector to an adjacent connector and two panels.

3. The building system of claim 1 further including panels secured to said connectors.

4. The building system of claim 3 wherein said panels have ends adapted to snugly engage and substantially seal about said thermal insulator.

5. The building system of claim 3 wherein said panels have recessed edges adapted to snugly receive said inner and outer load supporting members.

6. A connector comprising:

an inner and outer load supporting member;

a thermal insulator separating and secured to both said inner and outer load supporting members, said thermal insulator providing a substantially complete block to thermal transfer between said inner load supporting member and said outer load supporting member;

interconnection means adapted to permit interconnection of said connector to another connector; and

panel securing means adapted to secure said connector to two panels such that the each panel contacts a portion of each of said inner and outer load supporting members.

7. The connector of claim 6 wherein the inner and outer load supporting members each have a substantially T-shaped cross-section, such that said connector is substantially I-beam shaped.

* * * * *