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Kotlarz

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[54] **BASIC BEAM STRUCTURAL MEMBER AND STRUCTURES BUILT THEREFROM**

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[51] **Int. Cl.²** **E04B 1/92;** E04B 1/24

[58] **Field of Search** 52/403, 220, 475, 295, 52/729, 227, 23, 243, 168, 241, 274, 240, 235, 495; 239/207–209

[56] **References Cited**

UNITED STATES PATENTS

269,018	12/1882	Crowell et al.	52/23
1,417,102	5/1922	Nyman et al.	52/475 X
2,085,281	6/1937	Wagoner	52/403 X
2,706,541	4/1955	Crown	52/403 X
3,058,552	10/1962	Baras	52/475 X
3,104,060	9/1963	Bricmont	52/168 X
3,122,223	2/1964	Chell et al.	52/475 X
3,128,852	4/1964	Chell et al.	52/403 X
3,156,018	11/1964	Slayter	52/403 X
3,189,140	6/1965	Luss	52/495 X
3,295,283	1/1967	Griffith et al.	52/475
3,327,438	6/1967	Cooper	52/495 X
3,415,024	12/1968	Kotlarz	52/220
3,436,887	4/1969	Grossman	52/235
3,503,166	3/1970	Nakazawa et al.	52/475 X
3,520,345	7/1970	Lillibridge et al.	52/168
3,566,561	3/1971	Tozer	52/729 X
3,603,049	9/1971	Pierce	52/403 X
3,808,755	5/1974	Bott	52/241 X

FOREIGN PATENTS OR APPLICATIONS

1,104,160	4/1961	Germany	52/240
796,853	6/1958	United Kingdom	52/760
642,051	1/1960	Italy	52/241

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Assistant Examiner—Leslie A. Braum

[57] **ABSTRACT**

Disclosed is a high-strength, lightweight, basic beam of a single shape which can serve as a column, truss, girder, jamb or other structural member whereby an entire structure can be built using the same basic beam for all of the structural members. The basic beam structural member comprises a unitary, elongated rigid beam having a pair of parallel, opposed channel-shaped portions connected by a pair of spaced walls positioned inwardly from the sides of the channels to define a longitudinally extending slot therebetween and a pair of opposed recesses. A metal or plastic rectangular shaped tube is inserted in the longitudinal slot to provide extra strength and facilitate interconnecting of the structural members.

9 Claims, 9 Drawing Figures

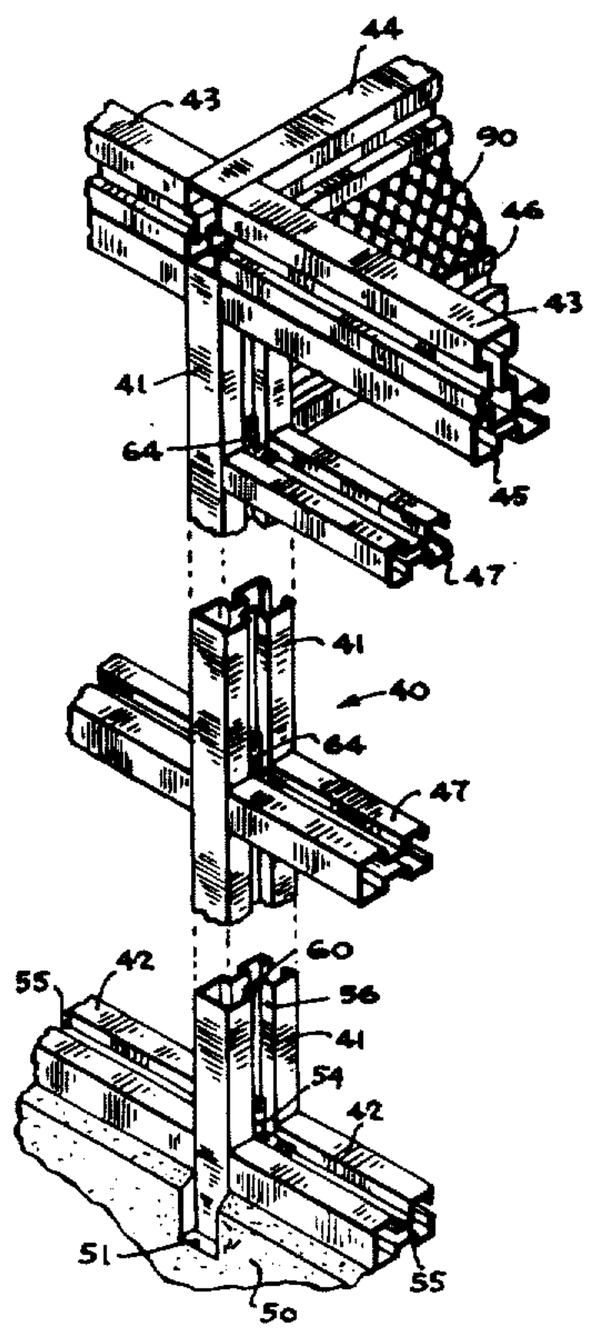


FIG.1

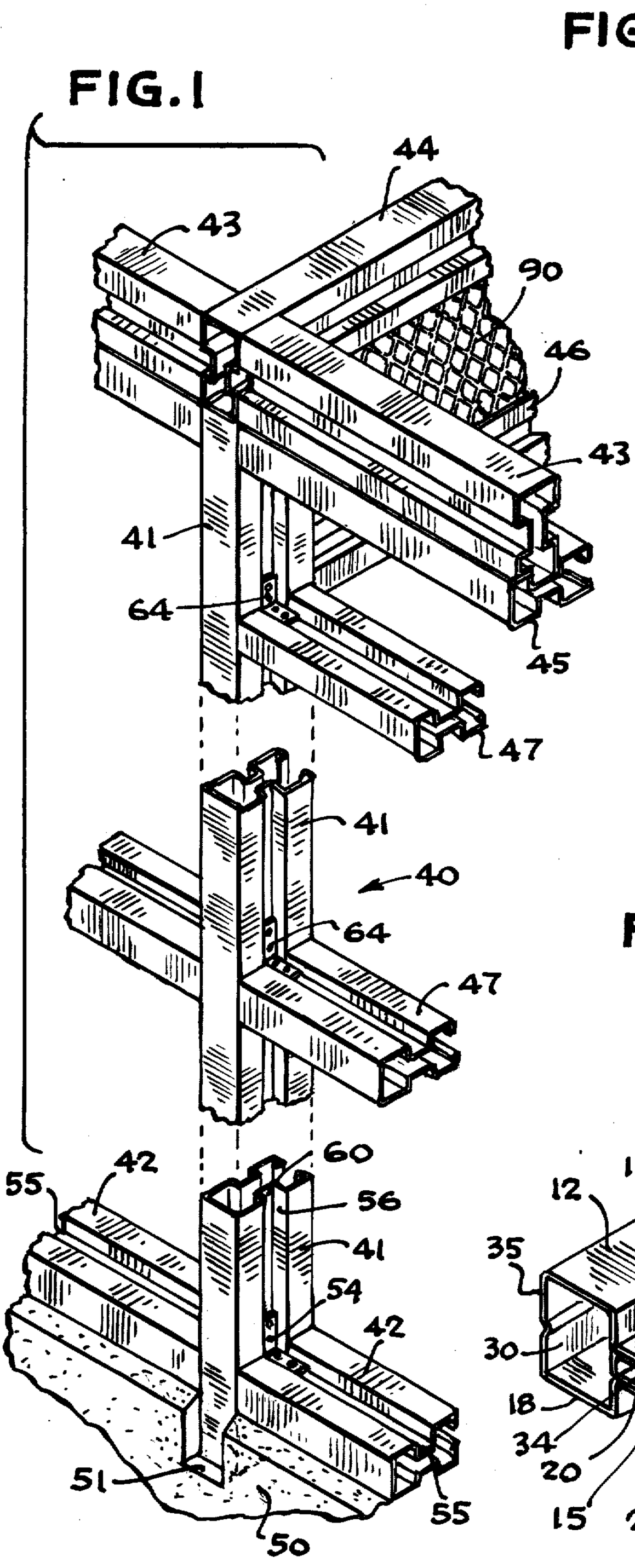
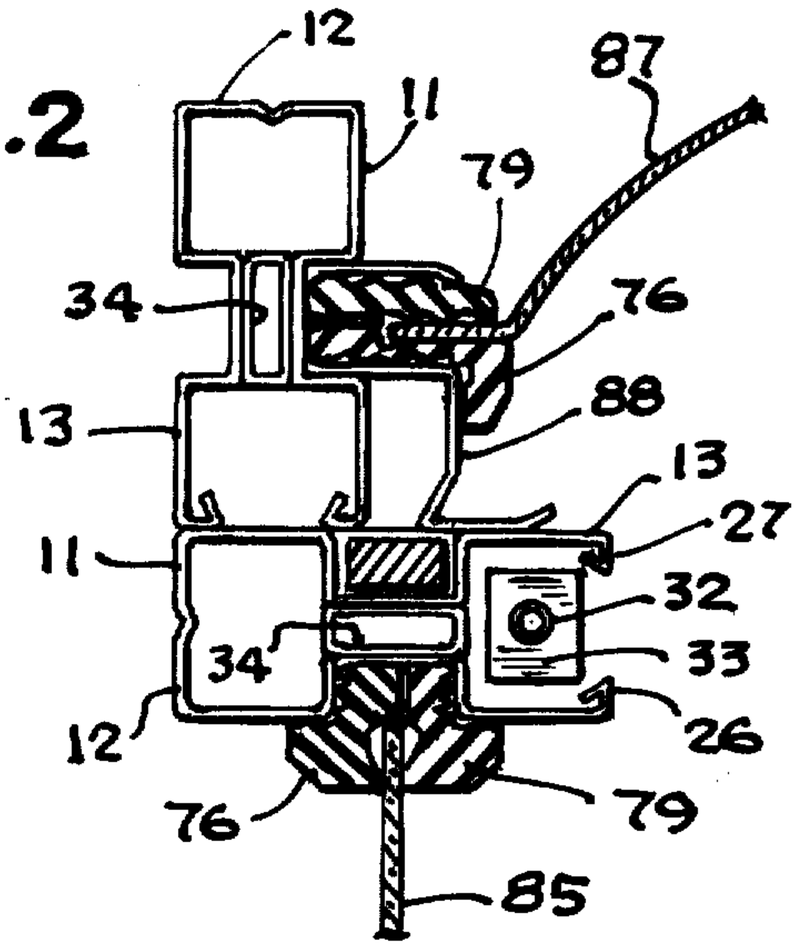


FIG.2



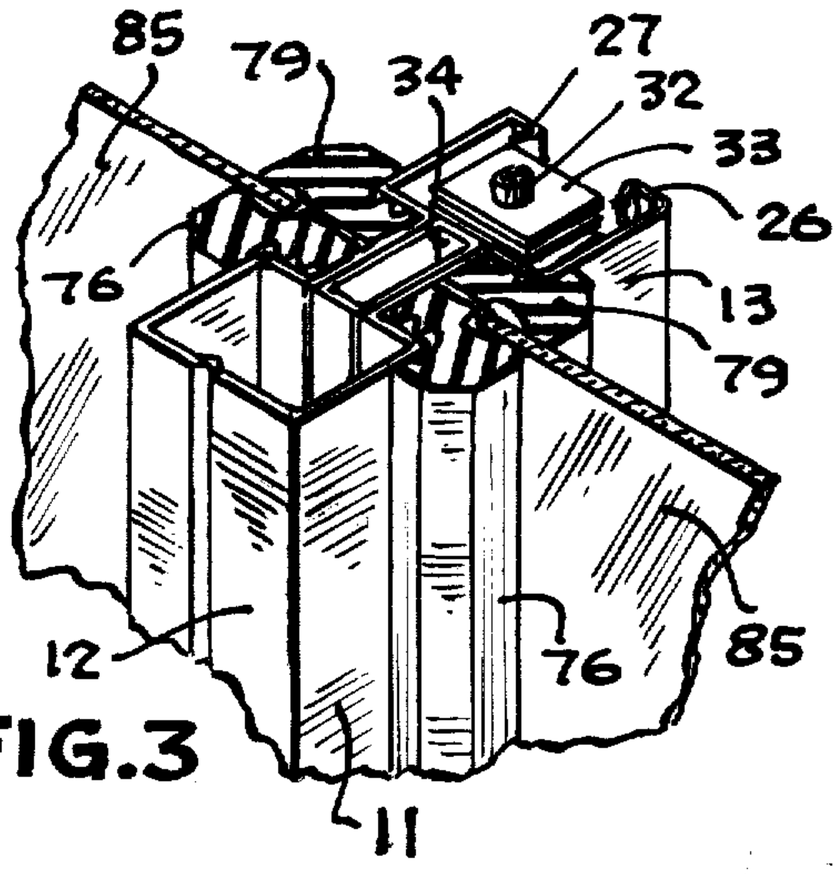


FIG.3

FIG.4

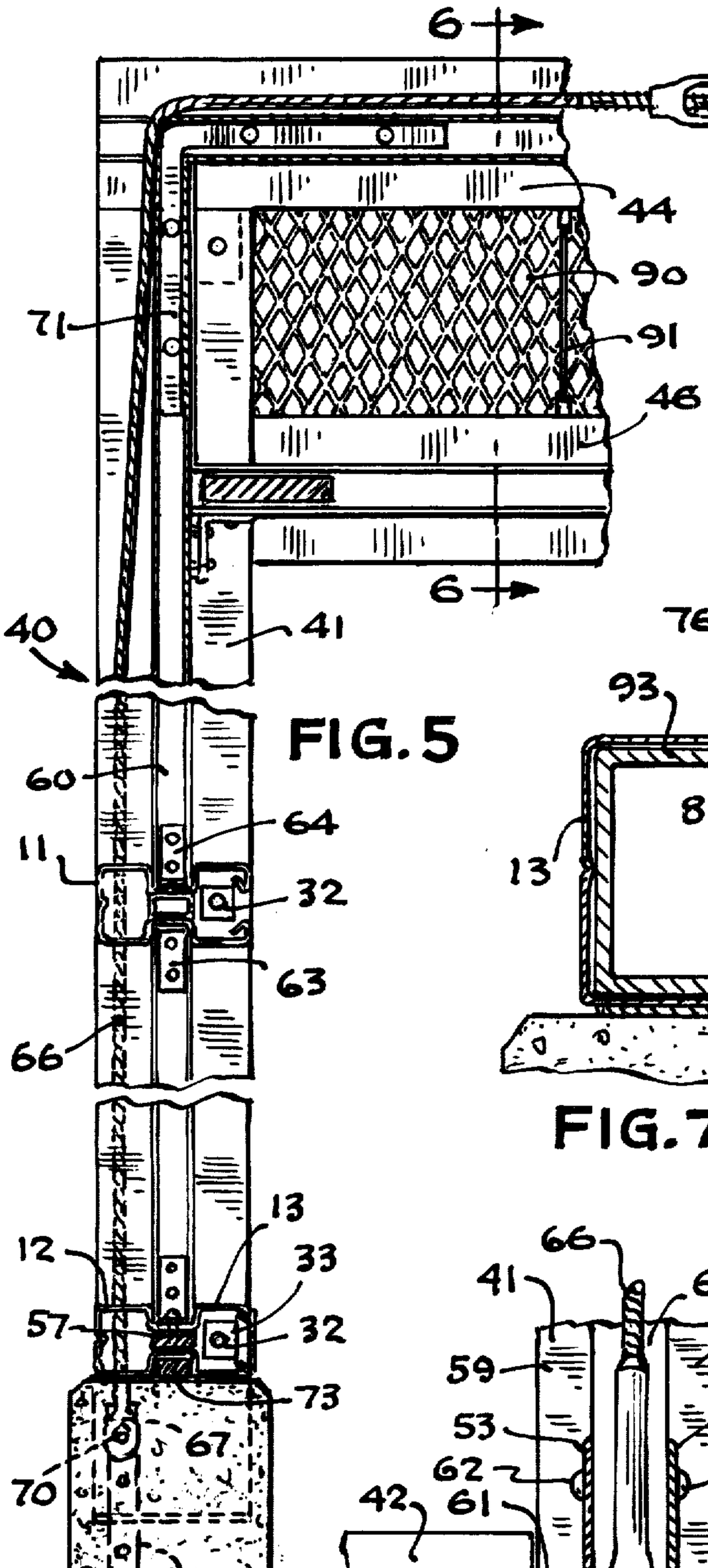


FIG. 5

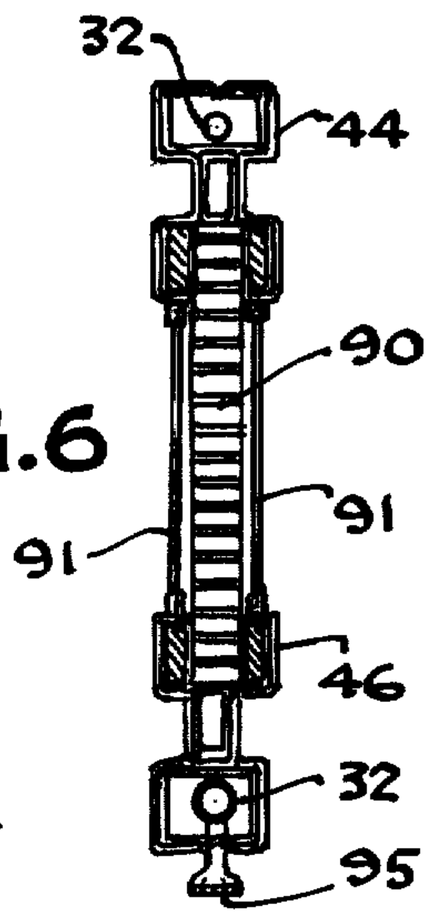


FIG. 6

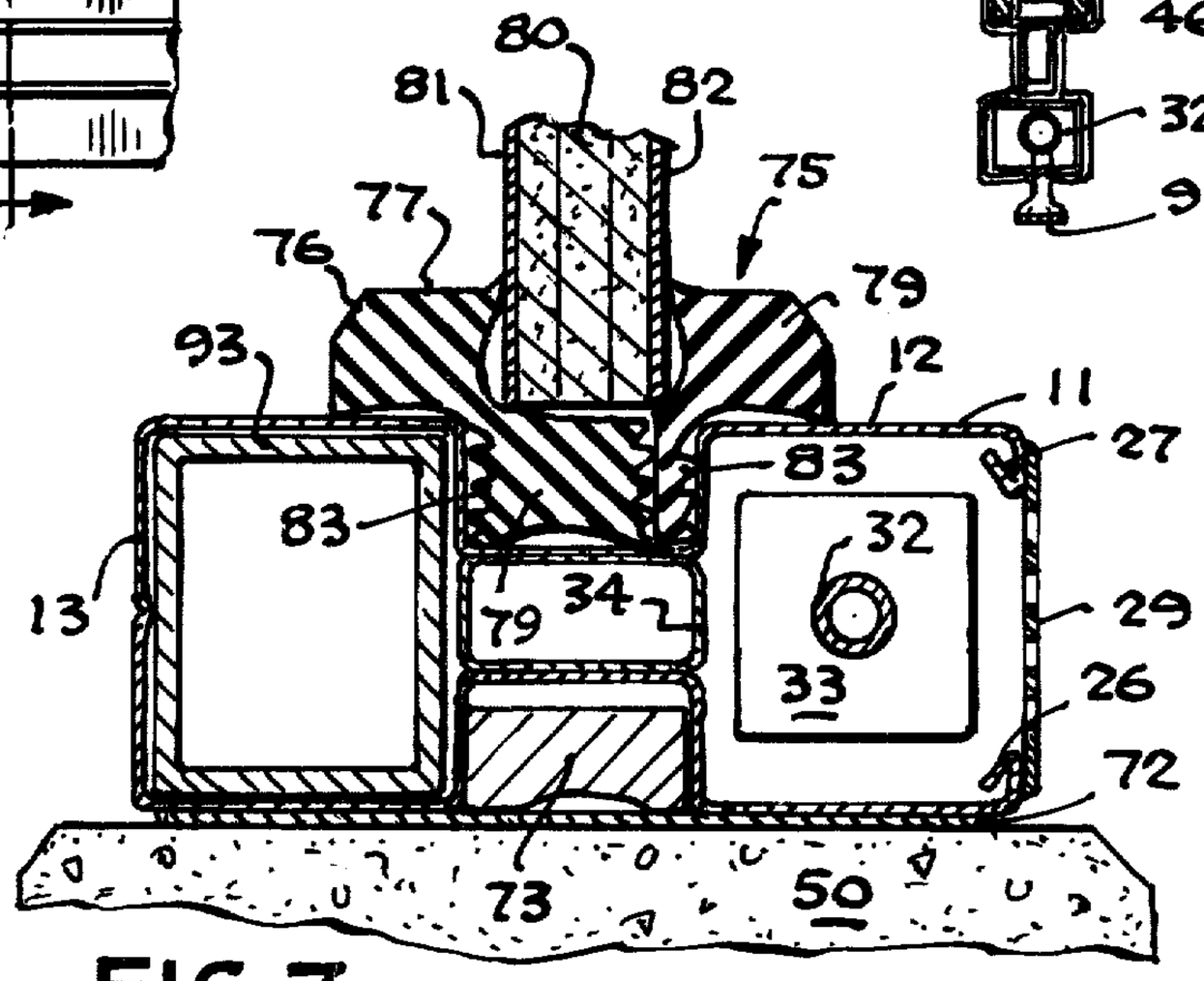


FIG. 7

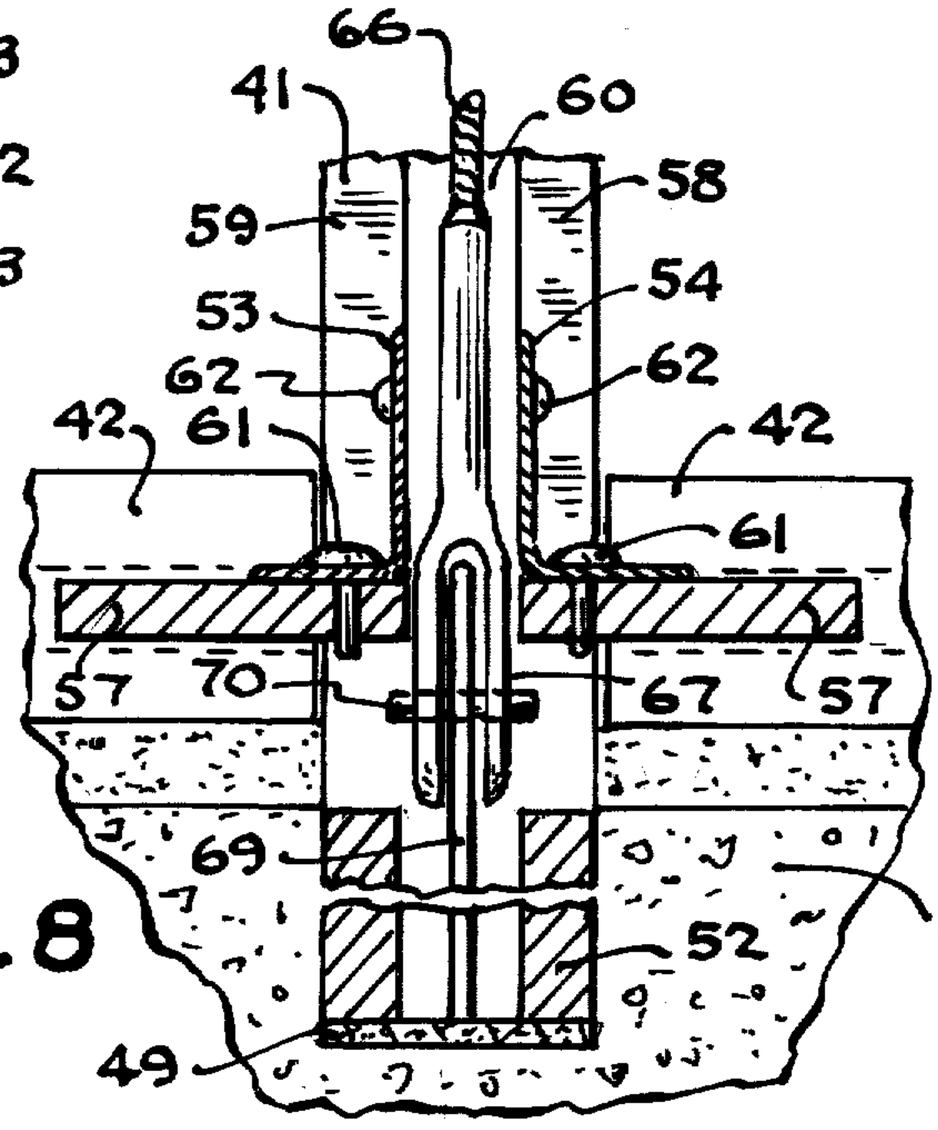


FIG. 8

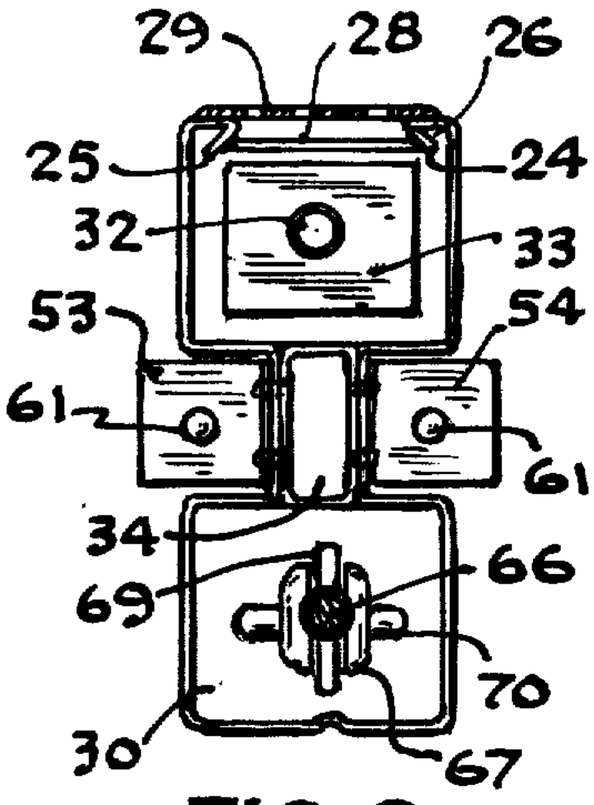


FIG. 9

BASIC BEAM STRUCTURAL MEMBER AND STRUCTURES BUILT THEREFROM

BACKGROUND OF THE INVENTION

Primarily due to the increased cost of conventional construction, which requires on-site forming and fitting of structural members as well as construction of heating, cooling and electrical systems, efforts have been made to pre-engineer portions of or entire structures. Examples are pre-fabricated walls which incorporate water and electrical systems. For larger structures or those incorporating large glazing panels, efforts have been made to pre-engineer the framework structures in order to simplify construction and thereby achieve an economy. An example is the United States Steel Corporation's ULTIMET framing system which provides curtain walls, windows and doors. With this system, the components are shipped "knocked down" to the job site ready to erect. U.S. Pat. Nos. 3,357,145 and 3,436,887, issued Dec. 12, 1967 and Apr. 8, 1969 respectively, disclose curtain wall structures. Such systems and structures are not load bearing, however, curtain walls being designed to enable architects to utilize both fixed glass or operable sash on the exterior of a building at economical costs. With such curtain walls, vertical mullions are anchored to a building structure and horizontal members are assembled thereto in interlocking fashion. While such curtain wall structures provide economy, simplicity, appearance and ease of assembly, they are not load-bearing and are fabricated from a multiplicity of different components. U.S. Pat. No. 3,415,024 issued Dec. 10, 1968, discloses building structures of the type incorporating glazing panels fitted within a framework structure such as translucent curtain walls, patio roofs, skylights, swimming pool enclosures and solariums and which comprise a supporting framework of hollow channel-like members having a fluid-flow manifold system therein for heating and cooling the structure. While entire structures, such as a swimming pool enclosure, are disclosed and in which the framework is supporting, each structural member such as the columns, girders and trusses are of a different design necessitating separate fabrication of each structural member.

SUMMARY OF THE INVENTION

The present invention relates to a high-strength, lightweight, basic beam of a single shape which can serve as a column, truss, mullion, purlin, header, sill, girder, jamb, threshold, top or bottom plate and thereby provide a basic beam structural system. Accordingly, an entire structure can be built using the same basic beam for all of the structural members. Such a high-strength, lightweight, basic beam structural system can be applied to a pre-engineered or conventional structures and is flexible in its application to various geometrical shapes and forms. Further, the basic beam of the present invention provides predetermined costs, total design, interchangeable components, minimum maintenance and is adaptable to future expansion.

Briefly, the basic beam structural member of the present invention comprises a unitary, elongated rigid beam having a pair of parallel, opposed channel-shaped portions connected by a pair of spaced walls positioned inwardly from the sides of the channels to define a longitudinally extending slot therebetween and a pair of opposed recesses. One side of one of the channels can be left open to provide a readily accessible passageway for electrical or fluid-flow systems. A metal or plastic rectangular shaped tube can be inserted in the longitudinal slot to provide extra strength and prevent buckling, particularly under compressive loads. By suitably interconnecting the various structural members, all of which comprise the same basic beam structural member, an entire structure can be assembled. A rigging cable, anchored to the foundation of the structure and positioned within the outermost channel of opposing columns and the interconnecting truss can provide additional rigidity to the structure.

Preferably, the basic beam structural members of the present invention are fabricated of stainless steel such as type 301, 302, 304 and 316. Stainless steel provides high strength and outstanding corrosion and fire resistance and, having good ductility and formability, can be fabricated by roll-forming techniques on roll-forming equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. **1** is a fragmentary perspective view of a basic beam structural system comprising a vertical column and interconnected base plate, top plate, truss, transom plate and horizontal members;

FIG. **2** is a vertical cross-section of the truss portions of a structure having a dome-like top and illustrating the positioning of gaskets and glazing panels;

FIG. **3** is a perspective view, partially in cross-section, illustrating the positioning of gaskets and glazing panels in a vertical column of the present invention;

FIG. **4** is a perspective view of a basic beam structural member of the present invention having a heating and cooling unit therein;

FIG. **5** is a fragmentary side elevation of a vertical column and attached bottom plate, truss and transom plate and illustrating the positioning of a reinforcing cable therein;

FIG. **6** is a section taken along the line **6—6** of FIG. **5**;

FIG. **7** is a vertical cross-section of a bottom plate illustrating the positioning of gaskets and wall panels therein;

FIG. **8** is a vertical cross-section illustrating anchoring of a vertical column, base plate and reinforcing cable; and

FIG. **9** is a horizontal cross-section of a vertical column having a heating and cooling unit and reinforcing cable therein and supporting brackets attached thereto.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. **1** through **9** of the drawings illustrate the high-strength, lightweight, basic beam of the present invention and exemplary construction employing the same basic beam for all of the structural members. As best seen in FIG. **4**, the high-strength, lightweight, basic beam **10** of the present invention comprises an integral, elongated, rigid structure **11** having a pair of opposed channel-shaped portions **12, 13** connected by a pair of spaced walls **14, 15** positioned inwardly from the respective sides **16, 17, 18** and **19** of the channel-shaped portions **12, 13** to define a longitudinally extending slot

20 therebetween and a pair of longitudinally extending, opposed recesses 21, 22. The front face 23 of the channel-shaped portion 13 is left open for the purpose hereinafter described. As best seen in FIG. 9, the edges 24, 25 of the front face 23 are crimped inwardly to form lips 26, 27 for added strength. Likewise, to add strength, bars 28 can be spaced along the length of the front face 23 and attached thereto by welding them to the lips 26, 27. In use, the basic beam 10 is positioned with the open face 23 directed to the inside of the structure being built and can thereafter be covered with a decorative panel 29. The passageways 30, 31 within the channel-shaped portions 12, 13 of the basic beam 10 can be utilized for telephones, electrical, water or heating and cooling systems and the like. In the embodiment illustrated, the passageway 31 in the channel-shaped portion 13, having an open face 23 contains a fluid conduit 32 with fins 33 attached thereto and can be used for heating or cooling purposes. To provide rigidity and facilitate the attachment of supporting brackets and the like, a rectangular reinforcing bar 34 is disposed within the longitudinal slot 20 of the basic beam 10, formed by the walls 14, 15 connecting the channel-shaped portions 12, 13; the bar 34 being coextensive with the length and width of the slot 20. The bar 34 may be hollow as illustrated or solid and may be made of a suitable plastic material as well as metal.

FIGS. 1 and 5 illustrate a structure 40 assembled from the basic beam structural member 10 of the present invention and comprising a vertical column 41, base plate 42, top plate 43, truss 44, girders 45, transom plate 46 and horizontal members 47, all having the same configuration and interconnected together which, when assembled with similar structures, form a complete building structure.

Referring to FIGS. 1, 5, 6 and 8, the vertical column 41 is anchored in a preformed opening 51 in the concrete foundation 50. The vertical column 41 rests on an anchor post block 52 which in turn rests on a plate 49 which also seals the bottom of the opening 51. Preferably, the anchor post block 52 is made of stainless steel or fluorocarbon and the plate 49 of stainless steel. Epoxy cement can be used to further anchor the vertical column 41 in place. As illustrated in FIG. 8, after the vertical column 41 is anchored in place in the foundation 50, the bottom plates 42 are positioned on the foundation 50 and fastened to the column 41 by means of L-shaped supporting brackets 53, 54 which are placed in the recesses of the vertical column 41 and bottom plates 42 in contact with both members and riveted or otherwise fastened thereto. Likewise, the horizontal members 47 are positioned against the vertical column 41 and similar opposed columns (not shown) and fastened thereto with supporting brackets 63, 64 placed in both the recesses 21, 22 in the channel-shaped portions 12, 13 of horizontal members 47 or other basic beam regardless of which structural member it may be. Thus, the top plate 43, truss 44, girders 45 and transom plate 46 can be attached to the vertical column 41 in the same manner.

When two basic beams 10 are positioned at right angles to each other for assembly, such as the vertical column 41 and base plates 42 illustrated in FIG. 8, the end 35 of one of the basic beams 10 rests against the sides 58, 59 of the other beam 41 so that a space remains between the end 35 of the one beam 10 and slot 20 formed by the walls 14, 15 (FIG. 4) of the other beam. Accordingly, to facilitate attachment of the L-shaped supporting brackets 53, 54 to the vertical column 41 and base plates 42, a short section of a solid bar 57 is positioned in the slot 20 of the base plate 42 extending into the recess 56 in the vertical column 41 and in abutment with the wall 60 in the vertical column 41 (see FIG. 1). As illustrated in FIG. 8, rivets 61 or other fastening means can then be utilized to fasten the brackets 53, 54 to the bars 57 in the base plates 42. In the same manner, rivets 62 can be used to fasten the brackets 53, 54 to the vertical column 41. Likewise, horizontal members 47, girders 45, transom plates 46 and all other structural members lying in a horizontal position can similarly be fastened to the vertical structural members or columns. As can be seen in FIGS. 1 and 5, horizontal members 47 and other horizontal structural members positioned intermediate the ends of the vertical structural members such as column 41 can be fastened by brackets 63, 64 placed in both the upper and lower recesses 21, 22 (FIG. 4) in the horizontal structural members 47.

To provide extra rigidity to the assembled structure 40, a rigging cable 66 can be placed in the passageway 30 of the vertical columns 41 and truss members 44. As can be seen in FIGS. 5, 8 and 9, the rigging cable 66 is positioned in the passageway 30 of the vertical column 41 and truss 44 and has a forked member 67 on one end and a turnbuckle 68 on the other end. The cable 66 is anchored to the foundation 50 by fastening the forked member 67 to a bar 69, which passes through the plate 49 and into the foundation 50, by means of a pin 70 inserted through openings in the forked member 67 and bar 69 (FIG. 8). Similarly, cable 66 is placed in the opposed vertical column (not shown) and the turnbuckle 68 is then tightened through the open front face 23 (FIG. 4) of the truss 44. Preferably, to minimize the possibility of the cable 66 being cut at the point at which it enters the passageway 30 in the truss 44 (FIG. 5), an angle-shaped support bar 71 is positioned in the corner formed by the vertical column 41 and the truss 44 (see FIG. 5). A groove (not shown) in the outwardly facing surfaces of the support 71 guides and retains the cable 66.

The angle support bar 71 is inserted in the slots 20 in the intersecting vertical column 41 and truss 44 and attached thereto and consequently also serves to fasten the two members together. As can be seen in FIG. 7, the base plate 42 rests on a sheet 72 and a slide-bearing block 73 is placed in the lower recess 30 in the base plate 42. The sheet 72 and bearing block 73 are preferably made of fluorocarbon plastic and, together with the anchor post blocks 52, permit slight movement of the structure 40 due to wind or other stresses as well as provide a seal against snow and water.

After the structure 40 is assembled from the basic beam structural members 10 as described, glazing panels or wall panels can be installed in the resulting framework to complete the building or structure 40. FIGS. 2, 3 and 7 illustrate the gasket system 75 for placing in either of the recesses 21, 22 in the basic beam structural member 10 for retaining the glazing 85 or wall panels 80. The gasket system 75 is reversible and comprises a generally L-shaped pillow block 76 having an elongated portion 77 engageable with one side 81 of the panel 80 and a shoulder 78 projecting from the elongated portion 77 and extending to the

other side of the panel **80**, upon which the panel **80** can rest, and an opposing insert portion **79** of elongated shape and engageable with the side **82** of the panel **80** opposite the side **81** of the panel **80** engageable with the elongated portion **77** of the pillow block **76.** Ribs **83** are preferably formed in the sides of the gaskets **76,** 79 engageable with the walls of the recess **20** or with each other and help to keep the gasket system **75** from slipping due to vibration caused by wind or other forces. As illustrated in FIG. **7,** the wall panel **80** is glazed from the inside of the structure **40.** The pillow block **76** is put in place in the recess **20** of the base plate **42** and other structural members forming the framework and then the wall panel **80** is positioned on the shoulder **78** of the pillow block **76** and in engagement with the elongated portion **77.** The insert portion **79** of the gasket system is subsequently put in place in the recess **20,** from the inside of the structure in engagement with the side **82** of the panel **80** and the shoulder **78** of the opposing pillow block **76** to thereby retain the wall panel **80** in place. If desired, the position of the pillow block **76** and insert portion **79** can be reversed so that the wall panel **80** can be glazed from the outside. Glazing panels **85,** which can be made of glass or plastic, are glazed in the same manner, as illustrated in FIGS. **2** and **3.**

The gasket system **75** is preferably made of neoprene and, being resilient, permits some expansion and contraction of the wall panel **80** or glazing panel **85** thereby minimizing any cracking of the panels or leaking.

FIG. **2** illustrates the arrangement of a top plate **43** and girder **45,** gasket system **75** and glazing panel **85.** As illustrated, a dome panel **87** is installed to cover the structure **40,** the dome panel **87** being held in place by means of a retaining clip **88** and gasket system **75** combination.

The versatility of the basic beam structural member **10** of the present invention permits a variety of designs and combinations. FIGS. **5** and **6** illustrate a honeycomb panel **90** installed in the opposing passageways **31** of the truss **44** and transom plate **46** members with spaced struts **91** affixed to both members to provide additional support and strength. Likewise, if desired, insulation **93** can be installed in the passageway **30** of the basic beam structural members **10** of the building structure **40** which face the outside. If made of reinforced plastic, the insulation **93** will strengthen and stiffen the structural member as well as provide insulation. As previously described, a fluid conduit **32** can be positioned in either of the passageways **30, 31** of the basic beam structural members **10** for heating or cooling of the building structure **40.** Similarly, a sprinkler system can be installed by positioning sprinkler heads **95** along the conduit **32** in the truss **44** or transom plate **46** as illustrated in FIG. **6.** Likewise, sprinkler heads **95** can be placed in any of the other structural members, including the vertical columns **41.**

As is readily apparent, a complete structural framework can be assembled from structural members fabricated from the same high-strength, lightweight, basic beam structural member **10** of the present invention. Additionally, the basic beam structural system is flexible in its application, can be easily and economically assembled, and can be utilized for the installation of heating and cooling systems, electrical and communication systems, as well as sprinkler systems.

What is claimed is:

1. A building structure assembled from a plurality of the same basic beam structural members, said structure comprising:

parallel, spaced, generally horizontally and vertically disposed basic beam structural members arranged in transverse relation to each other;

said horizontal members being engaged with said vertical members at preselected vertical heights thereon to form a framework structure with the vertical members; and

fastening means for said horizontal members to said vertical members in a secure abutting relation;

each of said horizontal members and said vertical members comprising an integral, elongated rigid structure having a pair of parallel, spaced, opposed U-shaped channel members, each said channel member having an end face and two side walls, and said side walls of each said channel extending towards and in a spaced, parallel relationship with the walls of the other channel member said U-shaped channel members defining passageways therein, one of said U-shaped channel members having an open face to provide access to the passageway therein;

a pair of longitudinally extending, opposed recesses in the side walls of said U-shaped channel members, said recesses being formed by walls projecting inwardly from the respective side walls of the channel members, and a pair of spaced walls disposed between the inwardly projecting walls to thereby connect the opposed channel members, the pair of spaced walls defining a longitudinally extending slot therebetween;

a reinforcing member disposed within the longitudinally extending slot, said member being coextensive with the length and width of the slot; and

a cable disposed in the passageways of an interconnected vertical member, uppermost horizontal member forming a truss, and opposing vertical member, said cable being anchored to the foundation at each end thereof at the bottom of each of the opposing vertical members to thereby provide extra rigidity to the assembled structure.

2. The building structure of claim **1** including an angle support positioned in the corner formed by the vertical members and the truss to guide and retain said cable.

3. The building structure of claim **2** wherein said cable includes a forked member on either end thereof and tightening means intermediate the ends, said forked members being fastened to a bar inserted in the foundation upon which said structure rests.

4. The building structure of claim **1** wherein the fastening means for fastening the horizontal members to the vertical members comprises a supporting bracket disposed in the recess in the vertical member and the opposing recess in the horizontal member, said supporting bracket being fastened to both members to thereby maintain said members in a secure abutting relation.

5. The building structure of claim **4** including a solid bar disposed in the slot in the horizontal member, said bar extending into the recess in the vertical member and in abutment with the wall in the vertical column to thereby facilitate attachment of the supporting brackets.

6. The building structure of claim 5 including a base plate, said base plate resting on a sheet of fluorocarbon plastic, and a slide-bearing block disposed in the recess in the base plate facing said sheet, said sheet and block permitting slight movement of the structure as well as providing a seal against snow and water.

7. The building structure of claim 5 including a fluid conduit disposed in the passageways in the horizontally and vertically disposed structural members.

8. The building structure of claim 7 including spaced sprinkler heads positioned along said fluid conduit to provide a fire protection system.

9. The building structure of claim 1 including gaskets disposed within the framework structures formed by the vertical and horizontal members, and panels fitted within the gaskets.

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