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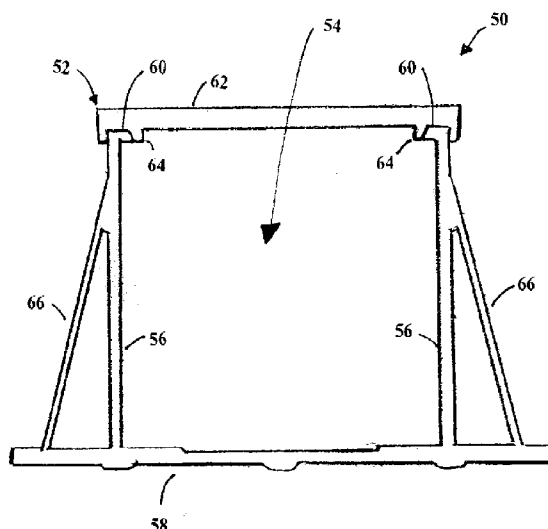
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(54) Title: CABLE TROUGH



(57) Abstract: A cable trough for installing cables alongside a railway line or other right of way is described. The cable trough is constructed using longitudinally oriented reinforcing fibers coated with polymeric resin that generally aligns the reinforcing fibers with the length of the cable trough. One or more angled members extend at an angle from one or more sidewalls to a bottom of the cable trough. One or more connector clips may be used to secure respective portions of the cable trough to one another. The cable trough is provided with a cover that may be removably secured to an elongate channel to protect the cables housed within the cable trough. Elbows, corners, tees, and other connectors may be provided to run the cable trough in any desired direction. A method of installing cables in a cable trough is also described.

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CABLE TROUGH

TECHNICAL BACKGROUND

[0001] The disclosure relates to a conduit system adapted for containing and protecting various types of wiring laid alongside, beneath, or otherwise adjacent to railroad tracks.

BACKGROUND

[0002] Railroad lines provide an ideal location for the placement of various types of cabling. Included in this group are electrical cables and other types of communication cabling. However, because of the nature of the materials from which railway lines are constructed, it is inadvisable to simply bury a cable beneath a railroad line. The pressures and abrasive action of the ballast used to support railway lines quickly degrade any cables buried without protection. In addition, repairs to cabling may interfere with the travel of trains over the railway lines.

[0003] Various types of conduit have been provided for the protection of cables laid alongside or beneath rail lines. Examples include extruded plastic, pre-cast concrete, cast-in-place concrete, molded composite materials having random orientation of fiber-reinforcing strands therein, and steel. Concrete, both pre-cast and cast-in-place, is extremely heavy and therefore installation may be quite expensive. Extruded plastic cable troughs, both unreinforced and reinforced with randomly oriented fiber strands, have relatively low strengths and, accordingly, shorter life spans and reduced ability to withstand the rigors of installation adjacent a railway lines. Cast or molded thermoplastic materials having randomly oriented fibers tend to be somewhat stronger than unreinforced types of cabling trough, but are quite expensive. Steel cable trough can also be quite expensive. Accordingly, there is recognized a need for a cable trough for railway cabling that has high strength and is lightweight, durable, and inexpensive.

[0004] These and other objectives and advantages will appear more fully from the following description, made in conjunction with the accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views.

SUMMARY OF THE DISCLOSURE

[0005] The cable trough disclosed herein embodies an elongate channel that has a bottom and a pair of sidewalls that extend upwardly therefrom in a generally parallel relationship with each other. A removable top is adapted to be placed onto the sidewalls and can be secured to the channel in order to enclose cables disposed within the channel. Preferably, both the channel and the top of the cable trough are formed from a thermosetting resin having contained therein generally uniformly longitudinally oriented reinforcing fibers. These materials are fabricated into the cable trough, preferably using a pultrusion process.

[0006] Respective lengths or sections of the channel from which the cable trough is made are connected to one another by one or more, and preferably three, connecting clips that are secured between the sidewalls and/or the bottom of the respective sections in order to connect them to one another. The connecting clip has a central web with a first and second edge and a pair of stringers that are connected to the first and second edges. The stringers are spaced apart by the web and are generally parallel to one another. The stringers and the web together form a pair of diametrically opposed mouths that are adapted to clamp therein a sidewall or bottom of the channel or the cover of the cable trough. In general, the connecting clip has an "H"-shaped cross-section. One benefit to the use of this type of connecting clip is that no tools are required to assemble a run of the cable trough.

[0007] The cable trough is relatively simple to install. A method for installation of the cable trough begins with identifying the path where the cables must be run. A first and then a second or subsequent section of the cable trough will then be emplaced along the path along which the cable is to

run in an end-to-end relationship. At least one of the connecting clips is installed between the respective ends of each subsequent section of cable trough in order to secure the sections to one another. Once the channel portion of the cable trough has been installed, the requisite cables are laid within the trough and the cable trough covers are placed onto the channel sections of the cable trough and removably secured thereto in order to protect the cables from the exterior environment.

[0008] It is to be understood that the cable trough may take many shapes and forms, including elongate straight sections, curved sections, T-connectors, and other variously shaped connectors and runs.

[0009] Additional objects, advantages, and features will become apparent from the following description and the claims that follow, considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is an exploded cross-sectional perspective view of a typical cable trough illustrating the relationship between the channel of the trough and its cover.

[0011] Figures 2a-2c illustrate a T-section, a 45° bend, and a 90° bend in the cable trough, respectively.

[0012] Figure 3 illustrates an H-clip of the type used to assemble two sections of cable trough.

[0013] Figure 4 illustrates a cross-sectional view of a cable trough according to another embodiment.

[0014] Figure 5 illustrates a perspective view of the cable trough of Figure 4.

DESCRIPTION OF VARIOUS EMBODIMENTS

[0015] Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice various embodiments, the physical embodiments herein disclosed merely exemplify the invention, which may be embodied in other specific structures. While certain embodiments have been

described, the details may be changed without departing from the spirit and scope of the present invention, which is defined by the claims.

[0016] Cable trough is typically installed alongside railway lines, either above grade or below grade, depending on the application. Above-grade installations of cable trough may be made directly on the surface of the ballast that supports a railway line, or in an elevated position where the cable trough has been secured to, for example, the wall of a railway tunnel.

[0017] Figure 1 illustrates a cross-section of a typical cable trough constructed and arranged according to one example embodiment. Note that any dimensions appearing in the figures are by way of illustration only and it is to be understood that the embodiments disclosed herein are not limited to those dimensions. The cable trough 10 essentially comprises a channel 12 having a top such as cover 14. The channel comprises a pair of generally vertical sidewalls 16 extending upwardly from and secured to a bottom such as base plate 18. Each of the sidewalls 16 has on an inner surface thereof an inwardly extending lip 20 that may be formed continuously along the sidewall 16 or in certain predetermined locations as desired. The lip 20 serves as a part of a closure mechanism that retains the cover 14 on the channel 12 once the cable trough 10 has been installed.

[0018] The cover 14 essentially comprises an elongate plate 22 that has a width and length that are commensurate in scope with those of the channel 12. The plate 22 has a pair of channel members 24 that extend downwardly therefrom and that engage the upper edges of the respective sidewall 16 of the channel 12. Note that the channel members 24 address both sides of the upper edge of the sidewalls 16. In Figure 1, the cover 14 and channel 12 are shown in their disassembled position.

[0019] When the cover 14 has been seated firmly onto the channel 12, with the upper edges of the sidewalls 16 seated within the channel members 24 of the cover 14, one or more connector bolts may be passed downwardly through the cover through countersunk bores 26 formed therein. The connector bolts (not shown) have a cam or other offset projection extending from a distal end thereof such that when the connector bolt is rotated, as by

screwdriver or the like, to a closed position, the cam or projection will be positioned beneath the lip 20 of the sidewall 16. When in its closed position, the connector bolts will secure the top 14 to the channel 12 to complete the cable trough 10. As can be appreciated, cabling, whether electrical, mechanical or fiber optic, is laid in the channel 12 of the cable trough 10 before the cover 14 is placed thereon.

[0020] It should be understood that the cable trough 10 is not waterproof as such. Accordingly, in order to prevent the accumulation of water and ice inside the channel 12 of the cable trough 10, one or more drain holes 15 may be formed through the bottom of the trough to allow water to exit the channel 12.

[0021] Figures 2a-2c illustrate various types of connectors that may be interposed between straight sections in order to run the cable trough 10 around corners and to create slightly more complex networks. Figure 2a illustrates a simple tee 30. Figure 2b illustrates a 45° bend 32 and Figure 2c illustrates a 90° bend 34. It is to be understood that the connectors illustrated in Figures 2a-2c are exemplars only, and many more connectors useable with the cable trough 10 may be created for use therewith.

[0022] Figure 3 is a schematic view of the cable trough 10 of the illustrating how two sections of the cable trough 10 are secured to one another. As can be seen in Figure 3, successive sections of cable trough 10 are laid end to end. One or more clips 40 are used to connect the respective bottom surfaces 18 and sidewalls 16 of the cable trough portions 10. The clips 40 are generally "H" shaped in profile having a central web 42 that connects first and second stringers 44 and maintains them in a generally parallel relationship with one another. These stringers 44 are spaced apart or otherwise constructed and arranged to resiliently clamp the sidewalls 16 of the respective cable trough portions therebetween. It is preferred to utilize a single clip 40 for each sidewall 16 and bottom 18 in order to connect the successive portions of cable trough 10. The assembly of the successive portions of cable trough 10 may be achieved without the use of tools, the clamping action of the clips 40 working in conjunction with the weight of

ballast typically placed on or around the cable trough 10 to maintain the cable trough 10 in its assembled state.

[0023] The method of assembling cable trough 10 comprises the steps of emplacing a first portion of cable trough in a predetermined position and emplacing a second portion of cable trough 10 in the second predetermined position adjacent the first portion of cable trough such that the end portions of the cable trough are adjacent one another. The clips 40 are attached to the end of the first portion of cable trough 10 and the end of the second portion of cable trough is then inserted into the remaining free ends of the clips 40 to secure the two portions of cable trough to one another. Note that this process is essentially the same for connecting straight portions of cable trough 10 as for connecting straight portions to connectors, or connectors to connectors. Once the portions of channel 12 have been secured to one another and the desired cabling has been placed therein, complementary covers 14 are placed onto the channels 12 of the cable trough 10 and secured thereto using connector bolts passed through countersunk bores 26 in the cover 14.

[0024] In order to achieve a suitable level of strength the channels 12 of the cable trough, and preferably the connectors as well, are produced using an extrusion method commonly referred to as pultrusion. Essentially, continuous strands of reinforcing fibers, typically glass, although other types of reinforcing fibers may be used, are coated or wetted with a heat-curable thermosetting polymeric resin and then pulled through a forming die. The forming die is heated so as to set and cure the resin in the desired shape. The benefit to using this pultrusion method is that the reinforcing fibers present within the sidewall 16 and bottom 18 of the channel, and also those reinforcing fibers present in the cover 14, run longitudinally through these structures, thereby creating a much more rigid structure. The uniformly oriented reinforcing fibers in the cable trough 10 result in greater ultimate strength, rigidity, and lower deflections. This greater strength and rigidity enables the cable trough to last longer than typical prior art cable troughs made of cast concrete or molded or extruded thermoplastics having randomly oriented reinforcing fibers incorporated thereinto. The increased strength not

only improves the cable trough's resistance to damage, but also results in a longer useful life for the cable trough 10, thereby greatly reducing its effective cost.

[0025] Given the flexible nature of the pultrusion process used to produce the cable trough 10, the geometry of the sidewalls 16, bottom 18 and cover 14 may be easily changed. This flexibility in manufacturing allows the cable trough 10 to be adapted for varying situations very rapidly and inexpensively. In addition, because the longitudinal orientation of the reinforcing fibers in the cable trough structures, there is a near exponential increase in the loading capacity of the cable trough 10 per unit increase in the thickness of the sidewall 16. This feature of the cable trough 10 allows relatively small changes in the geometry of the trough 10 to account for large variations in the manner in which the trough 10 may be used. This feature also allows this customization to be accomplished relatively inexpensively, as little extra material need be used to realize large increases in the strength of the trough 10.

[0026] Figures 4 and 5 illustrate another embodiment of a cable trough 50 having a top, such as a cover 52, which defines a channel 54. The channel 54 is also defined by a pair of generally vertical sidewalls 56 extending upwardly from and secured to a bottom, such as a base plate 58. Each of the vertical sidewalls 56 has on an inner surface thereof an inwardly extending lip 60 that may be formed continuously along the sidewall 56 or in certain predetermined location as desired. The lip 60 serves as a part of a closure mechanism that retains the cover 52 on the channel 54 once the cable trough 50 has been installed.

[0027] The cover 52 essentially comprises an elongate plate 62 that has a width and length that are commensurate in scope with the length and width of the channel 54. For example, in the particular embodiment illustrated in Figures 4 and 5, the plate 62 is approximately 10 inches (25.4 centimetres) wide and 120 inches (3.048 metres) long. The plate 62 has a pair of channel members 64 that extend downwardly from the plate 62 and that engage upper edges of the sidewalls 56. Note that the channel members 64 address both

sides of the upper edge of the sidewalls 56. In Figures 4 and 5, the cover 52 and channel 54 are shown in an assembled position.

[0028] In the embodiment shown in Figures 4 and 5, angled members 66 connect the sidewalls 56 and the bottom of the cable trough 50, *e.g.*, the base plate 58. In the illustrated embodiment, each angled member 66 is positioned at an angle of approximately 72° relative to the base plate 58 and at an angle of approximately 18° relative to the respective sidewall 56. These angles are not critical, however. For example, in another embodiment, each angled member 66 may be positioned at angles of approximately 45° with respect to both the base plate 58 and the respective sidewall 56. The angled members 66 add rigidity to the structure of the cable trough 50 and may reduce or prevent deflection of the sidewalls 56.

[0029] When the cover 52 has been seated firmly onto the channel 54, with the upper edges of the sidewalls 56 seated within the channel members 64 of the cover 52, one or more connector bolts may be passed downwardly through the cover 52 through countersunk bores (not shown in Figures 4 and 5) formed therein. The connector bolts (not shown in Figures 4 and 5) have a cam or other offset projection extending from a distal end thereof such that when the connector bolt is rotated, as by screwdriver or the like, to a closed position, the cam or projection will be positioned beneath the lip 60 of the sidewall 56. When in its closed position, the connector bolts will secure the top 52 to the channel 54 to complete the cable trough 50. As can be appreciated by those of ordinary skill in the art, electrical, mechanical, fiber optic, or another type of cabling may be laid in the channel 54 of the cable trough 50 before the cover 52 is placed thereon.

[0030] It should be understood that the cable trough 50 is not waterproof as such. Accordingly, in order to prevent the accumulation of water and ice inside the channel 54 of the cable trough 50, one or more drain holes (not shown in Figures 4 and 5) may be formed through the bottom of the trough to allow water to exit the channel 54.

[0031] It will be understood by those who practice the embodiments described herein and those skilled in the art that various modifications and

improvements may be made without departing from the spirit and scope of the disclosed embodiments. The scope of protection afforded is to be determined solely by the claims and by the breadth of interpretation allowed by law.

CLAIMS

What is claimed is:

1. A cable trough for containing cables, the cable trough of the type comprising an elongate channel (54) having a bottom (58) with a pair of sidewalls (56) formed continuously along a length of the bottom (58) and extending upwardly therefrom and a removable top (52) being operatively configured to engage upper edges of the sidewalls (56) and secured to the channel (54) to form an enclosed cable trough having a generally rectangular cross-section, the channel (54) and the top (52) of the cable trough being formed from longitudinally oriented reinforcing fibers coated with polymeric resin, the cable trough characterised by:
a first angled member (66) extending at an angle from a sidewall (56) to the bottom (58);
a connecting clip (40) having a central web (42) with a first edge and a second edge; and
a pair of stringers (44) connected to the first and second edges of the central web in a generally parallel relationship with one another and spaced apart by the web (42), the stringers (44) and the web (42) forming a pair of opposing mouths that are constructed and arranged to receive therein at least one of a sidewall (56), a bottom (58), and the top (52) of the cable trough.
2. The cable trough of claim 1, further comprising a second angled member (66) extending at an angle from the other sidewall (56) to the bottom (58).
3. The cable trough of claim 1, wherein the first angled member (66) extends at substantially a 45° angle from the sidewall (56) to the bottom (58).

4. The cable trough of claim 1, wherein the opposing mouths resiliently secure to distinct sections of cable trough so as to connect the distinct sections of cable trough to one another.
5. The cable trough of claim 1, wherein at least one of the sidewalls (56) comprises an inner surface with an inwardly extending lip (60) that serves as part of a closure mechanism.
6. The cable trough of claim 5, wherein the inwardly extending lip (60) is formed continuously along the sidewall (56).
7. The cable trough of claim 5, wherein the removable top (52) comprises a pair of channel members (64) extending downward therefrom that are formed to mate with the sidewall lip (60) as a part of the closure mechanism.
8. The cable trough of claim 1, wherein the cable trough is formed from generally uniformly longitudinally oriented glass reinforcing fibers coated within heat-curable thermosetting polymeric resin.
9. The cable trough of claim 1, wherein the elongate channel (54) comprises a substantially straight section.
10. The cable trough of claim 1, wherein the elongate channel (54) comprises a connector (30) having a tee shape and operatively configured to be interposed between substantially straight sections.
11. The cable trough of claim 1, wherein the elongate channel (54) comprises a connector (32, 34) having a bend shape and operatively configured to be interposed between substantially straight sections in order to run the cable trough around corners.

12. A cable trough assembly comprising a first cable trough section and a second cable trough section, each of the first and second cable trough sections of the type comprising an elongate channel (54) having a bottom (58) with a pair of sidewalls (56) formed continuously along a length of the bottom (58) and extending upwardly therefrom and a removable top (52) being operatively configured to engage upper edges of the sidewalls (56) and secured to the channel (54) to form an enclosed cable trough having a generally rectangular cross-section, the channel (54) and the top (52) of the cable trough being formed from longitudinally oriented reinforcing fibers coated with polymeric resin, wherein the improvement comprises:

a first angled member (66) extending at an angle from a sidewall (56) to the bottom (58);

a connecting clip (40) having a central web (42) with a first edge and a second edge; and

a pair of stringers (44) connected to the first and second edges of the central web in a generally parallel relationship with one another and spaced apart by the web (42), the stringers (44) and the web (42) forming a pair of opposing mouths that are constructed and arranged to receive therein at least one of a sidewall (56), a bottom (58), and the top (52) of the cable trough,

wherein the first cable trough section is coupled to the second cable trough section with at least one connecting clip (40) interposed between the first and second cable trough sections.

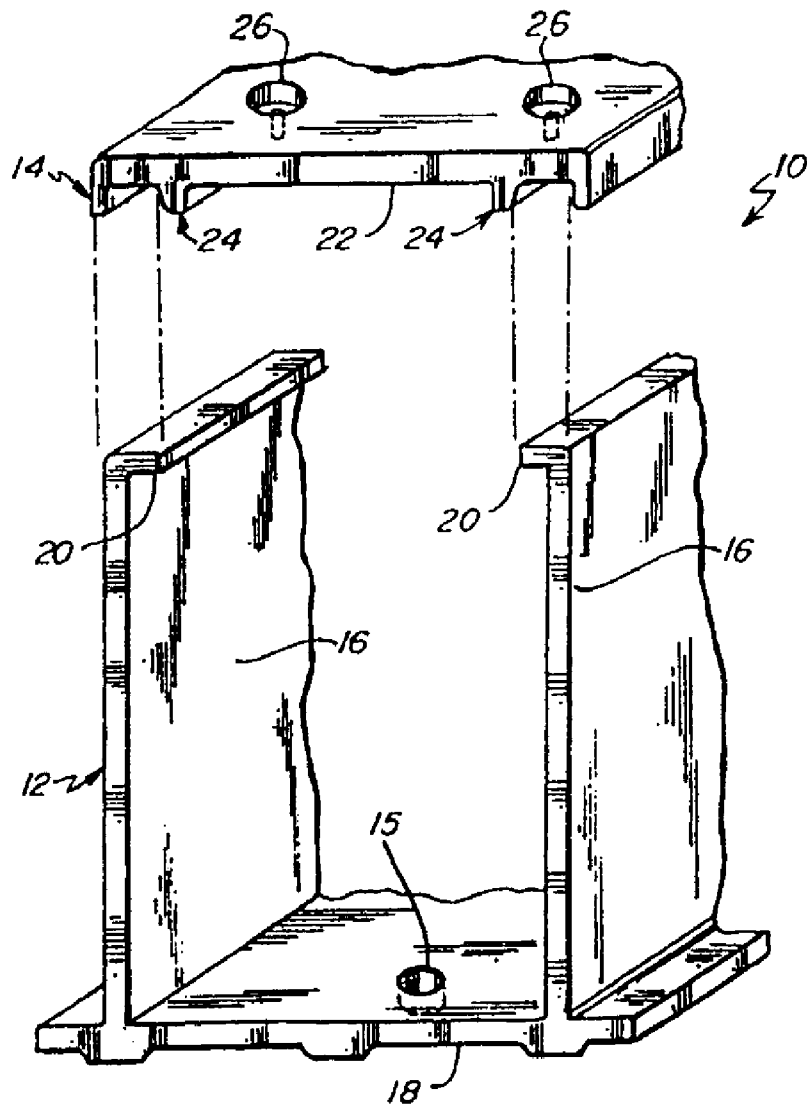


Fig.1.

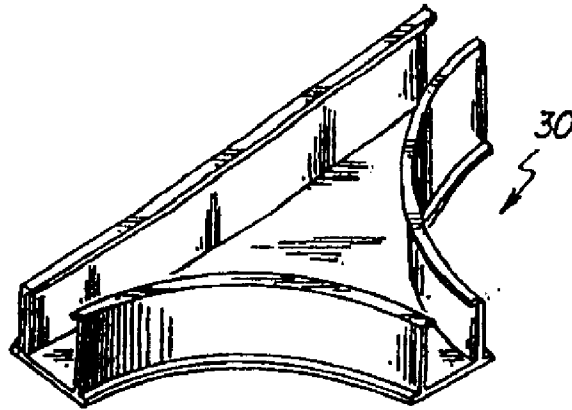


Fig. 2a.

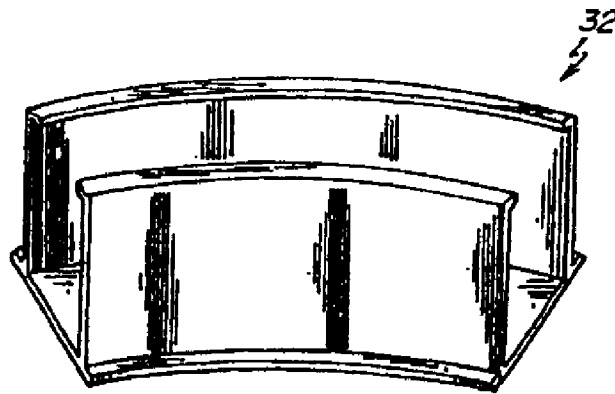


Fig. 2b.

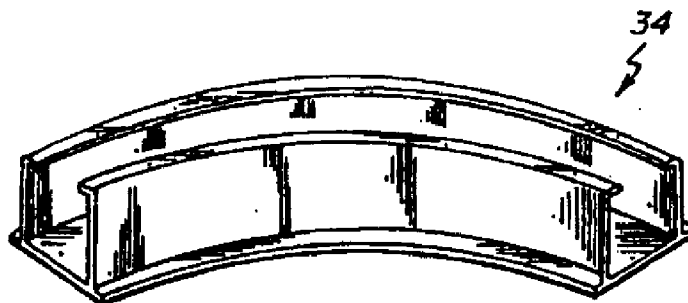


Fig. 2c.

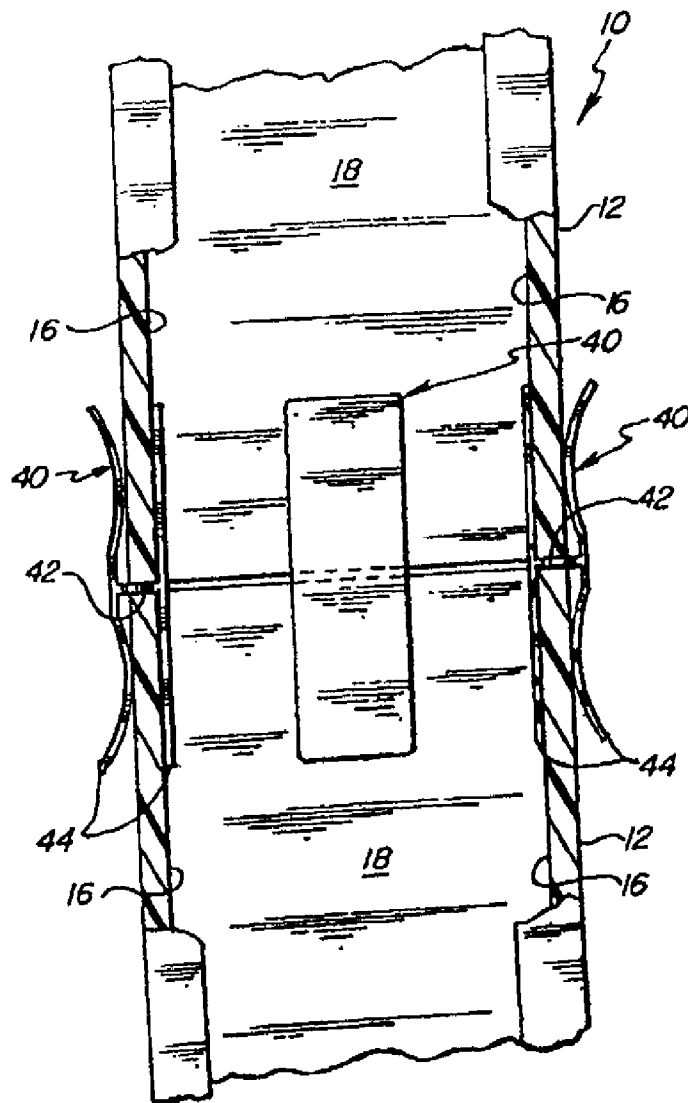


Fig. 3.

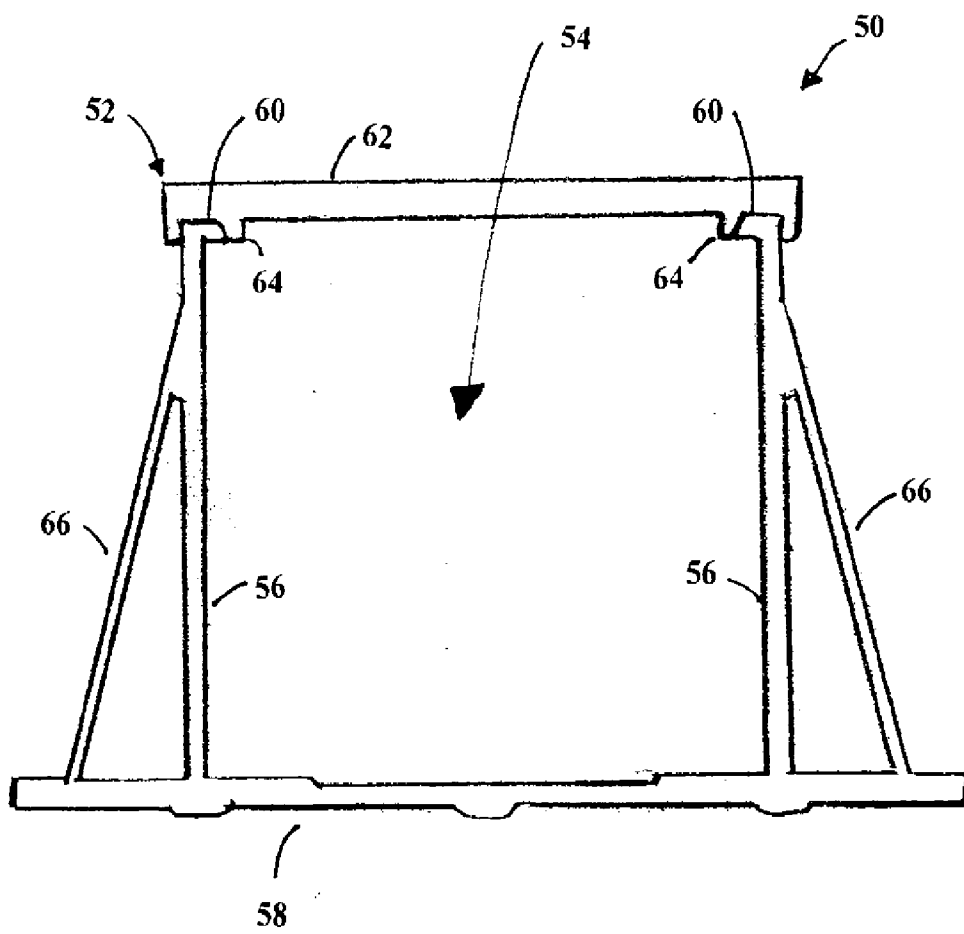


Fig. 4

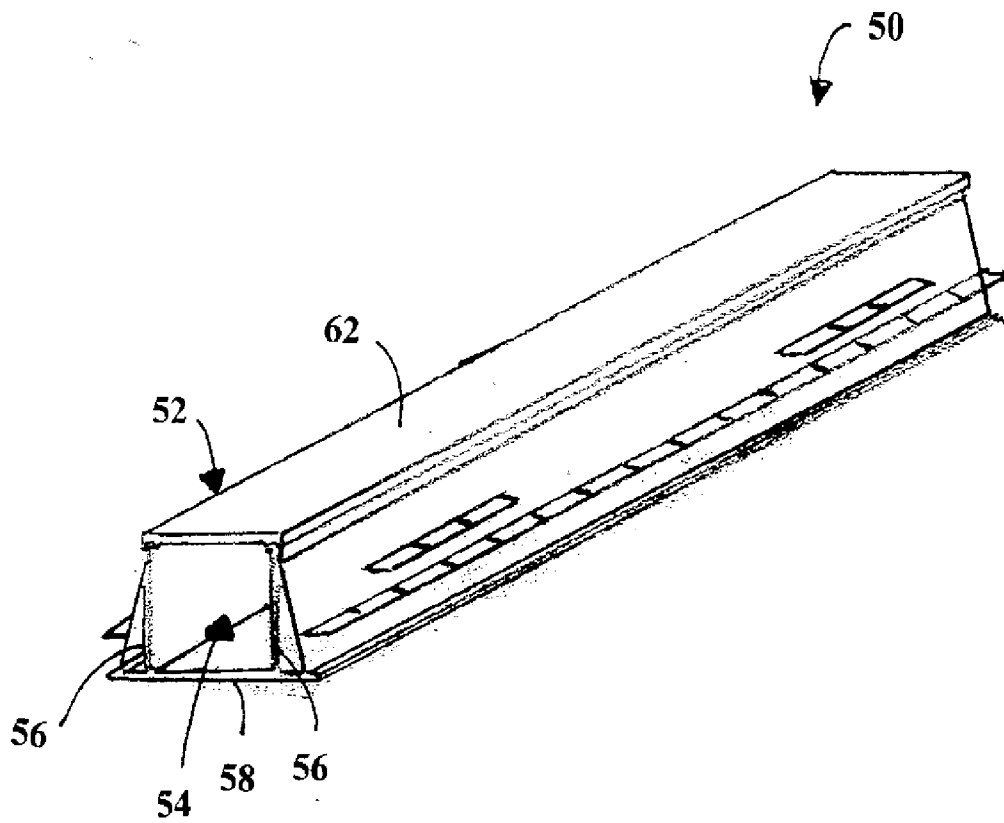


Fig. 5