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(71) Applicant: SHIMIZU CONSTRUCTION Co. LTD.
16-1, Kyobashi 2-chome
Chuo-ku Tokyo 104(JP)

(72) Inventor: Sato, Takanori Shimizu Construction Co. Ltd.
16-1 Kyobashi 2-chome
Chuo-ku Tokyo(JP)

(72) Inventor: Nakajima, Hideo Shimizu Construction Co. Ltd.
16-1 Kyobashi 2-chome
Chuo-ku Tokyo(JP)

(72) Inventor: Watanabe, Yasushi Shimizu Construction Co. Ltd.
16-1 Kyobashi 2-chome
Chuo-ku Tokyo(JP)

(72) Inventor: Nakamura, Yasukazu Shimizu Construction Co. Ltd.
16-1 Kyobashi 2-chome
Chuo-ku Tokyo(JP)

(74) Representative: Arthur, Bryan Edward et al,
Withers & Rogers 4 Dyer's Buildings Holborn
London EC1N 2JT(GB)

(54) Filler filled steel tube column.

(57) A filler filled steel tube column including: a steel tube having an inner face; a core made of the filler and disposed within the steel tube; and a first separating layer, interposed between said inner face of the steel tube and said core, for separating the core from the inner face of the steel tube so that the steel tube is not bonded to the core. The steel tube includes a pair of tube pieces coaxially aligned with their adjacent ends spaced apart, so that a ring-shaped gap is formed between the adjacent ends of the tube pieces. The gap absorbs the axial strain in the steel tube by reducing its axial width when the steel tube is subjected to an axial compressive load, thereby inhibiting axial strain from being brought into the tube pieces. In the view of Mieses's yield conditions, lateral confinement of the steel tube which is provided on the core is enhanced.

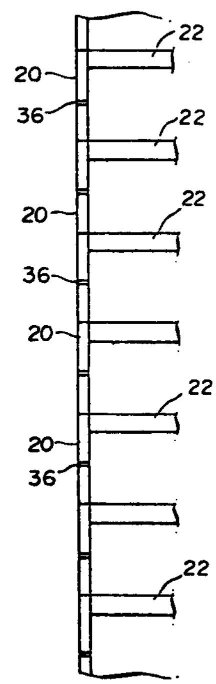

FIG.1

EP 0 214 800 A2

Croydon Printing Company Ltd.

FILLER FILLED STEEL TUBE COLUMN

BACKGROUND OF THE INVENTION

This invention relates to a filler filled steel tube column which may be used for columns and piles of building structures.

Heretofore, this type of steel tube column, such as those concrete filled, is constructed by erecting a steel tube which also serves as a framework other than a casing and then by filling the steel tube with concrete to form a concrete core. Because the steel tube and the concrete core are bonded to each other, they move in singular alignment when axial compression is applied to the steel encased concrete column. When the concrete column is subjected to an axial compression beyond a predetermined compression strength, excess strains develop in the steel tube and the concrete core, resulting in a local buckling in the steel tube or in that the steel tube reaches an yield area under Mieses's yield condition. Thus, the steel tube does not provide the concrete core with sufficient confinement, which causes the concrete core to reach a downward directed area of the stress-strain curve at a load applied considerably lower than a predetermined load. For this reason, it cannot be expected to efficiently enhance the concrete core in compression strength by the lateral confinement of the steel tube and hence a relatively large cross-sectional area must be given to the concrete filled steel tube column to provide sufficient strength to it.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a filler filled steel tube column which efficiently enhance the core in compression strength thereby enabling a considerable reduction in the cross-section thereof as compared to the prior art column.

Another object of the present invention is to provide a filler filled steel tube column capable of resisting the axial tensile load due to the overturning moment of the whole building caused, for example, by an earthquake and thus to effectively enhance the building in rigidity.

With these and other objects in view the present invention provides a filler filled steel tube column including: a steel tube having an inner face; a core made of the filler and disposed within the steel tube; and a first separating layer, interposed between said inner face of the steel tube and said core, for separating the core from the inner face of the steel tube so that the steel tube is not bonded to the core. Moreover, the steel tube includes a pair of tube pieces coaxially aligned with their adjacent ends spaced apart forming a ring-shaped gap between the adjacent ends of the tube pieces. This gap absorbs the axial strain in the steel tube by reducing its axial width when the steel tube is subjected to an axial compressive load, thereby inhibiting axial strain from being brought into the tube pieces. Thus, in the view of Mieses's yield conditions, lateral confinement of the steel tube which is provided on the core is enhanced.

Preferably, the steel tube includes spacing means, interposed between the adjacent ends of the tube pieces, which retains the gap between the adjacent ends of the tube pieces while allowing the gap to reduce its axial width. The spacing means may be composed of a ring-shaped matrix fitting concentrically into the ring-shaped gap, and an elongated element embedded within the matrix along the circumferential direction of the matrix to form a coil within the matrix.

It is more preferable that the steel tube includes means for coupling the tube pieces coaxially in series while allowing the tube pieces to be axially movable in relation to each other.

The coupling means may be a pipe coupling which fits around both adjacent ends of the tube pieces. The pipe coupling may include, a pipe body defining a space between its inner surface and the tube pieces, an inner layer made of the filler and disposed within the space, and a second separating layer interposed between the inner layer and at least one of the tube pieces.

Otherwise, the coupling means may be a joining tube one end portion of which is coaxially joined to the inner face of one of the tube pieces and the other end portion of which fits coaxially to the inner face of the other tube piece so that the joining tube is axially slidable in relation to the other tube piece. Means for transferring an axial load exerted on one of the tube pieces to said core may be mounted on the joining tube. The load transfer means, preferably, is an inner flange circumferentially joined to one of the opposite ends of the joining tube and projecting radially inwards. It is also preferable that the joining tube has an axially pliant member which is circumferentially disposed on the upper end of the joining tube. This pliant member reduces the axial compressive load exerted from the core to the joining tube.

The steel tube may include fastening means for allowing the tube pieces to approach each other and preventing them from going away from each other. This fastening means may have a pair of outer flanges circumferentially joined to the adjacent ends of the tube pieces respectively, and a plurality of engaging members. The outer flanges project radially outwards and face each other, thus, each of the outer flanges has an inner facing surface and an outer surface. Each of the engaging member has opposite end portions which are in direct contact with the outer surfaces of the outer flanges respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary view of a building framework having a plurality of filler filled steel tube columns according to the present invention;

FIG. 2 is a enlarged fragmentary axial-sectional view of the steel tube column in FIG. 1;

FIG. 3 is a perspective view partially cutaway of the spacing ring in FIG. 2;

FIG. 4 is a fragmentary axial-sectional view of another embodiment of the present invention;

FIG. 5 is a view taken along the line V-V in FIG. 4;

FIG. 6 is a cross-sectional view of a modification of the steel tube column in FIG. 5;

FIG. 7 is a fragmentary view partly in section of another building framework having still another embodiment according to the present invention;

FIG. 8 is a enlarged fragmentary axial-sectional view of the steel tube column in FIG. 7;

FIG. 9 is a fragmentary axial-sectional view of a modified form of the steel tube column in FIG. 8;

FIG. 10 is a fragmentary axial-sectional view of another modified form of the steel tube column in FIG. 8;

FIG. 11 is a fragmentary axial-sectional view of still another modified form of the steel tube column in FIG. 8;

FIG. 12 is a fragmentary axial-sectional view of a further embodiment according to the present invention; and

FIG. 13 is a fragmentary axial-sectional view of a modified form of the steel tube column in FIG. 12.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawings, like reference characters designate corresponding parts throughout views, and descriptions of the corresponding parts are omitted after once given.

FIG. 1 illustrates a part of a building framework according to the present invention. This framework has a plurality of steel tube columns 20 concentrically joined in series, and a plurality of steel beams 22, each joined at its inner end to the upper end of each column 20. Each column 20 includes, as shown in FIG. 2, a steel tube 24 coated over its inner face 24a with a separating layer 26, and a core 28 disposed within the steel tube 24. The separating layer 26 may be made of a separating material, such as asphalt, grease, paraffin wax, petrolatum, oil, synthetic resin and paper. The core 28 is made of a filler, such as concrete, mortar, sand, soil, clay, glass particles, metal powder, and synthetic resin, which achieves high compressive strength when it is consolidated. The separating layer 26 serves to separate the steel tube 24 from the core 28 so that the core 28 is not bonded to the steel tube 24.

As shown in FIG. 2, the steel tube 24 includes a pair of tube pieces 30 and 32 both made of steel and both having circular cross-sections of the same size. The thickness of each of the tube pieces 30 and 32 is in the range of 1/500 to 1/10 of its outer diameter. These tube pieces 30 and 32 are coaxially aligned and are spaced apart so that a ring-shaped gap 36 is formed between the adjacent ends 30a and 32a of the tube pieces. In FIG. 1, the gap 36 is placed at an intermediate point, i.e. at the inflection point of moment of each of the columns 20, Therefore, by reducing its axial width W, the gap 36 absorbs the axial strain which develops in the steel tube 24 of each of the columns 20 when the columns 20 undergo an axial compressive load. The axial width W of the gap 36 is preferably in the range of a maximum axial strain of the steel tube 24, which is caused by the overturning moment of the building.

The steel tube 24 also includes a spacing ring 34 having an equal inner diameter to the tube pieces 30 and 32. This spacing ring 34 fits coaxially into the gap 36 so that the gap 36 is substantially retained between the tube pieces 30 and 32. In FIG. 3, the spacing ring 34 consists of a ring-shaped matrix 38 and an elongated element 40 which is embedded within the matrix 38 along the circumferential direction of the matrix 38 to form a coil in the matrix. The matrix 38 may be made of rubber, vinyl chloride resin or polyetheretherketone resin so as to achieve a lower compressive strength and a lower rigidity than the tube pieces 30 and 32. The elongated element 40 may be made of aramide fiber, glass fiber or carbon fiber so as to achieve almost as high tensile strength as the tube pieces. Consequently, the spacing ring 34 promotes both high circumferential and radial tensile strength as well as axial flexibility. That is, the ring 34 allows the gap 36 to reduce its axial width W and also provides the core 28 with a lateral confinement when an axial compressive load is applied on the column 20. The thickness of the ring 34 may be determined according to the compressive strength of the tube pieces 30 and 32.

Returning to FIG. 2, the spacing ring 34 has its upper and lower end portions 34a and 34b which have a smaller outer diameter than the main portion of the ring 34. The tube pieces 30 and 32 are provided at their adjacent ends 30a and 32a respectively with recesses 42 and 44 which extend circumferentially in the inner faces of the tube pieces 30 and 32. The spacing ring 34 is engaged with both the tube pieces 30 and 32 by inserting its upper and lower end portions 34a and 34b respectively into the recesses 42 and 44 of the tube pieces.

In the presence of the separating layer 26, the steel tube 24 is axially movable relative to the core 28. Therefore, when the core 28 undergoes axial compression, the steel tube 24 follows the core 28 with a much smaller degree of axial strain than the prior art steel tube bonded to its core. Moreover, the gap 36 absorbs the axial strain in the steel tube 24 by reducing its axial width W. In other words, the steel tube 24 reduces its axial length by deforming only the spacing ring 34, when the axial compression is exerted on it. Therefore, the axial strain is hardly brought into the tube pieces 30 and 32 even though it develops in the core 28. This means that the steel tube 24 increases its strength against the circumferential stress which develops in it due to transverse strain of the core 28, thus, in the view of Mieses's yield conditions, enhancing lateral confinement of the steel tube 24 which is provided on the core 28. As a result, the compression strength of the core 28 is efficiently enhanced thereby enabling a considerable reduction in the cross-section of the column 20 as compared to the prior art column.

FIG. 4 illustrates another embodiment of the present invention, in which a steel tube 46 has a pipe coupling 48 which couples tube pieces 50 and 52 in series. The pipe coupling 48 includes a pipe body 54 which surrounds both the adjacent ends 50a and 52a of the tube pieces 50 and 52 to define an annular space 56 between its inner face 54a and the tube pieces (see FIG. 5). An inner layer 58, made of concrete in this embodiment, is disposed within the annular space 56 to fill out the space, and a separating layer 60 is interposed between the inner layer 60 and the tube pieces 50 and 52 so that the inner layer is not bonded to the tube pieces 50 and 52. The separating layer 60 may be made of the same separating material as that used in FIG. 2. An annular packing 62 fits in the lower end of the pipe body 54 and around the tube piece 52 to close the lower opening of the space 56. In the presence of the pipe coupling 48, the steel tube 46 increases its mechanical strength and still reduces its axial length by reducing the width of the gap 36 when the axial compression is exerted on it. In this embodiment, a spacing ring 64 which is made of only flexible material such as rubber fits concentrically into the gap 36, and a plurality of reinforcements 66 are axially embedded within a core 68. The core 68 may be made of hydraulic material such as concrete. The upper tube piece 50 is provided at its adjacent end portion with a plurality of through holes 70. When concrete is being filled into the tube piece 50, the concrete passes through the holes 70 out of the tube piece 50 thereby filling the annular space 56 at the same time that it forms the core 68.

The separating layer 60 may be interposed between the inner layer 58 and one of the tube pieces 50 and 52 instead of being interposed between the inner layer and both the tube pieces. A pipe body directly fitting around both adjacent ends 50a and 52a of tube pieces 50 and 52 may be employed in place of the pipe body 54. Prestressed reinforcements may be employed in place of the reinforcements 66. Further more, in place of the spacing rings in FIG. 2 and 4, a plurality of block-shaped spacers made of flexible material may be interposed between the tube pieces at equal angular intervals around the axis of the tube pieces. Tube pieces having a polygonal cross-section, such as a tube piece 72 having an octagonal cross-section as shown in FIG. 6, may be employed in place of the tube pieces in FIG. 2 and 4.

FIGS. 7 and 8 show still another embodiment of the invention. In FIG. 7, a plurality of columns 74 are joined in series to form a building framework. Each column 74 has a steel tube 76 to the upper end portion of which a plurality of steel beams 78 are welded. The steel beams 78 of each column 74 are to support each floor slab of the building subsequently. As illustrated in FIG. 8, the steel tube 76 of every three columns 74 includes, a pair of tube pieces 80 and 82, and a joining tube 84 which couples the tube pieces 80 and 82 concentrically in series. The upper tube piece 80 consists of, a tube piece body 86, and a ring-shaped tube 88 coaxially welded at its upper end to the lower end of the tube piece body 86. That is, ring-shaped tube 88 forms the adjacent end portion of the upper tube piece 80. The joining tube 84 is joined coaxially at its upper end portion 90 to the inner face 80a of the upper tube piece 80, and fits its lower end portion 92 coaxially to the inner face 82a of the lower tube piece 82. Between the lower end portion 92 of the joining tube 84 and the inner face 82a of the lower tube piece 82, a lubricating layer 94 made of antifriction material such as tetrafluoroethylene is interposed so that the joining tube 84 is axially slidable in relation to the lower tube piece 82. Furthermore, joining tube 84 is welded circumferentially at its lower end 84a with an inner flange 96 which project radially inwards so that an axial load applied to the upper tube piece 80 is transferred via the flange 96 to the core 28.

In assembling the steel tube column in FIG. 8, the joining tube 84 is coaxially welded to the inner face of the ring-shaped tube 88 before or after the inner flange 96 is welded to it in a assembling factory. The ring-shaped tube 88 is then welded at its upper end to the lower end of the tube piece body 86. Thereafter, the upper tube piece 80 with the joining tube 84 thus prepared is brought into a construction site and is coupled with the lower tube piece 82 which has already been erected there so that the gap 36 is defined between the tube pieces 80 and 82. Then, a concrete is charged into the steel tube 76 (i.e. the tube pieces 80 and 82 and the joining tube 84) and cured. Alternatively, the ring-shaped tube 88 with joining tube 84 is coupled to the lower tube piece 82 at the construction site, and then the tube piece body 86 is welded at its lower end to the ring-shaped tube 88 as a process preceding the concrete filling process. In either of these assembling methods, spacing instruments for retaining the gap 36 between the tube pieces 80 and 82 are required. For example, these instruments may be spacers which are attached with the capacity of being detached between the adjacent ends 80a and 82a of the tube pieces or the spacing rings like those shown in FIGS. 2 and 4. Otherwise, the tube pieces 80 and 82 are coupled together with their adjacent ends in contact with each other, and after the concrete is charged and cured either of the adjacent end portions are cut off so that the gap 36 is formed between them. Careful operation is required upon cutting off the end portion so as not to damage the joining tube 84.

In the construction in FIG. 7, shearing force from the beams 78 is transferred to each steel tube 76 to which the beams 78 are joined. Then, the shearing force in the three continuous steel tubes 76 between two joining tubes 84 is transferred via the inner flange 96 of the lower joining tube 84 to the core 28 without being transferred to steel tubes 76 aligned lower than the gap 36. In other words, the steel tube 76 is subjected to the shearing force (an axial compressive force) transferred from the beams 78 of only three columns. That is, the steel tube 76 undergoes much less axial compressive force than the prior art steel tube, which enhances lateral confinement of the steel tube 76 provided on the core 28.

A modified form of the steel tube column in FIG. 8 is illustrated in FIG, 9, in which a joining tube 98 and a ring-shaped tube 100 are molded into a unitary construction. An inner flange 102 and the joining tube 98 are also molded together, otherwise the inner flange 102 is welded to the joining tube 98. The column with this construction is easy to assemble since the process of joining the joining tube to the ring-shaped tube is omitted. A ring-shaped tube integral with the tube piece body 86 may be employed in place of the tube 100.

Another modified form of the column in FIG. 8 is shown in FIG. 10, in which the joining tube 84 is circumferentially provided at its upper end 84b with a pliant member 104. This member 104 is made of, for example, rubber so as to reduce an axial compressive load exerted from the core 28 to the joining tube 84. As shown in FIG. 11, a ramp 106 may be formed at the upper end 84b of the joining tube 84 in place of the pliant member 104, . This ramp 106 is inclined to a plane perpendicular to the axis of the joining tube 84 to converge toward the lower end of the joining tube.

FIG. 12 illustrates another embodiment of the invention, in which the tube pieces 80 and 82 are circumferentially welded at their adjacent ends 80b and 82b with a pair of outer flanges 108 and 110 respectively. These outer flanges 108 and 110 project radially outwards facing each other and have a plurality of screw rods 112 which pass loosely through both of them at equal angular intervals around their axis. The opposite end portions 112a and 112b of each of the rods 112 are threadedly engaged with a pair of nuts 114 and 116 respectively and thereby brought into firm contact with the outer surfaces 108a and 110a of the outer flanges respectively through the nuts 114 and 116. This construction prevents the tube pieces 80 and 82 from going away from each other while allowing them to approach each other. Accordingly, the column in this embodiment is capable of resisting an axial tensile load due to the overturning moment of the building caused by short time loading such as seismic force and thus enhancing the building in rigidity and durability. In addition, each of the outer flanges 108 and 110 has a plurality of reinforcing ribs 118 mounted on it at equal angular intervals around its axis. The ribs on the upper flange 108 are welded at their lower edges to the outer surface 108a of the flange 108 and welded at their radially inner edges to the outer face of the upper tube piece 80. On the other hand, the ribs 118 on the lower flange 110 are welded at their upper edges to the outer surface 110a of the flange 110 and at their radially inner edges to the outer face of the lower tube piece 82. That is, the ribs 118 joins the outer surfaces 108a and 110a of the outer flanges to the outer faces of the tube pieces 80 and 82 respectively so that the flanges 108 and 110 are reinforced against an axial load.

In assembling the steel tube column in FIG. 12, the joining tube 84, ring-shaped tube 88, the inner flange 96, the outer flange 108, ribs 118, and the pliant member 104 are joined together in a steel assembling factory, and then the tube piece body 86 is welded to the ring-shaped tube 88. This upper tube piece 80 with the other joined members is then brought into a construction site and coupled with the lower tube piece 82 welded with the outer flange 110, which has already been erected there. Upon this coupling process, spacers (not shown) may be interposed between the flanges 108 and 110 so that the ring-shaped gap 36 is retained between the flanges. Thereafter, the nuts 114 and 116 engaging with the screw rods 112 are attached to the outer flanges 108 and 110. Finally, a concrete is charged into the tube pieces 80 and 82 and the joining tube 84, and after the concrete is cured, the spacers are removed from the gap 36. As the columns are joined longer, the steel tubes undergo more compressive load thereby reducing the axial width W of the gap 36. In this case, the threaded connection between each of the screw rods 112 and the nuts 114 and 116 must be retightened so that the nuts are brought again into direct contact with the outer surfaces 108a and 110a of the flanges 108 and 110.

The tube piece body 86 may be welded to the ring-shaped tube 88 after the ring-shaped tube 88 with the other joined members is coupled with the lower tube piece 82 and the screw rods 112 are attached to the flanges 108 and 110. In another way, the concrete may be charged into the lower tube piece 82 before the upper tube piece 80 or the ring-shaped tube 88 is coupled with the lower tube piece 82. In case the spacer is made of flexible material, it may be kept in the gap 36 even after the concrete is cured. In place of the spacers, another pair of nuts may be threadedly engaged with each of the screw rods 112 so as to be in direct contact with the inner facing surfaces 108b and 110b of the flanges 108 and 110 respectively.

FIG. 13 shows a modified form of the column in FIG. 12, in which the lower tube piece 122 consists of, a tube piece body 124, and a ring-shaped tube 126 coaxially welded at its lower end to the upper end of the tube piece body 124. That is, ring-shaped tube 126 forms the adjacent end portion of the lower tube piece 122. The joining tube 84 is joined coaxially at its lower end portion 92 to the inner face 122a of the lower tube piece 122, and fits coaxially its upper end portion 90 to the inner face 120a of the upper tube piece 120. Between the upper end portion 90 of the joining tube 84 and the inner face 120a of the upper tube piece 120, a lubricating layer 94 is interposed so that the joining tube 84 is axially slidable in relation to the upper tube piece 120. Furthermore, joining tube 84 is welded at its upper end 84b circumferentially with an inner flange 96 so that an axial load applied to the lower tube piece 122 is transferred via the flange 96 to the core 28. The pliant member 104 is circumferentially attached on top of the inner flange 96.

In the construction in FIG. 13, shearing force from the beams which is joined to the lower tube piece 122 is transferred to the lower tube piece 122. Then, the shearing force in the lower tube piece 122 is transferred via the inner flange 96 to the core 28. Shearing force in the upper tube piece 120 is not transferred to the lower tube piece 122 because of the gap 36. That is, according to the same reason as the embodiment in FIG. 8, lateral confinement of the tube pieces 120 and 122 which is provided on the core 28 is enhanced.

In place of the inner flange 96, a cross-shaped member may be welded at its ends to one of the opposite ends 84a and 84b of the joining tube 84. This cross-shaped member is formed, for example, by a pair of steel bars perpendicularly welded to each other to form a cross shape. The inner flange 96 as well as the cross-shaped member may be welded to the inner face of the joining tube 84 instead of being welded to one of the opposite ends of the joining tube 84. Also, the outer flanges 108 and 110 may be welded to the outer faces of the tube pieces instead of being welded to the adjacent ends of the tube pieces. A pliant member made of foam polystyrene or clay may be employed in place of the pliant member 104.

It is understood that although preferred embodiments of the present invention have been shown and described, various modifications thereof will be apparent to those skilled in the art, and, accordingly, the scope of the present invention should be defined only by the appended claims and equivalents thereof.

CLAIMS:

1. A filler filled steel tube column comprising:

a steel tube having an inner face;

a core made of the filler and disposed within said steel tube; and

a first separating layer, interposed between said inner face of the steel tube and said core, for separating the core from the inner face of the steel tube so that the steel tube is not bonded to the core;

said steel tube including a pair of tube pieces coaxially aligned with adjacent ends thereof spaced apart so that a ring-shaped gap is formed between the adjacent ends of said tube pieces, said gap absorbing the axial strain in the steel tube by reducing the axial width thereof when the steel tube is subjected to an axial compressive load.

2. A filler filled steel tube column as recited in Claim 1, wherein said steel tube further includes spacing means, interposed between said adjacent ends of the tube pieces, for retaining said gap between said adjacent ends of the tube pieces while allowing the gap to reduce the axial width thereof when the steel tube is subjected to an axial compressive load.

3. A filler filled steel tube column as recited in Claim 2, wherein said spacing means comprises: a ring-shaped matrix fitting concentrically into said ring-shaped gap, said matrix having a lower compressive strength and a lower rigidity than the tube pieces; and an elongated element embedded within the matrix along the circumferential direction of the matrix to form a coil

within the matrix, said elongated element having approximately as high tensile strength as the tube pieces.

4. A filler filled steel tube column as recited in Claim 1 or 2, wherein said steel tube further includes means for coupling said tube pieces coaxially in series while allowing the tube pieces to be axially movable in relation to each other.

5. A filler filled steel tube column as recited in Claim 4, wherein said coupling means comprises a pipe coupling, fitting around both said adjacent ends of the tube pieces while being axially slidable relative to at least one of the tube pieces.

6. A filler filled steel tube column as recited in Claim 5, wherein said pipe coupling includes: a pipe body having an inner surface, said pipe body defining a space between said inner surface thereof and said tube pieces; an inner layer made of the filler and disposed within said space; and a second separating layer interposed between said inner layer and at least one of the tube pieces.

7. A filler filled steel tube column as recited in Claim 4, wherein each of said tube pieces has an inner face, and wherein said coupling means comprises: a joining tube having one and the other end portions, said one end portion being coaxially joined to the inner face of one of the tube pieces, the other end portion fitting coaxially to the inner face of the other tube piece so

that the joining tube is axially slidable in relation to the other tube piece; and load transfer means, mounted on the joining tube, for transferring an axial load exerted on one of the tube pieces to said core.

8. A filler filled steel tube column as recited in Claim 7, wherein said load transfer means comprises an inner flange circumferentially joined to one of the opposite ends of said joining tube to project radially inwards.

9. A filler filled steel tube column as recited in Claim 8, wherein said coupling means has an upper end and wherein said coupling means further comprises a pliant member being axially pliant, said pliant member circumferentially disposed on the upper end of the coupling means for reducing an axial compressive load exerted from said core to said joining tube.

10. A filler filled steel tube column as recited in Claim 1, 2, 3, 7, 8 or 9, wherein said steel tube further comprises means for fastening said tube pieces to each other while allowing the tube pieces to approach each other but preventing the tube pieces from going away from each other, said fastening means comprising: a pair of outer flanges circumferentially joined to the adjacent ends of the tube pieces respectively, said outer flanges project radially outwards and face each other, each of the outer flanges having an inner facing surface and an outer surface; and a plurality of engaging members, each

having opposite end portions, said opposite end portions being in direct contact with the outer surfaces of said outer flanges respectively.

FIG.1

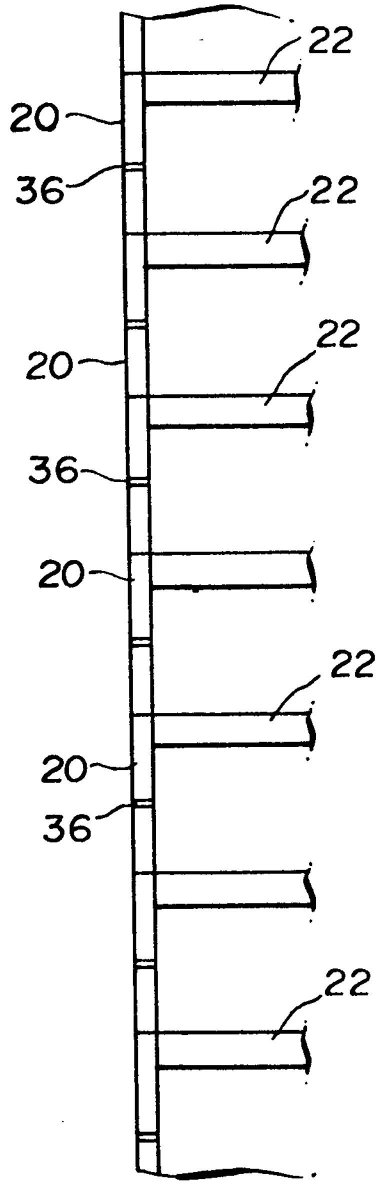

FIG.2

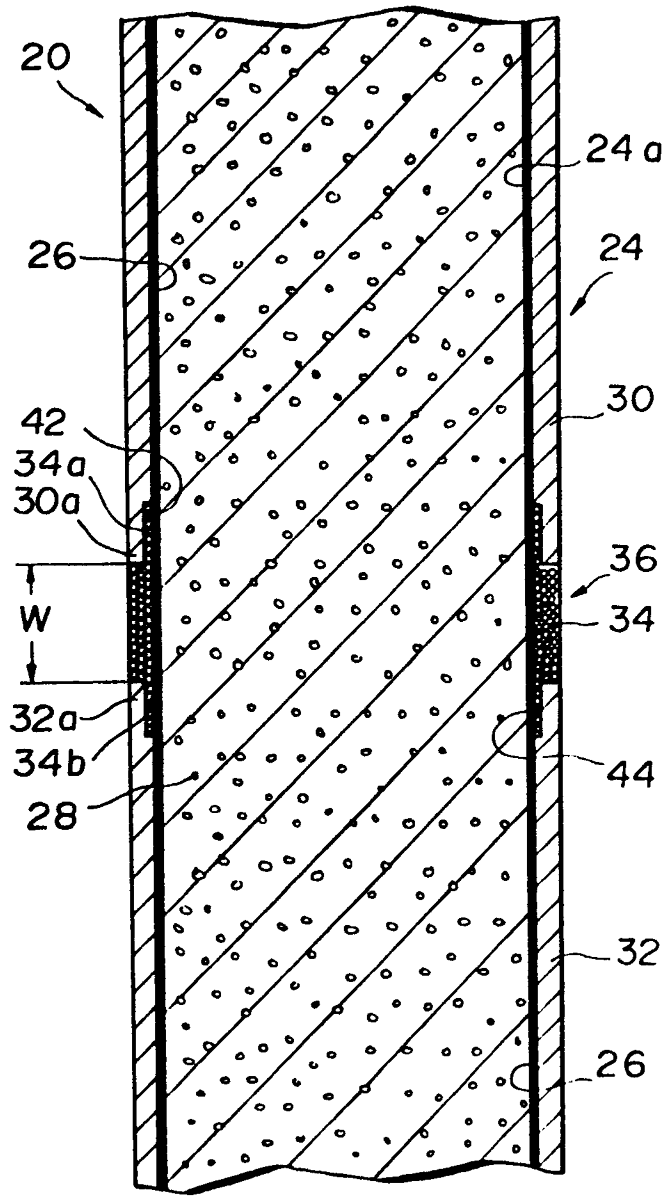

FIG.3

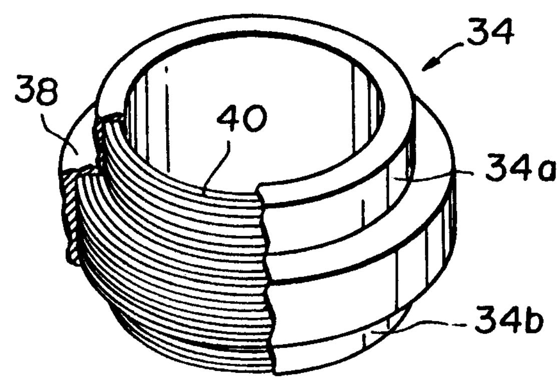

FIG.4

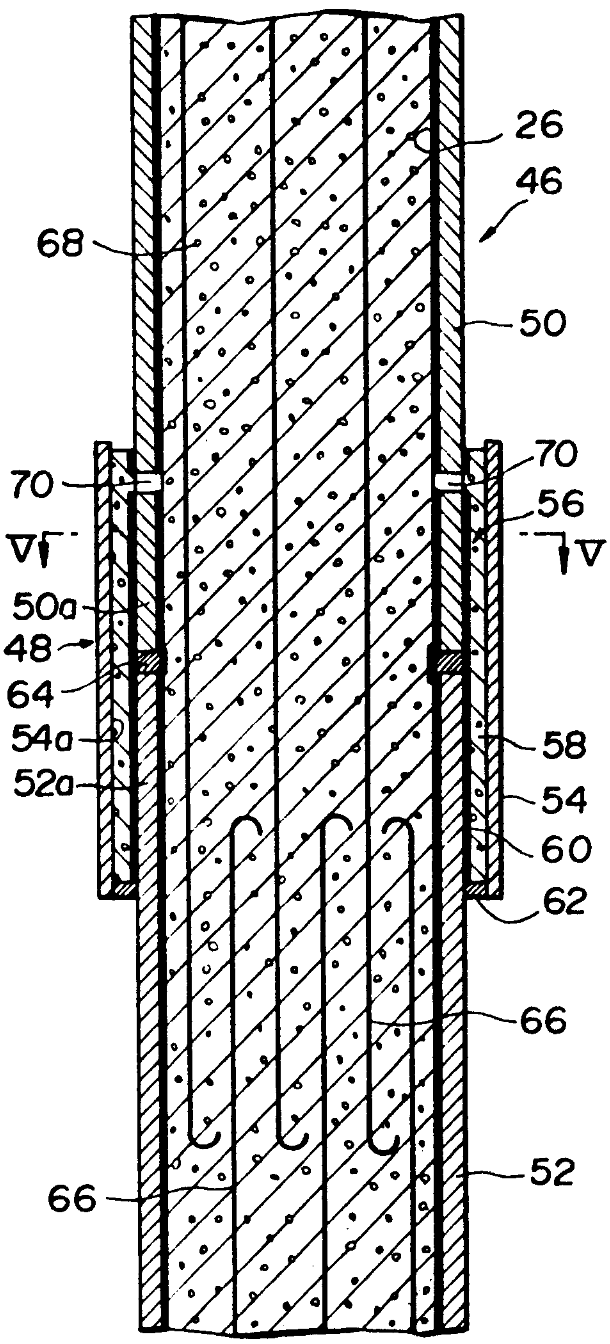

FIG.5

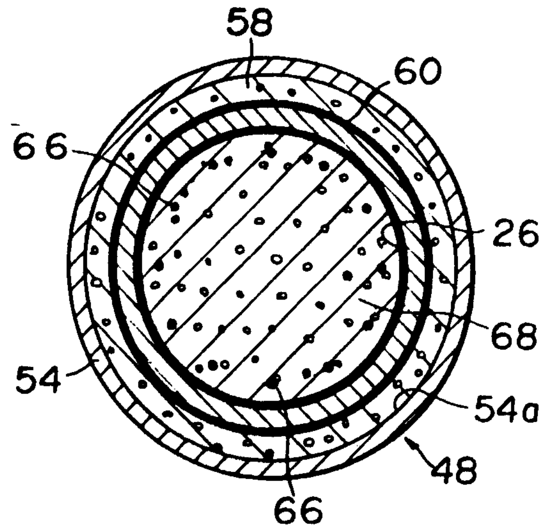

FIG.6

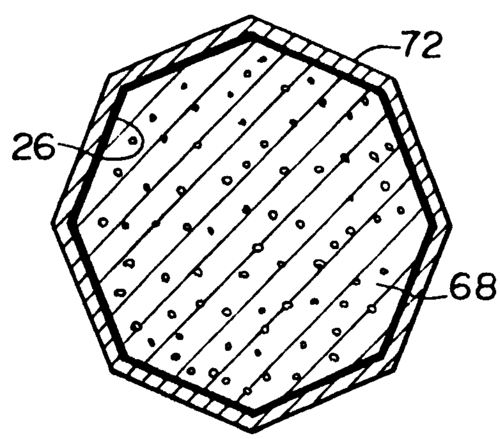

FIG.7

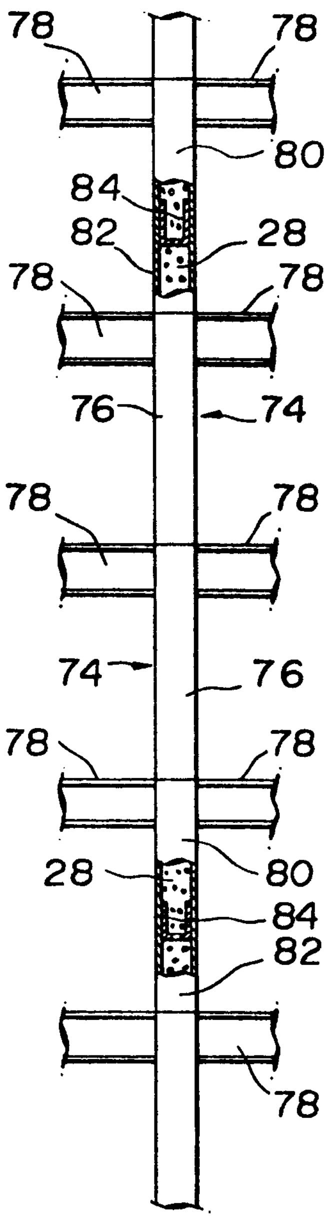
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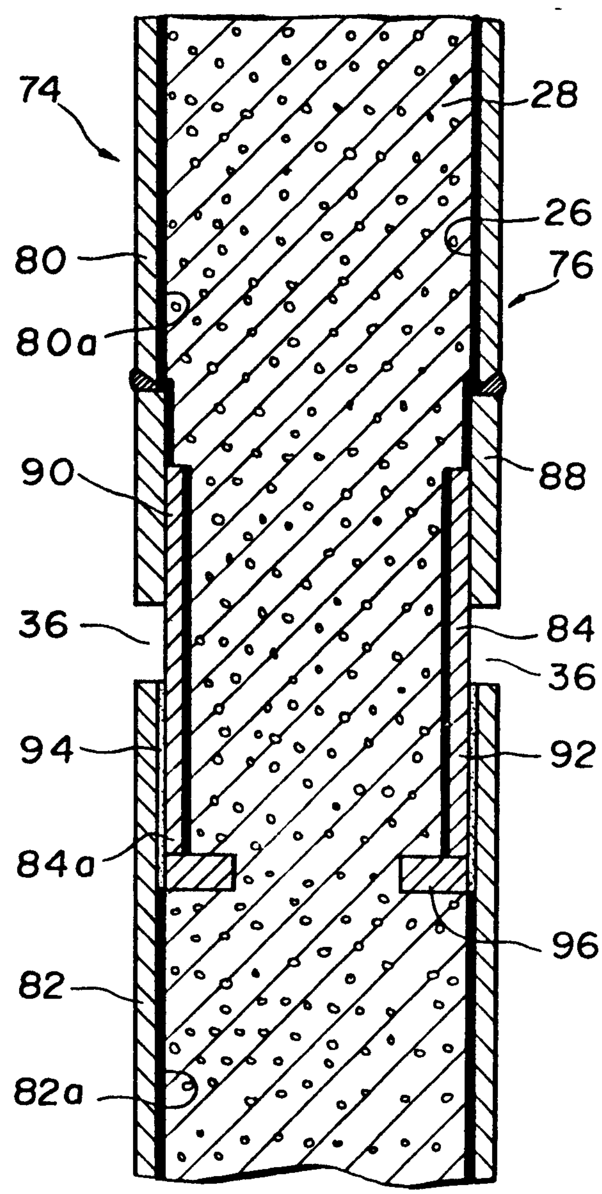
FIG.8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82a

FIG. 9

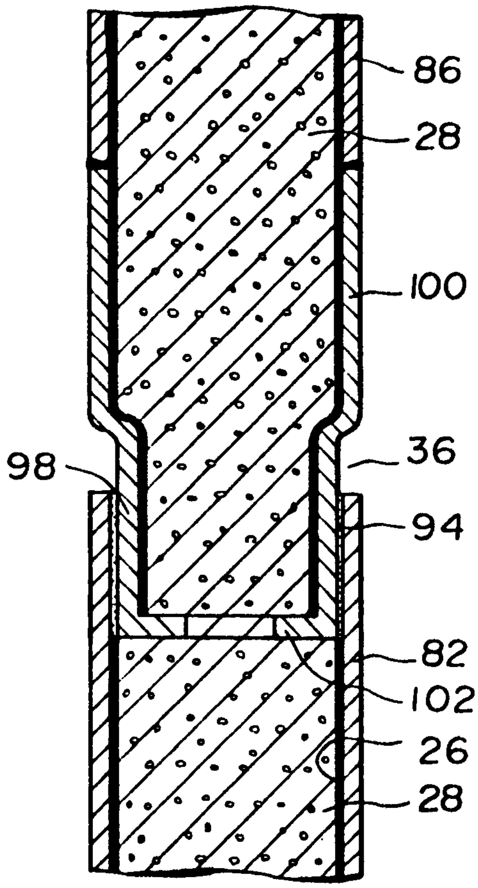


FIG. 10

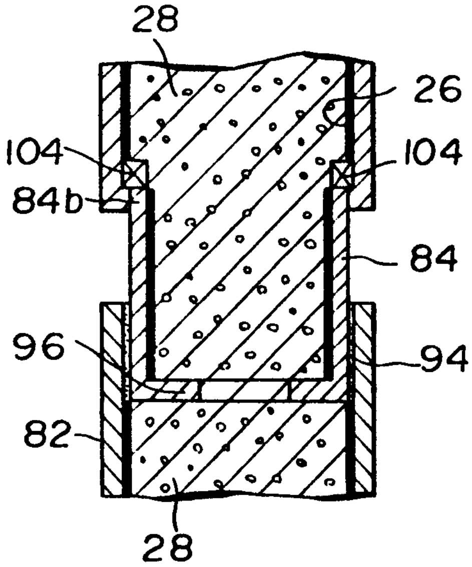


FIG. 11

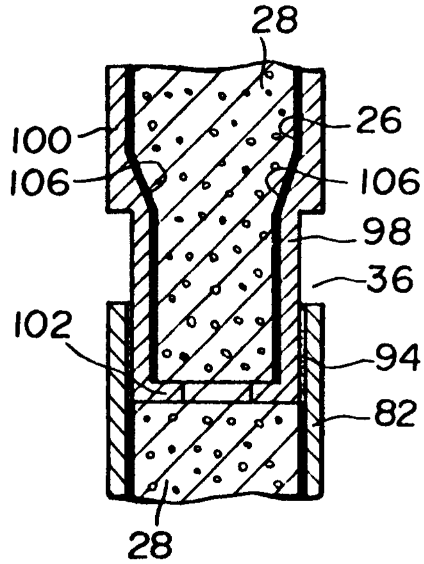


FIG.13

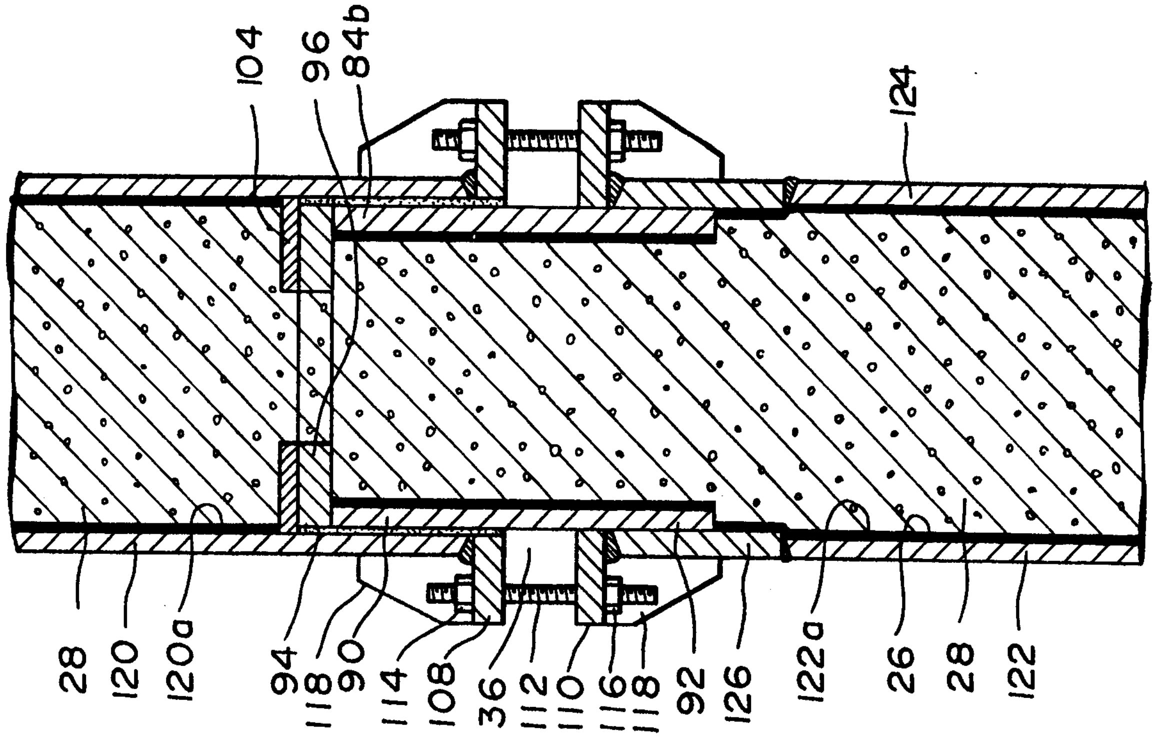
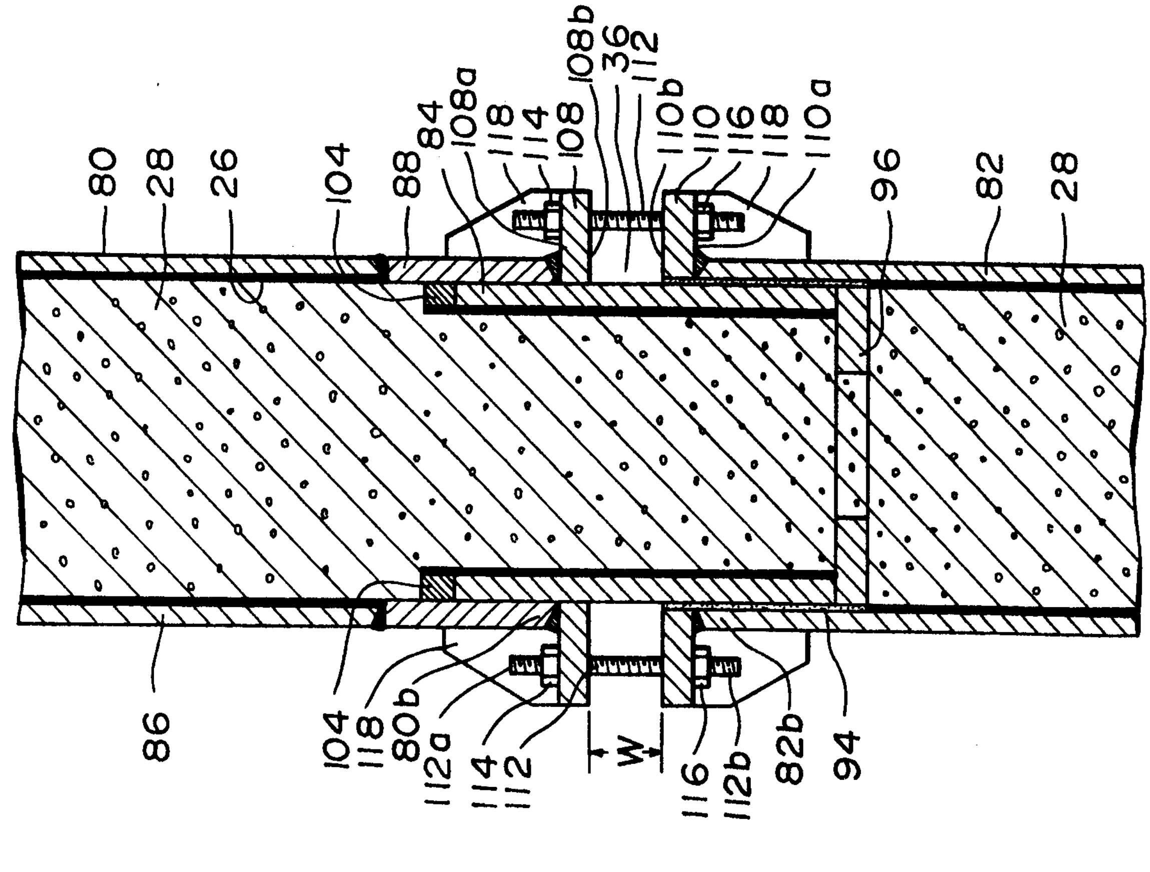

104
96
84b
124
28
120
120a
94
118
90
114
108
36
112
110
116
118
92
126
122a
26
28
122

FIG.12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82
28
86
104
118
80b
112a
114
112
W
116
112b
82b
94