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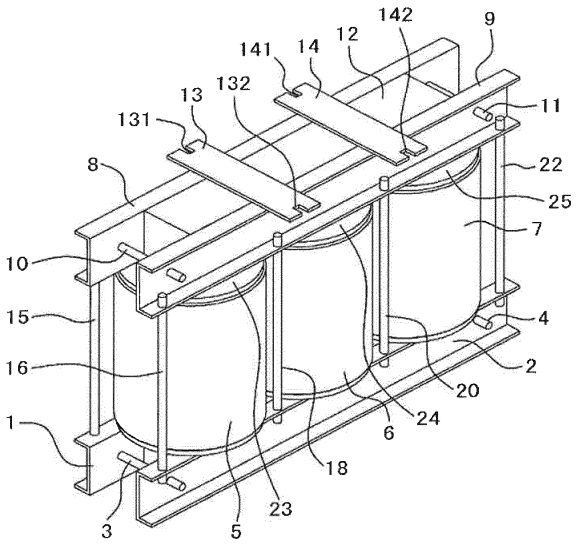
(54) **TRANSFORMER**

(57) In such transformers as oil-filled transformers, if the transformer is placed within a ship or a floating wind power tower, there is a possibility that displacement may occur to a coil or core within a tank of the transformer if swinging or tiling continue to be added to the transformer by effects of waves or the like. The present invention provides a transformer which can withstand the effects of such waves. The present invention is a transformer provided with cores, coils wound around the cores, an upper core fastener and a lower core fastener which fix the cores from respective top and a lower core fastener which fix the cores from respective top and bottom directions, and a tank which houses the same, wherein: on the upper core fastener are disposed anti-vibration metal fitting for a core coil assembly incorporating the cores and the coils; the anti-vibration metal fittings have notches; and projections of shapes mating at the notches of the anti-vibration metal fittings are disposed on the inner side of the tank.

F I G . 1A



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Description

Technical Field

[0001] The present invention relates to a transformer such as an oil-filled transformer, and particularly, to a structure in which a core coil assembly accommodated in a transformer withstands a shaking or inclining action.

Background Art

[0002] In a transformer of the related art, an anti-vibration rubber member is provided at the upper portion of the transformer and a transformer body is fixed to a board. In the transformer of the related art, a problem arises in that the vibration of the transformer body is transmitted to the board through the anti-vibration rubber member. In order to solve this problem, Patent Document 1 (JP 2008-103578 A) discloses a structure in which a steadying brace is provided in a transformer body, a steadying sheet is provided at an outer plate of a board, a bolt is fixed to the steadying brace, an annular hole is provided in the steadying sheet, and the bolt is inserted through the annular hole. Accordingly, the bolt and the annular hole of the steadying sheet do not contact each other in a normal state.

Citation List

Patent Document

[0003] Patent Document 1: JP 2008-103578 A

Summary of Invention

Technical Problem

[0004] Since a transformer such as a power distribution oil-filled transformer is generally provided on a land, a shaking or vibrating action generated in the transportation is taken into consideration. However, a shaking or inclining action caused by waves is not considered for a case where the transformer is provided in a ship or a floating wind power tower.

[0005] When the transformer is used in the ship or the floating wind power tower, the transformer is normally shaken or inclined. As a result, there is a possibility that the core or the coil may be deviated inside the tank of the transformer.

[0006] An object of the invention is to provide a transformer capable of withstanding a shaking or inclining action of a core or a coil inside a tank of the transformer due to external energy such as waves when the transformer is provided in a ship or a floating wind power tower.

Solution to Problem

[0007] In order to solve the above-described problems, for example, the structure of claims is employed.

[0008] The invention includes means for solving the problem of the related art. As an example, a "transformer includes: a core; a coil which is wound around the core; upper and lower core fasteners which fix the core in the vertical direction; and a tank which accommodates the core, the coil, and the upper and lower core fasteners, wherein a steadying brace of a core coil assembly obtained by assembling the core and the coil is disposed in the upper core fastener, wherein the steadying brace includes a notch, and wherein a projection having a shape to be fitted to the notch of the steadying brace is disposed in the tank".

Advantageous Effects of Invention

[0009] According to the invention, it is possible to provide a transformer capable of withstanding a shaking or inclining action by employing a structure in which an entire core coil assembly obtained by assembling a coil and a core inside a tank of the transformer is fixed to the tank when the transformer such as an oil-filled transformer is provided in a ship or a floating wind power tower.

Brief Description of Drawings

[0010]

FIG. 1A is an external perspective view of a core coil assembly of a first embodiment of the invention.
FIG. 1B is a perspective view of components disassembled from the core coil assembly of FIG. 1A.
FIG. 1C is a perspective view of a steadying brace of the core coil assembly of the invention.
FIG. 1D is a cross-sectional view of a tank of a transformer.
FIG. 1E is a top view illustrating components arranged inside the transformer and illustrating a relation between a stay of the transformer and the steadying brace of the core coil assembly.
FIG. 2 is an external perspective view of a core coil assembly of a second embodiment of the invention.
FIG. 3 is an external perspective view of a core coil assembly of a third embodiment of the invention.
FIG. 4 is an external perspective view of a core coil assembly of a fourth embodiment of the invention.
FIG. 5A is an external perspective view of a core coil assembly of a fifth embodiment of the invention.
FIG. 5B is a view illustrating a relation between a stay of a transformer and a steadying brace of a core coil assembly.
FIG. 6 is an external perspective view of a core coil assembly of a sixth embodiment of the invention.
FIG. 7A is an external perspective view of the core coil assembly when the core of the core coil assembly of the invention is formed as a wound core.
FIG. 7B is a perspective view of components disassembled from the core coil assembly of FIG. 7A.

FIG. 8 is an external perspective view of an oil-filled transformer.

Description of Embodiments

[0011] Hereinafter, embodiments of the invention will be described with reference to the drawings.

(First Embodiment)

[0012] FIG. 1A is a perspective view of a core coil assembly of a transformer of a first embodiment of the invention and FIG. 1B is a perspective view of components disassembled from the core coil assembly of FIG. 1A.

[0013] In FIGS. 1A and 1B, Numeral 200 indicates a core coil assembly, Numerals 1 and 2 indicate lower core fasteners, Numerals 3 and 4 indicate studs which fasten two lower core fasteners at the ends of the lower core fasteners in the longitudinal direction, Numerals 5, 6, and 7 indicate coils, Numerals 8 and 9 indicate upper core fasteners, Numerals 10 and 11 indicate studs which fasten two upper core fasteners at the ends of the upper core fasteners in the longitudinal direction, Numeral 12 indicates a layered core, and Numerals 13 and 14 indicate a steadying brace of the core coil assembly.

[0014] Numerals 15 to 22 indicate studs which fasten the upper core fasteners 8 and 9 to the lower core fasteners 1 and 2, and Numerals 23 to 28 indicate insulation walls which are sandwiched between the coil and the layered core 12.

[0015] In FIG. 1A, the coils 5, 6, and 7 are inserted into the layered core 12. The layered core 12 may be of a strip type, a frame type, or a V-notch type, but herein the strip type layered core will be described.

[0016] The strip type layered core has a structure in which silicon steel plates each cut into a strip shape are layered so as to form a bridge and a yoke of a core. Then, in a case where the coils 5, 6, and 7 are inserted into the core, one yoke is removed, the coils are inserted into the core, and the yoke is returned to the original position again, thereby assembling a three-phase tripod core. After the layered core 12 and the coils 5, 6, and 7 are assembled to one another, two lower core fasteners 1 and 2 and two upper core fasteners 8 and 9 are disposed in parallel so as to face each other, the layered core 12 is sandwiched therebetween, and the upper and lower core fasteners are fastened by the studs 3, 4, 10, and 11.

[0017] Then, the lower core fasteners 1 and 2 and the upper core fasteners 8 and 9 are fastened by the studs 15 to 22. Here, the lower core fastener and the upper core fastener have a structure in which thin and elongated U-shaped metal plates are disposed so that U-shaped bottom portions face each other, and the layered core 12 is sandwiched between the bottom portions. Then, the lower core fasteners 1 and 2 and the upper core fasteners 8 and 9 are fastened by the studs 3, 4, 10, and 11. The fastening positions are set on the longitudinal axes of the bottom portions other than the ends sandwiching the layered core 12 while being located at the U-shaped bottom portions.

[0018] Further, each of the lower core fasteners 1 and 2 and the upper core fasteners 8 and 9 has a compact length in which the longitudinal length formed when three coils 5, 6, and 7 are inserted into the layered core 12 is increased by the length of the studs fastening the upper and lower core fasteners to each other. Then, the positions of the studs 15 to 22 fastening the lower core fasteners 1 and 2 and the upper core fasteners 8 and 9 are formed at the upper sides of the U-shaped portions of the lower core fasteners 1 and 2 and the lower sides of the U-shaped portions of the upper core fasteners 8 and 9. Here, the positions of the studs are set as the points of both ends of the upper and lower core fasteners and two points substantially dividing the upper and lower core fasteners into three parts.

[0019] Next, the insulation walls 23 to 28 are provided among the coils 5, 6, and 7, the upper core fasteners 8 and 9, and the lower core fasteners 1 and 2 so as to insulate the coils from the layered core. Further, the insulation walls 23 to 28 also insulate the coils from the upper and lower core fasteners. As the insulation wall, a press board or kraft paper formed of epoxy and having excellent humidity resistance, heat resistance, and oil resistance is generally employed to achieve an electric insulation property.

[0020] The coils and the layered core are assembled, and the steadying braces 13 and 14 are disposed at the upper sides of the upper core fasteners 8 and 9 of the core coil assembly 200 fastened by the upper and lower core fasteners. The steadying braces 13 and 14 are provided so as to connect the upper sides of two upper core fasteners 8 and 9 of which the U-shaped bottom portions face each other while the steadying braces are perpendicular to the upper sides at the points substantially dividing the upper surfaces into three parts. Further, as illustrated in FIG. 1C, each of the steadying braces 13 and 14 is formed by a thin and elongated rectangular metal plate, and the length of the steadying brace in the longitudinal direction is slightly shorter than the length of the short side inside the tank of the transformer in order to accommodate the steadying brace inside the tank of the transformer. Further, concave notches 131 and 132 are formed at the center positions of both ends of the short side of the steadying brace 13. The steadying braces 13 and 14 are provided and fixed to the upper sides of the U-shaped portions of the upper core fasteners 8 and 9 by screwing or welding.

[0021] Next, a tank 29 of the transformer will be described with reference to FIG. 1D.

[0022] FIG. 1D is a cross-sectional view of the tank 29 of the transformer. Here, the tank 29 extends in a direction in which the coils are arranged, and the cross-section of the tank has a lateral rectangular shape.

[0023] Then, stays 291 to 294 each having a convex shape (a projection shape) are disposed at two points substantially dividing the longitudinal length inside the

tank into three parts and two positions facing the two points inside the tank.

[0024] Next, FIG. 1E is a top view illustrating the inside of the tank when the core coil assembly illustrated in FIG. 1A is accommodated inside the tank of the transformer.

[0025] FIG. 1E is a top view of the core coil assembly accommodated inside the tank of the transformer, where the layered core 12 is sandwiched by two upper core fasteners 8 and 9, the longitudinal length of each upper core fastener is set to be slightly shorter than the longitudinal length of the tank, and the studs 10 and 11 which fasten the upper core fasteners 8 and 9 to each other are fastened at a position separated from the layered core while being located at both ends of the core fastener.

[0026] Further, the steadying braces 13 and 14 of the core coil assembly are disposed at the upper sides of the upper core fasteners 8 and 9 so as to be substantially perpendicular to two points substantially dividing the upper and lower core fasteners into three parts, and are also disposed so as to be substantially perpendicular to the tank of the transformer.

[0027] Then, the concave notches 131, 132, 141, and 142 of the steadying braces 13 and 14 of the core coil assembly are respectively fitted to the stays 291 to 294 disposed inside the tank of the transformer. FIG. 1E(b) is an enlarged view of the fitted state (a part A of FIG. 1E), and FIG. 1E(c) is a perspective view of the fitted state.

[0028] FIGS. 1E(b) and 1E(c) illustrate a state where the stay inside the tank of the transformer is fitted to the steadying brace of the core coil assembly, and the width t of the stay 294 inside the tank 29 is smaller than the width T of the concave notch of the steadying brace 14 by a slight gap.

[0029] Further, as illustrated in FIG. 1E(c), the thickness (L) of the stay inside the tank of the transformer is thicker than the thickness (l) of the steadying brace 14 of the core coil assembly in the height direction. This structure is used to prevent the release of the fitting state when the transformer is shaken or inclined.

[0030] With such a structure, it is possible to perform a tanking operation by using the stay as a guide when the core coil assembly is accommodated inside the tank of the transformer in a suspended state.

(Second Embodiment)

[0031] Next, a second embodiment of the invention will be described with reference to the drawings.

[0032] FIG. 2 is a perspective view of a core coil assembly of the second embodiment. Here, this embodiment is different from the first embodiment in that the steadying brace of the core coil assembly has a different shape.

[0033] Further, since this embodiment is similar to the first embodiment except for the steadying brace, the description other than the steadying brace will not be presented.

[0034] In FIG. 2, steadying braces 30, 31, 32, and 33 are disposed on the upper sides of the U-shaped portions of the upper core fasteners 8 and 9. Each of the steadying braces 30, 31, 32, and 33 is formed in a rectangular shape disposed at the upper side of each core fastener instead of the shape of connecting two core fasteners 8 and 9 as in the first embodiment, and the arrangement positions correspond to two points substantially dividing the length of each of the core fasteners 8 and 9 in the longitudinal direction into three parts. Then, concave notches 301, 311, 321, and 331 are respectively formed at the center portions of the outer sides of the steadying braces 30, 31, 32, and 33.

[0035] Although not illustrated in the drawings, concave stays to be respectively fitted to the concave notches 301, 311, 321, and 331 are formed inside the tank of the transformer.

[0036] In FIG. 2, the steadying braces 30 and 31 and the steadying braces 32 and 33 are respectively disposed so as to face each other. However, the steadying braces can be disposed at different positions and the number of the steadying braces can be increased.

(Third Embodiment)

[0037] Next, a third embodiment of the invention will be described with reference to the drawings.

[0038] FIG. 3 is a perspective view of a core coil assembly of the third embodiment. Here, this embodiment is different from the first embodiment in that the steadying brace of the core coil assembly has a different structure.

[0039] Further, since this embodiment is similar to the first embodiment except for the steadying brace, the description other than the steadying brace will not be presented.

[0040] In FIG. 3, the third embodiment has a structure in which the steadying braces of the core coil assembly provided in the upper core fasteners 8 and 9 are integrated with the core fasteners 8 and 9.

[0041] Steadying braces 34 to 37 are formed in a manner such that rectangular projections are formed in the upper sides of the U-shaped portions of the upper core fasteners 8 and 9 and are bent or pressed.

[0042] Further, concave notches 341, 351, 361, and 371 are respectively formed at the center portions of the front ends of the steadying braces integrated with the upper core fasteners.

[0043] Then, the stays to be fitted to the steadying braces are disposed inside the tank of the transformer.

[0044] According to the structure of the third embodiment, since the steadying braces are integrated with the core fasteners without the need of screws or welding as in the first and second embodiments, the steadying braces can be formed with high precision.

(Fourth Embodiment)

[0045] Next, a fourth embodiment of the invention will

be described with reference to the drawings.

[0046] FIG. 4 is a perspective view of a core coil assembly of the fourth embodiment. Here, this embodiment is different from the first embodiment in that the steadying brace is formed by a rectangular metal plate so as to connect two core fasteners 8 and 9 at both ends of the upper core fasteners differently from the arrangement of the steadying braces of the first embodiment.

[0047] Then, concave notches 401 and 411 are respectively formed at the center portions of the outer sides of both steadying braces 40 and 41 disposed at both ends of the core fasteners 8 and 9.

[0048] Further, the stays to be fitted to the steadying braces 13 and 14 and the steadying braces 40 and 41 are disposed inside the tank of the transformer.

[0049] In the structure of the fourth embodiment, the shaking action of the core coil assembly 200 in the longitudinal direction can be prevented by the steadying braces 13 and 14, the shaking action of the core coil assembly 200 in the lateral direction can be prevented by the steadying braces 40 and 41, and hence the shaking action of the core coil assembly within two dimensions inside the tank can be prevented.

(Fifth Embodiment)

[0050] Next, a fifth embodiment of the invention will be described with reference to the drawings.

[0051] FIG. 5A is a perspective view of a core coil assembly of the fifth embodiment. Here, this embodiment is different from the first embodiment in that the steadying braces are disposed at the lower sides of the lower core fasteners similarly to the steadying braces disposed at the upper sides of the upper core fasteners differently from the arrangement of the first embodiment.

[0052] That is, in FIG. 5A, this embodiment is similar to the first embodiment in that the steadying braces 13 and 14 of the thin and elongated rectangular core coil assembly are disposed at the upper sides of the U-shaped portions of the upper core fasteners 8 and 9 so as to connect the upper core fasteners 8 and 9, but is different from the first embodiment in that the steadying braces 50 and 51 each having the same size as the upper steadying brace are disposed at the lower sides of the U-shaped portions of the lower core fasteners 1 and 2 so as to connect two lower core fasteners 1 and 2 to each other.

[0053] By the structure of FIG. 5A, concave notches 501 and 511 are formed at the center portions of both ends of the short sides of the lower steadying braces 50 and 51. The steadying brace 13 provided in the upper core fasteners 8 and 9 and the steadying brace 50 provided in the lower core fasteners 1 and 2 are disposed so as to match each other in the vertical direction. Similarly, the upper steadying brace 14 and the lower steadying brace 51 are disposed so as to match each other in the vertical direction. As a result, the concave notches respectively formed in the steadying braces match each other in the vertical direction. With such a structure, the core coil assembly 200 can be accommodated by using a stay 52 formed in the tank 29 of the transformer as a guide as illustrated in FIG. 5B. FIG. 5B is a diagram illustrating a state where the rectangular parallelepiped stay (projection) 52 disposed perpendicularly inside the tank 29 of the transformer is fitted to concave notches 132 and 501 of the upper and lower steadying braces 13 and 50 of the core coil assembly 200.

[0054] The shaking action preventing structure at the upper and lower portions inside the tank of the transformer can prevent the shaking or inclining action of the core coil assembly with respect to the external shaking or inclining action of the transformer.

(Sixth Embodiment)

[0055] Next, a sixth embodiment of the invention will be described with reference to the drawings.

[0056] In the structure of the fifth embodiment, each of the steadying braces 13 and 14 of the upper core fastener 8 and the steadying braces 50 and 51 of the lower core fastener 9 is formed by a thin and elongated rectangular metal plate. However, FIG. 6 is a perspective view of a core coil assembly in which the upper and lower steadying braces are respectively integrated with the upper and lower core fasteners. In the structure obtained by integrating the steadying braces, steadying braces 64 and 65 are integrated with the lower core fasteners 1 and 2 even in the sixth embodiment as described in the third embodiment.

[0057] With such a structure of the sixth embodiment, since the steadying braces are integrated with the core fastener, the steadying braces are formed with high precision, and hence particularly the vertical positioning operation can be easily performed. Then, the tanking operation can be smoothly performed.

(Seventh Embodiment)

[0058] Next, a seventh embodiment of the invention will be described with reference to the drawings.

[0059] FIG. 7A is a perspective view of a core coil assembly of a transformer of the seventh embodiment, and FIG. 7B is a perspective view illustrating components disassembled from the core coil assembly 200 of FIG. 7A. In FIGS. 7A and 7B, Numeral 70 indicates a wound core, Numerals 71, 72, and 73 indicate coils, Numeral 74 indicates an upper core fastener, Numeral 75 indicates a lower core fastener, Numerals 76 and 77 indicate steadying braces of a core coil assembly, Numerals 78 to 85 indicate studs fastening the upper core fastener 74 and the lower core fastener 75, and Numerals 86 to 91 indicate insulation walls.

[0060] In FIG. 7A, the coils 71, 72, and 73 are inserted into the wound core 70.

[0061] The wound core 70 has a structure illustrated in FIG. 7B. In a case where the coils are inserted into the

wound core, the upper wrap portion of the wound core is opened, the coil is inserted thereinto, and the wound core and the coil are assembled by the wrapping operation. At this time, insulation walls 86 to 91 are respectively interposed between the wound core 70 and the coils 71, 72, and 73 so as to insulate the wound core and the coil. Further, the insulation wall is also used to insulate the upper core fastener 74 and the lower core fastener 75. A three-phase tripod core is assembled, the wound core 70 and the coils 71, 72, and 73 are assembled, and the wound core 70 is fastened by the studs 78 to 85 while being sandwiched between the upper core fastener 74 and the lower core fastener 75 in the vertical direction.

[0062] Further, the structure of each of the upper core fastener 74 and the lower core fastener 75 is different from that of the first embodiment. In the structure, the front ends of the sides of the thin and elongated U-shaped portions are bent so as to form flanges 99, the concave portions of the U-shaped portions sandwich the wound core 70 in the vertical direction while being respectively formed as a reverse U-shape and a U-shape, and the flanges 99 are fastened by the studs 78 to 85.

[0063] With this structure, the steadying braces 76 and 77 of the core coil assembly 200 are disposed in the reverse U-shaped flat portion of the U-shaped portion of the upper core fastener 74.

[0064] The steadying braces 76 and 77 are formed by the thin and elongated rectangular metal plate, are disposed on the flat portion of the upper surface of the upper core fastener 74 in a direction perpendicular to the longitudinal direction, and are fixed by screwing or welding.

[0065] Further, concave notches 761, 762, 771, and 772 are respectively formed at the center portions of both ends of the short sides of the steadying braces 76 and 77. Then, the stays corresponding to the concave notches of the steadying braces 76 and 77 are disposed inside the tank of the transformer similarly to the first embodiment. Accordingly, in the structure of the seventh embodiment, the tanking operation is performed so as to charge oil into the tank while the core coil assembly is accommodated in the tank of the transformer. As a result, the transformer which is manufactured in this way withstands a shaking action.

[0066] Next, an oil-filled transformer which accommodates the core coil assembly obtained by assembling the core and the coil of the invention will be described. FIG. 8 is a perspective view illustrating an appearance of the oil-filled core transformer equipped with a core of a silicon steel plate or an amorphous thin strip. In FIG. 8, an oil-filled core transformer 100 has a structure in which wave ribs 95 are provided in the peripheral edge of the tank 29 storing insulation oil for insulating or cooling the coil attached to the layered core or the wound core and are used to cool heat generated from the coil or the core.

[0067] In FIG. 8, Numeral 96 indicates weld lines welded to the upper and lower positions of the wave ribs 95 so as to prevent the deformation of the wave ribs 95 while giving a strength thereto. Numeral 97 indicates primary terminals provided at the upper portion of the tank 29 and connected to high-voltage power transmitted from a power plant. Numeral 98 indicates secondary terminals provided at the upper portion of the tank 29 and transmitting a voltage increased or decreased by the transformer to a load component.

[0068] Further, since the core coil assembly illustrated in FIG. 1A, that is, the assembly in which the coil is disposed in the lateral direction is accommodated in the tank 29, the entire transformer is formed in a laterally elongated shape.

List of Reference Signs

[0069]

1, 2 Lower core fastener
3, 4 Stud
5, 6, 7 Coil
8, 9 Upper core fastener
10, 11 Stud
12 Layered core
13, 14 Steadying brace of core coil assembly
131, 132, 141, 142 Concave notch
15 to 22 Stud
23 to 28 Insulation wall
29 Tank
291, 292, 293, 294 Stay (projection)
30, 31, 32, 33 Steadying brace
301, 311, 321, 331 Concave notch
34, 35, 36, 37 Steadying brace integrated with upper core fastener
341, 351, 361, 371 Concave notch
40, 41 Steadying brace
401, 411 Concave notch
50, 51 Steadying brace in lower core fastener
501, 502 Concave notch
52 Stay
60, 61 Steadying brace integrated with upper core fastener
62, 63 Steadying brace integrated with lower core fastener
601, 611, 641, 651 Concave notch
70 Wound core
71, 72, 73 Coil
74 Upper core fastener
75 Lower core fastener
76, 77 Steadying brace of core coil assembly
761, 762, 771, 772 Concave notch
78 to 85 Stud fastening upper core fastener 74 to lower core
fastener 75
86 to 91 Insulation wall
95 Wave rib
96 Weld line
97 Primary terminal
98 Secondary terminal
99 Flange

100 Oil-filled core transformer
200 Core coil assembly

Claims

1. A transformer comprising:

   a core;
   a coil which is wound around the core;
   upper and lower core fasteners which fix the core in the vertical direction; and
   a tank which accommodates the core, the coil, and the upper and lower core fasteners,
   wherein a steadying brace of a core coil assembly obtained by assembling the core and the coil is disposed in the upper core fastener,
   wherein the steadying brace includes a notch, and
   wherein a projection having a shape to be fitted to the notch of the steadying brace is disposed in the tank.

2. The transformer according to claim 1,
   wherein the steadying brace of the core coil assembly is formed by a rectangular metal plate and the length of the steadying brace in the longitudinal direction is set to be slightly shorter than the length of the short side inside the tank of the transformer, and
   wherein a concave notch is formed at the center portion of the end of the short side of the steadying brace.

3. The transformer according to claim 1,
   wherein the upper and lower core fasteners of the core coil assembly are fastened by studs while the thin and elongated U-shaped bottom portions face each other and one or more steadying braces are disposed at the upper sides of the upper core fasteners so as to connect the upper core fasteners to each other in a direction perpendicular to the longitudinal direction of the upper core fasteners.

4. The transformer according to claim 1,
   wherein the upper core fastener is formed in a thin and elongated U-shape and the steadying brace is integrated with one side of the U-shaped portion.

5. The transformer according to claim 1,
   wherein the steadying braces of the core coil assembly are disposed in the upper core fastener in the longitudinal and lateral directions of the upper core fastener.

6. The transformer according to claim 1,
   wherein the notch of the steadying brace of the core coil assembly is formed in a concave shape,
   wherein the projection of the tank of the transformer to be fitted to the concave notch is formed in a rectangular parallelepiped shape, and
   wherein the length of the projection of the tank is set to be larger than the thickness of the steadying brace.

7. A transformer comprising:

   a core;
   a coil which is wound around the core;
   upper and lower core fasteners which fix the core in the vertical direction; and
   a tank which accommodates the core, the coil, and the upper and lower core fasteners,
   wherein steadying braces of the core coil assembly are disposed in the upper and lower core fasteners,
   wherein a concave notch is formed in the steadying braces, and
   wherein a projection having a shape to be fitted to the notch of the steadying brace is disposed inside the tank of the transformer.

8. The transformer according to claim 7,
   wherein the steadying brace disposed in the upper core fastener and the steadying brace disposed in the lower core fastener are disposed so that the concave notches match each other in the vertical direction.

9. The transformer according to claim 7,
   wherein the projection disposed inside the tank to be fitted to the concave notch of the steadying brace is formed in a rectangular parallelepiped shape and the length of the projection is set to be larger than the distance between the upper and lower steadying braces.

FIG. 1A

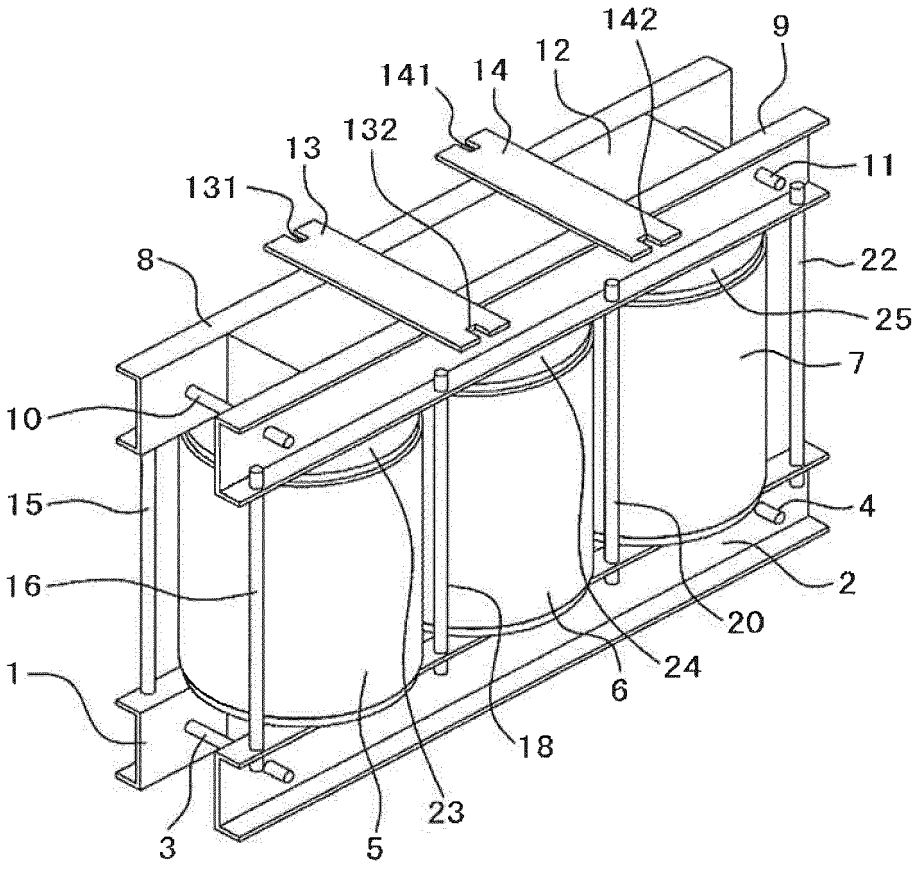

FIG. 1B

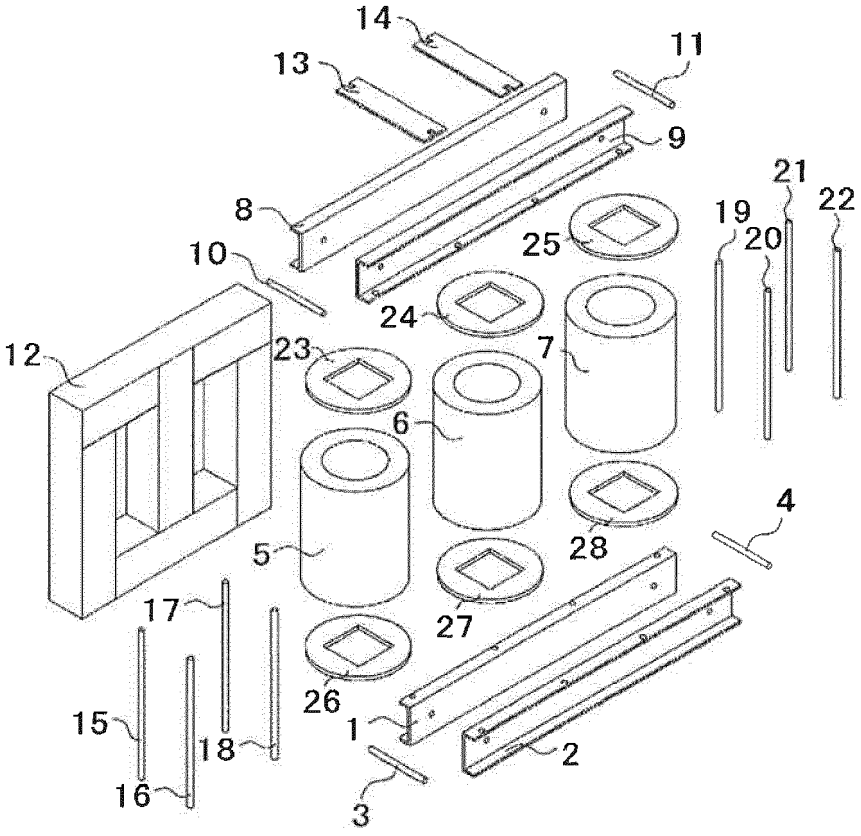
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FIG. 1C

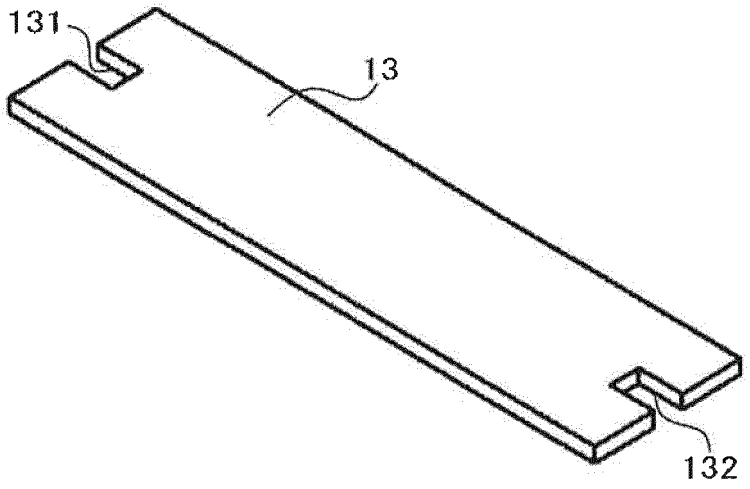
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FIG. 1D

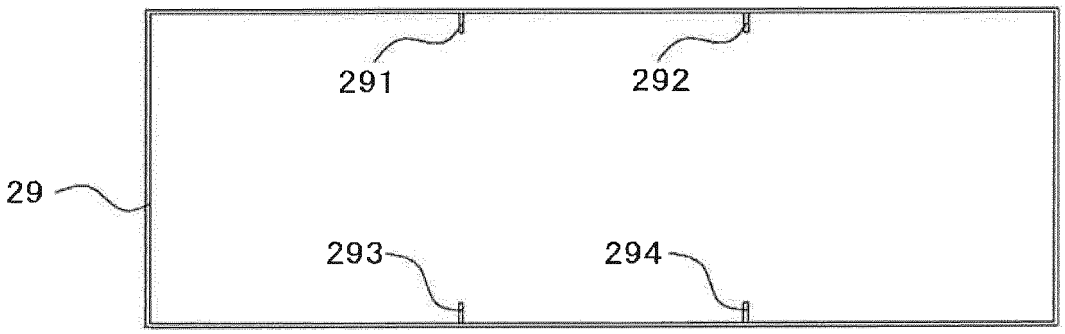
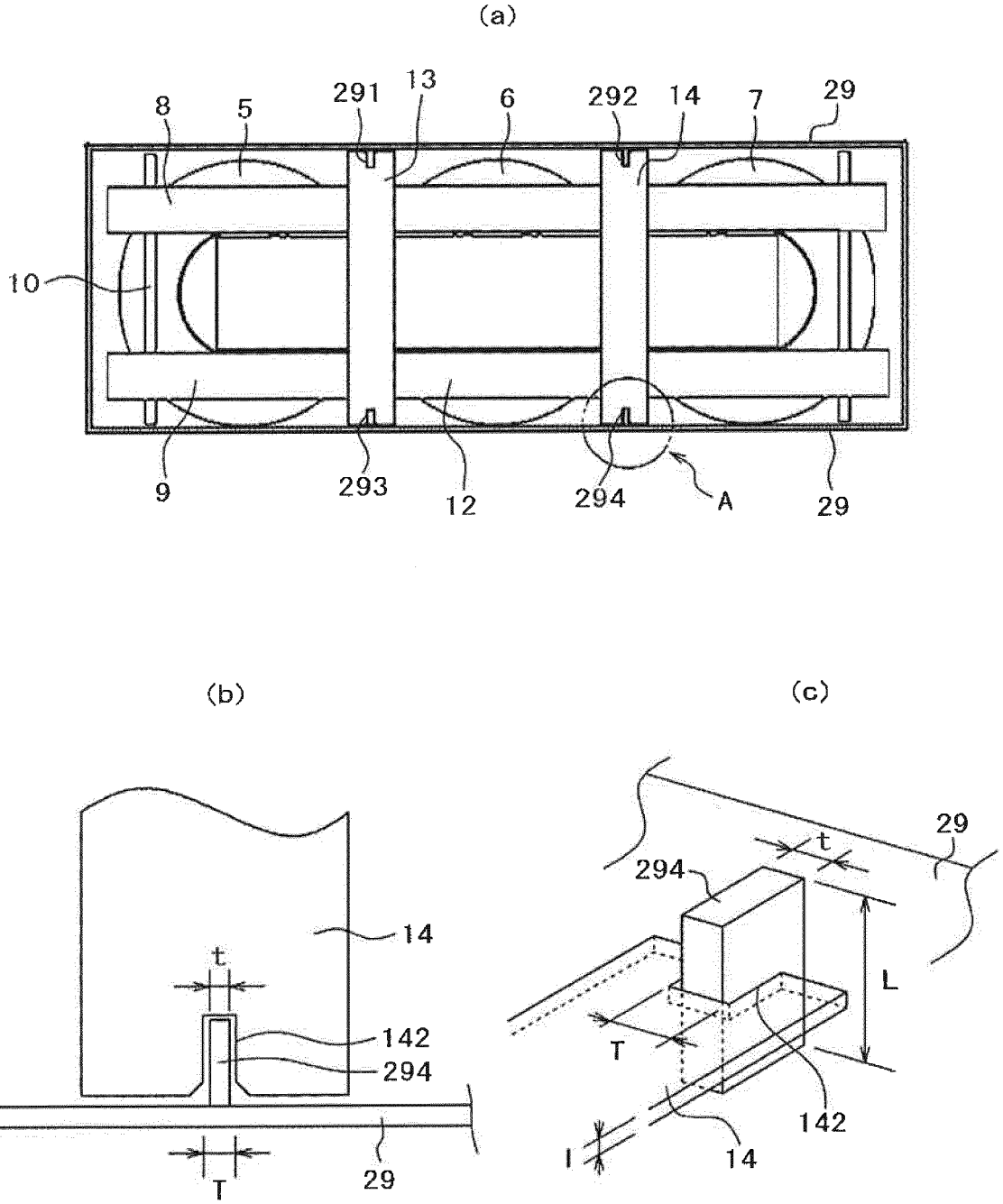


FIG. 1E


(a)
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(b)
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(c)
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I

FIG. 2

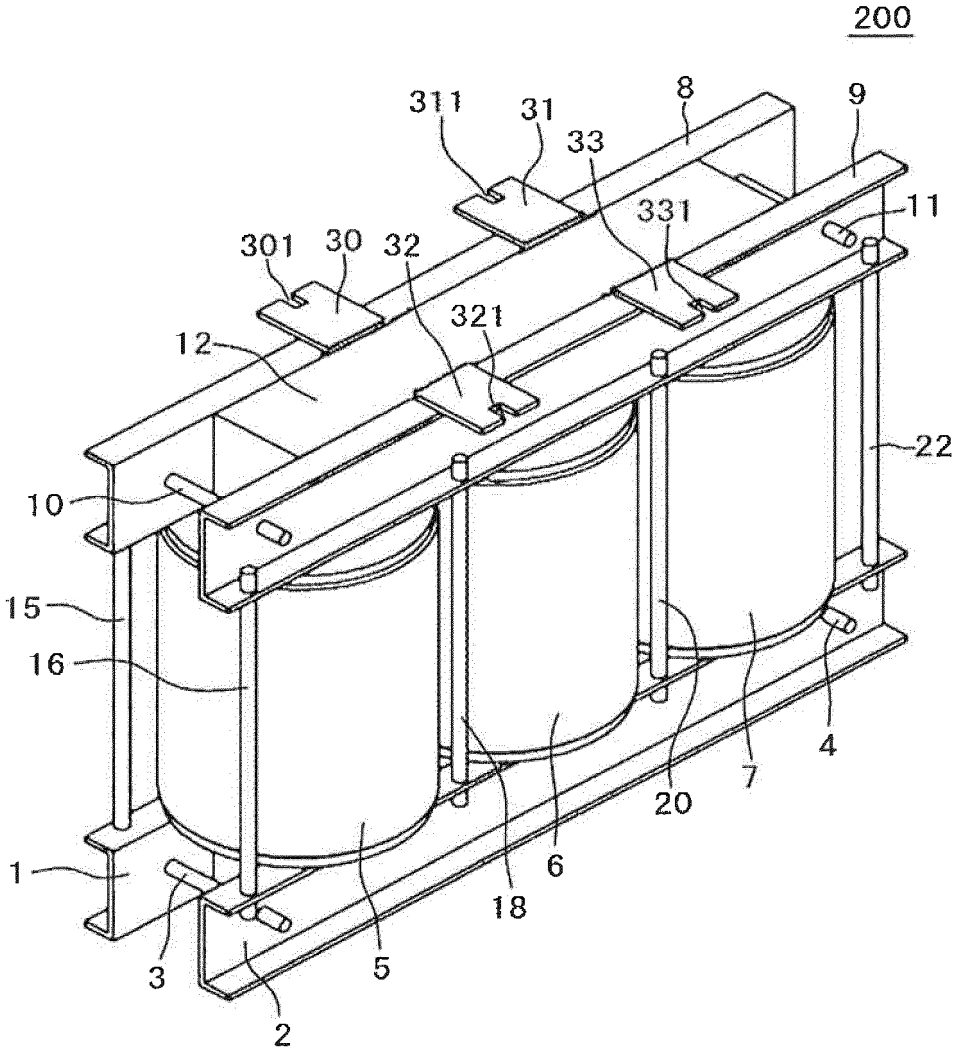

FIG. 3

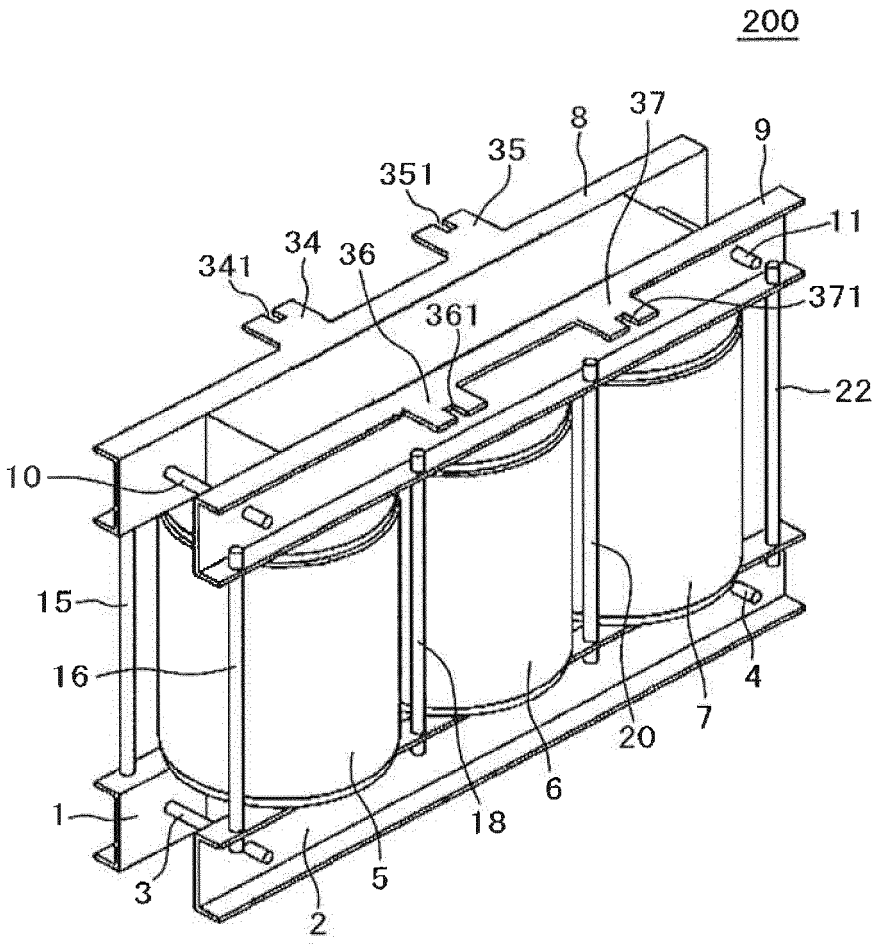

FIG. 4

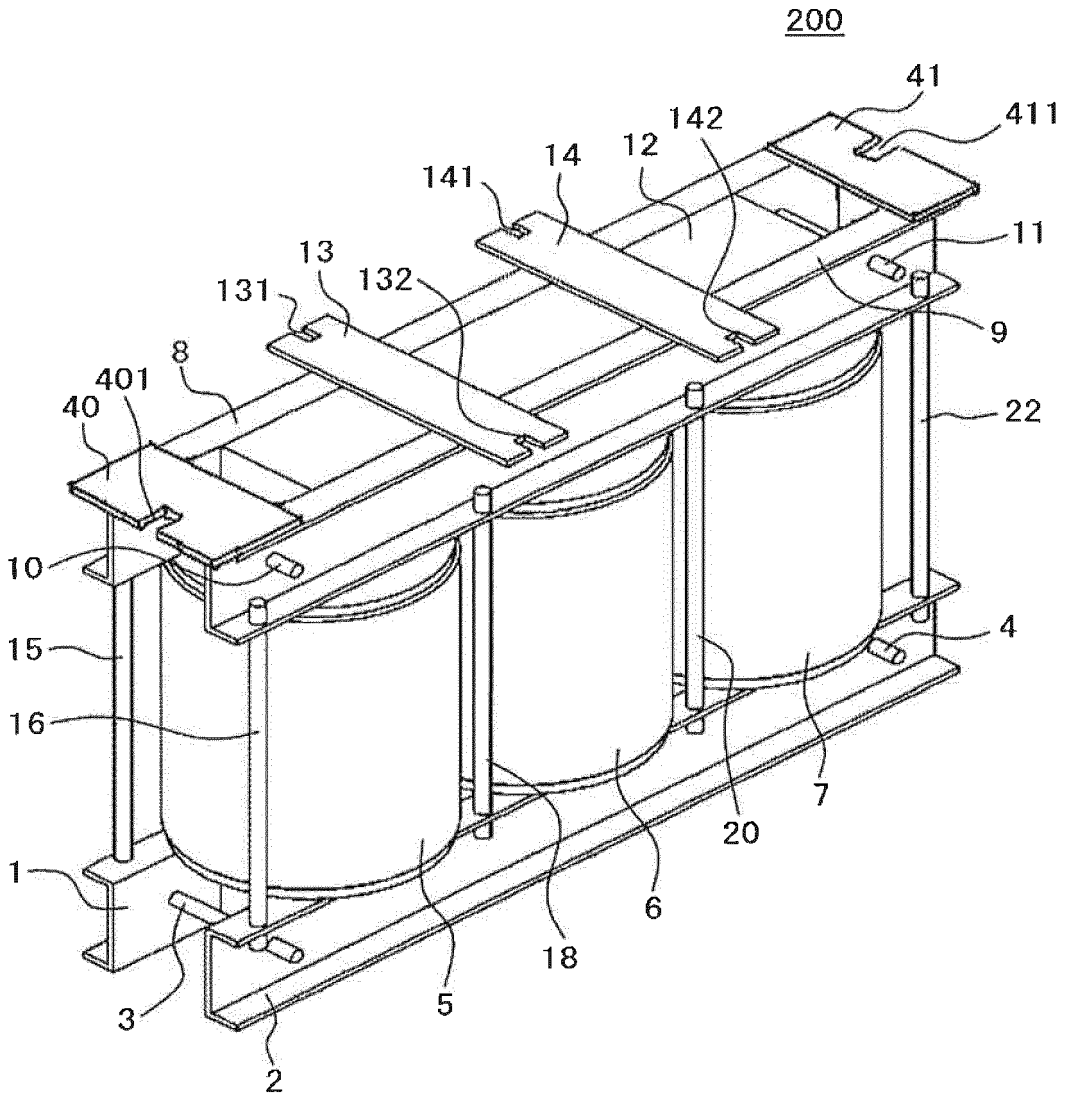
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FIG. 5A

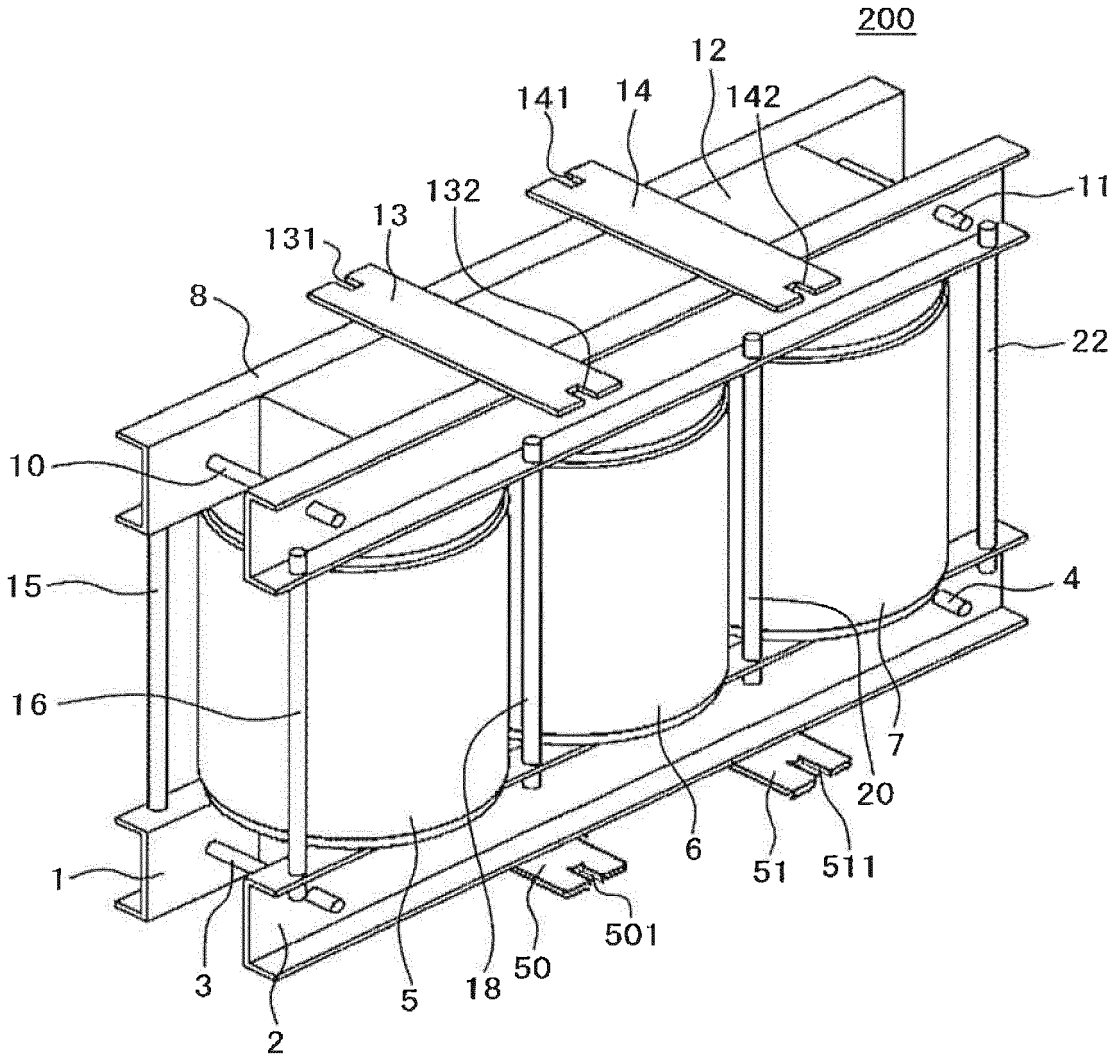
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FIG. 5B

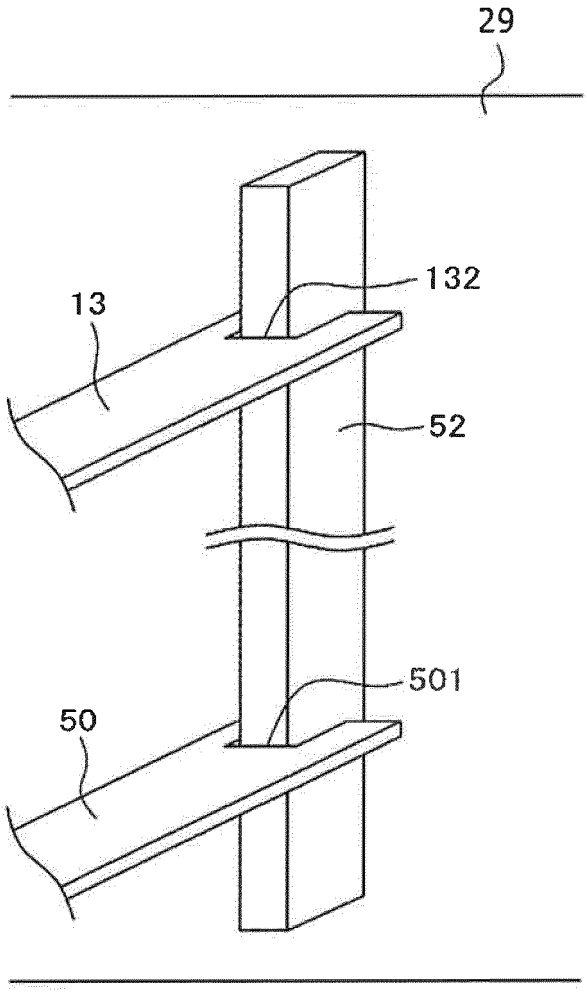

FIG. 6

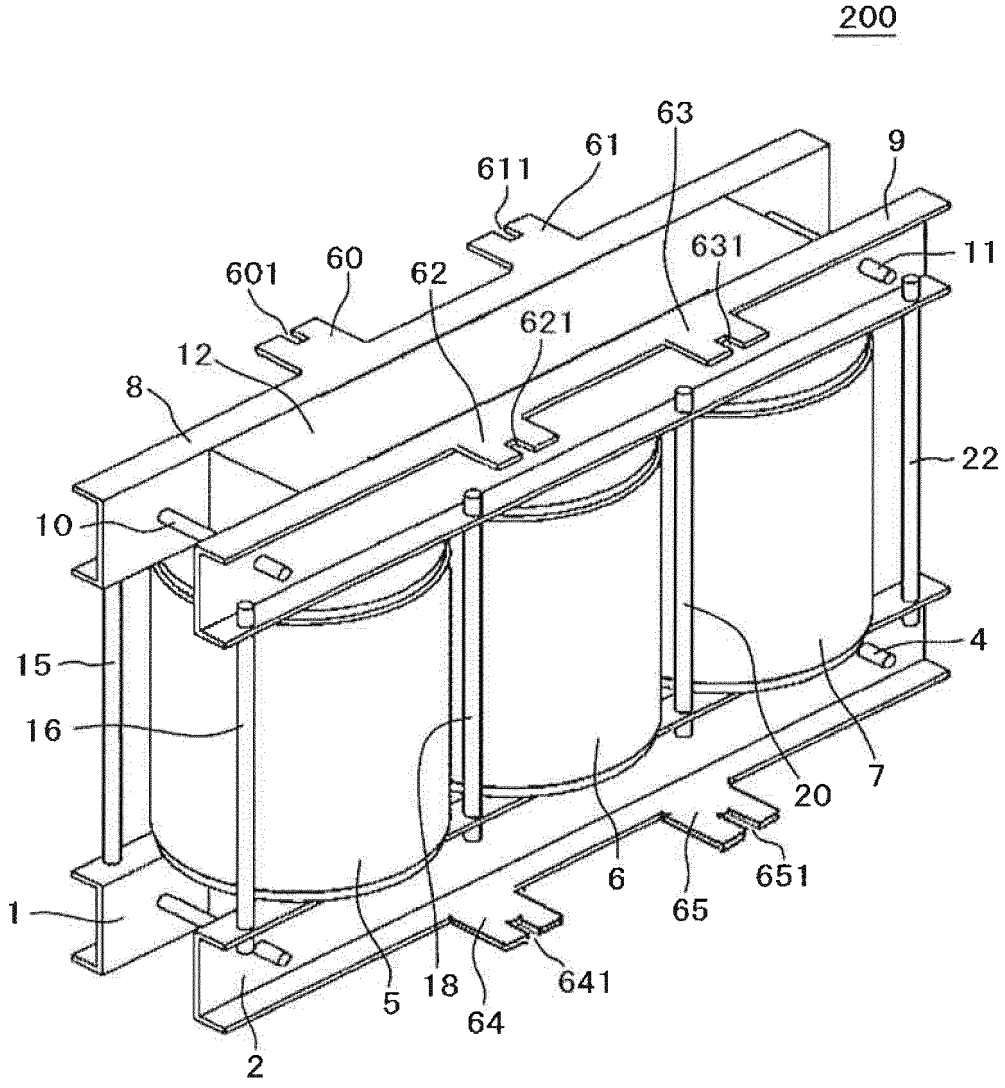
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FIG. 7A

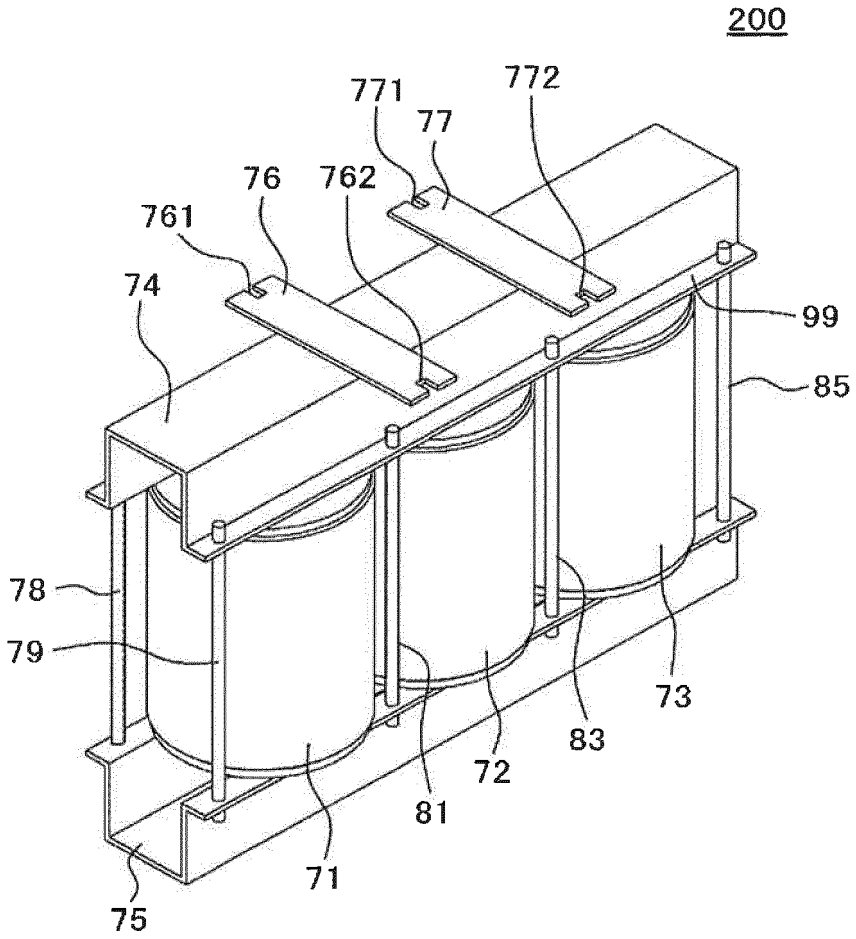


FIG. 7B

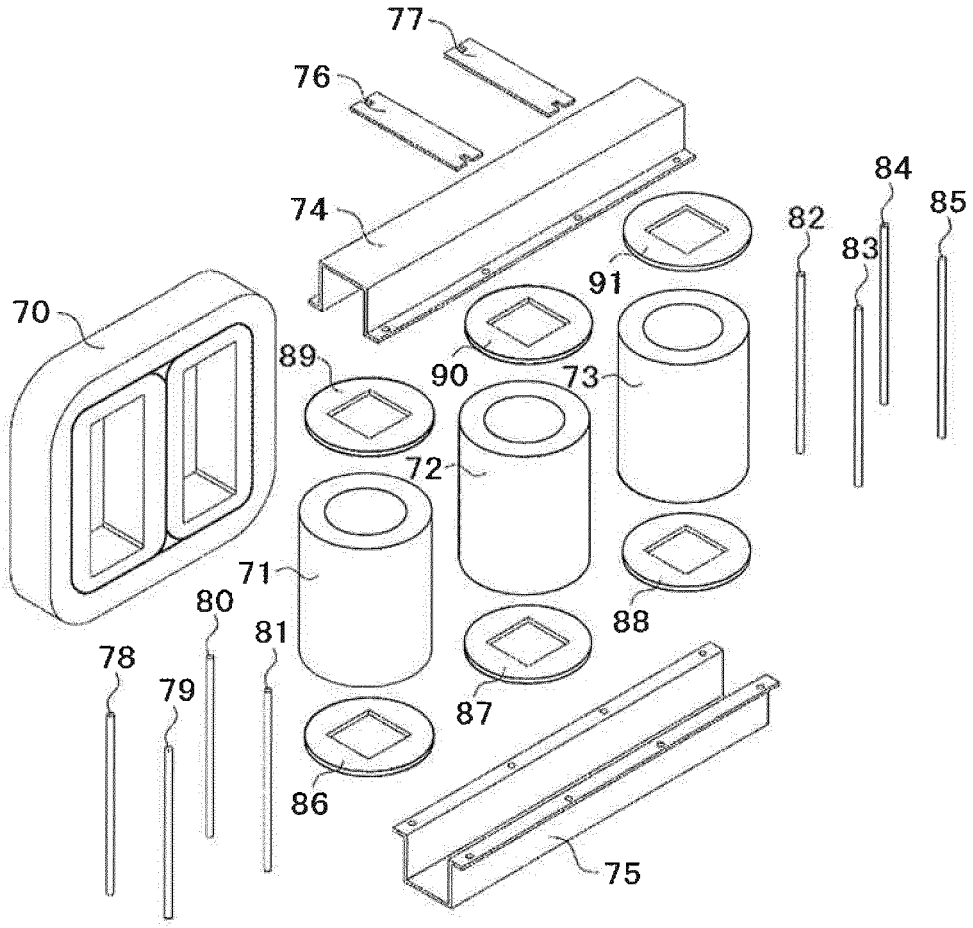
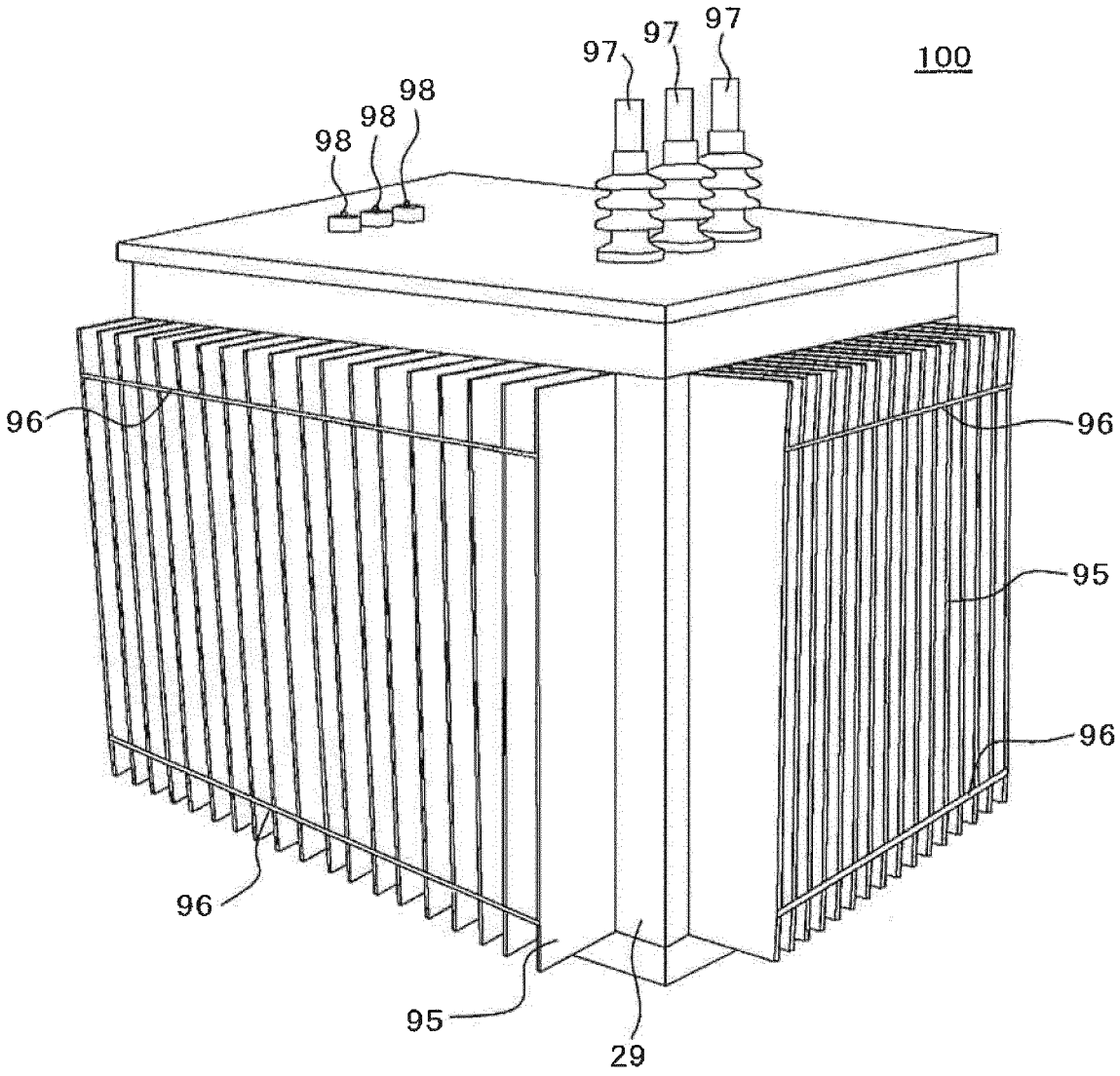


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/061430

A. CLASSIFICATION OF SUBJECT MATTER
H01F27/06(2006.01)i, *H01F30/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01F27/06, H01F30/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 048520/1984(Laid-open No. 160518/1985) (Toshiba Corp.), 25 October 1985 (25.10.1985), specification, page 2, line 3 to page 3, line 4; page 4, lines 13 to 17; page 5, lines 5 to 13; fig. 1 to 5 (Family: none)	1 2-9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
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Date of the actual completion of the international search	Date of mailing of the international search report
26 June, 2013 (26.06.13)	09 July, 2013 (09.07.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/061430

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 134282/1984(Laid-open No. 049426/1986) (Fuji Electric Co., Ltd.), 03 April 1986 (03.04.1986), specification, page 2, lines 3 to 10; page 3, line 19 to page 4, line 4; page 4, lines 5 to 17; fig. 1 to 5 (Family: none)	2-5
Y	JP 08-069922 A (Hitachi, Ltd.), 12 March 1996 (12.03.1996), paragraph [0006]; fig. 1 (Family: none)	3
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 040262/1982(Laid-open No. 142923/1983) (Kabushiki Kaisha Aichi Denki Kosakusho), 27 September 1983 (27.09.1983), specification, page 2, lines 7 to 14; fig. 1, 2 (Family: none)	4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 141064/1983(Laid-open No. 049609/1985) (Mitsubishi Electric Corp.), 08 April 1985 (08.04.1985), specification, page 2, lines 6 to 19; fig. 1, 2 (Family: none)	6
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 000367/1992(Laid-open No. 057822/1993) (Daihen Corp.), 30 July 1993 (30.07.1993), paragraphs [0013] to [0016]; fig. 1 to 3 (Family: none)	7-9

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Patent documents cited in the description

- JP 2008103578 A **[0002] [0003]**