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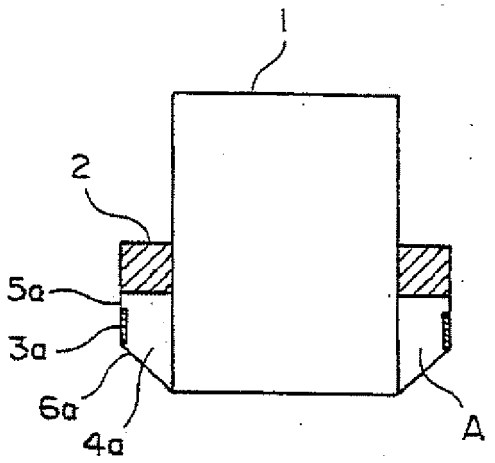
(54) DEVICE FOR REDUCING MOTION OF MARINE STRUCTURE

(57) A motion suppression device for marine structure by which motions of a marine structure can be sufficiently reduced is provided. The motion suppression device for marine structure comprises: a floating marine structure (1) of cylindrical shape, an overhang structure (2) fitted to a side wall of the floating marine structure (1) at a position below the sealevel and above a lower end of the side wall of the floating marine structure (1), a surrounding wall (3a, 3b, 3c, 3d, 3e, 3f, 3g) arranged at least below or above the overhang structure (2), and a communication opening (5a, 5b, 5c, 5d, 5e, 5f, 5g) formed between the overhang structure and surrounding wall.

Fig. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a motion suppression device for marine structure of SPAR type, monocolumn type or other floating type marine structures, such as offshore oil platforms, floating type amusement facilities or hotels or the like.

BACKGROUND ART

[0002] As a prior art device to reduce unstable motions of a floating type marine structure, such one as shown in Fig. 22 is proposed.

[0003] As shown there, a floating type marine structure comprises a lower hull 12 of disk shape and a column 11 of cylindrical shape arranged on the lower hull 12. An inside water section 13 is formed within the column 11 so as to communicate with outside water via a water port 14 provided in the lower hull 12. A fin 18 is provided around an outer circumferential periphery of the lower hull 12 so as to spread obliquely downwardly. The fin 18 is fixedly supported to the lower hull 12 via a strut 19 with a gap being maintained between the fin 18 and outer circumferential periphery of the lower hull 12. Thus, by effect of the fin 18, suppression of the motions is carried out.

Patent Document 1: Japanese laid-open patent application 1994-56074

[0004] However, as the result of various verification experiments of the prior art device, there is found a problem that little effect of motion suppression can be obtained.

DISCLOSURE OF THE INVENTION

[0005] In order to solve the above-mentioned problem, it is an object of the present invention to provide an effective motion suppression device for marine structure.

[0006] In order to achieve the above-mentioned object, a first means of the present invention is a motion suppression device for marine structure comprising: a floating marine structure of cylindrical shape, an overhang structure fitted to a side wall of the floating marine structure at a position below the sealevel and above a lower end of the side wall of the floating marine structure, a surrounding wall arranged at least below or above the overhang structure, and a communication opening formed between the overhang structure and surrounding wall.

[0007] A second means of the present invention is a motion suppression device for marine structure comprising: a floating marine structure of cylindrical shape, an overhang structure arranged with a gap between itself and a side wall of the floating marine structure at a position below the sealevel and above a lower end of the side wall of the floating marine structure, a surrounding wall arranged at least below or above the overhang structure, and a communication portion formed between the overhang structure and floating marine structure.

[0008] A third means of the present invention is a motion suppression device for marine structure comprising: a floating marine structure of cylindrical shape, an overhang structure fitted to a side wall of the floating marine structure at a position below the sealevel and above a lower end of the side wall of the floating marine structure, a surrounding wall arranged below and above the overhang structure, a communication portion wall arranged surrounding an outer periphery of the overhang structure and connecting to the surrounding wall, and a communication portion formed between the overhang structure and communication portion wall.

[0009] A fourth means of the present invention is a motion suppression device for marine structure as mentioned in any one of the first to third means, characterized in that at least six lateral movement preventing plates are vertically provided in a space surrounded by the overhang structure, surrounding wall and floating marine structure.

[0010] A fifth means of the present invention is a motion suppression device for marine structure as mentioned in the fourth means, characterized in that a seawater storing section is formed by the overhang structure, surrounding wall, floating marine structure and lateral movement preventing plates.

[0011] The present invention mentioned in claims as appended herein employs the above-mentioned first to fifth means, respectively, and the following effects can be obtained:

(1) As the invention of claim 1 or 2 employs the first or second means, the seawater storing section is formed by the floating marine structure, overhang structure and surrounding wall. Thereby, when the floating marine structure unstably moves, seawater stored in the seawater storing section functions as a mass to suppress the motions of the floating marine structure. Also, by the seawater stored in the seawater storing section erupting outside through the communication opening or communication portion of slit shape, the motions of the floating marine structure can be largely suppressed.

(2) As the invention of claim 3 employs the third means, the seawater storing section is formed by the floating marine structure, overhang structure and surrounding wall. Thereby, when the floating marine structure unstably moves, seawater stored in the seawater storing section functions as a mass to suppress the motions of the floating marine structure. Also, by the seawater moving up and down through the communication portion, the motions of the floating marine structure can be largely suppressed.

(3) As the invention of claim 4 or 5 employs the fourth or fifth means, the seawater stored in the seawater storing section is prevented from moving laterally

(horizontally) by the lateral movement preventing plates. Thereby, the motions of the floating marine structure can be more effectively suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 1 according to the present invention.
Fig. 2 is a bottom view of the embodiment 1 of Fig. 1.
Fig. 3 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 2 according to the present invention.
Fig. 4 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 3 according to the present invention.
Fig. 5 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 4 according to the present invention.
Fig. 6 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 5 according to the present invention.
Fig. 7 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 6 according to the present invention.
Fig. 8 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 7 according to the present invention.
Fig. 9 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 8 according to the present invention.
Fig. 10 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 9 according to the present invention.
Fig. 11 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 10 according to the present invention.
Fig. 12 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 11 according to the present invention.
Fig. 13 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 12 according to the present invention.
Fig. 14 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 13 according to the present invention.
Fig. 15 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 14 according to the present invention.
Fig. 16 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 15 according to the present invention.
Fig. 17 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 16 according to the present invention.
Fig. 18 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 17 according to the present invention.
Fig. 19 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 18 according to the present invention.
Fig. 20 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 19 according to the present invention.
Fig. 21 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 20 according to the present invention.
Fig. 22 is a vertical cross sectional view showing a construction of a prior art motion suppression device for marine structure.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] Herebelow, the present invention will be described with reference to figures based on embodiments according to the present invention.

[0014] Fig. 1 is a vertical cross sectional view showing a construction of a motion suppression device for marine structure of embodiment 1 according to the present invention. Fig. 2 is a bottom view of the embodiment 1 of Fig. 1. Figs. 3 to 21 are vertical cross sectional views showing constructions of motion suppression devices for marine structure of embodiments 2 to 20, respectively, of the present invention.

(Embodiment 1)

[0015] First, construction of a motion suppression device for marine structure of the embodiment 1 will be described with reference to Figs. 1 and 2.

[0016] As shown there, a floating type marine structure comprises a floating marine structure 1 of cylindrical shape and an overhang structure 2 of ring shape fitted to a side wall of the floating marine structure 1 at a position

below the sealevel and above a lower end of the side wall of the floating marine structure 1.

[0017] The overhang structure 2 is arranged being fitted to an entire outer circumferential periphery of the floating marine structure 1. Below an outer circumferential periphery of the overhang structure 2, a surrounding wall 3a of ring shape is arranged so as to surround the entire circumferential periphery of the floating marine structure 1 but not to outwardly protrude beyond the outer circumferential periphery of the overhang structure 2.

[0018] Communication openings 5a of slit shape are formed between the overhang structure 2 and surrounding wall 3a. In a space surrounded by the overhang structure 2, surrounding wall 3a and a side wall lower portion of the floating marine structure 1, a plurality of lateral movement preventing plates 4a are vertically provided. In Fig. 2, six lateral movement preventing plates 4a are radially arranged around the floating marine structure 1. Each of the lateral movement preventing plates 4a comprises an open end 6a that has its outer side connected to a lower end of the surrounding wall 3a and its inner side connected to the side wall lower end of the floating marine structure 1.

[0019] Thus, seawater storing sections A in which seawater is stored are formed by a lower surface of the overhang structure 2, the surrounding wall 3a, the outer circumferential periphery of the floating marine structure 1 and the lateral movement preventing plates 4a, 4 a.

[0020] It is to be noted that the lateral movement preventing plates 4a are provided for the purpose that while the floating marine structure 1 unstably moves, the seawater in the seawater storing sections A is prevented from moving laterally (horizontally). While the number of the lateral movement preventing plates 4a to be provided differs according to the size of the floating marine structure 1, at least 6 pieces thereof are necessary to be provided, as shown in Fig. 2.

[0021] In the construction mentioned above, as a large amount of seawater is stored in each of the seawater storing sections A, while the floating marine structure 1 unstably moves, the seawater stored in the seawater storing sections A functions as a mass to suppress the motions of the floating marine structure 1.

[0022] Moreover, as the seawater in the seawater storing sections A erupts outside through the communication openings 5a of slit shape and thereby also, the motions of the floating marine structure 1 can be suppressed. It is to be noted that the size of the communication openings 5a is preferable to be such size that when the floating marine structure 1 resonantly moves, the seawater in the seawater storing sections A erupts so as to generate vortices.

(Embodiment 2)

[0023] Next, construction of a motion suppression device for marine structure of embodiment 2 according to the present invention will be described with reference to Fig. 3.

[0024] In the motion suppression device for marine structure of the present embodiment 2, while the surrounding wall 3a of the embodiment 1 (Figs. 1 and 2) is arranged below the overhang structure 2, a surrounding wall 3b is arranged above the overhang structure 2.

[0025] In Fig. 3, parts and components having the same construction as those shown in Figs. 1 and 2 are given with the same reference numerals and points different from those described with respect to Figs. 1 and 2 will be mainly described.

[0026] As shown in Fig. 3, the surrounding wall 3b of ring shape is arranged above the outer circumferential periphery of the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1 but not to outwardly protrude beyond the outer circumferential periphery of the overhang structure 2. Communication openings 5b of slit shape are formed between the overhang structure 2 and surrounding wall 3b.

[0027] In a space surrounded by the overhang structure 2, surrounding wall 3b and a side wall upper portion of the floating marine structure 1, lateral movement preventing plates 4b are vertically provided, wherein the lateral movement preventing plates 4b are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections B are likewise formed. Each of the lateral movement preventing plates 4b comprises an open end 6b that has its outer side connected to an upper end of the surrounding wall 3b and its inner side connected to the side wall upper portion of the floating marine structure 1.

[0028] By the construction mentioned above, the same function and effect as the embodiment 1 can be obtained.

(Embodiment 3)

[0029] Construction of a motion suppression device for marine structure of embodiment 3 will be described with reference to Fig. 4.

[0030] In the motion suppression device for marine structure of the present embodiment 3, while the surrounding wall 3a of the embodiment 1 (Figs. 1 and 2) is vertically arranged below the overhang structure 2, a surrounding wall 3c is arranged to spread obliquely downwardly below the overhang structure 2.

[0031] In Fig. 4, parts and components having the same construction as those shown in Figs. 1 and 2 are given with the same reference numerals and points different from those described with respect to Figs. 1 and 2 will be mainly described.

[0032] As shown in Fig. 4, the surrounding wall 3c of truncated cone shape is arranged below the outer circumferential periphery of the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1. Communication openings 5c of slit shape are formed between the overhang structure 2 and surrounding wall 3c.

[0033] In a space surrounded by the overhang structure 2, surrounding wall 3c and side wall lower portion of the floating marine structure 1, lateral movement preventing plates 4c are vertically provided, wherein the lateral movement preventing plates 4c are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections A are formed. Each of the lateral movement preventing plates 4c comprises an open end 6c that has its outer side connected to a lower end of the surrounding wall 3c and its inner side connected to the side wall lower end of the floating marine structure 1.

[0034] By the construction mentioned above, a larger amount of seawater than in the case of the embodiment 1 can be stored in each of the seawater storing sections A and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 4)

[0035] Construction of a motion suppression device for marine structure of embodiment 4 will be described with reference to Fig. 5.

[0036] In the motion suppression device for marine structure of the present embodiment 4, while the surrounding wall 3a of the embodiment 1 (Figs. 1 and 2) is arranged below the overhang structure 2, a surrounding wall 3d is arranged below a space on the outer side of the outer circumferential periphery of the overhang structure 2.

[0037] In Fig. 5, parts and components having the same construction as those shown in Figs. 1 and 2 are given with the same reference numerals and points different from those described with respect to Figs. 1 and 2 will be mainly described.

[0038] As shown in Fig. 5, the surrounding wall 3d of ring shape is arranged below the space on the outer side of the outer circumferential periphery of the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1. Communication openings 5d of slit shape are formed between the overhang structure 2 and surrounding wall 3d.

[0039] In a space surrounded by the overhang structure 2, surrounding wall 3d and side wall lower portion of the floating marine structure 1, lateral movement preventing plates 4d are vertically provided, wherein the lateral movement preventing plates 4d are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections A are formed. Each of the lateral movement preventing plates 4d comprises an open end 6d that has its outer side connected to a lower end of the surrounding wall 3d and its inner side connected to the side wall lower end of the floating marine structure 1.

[0040] By the construction mentioned above, a larger amount of seawater than in the case of the embodiment 1 can be stored in each of the seawater storing sections A and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 5)

[0041] Construction of a motion suppression device for marine structure of embodiment 5 will be described with reference to Fig. 6.

[0042] In the motion suppression device for marine structure of the present embodiment 5, while the surrounding wall 3d of the embodiment 4 (Fig. 5) is vertically arranged, a surrounding wall 3e is arranged to spread obliquely downwardly.

[0043] In Fig. 6, parts and components having the same construction as those shown in Fig. 5 are given with the same reference numerals and points different from those described with respect to Fig. 5 will be mainly described.

[0044] As shown in Fig. 6, the surrounding wall 3e of truncated cone shape is arranged below the space on the outer side of the outer circumferential periphery of the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1. Communication openings 5e of slit shape are formed between the overhang structure 2 and surrounding wall 3e.

[0045] In a space surrounded by the overhang structure 2, surrounding wall 3e and side wall lower portion of the floating marine structure 1, lateral movement preventing plates 4e are vertically provided, wherein the lateral movement preventing plates 4e are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections A are formed. Each of the lateral movement preventing plates 4e comprises an open end 6e that has its outer side connected to a lower end of the surrounding wall 3e and its inner side connected to the side wall lower end of the floating marine structure 1.

[0046] By the construction mentioned above, a larger amount of seawater than in the case of the embodiment 4 can be stored in each of the seawater storing sections A and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 6)

[0047] Construction of a motion suppression device for marine structure of embodiment 6 will be described with reference to Fig. 7.

[0048] In the motion suppression device for marine structure of the present embodiment 6, while the surrounding wall 3a, etc. of the embodiment 1 (Figs. 1 and 2) are arranged below the overhang structure 2 as well as while the surrounding wall 3b, etc. of the embodiment 2 (Fig. 3) are arranged above the overhang structure 2, both of the surrounding wall 3a, etc. below the overhang

structure 2 and the surrounding wall 3b, etc. above the overhang structure 2 are arranged. That is, the embodiment 1 and embodiment 2 are combined.

[0049] In Fig. 7, parts and components having the same construction as those shown in Figs. 1, 2 and 3 are given with the same reference numerals.

[0050] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 7)

[0051] Construction of a motion suppression device for marine structure of embodiment 7 will be described with reference to Fig. 8.

[0052] In the motion suppression device for marine structure of the present embodiment 7, the embodiment 2 and embodiment 3 are combined. That is, the surrounding wall 3b, etc. above the overhang structure 2, as shown in Fig. 3, and the surrounding wall 3c, etc. below the overhang structure 2, as shown in Fig. 4, are arranged.

[0053] In Fig. 8, parts and components having the same construction as those shown in Figs. 3 and 4 are given with the same reference numerals.

[0054] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 8)

[0055] Construction of a motion suppression device for marine structure of embodiment 8 will be described with reference to Fig. 9.

[0056] In the motion suppression device for marine structure of the present embodiment 8, while the surrounding wall 3b above the overhang structure 2 of the embodiment 7 (Fig. 8) is vertically arranged, a surrounding wall 3f of inverse truncated cone shape is arranged to spread obliquely upwardly above the overhang structure 2.

[0057] In Fig. 9, parts and components having the same construction as those shown in Fig. 8 are given with the same reference numerals.

[0058] That is, as in the case of Fig. 8, the surrounding wall 3c of truncated cone shape, etc. are arranged below the overhang structure 2.

[0059] On the other hand, the surrounding wall 3f of inverse truncated cone shape is arranged above the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1. Communication openings 5f of slit shape are formed between the overhang structure 2 and surrounding wall 3f.

[0060] In a space surrounded by the overhang structure 2, surrounding wall 3f and side wall upper portion of the floating marine structure 1, lateral movement preventing plates 4f are vertically provided, wherein the lateral movement preventing plates 4f are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections B are formed. Each of the lateral movement preventing plates 4f comprises an open end 6f that has its outer side connected to an upper end of the surrounding wall 3f and its inner side connected to the side wall upper portion of the floating marine structure 1.

[0061] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 9)

[0062] Construction of a motion suppression device for marine structure of embodiment 9 will be described with reference to Fig. 10.

[0063] In the motion suppression device for marine structure of the present embodiment 9, the embodiment 2 (Fig. 3) and embodiment 4 (Fig. 5) are combined. That is, the surrounding wall 3b, etc. above the overhang structure 2, as shown in Fig. 3, and the surrounding wall 3d, etc. below the overhang structure 2, as shown in Fig. 5, are arranged.

[0064] In Fig. 10, parts and components having the same construction as those shown in Figs. 3 and 5 are given with the same reference numerals.

[0065] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 10)

[0066] Construction of a motion suppression device for marine structure of embodiment 10 will be described with reference to Fig. 11.

[0067] In the motion suppression device for marine structure of the present embodiment 10, the embodiment 2 (Fig. 3) and embodiment 5 (Fig. 6) are combined. That is, the surrounding wall 3b, etc. above the overhang structure 2, as shown in Fig. 3, and the surrounding wall 3e, etc. below the overhang structure 2, as shown in Fig. 6, are arranged.

[0068] In Fig. 11, parts and components having the same construction as those shown in Figs. 3 and 6 are given with the same reference numerals.

[0069] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 11)

[0070] Construction of a motion suppression device for marine structure of embodiment 11 will be described with reference to Fig. 12.

[0071] In the motion suppression device for marine structure of the present embodiment 11, the construction below the overhang structure 2 of the embodiment 8 (Fig. 9) is replaced with the construction below the overhang structure 2 of the embodiment 5 (Fig. 6). That is, the surrounding wall 3f, etc. above the overhang structure 2, as in the case of Fig. 9, and the surrounding wall 3e, etc. below the overhang structure 2, as in the case of Fig. 6, are arranged.

[0072] In Fig. 12, parts and components having the same construction as those shown in Figs. 6 and 9 are given with the same reference numerals.

[0073] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 12)

[0074] Construction of a motion suppression device for marine structure of embodiment 12 will be described with reference to Fig. 13.

[0075] In the motion suppression device for marine structure of the present embodiment 12, while the surrounding wall 3b of the embodiment 9 (Fig. 10) is arranged above the outer circumferential periphery of the overhang structure 2, a surrounding wall 3g is arranged above the space on the outer side of the outer circumferential periphery of the overhang structure 2.

[0076] In Fig. 13, parts and components having the same construction as those shown in Fig. 10 are given with the same reference numerals.

[0077] That is, as in the case of Fig. 10, the surrounding wall 3d, etc. are arranged below the overhang structure 2.

[0078] On the other hand, the surrounding wall 3g of ring shape of the same size as the surrounding wall 3d is arranged above the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1. Communication openings 5g of slit shape are formed between the overhang structure 2 and surrounding wall 3g.

[0079] In a space surrounded by the overhang structure 2, surrounding wall 3g and side wall upper portion of the floating marine structure 1, lateral movement preventing plates 4g are vertically provided, wherein the lateral movement preventing plates 4g are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections B are formed. Each of the lateral movement preventing plates 4g comprises an open end 6g that has its outer side connected to an upper end of the surrounding wall 3g and its inner side connected to the side wall upper portion of the floating marine structure 1.

[0080] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 13)

[0081] Construction of a motion suppression device for marine structure of embodiment 13 will be described with reference to Fig. 14.

[0082] In the motion suppression device for marine structure of the present embodiment 13, the surrounding wall 3d, etc. below the overhang structure 2 of the embodiment 12 (Fig. 13) are replaced with the surrounding wall 3e, etc. below the overhang structure 2 of the embodiment 5 (Fig. 6).

[0083] In Fig. 14, parts and components having the same construction as those shown in Figs. 13 and 6 are given with the same reference numerals.

[0084] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 14)

[0085] Construction of a motion suppression device for marine structure of embodiment 14 will be described with reference to Fig. 15.

[0086] In the motion suppression device for marine structure of the present embodiment 14, while the surrounding wall 3g above the space on the outer side of the outer circumferential periphery of the overhang structure 2 of the embodiment 13 (Fig. 14) is vertically arranged, a surrounding wall 3h of inverse truncated cone shape is arranged to spread obliquely upwardly.

[0087] In Fig. 15, parts and components having the same construction as those shown in Fig. 14 are given with the same reference numerals.

[0088] That is, as in the case of Fig. 14, the surrounding wall 3e of truncated cone shape, etc. are arranged below the overhang structure 2.

[0089] On the other hand, the surrounding wall 3h of inverse truncated cone shape is arranged above the space on the outer side of the outer circumferential periphery of the overhang structure 2 so as to surround the entire circumferential periphery of the floating marine structure 1. Communication openings 5h of slit shape are formed between the overhang structure 2 and surrounding wall 3h.

[0090] In a space surrounded by the overhang structure 2, surrounding wall 3h and side wall upper portion of the floating marine structure 1, lateral movement preventing plates 4h are vertically provided, wherein the lat-

eral movement preventing plates 4h are radially arranged around the floating marine structure 1 and the number thereof is at least 6 as in the case of Fig. 2. By this construction, seawater storing sections B are formed. Each of the lateral movement preventing plates 4h comprises an open end 6h that has its outer side connected to an upper end of the surrounding wall 3h and its inner side connected to the side wall upper portion of the floating marine structure 1.

[0091] By the construction mentioned above, a large amount of seawater can be stored in each of the seawater storing sections A and B and the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 15)

[0092] Construction of a motion suppression device for marine structure of embodiment 15 will be described with reference to Fig. 16.

[0093] In the motion suppression device for marine structure of the present embodiment 15, while the overhang structure 2 in the embodiments 1 to 14 is directly fitted to the floating marine structure 1, an overhang structure 2a of ring shape is arranged with a gap between the overhang structure 2a and side wall of the floating marine structure 1 at a position below the sealevel and above the lower end of the side wall of the floating marine structure 1.

[0094] A communication portion 7 is formed between the overhang structure 2a and side wall of the floating marine structure 1.

[0095] On lower and/or upper surfaces of the overhang structure 2a, such surrounding walls 3a, 3b, 3c and 3f as shown in Figs. 1, 3, 4, 7, 8 and 9 are directly fitted.

[0096] Also, the lateral movement preventing plates 4a, 4b, 4c and 4f are likewise arranged so that the seawater storing sections A and/or B are formed.

[0097] By the present embodiment 15 also, the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 16)

[0098] Construction of a motion suppression device for marine structure of embodiment 16 will be described with reference to Fig. 17.

[0099] In the motion suppression device for marine structure of the present embodiment 16, while the surrounding walls 3d and 3g of the embodiment 12 (Fig. 13) are arranged independent of each other, a communication portion wall 9 is provided surrounding the space on the outer side of the outer circumferential periphery of the overhang structure 2 so that the surrounding walls 3d and 3g are connected to each other via the communication portion wall 9.

[0100] In Fig. 17, parts and components having the same construction as those shown in Fig. 13 are given with the same reference numerals.

[0101] That is, below the overhang structure 2, the surrounding wall 3d of ring shape and the lateral movement preventing plates 4d are arranged so as to surround the entire outer circumferential periphery of the floating marine structure 1 and thereby the seawater storing sections A are formed. Also, above the overhang structure 2, the surrounding wall 3g of ring shape of the same size as the surrounding wall 3d and the lateral movement preventing plates 4g are arranged so as to surround the entire outer circumferential periphery of the floating marine structure 1 and thereby the seawater storing sections B are formed.

[0102] The communication portion wall 9 connecting to the surrounding walls 3d and 3g, respectively, is arranged on the outer side of the outer circumferential periphery of the overhang structure 2. A communication portion 7a of ring shape communicating with the seawater storing sections A and B, respectively, is formed between an inner side of the communication portion wall 9 and the outer circumferential periphery of the overhang structure 2.

[0103] By the construction mentioned above, when the floating marine structure 1 moves, seawater stored in the seawater storing sections A and B passes through the communication portion 7a to flow into the seawater storing sections B and A, respectively. Hence, by the fluid resistance at this time, the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 17)

[0104] Construction of a motion suppression device for marine structure of embodiment 17 will be described with reference to Fig. 18.

[0105] In the motion suppression device for marine structure of the present embodiment 17, while the surrounding walls 3e and 3h of the embodiment 14 (Fig. 15) are arranged independent of each other, a communication portion wall 9 is provided surrounding the space on the outer side of the outer circumferential periphery of the overhang structure 2 so that the surrounding walls 3e and 3h are connected to each other via the communication portion wall 9.

[0106] In Fig. 18, parts and components having the same construction as those shown in Fig. 15 are given with the same reference numerals.

[0107] That is, below the overhang structure 2, the surrounding wall 3e of ring shape and the lateral movement preventing plates 4e are arranged so as to surround the entire outer circumferential periphery of the floating marine structure 1 and thereby the seawater storing sections A are formed. Also, above the overhang structure 2, the surrounding wall 3h of ring shape of the same size as the surrounding wall 3e and the lateral movement preventing plates 4h are arranged so as to surround the entire outer circumferential periphery of the floating ma-

rine structure 1 and thereby the seawater storing sections B are formed.

[0108] The communication portion wall 9 connecting to the surrounding walls 3e and 3h, respectively, is arranged on the outer side of the outer circumferential periphery of the overhang structure 2. A communication portion 7a of ring shape communicating with the seawater storing sections A and B, respectively, is formed between an inner side of the communication portion wall 9 and the outer circumferential periphery of the overhang structure 2.

[0109] By the construction mentioned above, when the floating marine structure 1 moves, seawater stored in the seawater storing sections A and B passes through the communication portion 7a to flow into the seawater storing sections B and A, respectively. Hence, by the fluid resistance at this time, the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 18)

[0110] Construction of a motion suppression device for marine structure of embodiment 18 will be described with reference to Fig. 19.

[0111] In the motion suppression device for marine structure of the present embodiment 18, while the overhang structure 2 of the embodiment 16 (Fig. 17) has its outer circumferential periphery formed flat, an overhang structure 2b has a central portion of its outer circumferential periphery protruded outwardly.

[0112] In Fig. 19, parts and components having the same construction as those shown in Fig. 17 are given with the same reference numerals.

[0113] That is, below the overhang structure 2b, the surrounding wall 3d of ring shape and the lateral movement preventing plates 4d are arranged so as to surround the entire outer circumferential periphery of the floating marine structure 1 and thereby the seawater storing sections A are formed. Also, above the overhang structure 2b, the surrounding wall 3g of ring shape of the same size as the surrounding wall 3d and the lateral movement preventing plates 4g are arranged so as to surround the entire outer circumferential periphery of the floating marine structure 1 and thereby the seawater storing sections B are formed.

[0114] The communication portion wall 9 connecting to the surrounding walls 3d and 3g, respectively, is arranged on the outer side of the outer circumferential periphery of the overhang structure 2. A communication portion 7b of ring shape communicating with the seawater storing sections A and B, respectively, is formed between the inner side of the communication portion wall 9 and the outwardly protruded outer circumferential periphery of the overhang structure 2b. Thus, an orifice portion 10 is formed by an inner side surface of the communication portion wall 9 and a protruded end portion of the outer circumferential periphery of the overhang structure 2b.

[0115] By the construction mentioned above, when the floating marine structure 1 moves, seawater stored in the seawater storing sections A and B passes through the communication portion 7b to flow into the seawater storing sections B and A, respectively. When the seawater flows through the orifice portion 10, flow velocity of the seawater is increased and the damping effect becomes large. Hence, the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

[0116] It is to be noted that the orifice portion 10 is also applicable to the construction of the embodiment 17 shown in Fig. 18.

[0117] Also, while the above-mentioned orifice portion 10 employs the overhang structure 2b having the vertical directional central portion of its outer circumferential periphery protruded outwardly, construction of the orifice portion is not limited thereto but may be such that an upper end or lower end of the outer circumferential periphery of the overhang structure 2b protrudes outwardly or the communication portion wall 9 protrudes inwardly toward the overhang structure 2b.

(Embodiment 19)

[0118] Construction of a motion suppression device for marine structure of embodiment 19 will be described with reference to Fig. 20.

[0119] In the motion suppression device for marine structure of the present embodiment 19, while the overhang structure 2a of the embodiment 15 (Fig. 16) has its inner side surface formed flat, an overhang structure 2c has a central portion of its inner side surface protruded inwardly toward the floating marine structure 1.

[0120] In Fig. 20, parts and components having the same construction as those shown in Fig. 16 are given with the same reference numerals.

[0121] That is, as in the case of the embodiment 15, the overhang structure 2c of ring shape is arranged with a gap between the overhang structure 2c and side wall of the floating marine structure 1 at a position below the sealevel and above the lower end of the side wall of the floating marine structure 1. A communication portion 7c is formed between the overhang structure 2c and side wall of the floating marine structure 1.

[0122] Also, the overhang structure 2c has the vertical directional central portion of its inner side surface protruded inwardly. Thus, an orifice portion 10 is formed by the side wall of the floating marine structure 1 and a protruded end portion of the inner side surface of the overhang structure 2c.

[0123] On lower and/or upper surfaces of the overhang structure 2c, such surrounding walls 3a, 3b, 3c and 3f as shown in Figs. 1, 3, 4, 7, 8 and 9 are directly fitted.

[0124] Also, the lateral movement preventing plates 4a, 4b, 4c and 4f are likewise arranged so that the seawater storing sections A and/or B are formed.

[0125] By the present embodiment 19 also, the effect

to suppress the motions of the floating marine structure 1 can be further enhanced.

(Embodiment 20)

[0126] Construction of a motion suppression device for marine structure of embodiment 20 will be described with reference to Fig. 21.

[0127] In the motion suppression device for marine structure of the present embodiment 20, while the overhang structure 2a of the embodiment 15 (Fig. 16) has its inner side surface arranged in parallel relative to the side wall of the floating marine structure 1, an overhang structure 2d has its inner side surface arranged obliquely relative to the side wall of the floating marine structure 1.

[0128] In Fig. 21, parts and components having the same construction as those shown in Fig. 16 are given with the same reference numerals.

[0129] That is, as in the case of the embodiment 15, the overhang structure 2d of ring shape is arranged with a gap between the overhang structure 2d and side wall of the floating marine structure 1 at a position below the sealevel and above the lower end of the side wall of the floating marine structure 1. A communication portion 7d is formed between the overhang structure 2d and side wall of the floating marine structure 1.

[0130] Also, the overhang structure 2d has an upper end portion of its oblique inner side surface protruded inwardly. Thus, an orifice portion 10 is formed by the side wall of the floating marine structure 1 and a protruded end portion of the inner side surface of the overhang structure 2d.

[0131] On lower and/or upper surfaces of the overhang structure 2d, such surrounding walls 3a, 3b, 3c and 3f as shown in Figs. 1, 3, 4, 7, 8 and 9 are directly fitted.

[0132] Also, the lateral movement preventing plates 4a, 4b, 4c and 4f are likewise arranged so that the seawater storing sections A and/or B are formed.

[0133] By the present embodiment 20 also, the effect to suppress the motions of the floating marine structure 1 can be further enhanced.

[0134] It is to be noted that all of Figs. 1 to 21 illustrate only the portions below the sealevel of the construction of the floating marine structure 1 and the construction on or above the sealevel may be freely set independent thereof. For example, if a plurality of the floating marine structures 1 as shown in Figs. 1 to 21 are provided and a common station is placed thereon so as to be positioned above the sealevel, it can be appropriately used as amusement facilities or hotels.

[0135] In the above, while the present invention has been described based on the embodiments 1 to 20, the present invention is not limited thereto but, as a matter of course, may be added with various modifications in the concrete construction within the scope of claims as appended herein.

[0136] For example, the horizontal cross sectional shapes of the floating marine structure 1, overhang structures 2, 2a, surrounding walls 3a, 3b, 3c, 3d, 3e, 3f, 3g and 3h and communication portion wall 9 are not limited to the circular shape but may be other various shapes including a polygon, octagon, square or the like.

[0137] Also, the overhang structures 2, 2a, 2b, 2c and 2d are not limited to those having the square or substantially square vertical cross sectional shapes as shown in Figs. 1 to 21 but may be a structure of thin plate shape including a disk or the like.

[0138] Also, in the above-mentioned embodiments, while the surrounding walls 3a, 3c, 3d and 3e below the overhang structures 2, 2a are arranged so as not to downwardly protrude beyond the lower end of the floating marine structure 1, they are not limited thereto but may be of such a shape as to downwardly protrude beyond the lower end of the floating marine structure 1.

[0139] Even in such a case, the open ends 6a, 6c, 6d and 6e of the lateral movement preventing plates 4a, 4c, 4d and 4e are arranged to have their outer side connected to the lower ends of the surrounding walls 3a, 3c, 3d and 3e and their inner side connected to the side wall lower end of the floating marine structure 1.

Claims

1. A motion suppression device for marine structure comprising:

a floating marine structure of cylindrical shape,
an overhang structure fitted to a side wall of said floating marine structure at a position below the sealevel and above a lower end of the side wall of said floating marine structure,
a surrounding wall arranged at least below or above said overhang structure, and
a communication opening formed between said overhang structure and surrounding wall.

2. A motion suppression device for marine structure comprising:

a floating marine structure of cylindrical shape,
an overhang structure arranged with a gap between itself and a side wall of said floating marine structure at a position below the sealevel and above a lower end of the side wall of said floating marine structure,
a surrounding wall arranged at least below or above said overhang structure, and
a communication portion formed between said overhang structure and floating marine structure.

3. A motion suppression device for marine structure comprising:

a floating marine structure of cylindrical shape,

an overhang structure fitted to a side wall of said floating marine structure at a position below the sealevel and above a lower end of the side wall of said floating marine structure,
a surrounding wall arranged below and above said overhang structure,
a communication portion wall arranged surrounding an outer periphery of said overhang structure and connecting to said surrounding wall, and
a communication portion formed between said overhang structure and communication portion wall.

4. A motion suppression device for marine structure as claimed in any one of Claims 1 to 3, **characterized in that** at least six lateral movement preventing plates are vertically provided in a space surrounded by said overhang structure, surrounding wall and floating marine structure.

5. A motion suppression device for marine structure as claimed in Claim 4, **characterized in that** a seawater storing section is formed by said overhang structure, surrounding wall, floating marine structure and lateral movement preventing plates.

Fig. 1

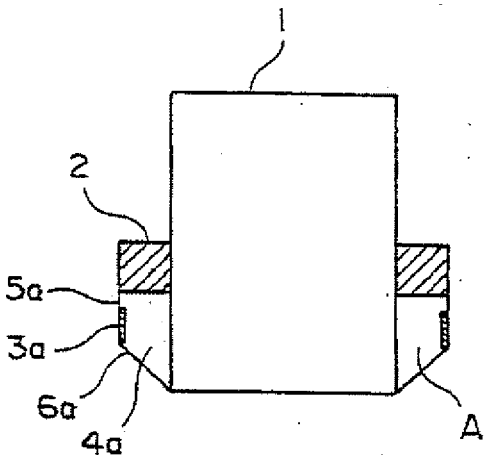


Fig. 2

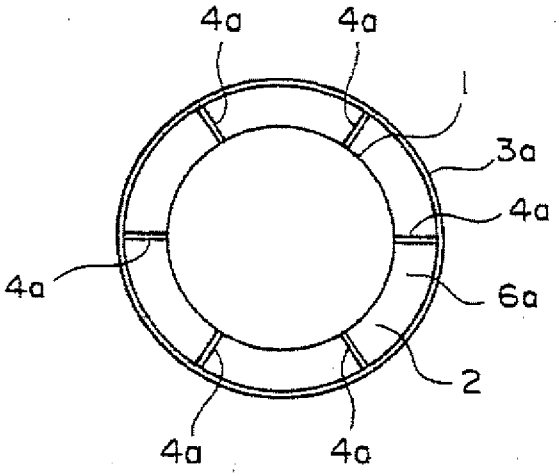


Fig. 3

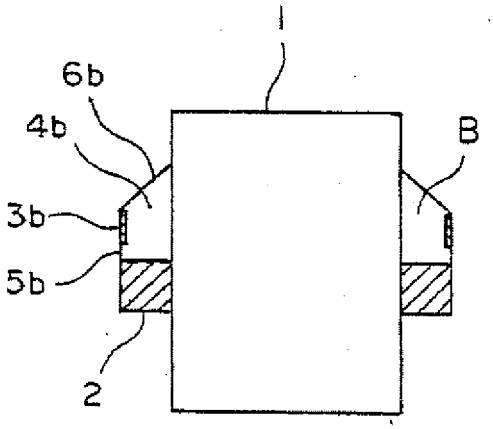


Fig. 4

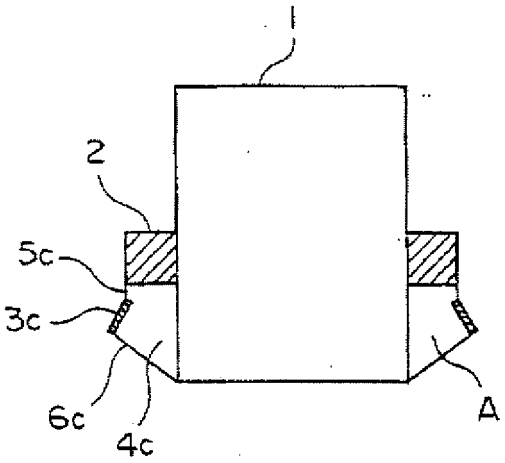


Fig. 5

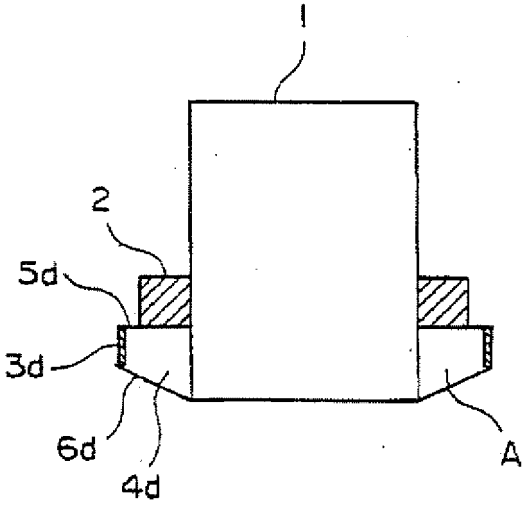


Fig. 6

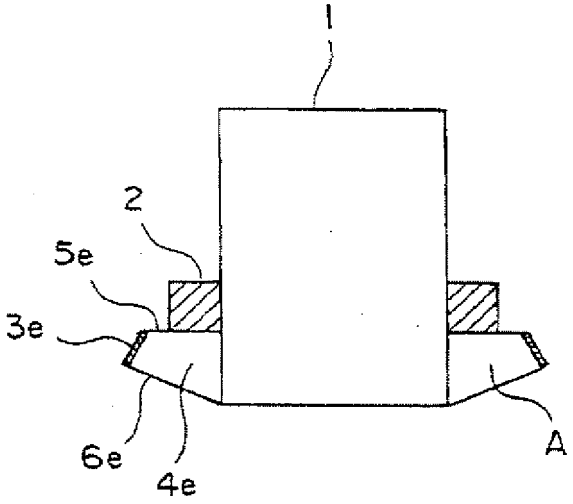


Fig. 7

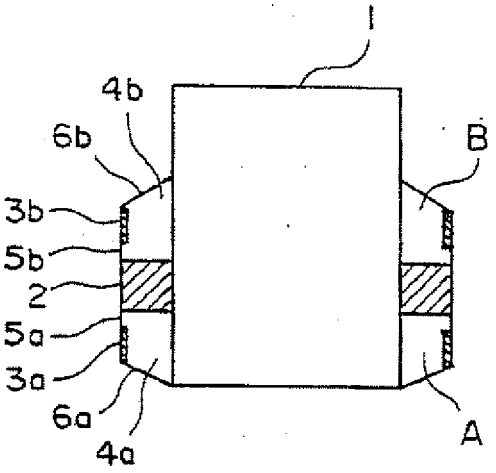


Fig. 8

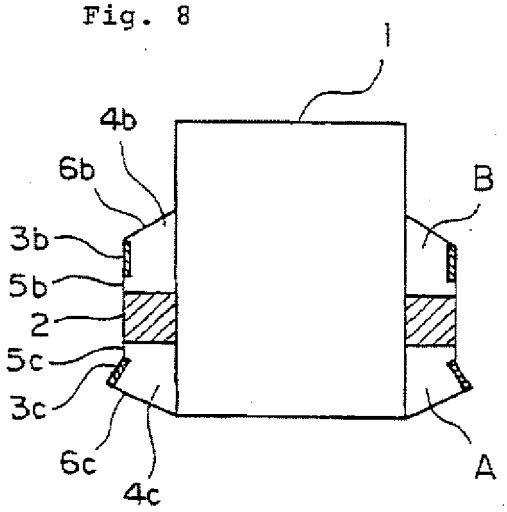


Fig. 9

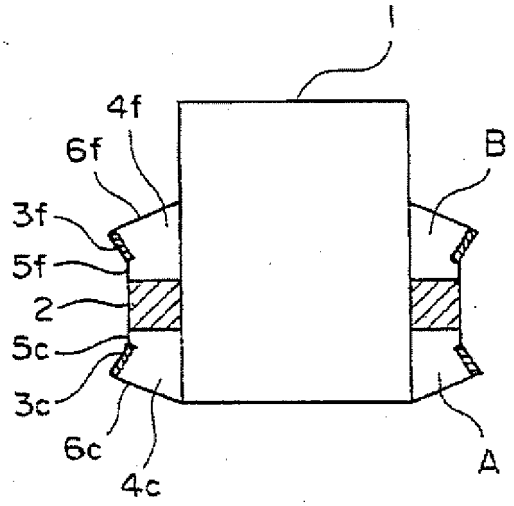


Fig. 10

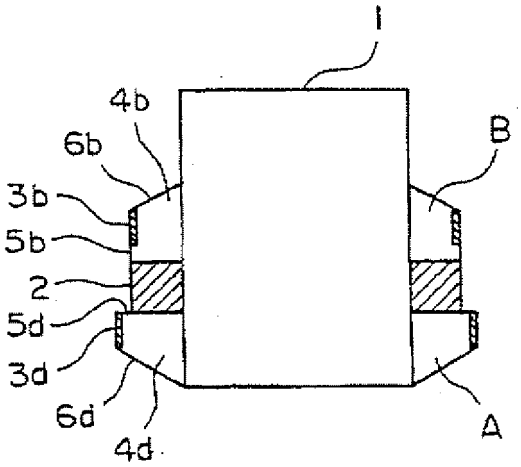


Fig. 11

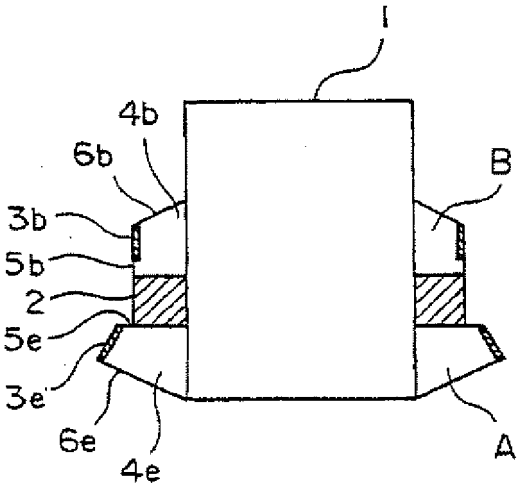


Fig. 12

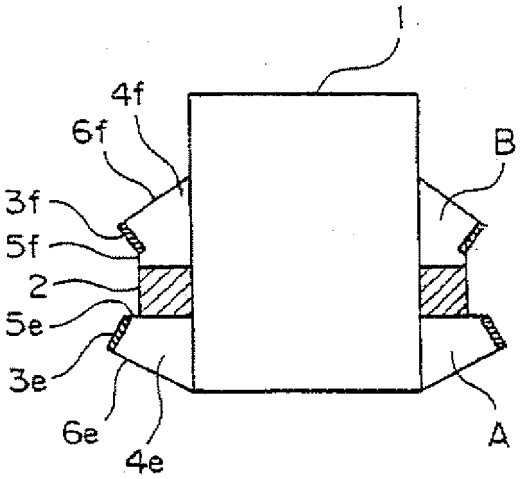


Fig. 13

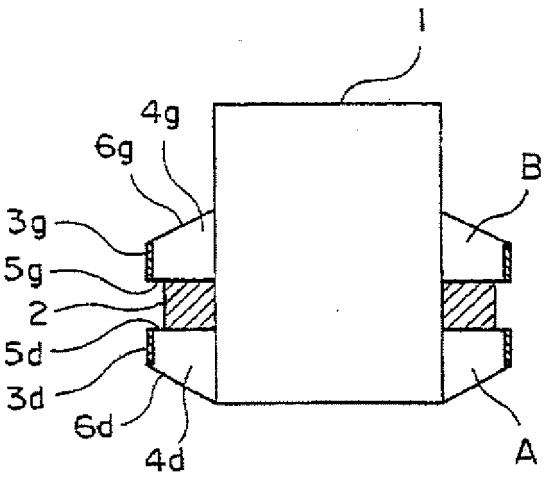


Fig. 14

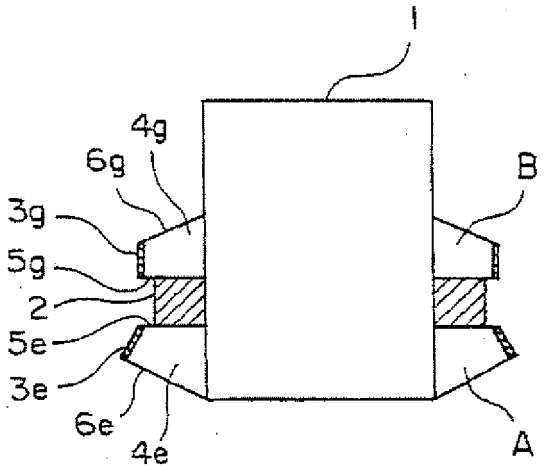


Fig. 15

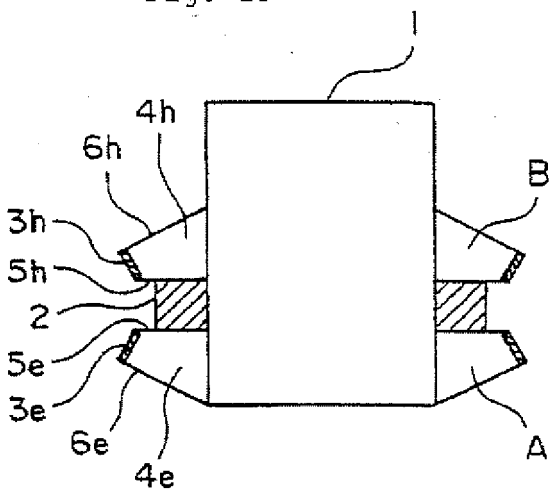


Fig. 16

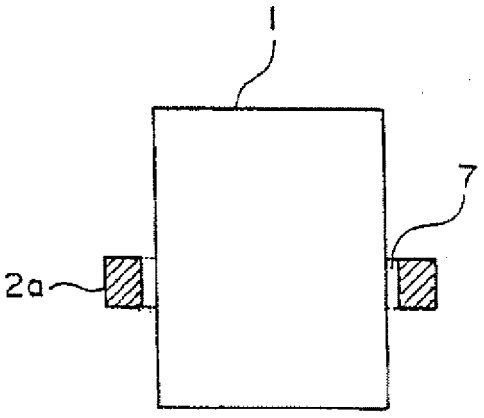


Fig. 17

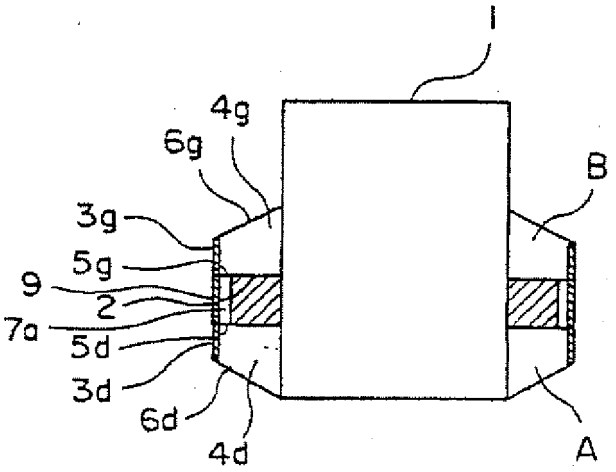


Fig. 18

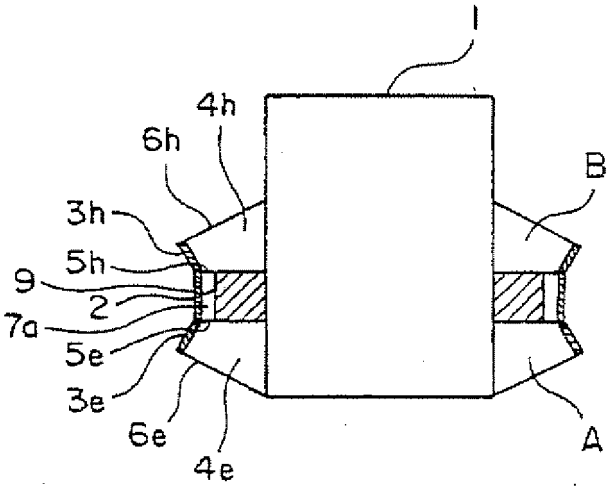


Fig. 19

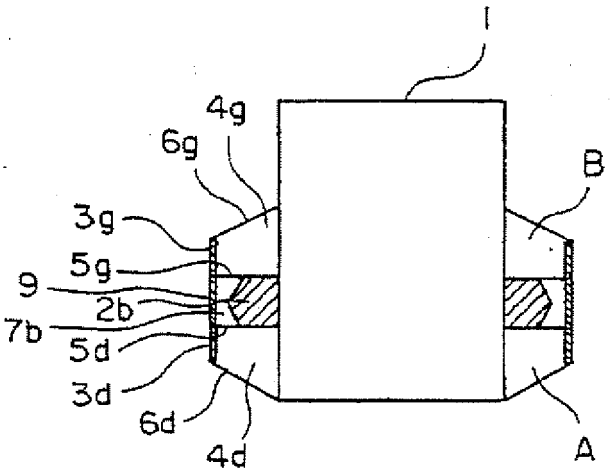


Fig. 20

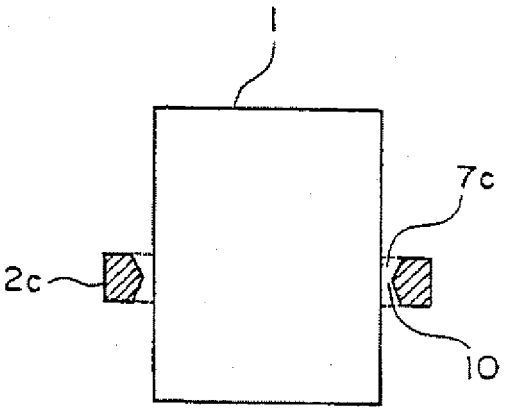


Fig. 21

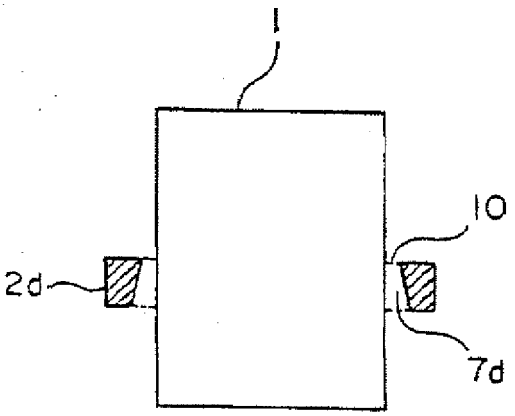
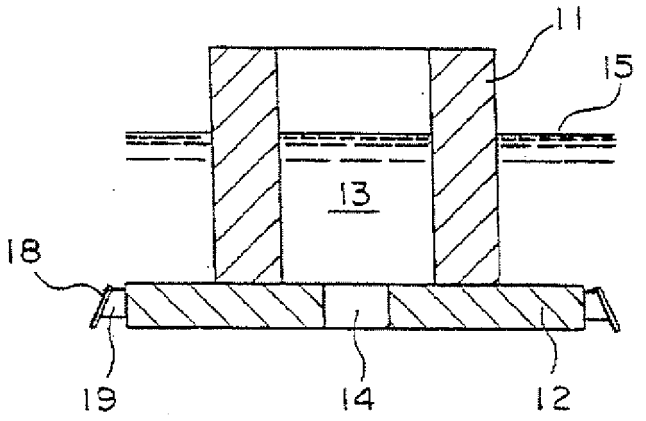


Fig. 22



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/002549

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B63B35/44, 39/03

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)
Int.Cl[7] B63B35/44, 39/03

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 1996-2005
Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005

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	JP 50-95989 A (Mitsubishi Heavy Industries, Ltd.), 30 July, 1975 (30.07.75), Page 2, upper left column, line 10 to lower left column, line 2; Fig. 3 (Family: none)	1
A	JP 3-90497 A (Mitsubishi Heavy Industries, Ltd.), 16 April, 1991 (16.04.91), Full text (Family: none)	1,3-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 May, 2005 (12.05.05)	31 May, 2005 (31.05.05)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/002549

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 62-292587 A (Sumitomo Heavy Industries, Ltd.), 19 December, 1987 (19.12.87), Full text (Family: none)	1,3-5

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/002549

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 2
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
The description of "a communication section formed between the overhanging structure and the overhanging structure" of claim 2 is not clear.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2004)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6056074 A **[0003]**