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(54) Multiple missile launcher structure with interchangeable containerized missiles and chimneys

(57) A structure for holding canisterized missiles or similarly dimensioned chimneys includes a structure which defines an array of canister/chimney holding chambers. The structure has a plenum at its lower end, which allows missile exhaust to communicate with one or more chimneys. At the upper end, the structure may have movable hatches which are opened to allow the missile to leave and exhaust gases to be released by the chimney.

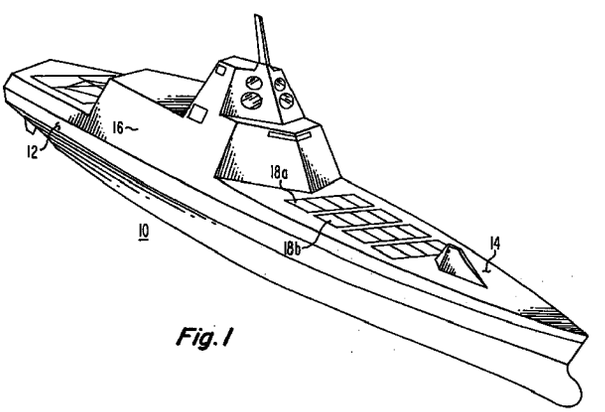

Fig. 1

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Description

[0001] This invention relates to multiple missile holding structures, and more particularly to such structures for holding containerized missiles and similarly dimensioned chimneys in positions suitable for firing of the missiles.

[0002] Modern warship weapon systems rely to a great extent on powered missiles. For this purpose, some warships carry a plurality of missiles, which may be of different types. For convenience, common launchers may be used for these different missile types. Some missiles come from the manufacturer encased in a protective container or canister, at least a part of which becomes part of the launcher. Such a canister is described in U.S. Patent 5,153,367, issued October 6, 1992 in the name of Marquart et al. Such containers or canisters may have different lengths as they arrive from the missile manufacturer, to accommodate different types of missiles. When missile canisters which are shorter than the longest standardized canister are to be used in a multiple-missile launcher, the shorter canisters can be fitted with external canister extensions to bring their lengths to a common dimension. With such an adjustment, each missile-bearing canister fits into the common launcher. When preparing a particular canisterized missile for loading into a multiple missile launcher, the rigid end covers of the canister are removed, exposing a frangible or "fly-through" protective covering, and the canister is then inserted into a canister chamber of the multiple launcher. Each missile-bearing canister also has a standardized canister connector by which signals can be coupled between the missile within the canister and the outside world. The canister connector is coded by the manufacturer, by interconnecting or jumpering certain pins by means of a coding plug within the canister, to identify the missile within, to avoid the possibility of human error in programming the missile. The standardized canister connector is connected by a standardized umbilical cable, which in one version contains 145 conductors, with a launch controller, which is controlled so that any one of the missiles may be armed and launched.

[0003] The fabricators of warships acquire the multiple missile launching apparatuses from fabricators of such systems. A complete missile launching system for a warship may include several multiple missile launching structures, each capable of holding and launching a particular number of missiles, such as eight. The number of such multiple missile launching structures which a warship will carry depends, in part, on the number of missiles which may be required during any engagement, since removal of a spent canister from the missile launching structure, and replacing it with a fresh canister, may take more time than is acceptable during an engagement. Thus, each warship must be fitted with as many multiple missile launchers as it can conveniently carry.

[0004] Each of the several multiple missile launching structures carried by a warship is mounted within the ship, flush with an upper deck, and with the missile canisters within the multiple missile launching structure protected from the environment by the ship's hull and deck, by the structure of the multiple missile launcher, and by the canister. When a missile is to be launched, the controller commands opening of a hatch, if any, over the particular one of the canisters containing the missile to be launched, and the missile's engine is started. The missile leaves the canister through the frangible protective sheet, and engages the target. The hatch is then closed to prevent ingress of water.

[0005] Each multiple missile launcher also includes a missile exhaust receiving chamber below the missile canisters, which receives the plasma from the rocket engine of the missile while the missile is within the canister, and before it leaves the warship, to prevent damage to the ship. The chamber is vented to the deck by way of a chimney. The very high temperatures of the missile exhaust, and its corrosive qualities, tend to erode both the chamber and the chimney. The high volume of the missile exhaust gases, in conjunction with the limited cross-section of the chimney, results in high transient pressures within the chamber. This high pressure, in turn, results in a need for substantial reinforcement of the walls of the chamber, to avoid rupture. The design of ships requires careful consideration of the location of the ship's payload. More particularly, the mass center of the ship's load should preferably be below the waterline, to avoid a tendency to capsize. Thus, since the multiple missile launcher is necessarily located immediately below an uppermost deck, much of the mass of the multiple missile launcher lies above the waterline.

Consequently, it is desirable to minimize the mass of the multiple missile launcher. This minimization of mass, in turn, makes it desirable to minimize the mass used for the missile exhaust receiving chamber and for its reinforcement.

[0006] The missile exhaust gases leaving the missile exhaust receiving chamber also tend to erode the chimney which extends from the chamber to the upper deck. The erosion of the chimney must he reduced to a level such that the chimney lasts until the multiple missile launcher itself is replaced, and ablative material is used within the chimney, and particularly at the juncture of the chimney and the missile exhaust receiving chamber, to minimize such erosion.

[0007] Once the multiple missile launchers are mounted within a warship, removal is difficult, and may require that the ship be returned to a shipbuilding facility. It is desirable that the multiple missile launcher be made to serve its purpose for as long as possible. Improved missile launch arrangements are desired.

[0008] A structure for holding canisterised missiles or similarly dimensioned chimneys includes a structure which defines an array of canister/chimney holding

chambers. The structure has a plenum at its lower end, which allows missile exhaust to communicate with one or more chimneys. At the upper end, the structure may have movable hatches which are opened to allow the missile to leave and exhaust gases to be released by the chimney.

[0009] More particularly, a multiple missile holding structure for holding missiles loaded into standardized canisters includes at least one chimney having a length substantially equal to the length of one of the standardized canisters, and also having cross-sectional dimensions no greater than those of one of the standardized canisters. The multiple missile holding structure also includes a multiple canister/chimney holding structure. The multiple canister/chimney holding structure defines an array of canister/chimney holding chambers, for holding a plurality of the canisters and chimneys mutually parallel in an array, with the exhaust ends of the canisters in a first common plane, and with the missile exit ends of the canisters in a second common plane. A shield plate has a thickness, and defines a first side and a second side. The first side of the shield plate is affixed to that end of the multiple canister holding structure which is adjacent to the first common plane. The shield plate defines a first array of canister/chimney apertures dimensioned and registered to closely fit the ends of canisters/chimneys held in the multiple canister holding structure. A plenum is coupled to, and completely encloses the second side of the shield plate, for providing a path for the flow of fluids or gases between any aperture in the shield plate and any other aperture in the shield plate. The plenum having at least one wall which is in the form of a portion of a circular cylinder. The multiple missile holding structure also includes a frame defining an array of canister/chimney apertures having dimensions no smaller than the exterior cross-sectional dimensions of one of the standardized canisters. The frame is affixed to the multiple canister holding structure adjacent to the second common plane, with the canister/chimney apertures registered with the array.

[0010] In a particular embodiment of the invention, each of the canister/chimney chambers includes a dog adapted for engaging a hold-down associated with a particular location on each of the canisters/chimneys. In another embodiment of the invention, the structure further includes energy absorbing material lying against at least a portion of the cylindrical wall of the plenum. The energy absorbing material may include ablative material. This ablative material may be affixed to the wall of that one of the canister/chimney apertures of the shield plate which is associated with the chimney, with the ablative material lying in the canister/chimney aperture at a location lying between the first and second sides of the shield plate.

[0011] In a preferred embodiment of the invention, the structure further includes a plurality of hatches affixed to the frame and movable relative thereto, with each of the hatches being associated with one of the canister/chimney apertures in the frame, for individually closing or opening the canister/chimney apertures in the frame.

[0012] In another embodiment of the invention, a sealing arrangement is coupled to the chimney aperture in the shield plate and to that end of the chimney adjacent to the first plane, for sealing the joint therebetween. The chimney may have a square or round cross-section, or any other desired shape.

FIGURE 1 is a simplified perspective or isometric view of a ship fitted with a plurality of multiple missile holding structures according to an aspect of the invention;

FIGURE 2a is a simplified, conceptual, partially exploded, perspective or isometric view of one of the multiple missile holding structures of FIGURE 1, and FIGURE 2b is a side view thereof;

FIGURE 3 is a more detailed representation of the arrangement of FIGURE 2, further illustrating a structure which has the same dimensions as a standardized canister or a standardized chimney; and

FIGURE 4 is a simplified illustration of another embodiment of a plenum.

[0013] In FIGURE 1, a warship 10 includes a hull 12, an upper deck 14, and a superstructure 16, all as well known. As illustrated in FIGURE 1, the deck 14 has a plurality of regions, some of which are illustrated as 18a and 18b, which contain an array of a plurality of apertures or hatches (not illustrated in FIGURE 1), which are more readily understood with reference to FIGURES 2a and 2b. In FIGURES 2a and 2b, multiple missile holding arrangement 18 includes a multiple canister/chimney holding structure designated generally as 20, which includes a plurality, illustrated as ten, of elongated canister/chimney holding structures, illustrated as an array of tubes 20a, 20b, 20c, 20d, 20e, 20f, 20g, 20h, 20i, and 20j, each having a square cross-section. Each tube 20a, 20b, 20c, 20d, 20e, 20f, 20g, 20h, 20i, and 20j has identical length, and also has identical cross-sectional dimensions. The canister/chimney holding chambers which are defined by tubes 20a, 20b, 20c, 20d, 20e, 20f, 20g, 20h, 20i, and 20j are designated generally as 22, and individually as 22a, 22b, 22c, 22d, 22e, 22h, 22i, and 22j, respectively. The upper ends of the canister/chimney holding tubes 20a, 20b, 20c, 20d, 20e, 20f, 20g, 20h, 20i, and 20j, which correspond with the missile exit ends, are coterminous at a common plane 24, and the lower ends of the tubes, corresponding to the missile exhaust ends, are conterminous at a common plane 26. The canister/chimney holding tubes of FIGURES 2a and 2b are held in a regular array, with the longitudinal axes of the canister/chimney holding chambers, some of which are designated as 8e, 8f, and 8j, mutually parallel.

[0014] At the lower end of the structure illustrated in

FIGURES 2a and 2b, a shield plate 28 having an upper side 28u adjacent the canister/chimney holding chambers, and also having a lower side 281 remote therefrom, defines a plurality 30 of canister/chimney apertures 30a, 30b, 30c, 30d, 30e, 30f, 30g, 30h, 30i, and 30j, which are registered with the missile-exhaust ends of their corresponding canister/chimney holding tubes 20a, 20b, 20c, 20d, 20e, 20f, 20g, 20h, 20i, and 20j, respectively, and affixed thereto.

[0015] A plenum 32 is defined by a plenum chamber 34 in FIGURES 2a and 2b. Plenum chamber 34 includes a wall 36 in the form of half a cylinder centered on an axis 7. The ends of the plenum are closed off by semicircular walls 38a and 38b. The entire plenum chamber 34, including semicylindrical wall 36, and end walls 38a and 38b, is affixed to the edges of shield plate 28, so as to define plenum 32 as being semicylindrical.

[0016] An upper frame illustrated as 40 in FIGURES 2a and 2b. Upper frame 40 is affixed to the deck 14 of ship 10 of FIGURE 1. Frame 40 defines a plurality of apertures, which are no smaller in cross-section than a canister or chimney which are accommodated by a canister/chimney holding chamber 22 of FIGURES 2a and 2b, to allow loading into a canister/chimney holding chamber 22 of a standardized missile canister or a standardized chimney. The apertures in upper frame 40 are not separately designated in FIGURE 2a, but correspond to the designations 22, and therefore the designation 22 is also applied to the array of apertures in upper frame 40.

[0017] FIGURE 3 is a more detailed representation of the arrangement of FIGURES 2a and 2b, and also illustrates a structure which may be either a canister or a chimney of rectangular cross-section, and which also illustrates two chimneys of round cross-section. In FIGURE 3, elements corresponding to those of FIGURES 2a and 2b are designated by like reference numerals. The structure illustrated in FIGURE 2a as canister/chimney holding tubes 20a, 20b, 20c, 20d, 20e, 20f, 20g, 20h, 20i, and 20j is represented in FIGURE 3 as a framework or latticework designated generally as 50, including an upper portion 50a, a middle portion 50b, and a lower portion 50c, which together define the canister/chimney holding chambers 22a, 22b, 22c, 22d, 22e, 22h, 22i, and 22j. Lower portion 50c of the latticework 50, when affixed to shield plate 28, forms a truss structure not unlike that of a bridge, which supports the weight of the remainder of the structure and of the canisters loaded therein. Lattice portion 50b provides a framework for the canister/chimney holding chambers, and upper lattice section 50a supports the hatch actuation system.

[0018] In FIGURE 3, a structure 310 having a rectangular cross-section represent either a canister or a chimney which may be used in any of the chambers of the multiple missile holding-arrangement 18. As illustrated, structure 310 is hollow, suggesting a chimney, but if its ends were closed, it would represent a canisterized missile. The length of structure 310 must be substantially equal to the length of the canister/chimney holding chambers 22. If the length of structure 310 were to be shorter than the length of the canister/chimney holding chamber, an additional section or spacer, illustrated as 314, could be added, to bring its length to the standard length. Structure 314 may be either an additional spacer, or an aid to providing a leak-free seal between the lower end of the canister and the corresponding aperture 30 in the shield plate 28.

[0019] As illustrated in FIGURE 3, apertures 30c and 30h extending through shield plate 28 are circular, rather than square, to accommodate round chimneys. The round chimneys are illustrated as 316a and 316b. Each chimney 316a and 316b is fitted at its upper end with a square flange, one of which is illustrated as 318a. The round apertures 30c and 30h provide a region of plate 28 to which the flanges, such as flange 318a, can be fastened to provide a leak-free joint.

[0020] A set of hatches 320 is illustrated as being fastened to upper frame 40 of FIGURE 3. Set 320 of hatches includes hatches 320a, 320b, 320c, 320d, 320e, 320f, 320g, 320h, 320i, and 320j. Each hatch is registered with, and movable with respect to, upper frame 40, to close off or open the end of the corresponding canister/chimney holding chamber 22. The structures illustrated as 322a and 322b are motorized mechanisms for opening and closing the hatches 322.

[0021] In FIGURE 3, a set 324 of elements, some of which are designated 324a, 324b, 324c, and 324d, which are affixed to the lowermost portion of latticework portion 50b, are dogs or clamps for engaging corresponding portions (not illustrated) of the standardized canisters or chimneys, for aiding in preventing longitudinal movement in the canister/chimney holding chambers 22.

[0022] When a missile canister is loaded into a canister holding chamber 22 of the canister holding structure 20 of FIGURE 3, the fit between the lower end of the canister 310 and the associated aperture 30 in the shield plate 28 is close enough to effectively seal the joint. If necessary, of course, some type of sealant structure can be added to the joint, as mentioned in relation to item 314. When a chimney is located in one of the canister/chimney holding chambers 22, the chimney may define a flange at its lower end, as well as at its upper end, as illustrated, for fastening to the shield plate aperture 30 to aid in sealing.

[0023] The semicylindrical plenum does not provide a good foundation for connecting the entire structure 18 of the multiple missile holding structure to the structure of the ship (or other carrier), because of its curved shape. Referring to FIGURE 3, it will be observed that shield plate 28 has a set 328 of a plurality of projecting tabs,some of which are designated 328a, 328b, 328c, 328d, and 328e. These tabs provide a load-bearing connection of the structure 18 to the underlying structure.

[0024] FIGURE 4 illustrates an alternate plenum structure in which four sides are curved.

[0025] The described structure has the salient advantages that the chimney itself is not an integral or monolithic part of the structure, and so may be removed and replaced when eroded. More important, when more energetic missiles (missiles with more voluminous exhaust gas generation) are introduced, the same canisterized missile holding structure may be used therewith, simply by substituting a second (or further) chimney for one or more of the missile canisters. The semicircular shape of the plenum provides the strength necessary for current and more energetic missiles, without the need for excessive reinforcement, thereby reducing the mass above the waterline, and also reducing cost. It will be understood that in order to fire a given containerized missile in the described structure, it is necessary to open at least two hatches, namely the one associated with that missile holding chamber containing the missile to be launched, and the one associated with the chimney. Naturally, if more than one chimney is provided, the associated hatches are also opened.

[0026] Other embodiments of the invention will be apparent to those skilled in the art. For example, the number of individual canister/chimney holding chambers 22 which may be associated with a given multiple missile holding structure may be more or less than the number (ten) which is illustrated, and the number of such multiple missile holding structures which may be associated with any one vessel or underlying support may be more or less than the number illustrated in FIGURE 1. Further, while only one wall of the plenum 34 has been illustrated as having a circular form, the entire plenum housing 34 would ideally be in the form of a hemisphere, so as to achieve maximum strength. An alternative might be a flat-bottomed, curved-sided structure such as that illustrated in FIGURE 4.

[0027] Thus, a structure (18)for holding canisterized missiles (318) or similarly dimensioned chimneys (318; 316) according to the invention includes a structure (20) which defines an array of canister/chimney holding chambers (22). The structure (18) has a plenum (34) at its lower or missile exhaust end (2601), which allows missile exhaust to communicate with one or more chimneys (310; 316). At the upper end (260u), the structure may have movable hatches (320) which are opened to allow the missile to leave and to allow exhaust gases to be released by the chimney.

[0028] More particularly, a multiple missile holding structure (18) for holding missiles loaded into standardized canisters (310) includes at least one chimney (310; 316) having a length substantially equal to the length of one of the standardized canisters, and also having cross sectional dimensions no greater than those of one of the standardized canisters. The multiple missile holding structure (18) also includes a multiple canister/chimney holding structure (20). The multiple canister/chimney holding structure (20) defines an array (22) of canister/chimney holding chambers, for holding a plurality of the canisters (310) and chimneys (310; 316) mutually parallel in an array, with the exhaust ends (2601) of the canisters in a first common plane (26), and with the missile exit ends (260u) of the canisters in a second common plane (24). A shield plate (28) has a thickness, and defines a first side (28u) and a second side (281). The first side (28u) of the shield plate (28) is affixed to that end of the multiple canister holding structure (20) which is adjacent to the first common plane (26). The shield plate (28) defines a first array (30) of canister/chimney apertures (30a, 30b, 30c, 30d, 30e, 30f, 30g, 30h, 30i, 30j) dimensioned and registered to closely fit the ends of canisters/chimneys held in the multiple canister holding structure (20). A plenum (34) is coupled to, and completely encloses the second side (281) of the shield plate (28), for providing a path for the flow of fluids or gases between any aperture (30) in the shield plate (28) and any other aperture (30) in the shield plate (28). The plenum (34) has at least one wall (36) which is in the form of a portion of a circular cylinder. The multiple missile holding structure (18) also includes a frame (40) defining an array (22) of canister/chimney apertures having dimensions no smaller than the exterior cross-sectional dimensions of one of the standardized canisters (310). The upper frame (40) is affixed to the multiple canister holding structure (20) adjacent to the second common plane (24), with the array (22) of canister/chimney apertures of the upper frame 40 registered with the array (20) of canister/chimney holding chambers (22).

[0029] In a particular embodiment of the invention, each of the canister/chimney holding chambers (22) includes a dog (324) adapted for engaging a hold-down associated with a particular location on each of the standardized canisters or chimneys. In another embodiment of the invention, the multiple missile holding structure (18) further includes energy absorbing material (270) lying against at least a portion of the cylindrical wall (36) of the plenum (34). The energy absorbing material may include ablative material. This ablative material may be affixed to the wall of that one of the canister/chimney apertures (30) of the shield plate (28) which is associated with a or the chimney, with the ablative material lying in the canister/chimney aperture (30) at a location lying between the first (28u) and second (281) sides of the shield plate (28).

[0030] In a preferred embodiment of the invention, the multiple missile holding structure (18) further includes a plurality of hatches (320) affixed to the frame (40) and movable relative thereto, with each of the hatches being associated with one of the canister/chimney apertures in the frame, for individually closing or opening the canister/chimney apertures in the frame.

[0031] In another embodiment of the invention, a sealing arrangement (flange) is coupled to the chimney aperture (30) in the shield plate (28) and to that end of the chimney adjacent to the first plane (26), for sealing

the joint therebetween. The chimney may have a square or round cross-section, or any other desired shape.

Claims

1. A kit of elements adapted for joint use, said elements comprising:

   a plurality of elongated standardized canisterized missiles, each of said canisterized missiles having substantially the same external cross-sectional and length dimensions, each of said standardized canisterized missiles also defining a missile exhaust end and a missile exit end;
   at least one chimney having a length substantially equal to said length of one of said standardized canisterized missiles, and cross-sectional dimensions no greater than those of one of said standardized canisterized missiles; and
   a multiple canister/chimney holding structure, said multiple canister/chimney holding structure defining an array of mutually parallel canister/chimney holding chambers, each of which is adapted for holding one of said canisters and chimneys, with said exhaust ends of said canisters lying in a first common plane, and said the missile exit ends of said canisters lying in a second common plane;
   a shield plate having a thickness and defining a first side and a second side, said first side of said shield plate being affixed to that end of said multiple canister holding structure which is adjacent to said first common plane, said shield plate defining a first array of canister/chimney apertures dimensioned and registered to closely fit the ends of canisters/chimneys which may be held in said multiple canister holding structure; and
   a plenum coupled to, and completely enclosing said second side of said shield plate, for providing a path for the flow of gases between any one of said apertures in said shield plate and any other aperture in said shield plate.

2. A kit according to claim 1, further comprising a frame defining an array of canister/chimney apertures having dimensions no smaller than said exterior cross-sectional dimensions of one of said standardized canisters, said frame being affixed to said multiple canister holding structure adjacent to said second common plane, with said canister/chimney apertures registered with said array of canister/chimney holding chambers.

3. A kit according to claim 1,wherein said plenum has at least one wall which is in the form of a portion of a circular cylinder.

4. A multiple missile holding structure, for holding missiles loaded into standardized canisters, said structure comprising:

   at least one chimney having length dimensions substantially equal to the length of one of said standardized canisters, and cross-sectional dimensions no larger than those of one of said standardized canisters;
   a multiple canister/chimney holding structure, said multiple canister/chimney holding structure defining an array of canister/chimney holding chambers for holding a plurality of said canisters and chimneys mutually parallel in an array, with the exhaust ends of said canisters in a first common plane, and with the missile exit ends of said canisters in a second common plane;
   a shield plate having a thickness and defining a first side and a second side, said first side being affixed to that end of said multiple canister holding structure which is adjacent to said first plane, said shield plate defining a first array of canister/chimney apertures dimensioned and registered to closely fit the ends of canisters/chimneys held in said multiple canister holding structure;
   a plenum coupled to, and completely enclosing said second side of said plate, for providing a path between any aperture in said shield plate and any other aperture in said shield plate, said plenum having at least one wall which is in the form of a portion of a circular cylinder; and
   a frame defining an array of canister/chimney apertures having dimensions no smaller than the exterior cross-sectional dimensions of one of said standardized canisters, said frame being affixed to said multiple canister holding structure adjacent to said second plane, with said canister/chimney apertures registered with said array.

5. A structure according to claim 4, wherein each of said canister/chimney chambers includes a dog adapted for engaging a hold-down associated with a particular location on each of said canisters/chimneys.

6. A structure according to claim 4, further comprising energy absorbing material lying against at least a portion of said cylindrical wall of said plenum.

7. A structure according to claim 4, wherein said energy absorbing material comprises ablative material.

8. A structure according to claim 6, further comprising ablative material affixed to the wall of that one of said canister/chimney apertures of said shield plate which is associated with said chimney, said ablative material lying in said canister/chimney aperture at a location lying between said first and second sides of said shield plate.

9. A structure according to claim 4, further comprising a plurality of hatches affixed to said frame and movable relative thereto, each of said hatches being associated with one of said canister/chimney apertures in said frame, for individually closing or opening said canister/chimney apertures in said frame.

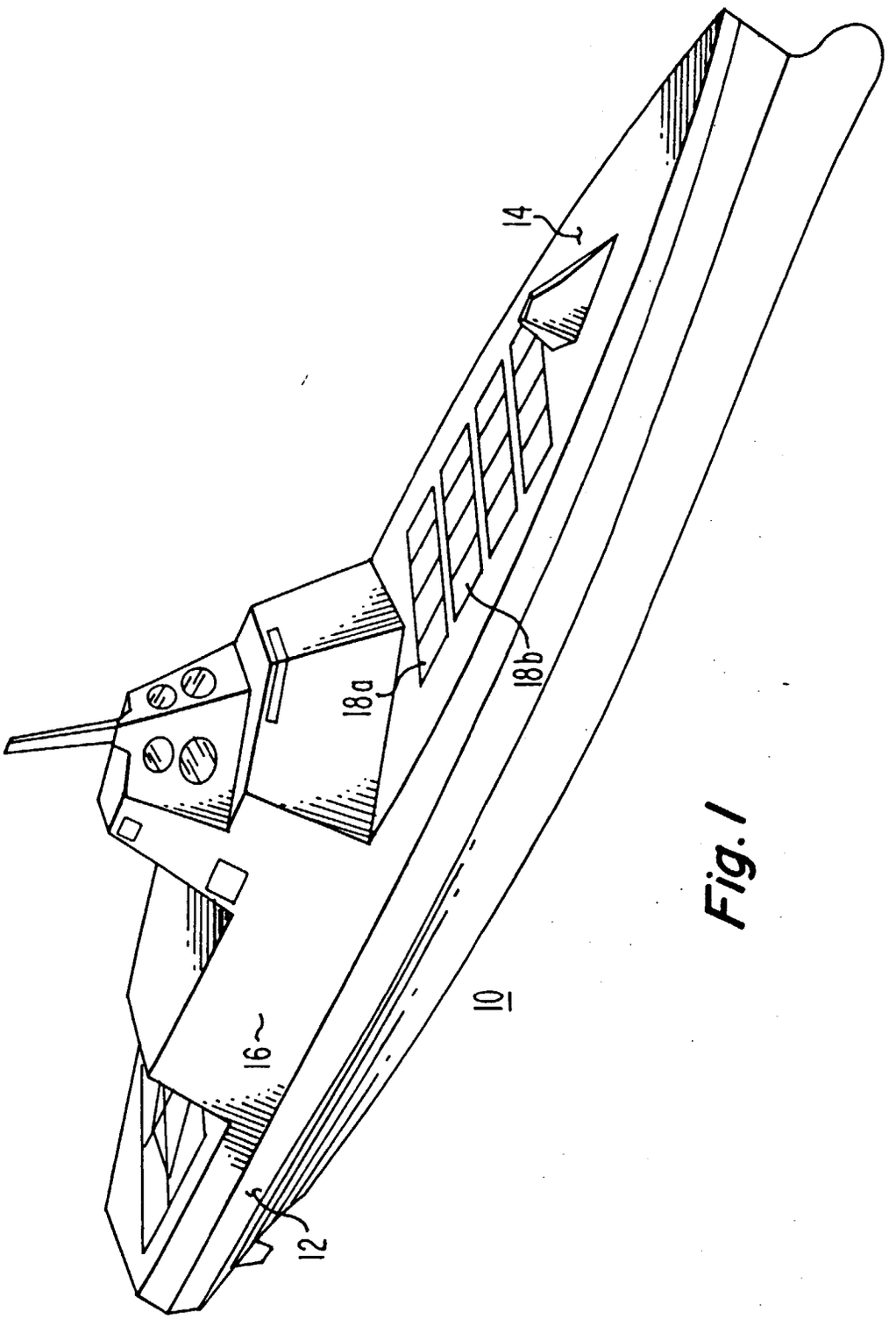

Fig. 1

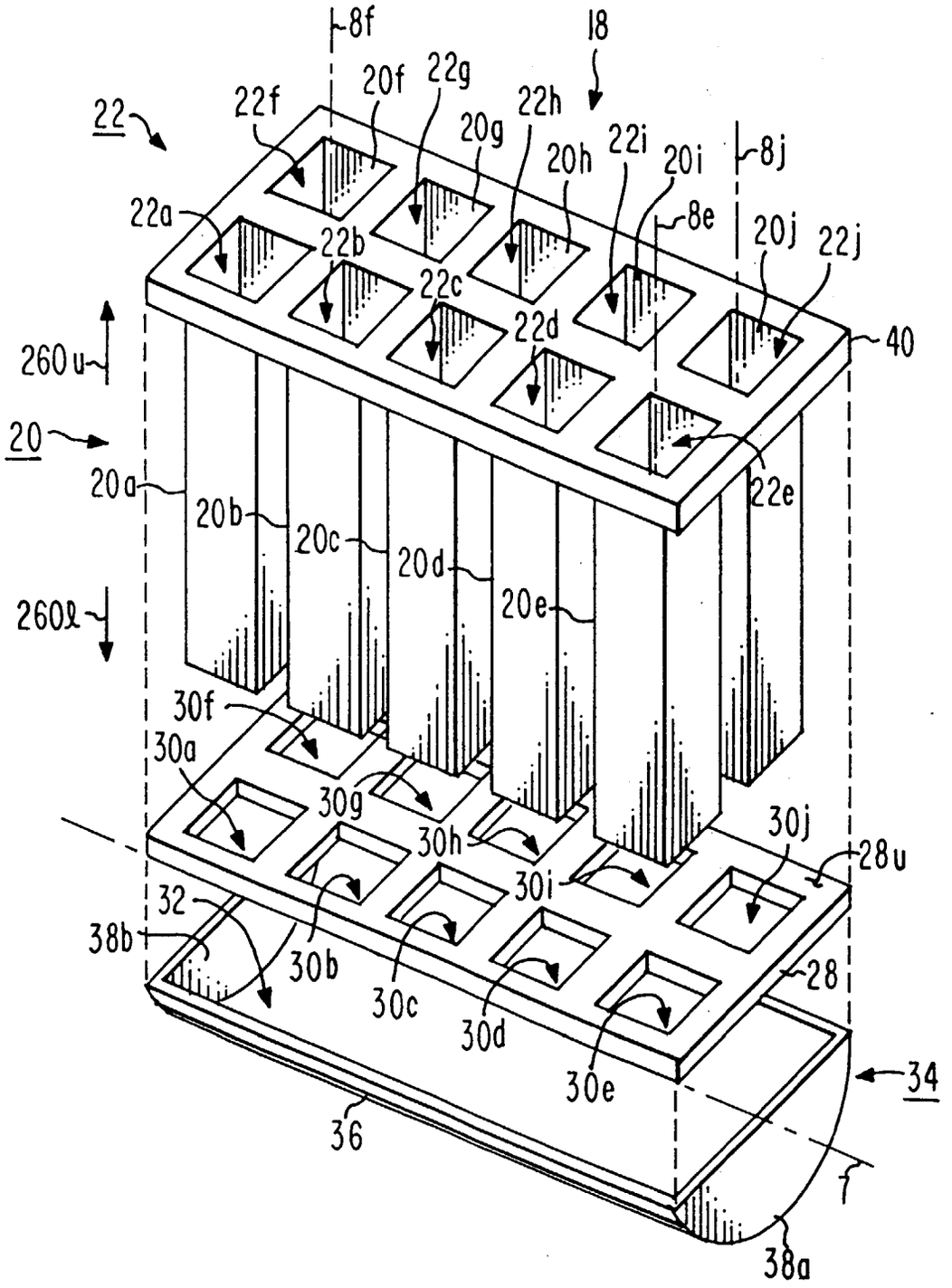
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Fig.2a

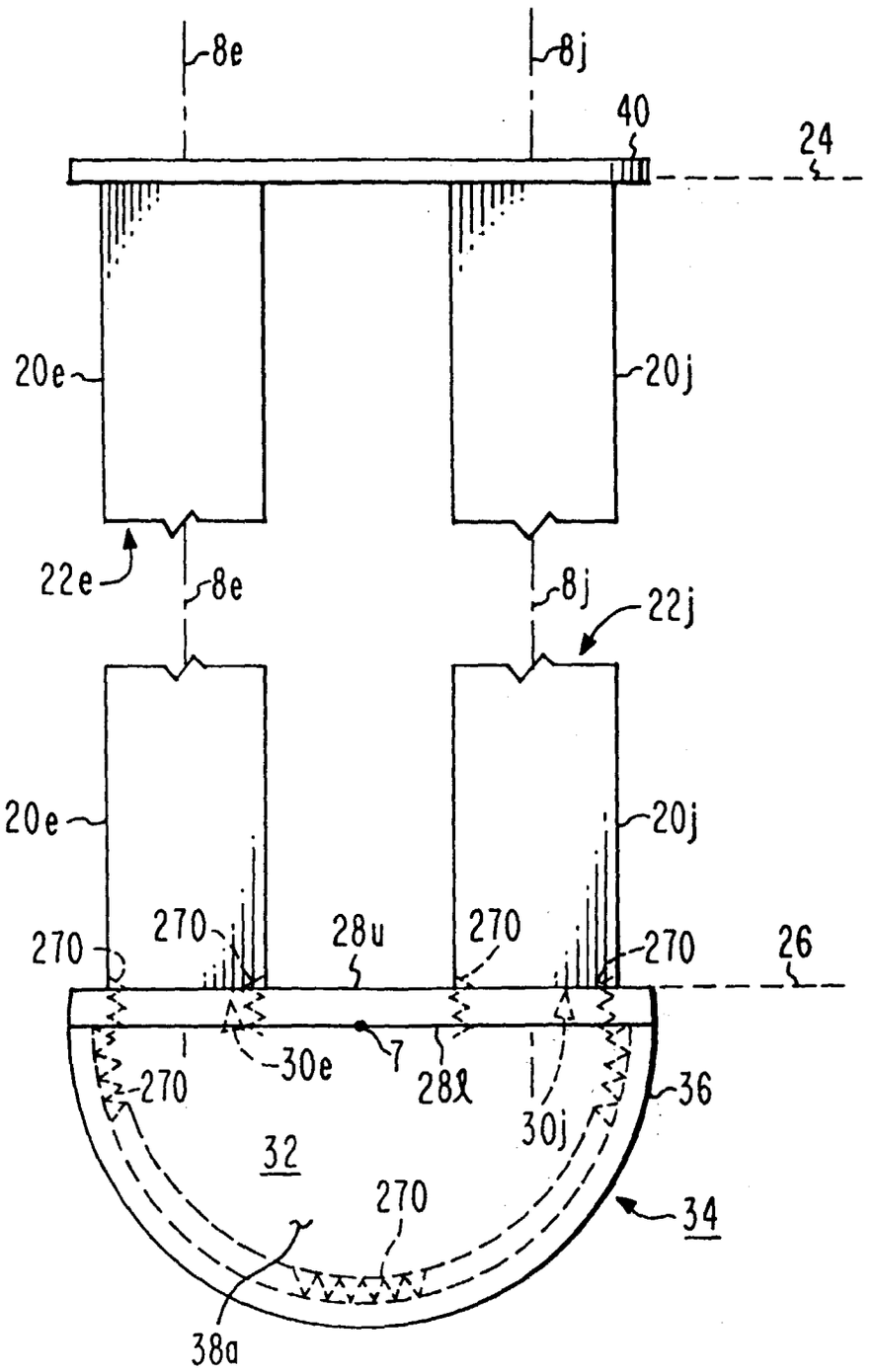
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Fig. 2b

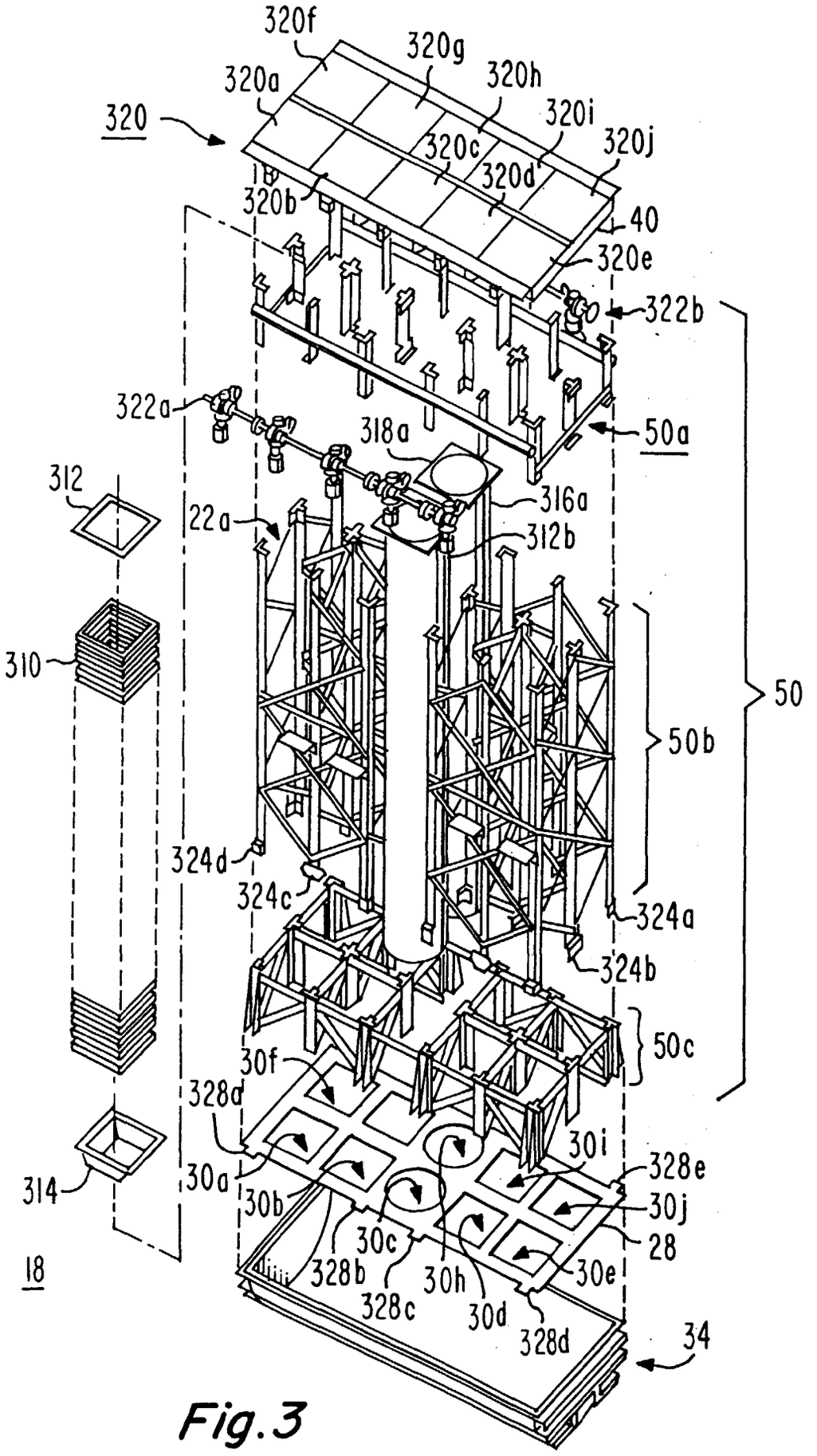
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Fig. 3

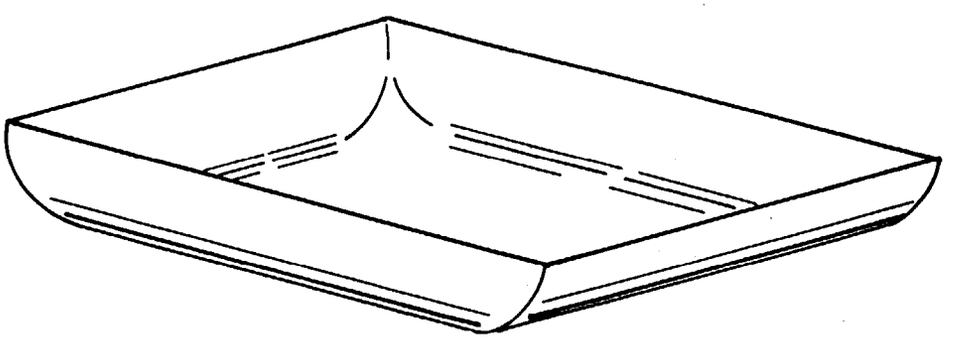

Fig. 4