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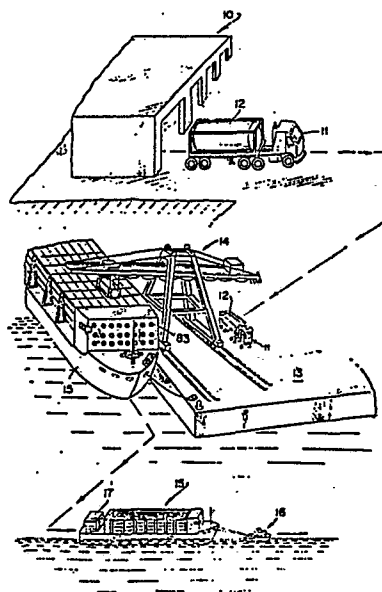
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⑤④ **Method and Ocean-going vessel for offshore incineration of hazardous waste materials.**

⑤⑦ A method and an ocean-going vessel are disclosed for more effectively incinerating hazardous liquid wastes at sea. Intermodal shipping tank containers (12) are filled at waste generation sites; transported to dockside and loaded above decks on an incinerator ship (15); taken out to sea and incinerated in horizontal, liquid burning type incinerators (17) so that the effluents emerge horizontally. Wastes flow by gravity from containers (12) into staging sumps (217) located below decks, and then pumped to incinerator.

Pollution abatement tanks, (206) also below decks, collect spilled waste from containers, as well as overflow from staging sumps. Material collected in abatement tanks is pumped into staging sump, and pumped to incinerator.

Fuel oil may be introduced into sumps for fueling incinerators to maintain incinerator operation when there is insufficient supply of waste. Effluents are sea-water scrubbed for cooling to eliminate thermal lift and carried promptly into sea.



Method and ocean-going vessel for offshore incineration  
of hazardous waste materials

This invention relates to the disposal of hazardous waste materials and, more particularly, to techniques for transporting them from the sites where they are generated, and for safely incinerating them at sea.

5

Although it may be useful in the disposal of solid waste materials, the invention was made in connection with attempts to more effectively dispose of liquid waste materials, and will therefore be described in  
10 connection with such use.

How to safely dispose of agricultural and industrial hazardous liquid wastes, including toxic chemicals and flammable liquids, is of increasing environmental  
15 concern. Handling of such materials is hazardous, and the cleaning up of any accidental spillage can be painstaking and expensive. When removed from the place of their generation they cannot be simply dumped at disposal sites on land or at sea without danger of  
20 seepage pollution of underground aquifers or of poisoning sea life, and their burial in containers is costly and poses similar risks. Moreover, incinerating of such wastes has caused atmospheric pollution, sometimes resulting in "acid rain" at locations far from the  
25 burnsite.

In the context of this specification, "liquid" waste

material includes not only liquids which are flowable by gravity, but also pumpable sludges, and materials which are similarly flowable or pumpable upon heating. Such materials, including non-flammable materials, are known to be incineratable in incinerators having liquid fuel burners, either by feeding the material directly into the burner or upon blending it with a fuel such as diesel oil immediately before introduction into the burner. Modern, controlled high temperature incinerators are highly efficient, and are effective to destroy 99.99 percent of such wastes. At sea incineration is advantageous in that it removes the destruction site from populated areas.

Several officially sanctioned shipboard test incineration operations have been successfully conducted on the incinerator ship M/T VULCANUS off the coast of Europe and of the United States. This ship was especially designed for the incineration of liquid chemical waste at sea, which it carries to the offshore burnsite in 15 cargo tanks below decks. The ship was designed in accordance with the latest regulations of the International Maritime Organization (IMO) and other regulatory bodies. The cargo is loaded by pumping the material through pipelines and hoses into the ship's cargo hold from large storage tanks at the waterfront facility where the ship docks, and the liquid waste material is often blended together, either in the storage tanks or in the ship's cargo holds. The ship sails to the burnsite location many miles off shore, at which

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the cargo is pumped from the storage tanks into two large liquid injection incinerators having vertical stacks.

- 5 Even these modern techniques for disposing of hazardous waste by incineration at sea continue to have disadvantages. For example, the thermal lift from the vertical shipboard incinerators carries the effluent gases high up into the atmosphere, and may  
10 be carried by winds many miles to regions over land or over sea lanes at which they may combine with moisture and fall as harmful "acid rain".

- It is essential to scrub the effluents with water to  
15 cleanse them, but the use of scrubbers on vertical stack incinerators, if possible at all, would reduce or eliminate the thermal lift of these gases, which thermal lift is necessary for proper operation of the incinerator.

- 20 The blending of hazardous liquid waste cargoes, either in the land based storage tanks at the dockside or within the ship's cargo holds, may detract from the efficiency of incineration due to differences between  
25 the optimum incineration temperatures for the several different types of chemicals which are mixed.

- Separate burning of different wastes permits precise time and geographic coordinates to be identified for  
30 each waste destroyed, thereby permitting certificates

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of ultimate destruction to be properly issued to the person who generated the waste as required by the Laws.

- 5 Moreover, the carrying of liquid cargo below decks presents some hazard and possible spillage upon grounding of the ship, or other hull penetration, and it is difficult to control any leakage from such cargo tanks. Of course, cargo held in tanks  
10 below decks must always be pumped because gravity flow is not possible, and the tanks and pumps are difficult to empty and clean. The same disadvantages of blending of the hazardous waste materials, and the difficulty of pumping from and cleaning the tanks are  
15 also incidental to the large storage tanks at dockside in which the waste materials are temporarily stored for loading on the incinerator ship. In addition, the waste material itself must be transported from the sites where it is generated and transferred into the  
20 storage tanks, which necessitates additional handling of the hazardous waste material.

Accordingly, it is intended by the present invention to provide a method of disposing of hazardous liquid  
25 waste materials in which the materials may be transported from the sites where they are generated to the offshore incinerator site and incinerated, without the need for intermediate transfer and consequent handling of the dangerous chemical materials. In addition, the present  
30 invention contemplates that the waste materials need

never be blended, but may be incinerated in the same form or composition as that in which the waste material was initially received from its generating site. Thus, its burn and other characteristics  
5 are more accurately determinable and controllable.

It is a further object of the invention to provide a means for storing the liquid waste material on board the ship which will facilitate its subsequent  
10 feeding to the incinerators, and by which spillage of any of the waste materials can be easily removed and incinerated, rather than requiring that it be discharged overboard.

15 Moreover, the manner of feeding the cargo to the incinerators must accommodate any desirable blending of cargo, or any desired addition of supplemental fuel oil to enhance the burning.

20 Further, it is intended by the present invention to provide means by which the effluent discharge from the incinerators will not be carried aloft to the atmosphere with the attendant danger of subsequent falling as acid rain.

25

Briefly and generally describing the present invention, it provides a method for disposing of blended or unblended hazardous liquid waste materials utilizing intermodal tank shipping containers which are filled with the  
30 waste material at the respective sites at factories,

etc. where they are generated; are then hauled over the road or via rail or feeder vessel to a dockside where they are lifted on board a barge or incinerator ship; are then transported to an offshore burnsite  
5 and incinerated using a horizontal incinerator and scrubbers to direct the effluent discharge from the incinerator towards and thus into the sea in the shortest possible time so as to avoid rise of the effluents into the atmosphere. Thus, the arrangement  
10 takes advantage of the known reduction of thermal lift of the effluents when a cold water scrubber is used, as well as of the beneficial cleansing of the gases as is effected by the scrubbing itself. Periodic collection and analysis of the scrubber water residue  
15 facilitates control of the burn system, as will be seen. It will also be noted that storage tanks at the dockside are eliminated, and no transfer of the hazardous material out of their initial containers is required prior to incineration. Costly construction and maintenance  
20 of storage tanks are avoided, and the hazards involved in waste handling are minimized.

In accordance with the invention these techniques can be practised utilizing a self-propelled vessel having  
25 one or more horizontal incinerators thereon in addition to container guides for receiving the intermodal containers; or a barge, preferably a tug-towed barge, having both the incinerator and container guides on board, this being the preferred arrangement; or a  
30 separate incinerator barge and a plurality of barges

for hauling the containers to and from the continuously operating incinerator barge on station at sea.

- 5 Thus, the present invention also provides a sea-going incinerator vessel, preferably a tug-towed barge, which carries one or more rearwardly facing and horizontally oriented incinerators or oxidizers on the weatherdeck of the vessel; container guides  
10 for carrying a number of the intermodal tank containers on and above its weatherdeck; and appropriately valved pipe conduits for selectively emptying the stacked containers by gravity flow or gravity-assisted flow, and with or without waste blending as may be  
15 desired, first to a staging sump located below the weatherdeck, and then by pumping from the staging sump to the burner of an on-board incinerator.

- Because all of the containers containing the hazardous  
20 liquid wastes are stored above the main or weatherdeck, all of the containers and the hazardous waste conduits on the ship are visible for prompt detection of leakage, and are protected from damage in the event of vessel grounding or other hull penetration. The containers  
25 can be located inboard to the extent necessary to meet international safety regulations. Moreover, the containers are more easily handled by a dockside crane and fully visible to the operator when loading or unloading them and, as previously mentioned, their storage on  
30 and above the weatherdeck takes advantage of gravity



flow and reduces the need for pumping. The below decks areas of the ship are free for filling with supplies, fuel, or ballast. Such ballast may be used to trim the vessel by its stern, to angle the incinerator discharge outlets down-wardly towards the sea so that the emerging effluents will contact the sea more promptly to avoid pollution of the atmosphere.

In addition, the use of intermodal shipping containers makes operation of the system relatively clean, with little likelihood of spillage and cleanup. However, should any of the containers leak or be damaged so that spillage results, by providing bulwarks, scuppers, and spillage abatement tanks as will be described, their disposition above the weatherdeck facilitates cleanup by conducting a flow of the spillage first into an abatement tank and thence into a staging sump for pumping to an incinerator, rather than necessitating pumping of the spillage overboard with resulting pollution of the waterway.

As will be seen the abatement tanks can also accommodate any overflow from a staging sump, without requiring such overflow to be discharged overboard, while the cause for such overflowing of a staging sump can be corrected.

The piping mounted on the weatherdeck of the vessel for conducting the flow of waste materials from the individual containers incorporates appropriate valving,

pumps, and a cleanout loop for convenient cleaning of the lines.

If desired, steam lines extend to one or more of the  
5 stacked groups of containers for introduction into one or more of the steam chambers of the respective tank containers for heating their contents to promote flow.

10 Flow from the containers is via risers respectively associated with each container group, and to which each container in the group is connected by flexible hose and a valve. The risers are respectively connected to a transversely extending header pipe mounted on the  
15 weatherdeck, which, in turn, leads through a shutoff valve into either of a pair of longitudinally extending header pipes mounted amidships on the weatherdeck. The longitudinal header conducts the flow to a staging sump at one of its ends. Another pair of  
20 longitudinal headers, also located amidships, services the groups of containers on the opposite side of the vessel via similar risers and transverse connecting headers.

25 The use of two pairs of headers servicing the rows of containers on each side of the ship facilitates the mounting and use of four incinerators at the stern of the ship, each being fueled by waste drawn from a separate, associated staging sump, as will  
30 be seen. Thus, one or more incinerators can be

dedicated to burn certain types of wastes, without affecting others.

The staging sumps also permit better control of the  
5 burn efficiencies of the respective incinerators  
because any desirable blending of hazardous wastes  
can be conducted in one staging sump without affecting  
the others. Similarly, if desired, diesel or other  
fuel can be added to any one sump to improve or maintain  
10 burning in one incinerator, without effect on any of  
the other incinerators. Further, as will become apparent,  
certain types of hazardous waste cargoes can be isolated  
in a given container grouping, and burned in a specially  
adapted incinerator or oxidizer.

15 Effluent discharge from each of the horizontally  
disposed oxidizers is directed horizontally rearward  
or angularly downward from the horizontal and towards  
the sea, so that the effluents reach and impinge upon  
20 the sea surface as promptly as possible. This downward  
pitch is preferably achieved by a corresponding downwardly  
angled shaping of the horizontal oxidizer discharge  
outlet itself. Alternatively or additionally, the ship  
may be ballasted and trimmed by its stern so that the  
25 aft-facing incinerator outlets of the incinerators  
will face angularly downward towards the sea.

The preferred arrangement also provides a pair of  
sea-water scrubbers, aligned one behind the other,  
30 adjacent to the discharge outlet of each incinerator.

Each scrubber takes the form of an annular conduit (such as a sprayer pipe arranged to form a square about the exhaust gas stream, with the pipe mounted in a cabinet or left un-enclosed) providing a water  
5 spray rack which directs sprays of water in all four directions inwardly and across the stream of effluents as it emerges from the incinerator outlet. The second scrubber is similar, though slightly larger in size, and is mounted about 60 cm. aft of the first.

10

Not only do these scrubbing sprays densify and cool the horizontally emerging hot effluent gases to virtually eliminate their thermal lift, but they saturate and dilute the emerging gases and entrap and  
15 remove particulates.

Thus, samples taken from the scrubbing water residue can be analyzed and compared with the composition of the sea water used for the spray, for indication of  
20 the effectiveness of the incineration.

These and other objects, features and advantages of the invention will be more readily apparent from the following detailed description of several of its  
25 embodiments.

In the description reference will be made to the accompanying drawings, in which:

Fig. 1 is a somewhat schematic illustration of a  
30 method for disposing of hazardous liquid waste materials

in accordance with the invention;

Fig. 2 is a profile view of a sea-going vessel in accordance with the invention for incinerating the hazardous liquid waste materials;

5 Fig. 3 is a plan view of the vessel of Fig. 2;

Fig. 4 is a transverse sectional view of the vessel as seen from line 4-4 in Fig. 3;

Fig. 5 is an enlarged fragmentary view of the vessel as seen from line 5-5 of Fig. 4;

10 Fig. 6 is a further enlarged fragmentary view in perspective and partly in section of a group of stacked intermodal tank containers as they would appear on board the vessel shown in Figs. 2-6, including an exploded showing of the manner of securing the containers  
15 thereon;

Fig. 7 is a perspective view of a typical intermodal tank container containing hazardous liquid waste material as it would appear while being lifted to be placed aboard the vessel;

20 Fig. 8 is a greatly enlarged and fragmentary elevational showing of a device for securing the intermodal tank containers within the container guides aboard the vessel;

Fig. 9 is a plan view of the device illustrated in

25 Fig. 8;

Fig. 10 is a fragmentary profile view of only the stern end portion of the vessel of Figs 1-9 to illustrate the stacked arrangement of its incinerators;

Fig. 11 is a fragmentary exploded view in perspective

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of the same incinerator mounting arrangement;

Fig. 12 is a greatly enlarged fragmentary perspective illustration of a locking device used in the incinerator mounting arrangement of Figs. 10 and 11;

5 Fig. 13 is a top plan view of a modified vessel arrangement in accordance with the invention;

Fig. 14 is a profile view of the vessel arrangement shown in Fig. 13;

Fig. 15 is a profile view of an incinerator vessel  
10 incorporating a further modification of the invention;

Fig. 16 is an enlarged end elevation of the vessel as seen from lines 16-16 in Fig. 15;

Fig. 17 is a still further enlarged side view of a connector device for use between the vessels shown

15 in Figs. 13 and 14;

Fig. 18 is a top view, partially in section, as seen from lines 18-18 in Fig. 17;

Fig. 19 is a further enlarged and fragmentary sectional view as seen from lines 19-19 in Fig. 18;

20 Fig. 20 is an enlarged plan view, partially in section, of a pair of incinerator units for mounting on a vessel in accordance with the invention;

Fig. 21 is a still further enlarged end view of the burner end of one of the incinerators illustrated in

25 Fig. 20, as seen from the left side of Fig. 22;

Fig. 22 is a sectional side elevation, to the scale of Fig. 21, of the burner portion of one of the incinerators as seen from lines 22-22 in Fig. 20;

Fig. 23 is a diagrammatic illustration of one type

of valving arrangement for the incinerators;

Fig. 24 is a diagrammatic profile of a sea-going incinerator barge-type vessel in accordance with a preferred embodiment of the invention;

5 Fig. 25 is a diagrammatic deck plan view of the vessel of Fig. 24:

Fig. 26 is an enlarged and fragmentary, diagrammatic transverse sectional illustration of the piping to the containers carried on the vessel of Figs. 24 and 25;

10 Fig. 27 is a fragmentary sectional profile showing certain details of one of the incinerators on the vessel of Figs. 24 and 25;

Fig. 28 is a fragmentary end view of the incinerator as seen from line 28-28 in Fig. 27; and

15 Fig. 29 is a fragmentary end view of the incinerator as seen from line 29-29 in Fig. 27.

Referring to the drawings and in particular to Figs.

1, 2 and 3, hazardous waste is removed from a shipper's  
20 plant 10 is an intermodal container 12 by truck 11  
or by rail car (not shown) to the marine terminal 13. The  
tank containers will not transfer their contents at  
the marine terminal. Nor will the containers remain  
for an extended storage period. The intermodal container  
25 12 is lifted from truck 11 by crane 14 onto the sea-going  
vessel 15. The sea-going vessel 15 with intermodal  
containers stacked in the mid section of the vessel and  
the incinerator 17 stacked in the stern section is  
pulled by tug 16 out to an incinerating station at sea.

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Thus location for burning is well removed for any residential area or industrial complex.

Sea-going vessel 15, a powerless barge, is held in position by tether 19 having one end secured to the barge 15 and its other end secured either to buoy 18 (Fig. 2) or self propelled vessel 20 (Fig. 3). The intermodal containers filled with hazardous wastes are placed in stacked rows. The stacks are each preferably three containers high (Fig. 4).

Hazardous wastes are fed by gravity flow or pumped to the incinerators 17 to be burned therein; the effluents escaping through incinerator oxidizers 17.

15

Incinerators 17 in Fig. 2 are each composed of two horizontal transverse pump and burner modules 26 and two horizontal longitudinal oxidizers 27. The pump and burner modules are shown in more detail as modules 102 and 101, respectively, in Fig. 20. The oxidizers 27 are composed of two modular elements 60 and 61 in Fig. 20, approximately 3 meters in length or they may be one continuous chamber of approximately 6 meters as in 216 of Fig. 24 and 25. Preferably the effluents are sprayed with sea water to reduce the tendency of the plume to rise into the air. Sea water may also be used to spray the outer walls of the incinerator and oxidizers to reduce the temperature thereof.



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The tethering of the barge or barges will allow the barge to swing with the wind so that the plume is blown away from the ship and safeguard the crew.

- 5 One arrangement comprises two powerless vessels such as two barges. A more detailed description of the arrangement and the operation of the present invention will be described in connection with a two barge system, Fig. 13 and 14.

10

- Such a system comprises a container barge 40 and a tether 19 releasably coupled to barge 40 and buoy 18. The stern portion of barge 40 is releasably coupled to the incinerator barge 41 by shock absorber 39. Barge 41  
15 carries the incinerator 17 of Fig. 13. Crane 38 insures that the disconnectable pipe 37 allows liquids to pass from barge 40 to barge 41. The coupling between barge 40 and barge 41 together with the tether will allow both barges to swing with the wind so that the plume  
20 86 from oxidizer 27 of incinerator 17 will be blown downwind. (Fig. 14).

A fan 36 (Fig. 15) may assist movement of the plume away from the barges and crew and in a downwind direction.

25

Figs 14, 15 and 16 also show a water curtain spray rack 85 mounted estern of the incinerator oxidizers 27 and extending the width of the vessel, from which inwardly directed sprays of water scrub the effluents 86

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as they emerge from the incinerators.

The housing of the containers, such as tanks 12 on the barge 40 comprises a cell structure 90 as  
5 illustrated in Fig. 6. Cell guides 31 are fastened to the deck. The upper end of the cell guides are connected to a fairing plate 43. Holding down devices 33 are arranged to prevent a stack of containers, such as a stack of three, being dislodged. Details  
10 of the construction of the holding down device 33 are illustrated in Figs. 8 and 9. Cell guides 31 and fairing plates 43 are provided to facilitate the insertion of the containers illustrated in Fig. 7. The containers are thus securely held on the barge to  
15 prevent movement of the containers.

As stated above, the detailed assembly of incinerator 17 is shown in Fig. 20 using its modular components 26 and 27. Several assemblies of incinerators may  
20 be grouped together, adjacent to one another and in tiers as shown in Fig. 11 in order to increase the overall waste disposal flow rate of the vessel. In the arrangement shown in Figs. 2 and 3, eight incinerator assemblies are possible; in the arrangement shown in  
25 Fig. 13, 14, 15 and 16, four assemblies are possible.

The number of assemblies is a function of the width of the incinerator vessel and how many tiers are utilized. Two tiers only are illustrated as typical.

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Securely fastened to the deck 28 in Fig. 11 are stanchions 87 onto which the lower tier is fastened.

Locks 32 (Fig. 12) hold the incinerators in position. The  
5 details and operation of such a lock are disclosed in U.S. Patent 3,894,493. The upper tier incinerator is similarly secured to the lower tier. The spacing of the incinerators from the deck will permit air and water to pass underneath the incinerator.

10

There is an option to double-tier the incinerator installations and to use intermodal modular incinerator units. Further details of the incinerator 17 using this option and of its control panel are illustrated in  
15 Figs. 20, 21, 22 and 23. There may be a plurality of incinerator installations on the vessel; an incinerator installation consists of an assembly of oxidizer modules 60 and 61, housing the principal combustion chambers, burner modules 101, housing the  
20 burners (Fig. 22) and pump room modules 102, housing the duplex liquid pumps 42 (Fig. 23) and fuel pump 64, each module having the same size, which is that of an intermodal shipping container as illustrated in Figs. 10, 11 and 20, e.g., each having dimensions about  
25 6 mt. long by 2,50 mt high by 2,50 mt wide. The geometrical configuration of oxidizer modules, burner modules and pump room modules may vary. The number of modules may also be changed.

The main hazardous waste burner 48 (Fig. 21) is surrounded by four supplementary burner nozzles 70, 71, 72 and 73 for better flow control when burning wastes of either very high or very low viscosities. The vaporizing section 44 (Fig. 22) and primary combustion chamber 45 indicate the direction of the movement of the combustion gases. A primary combustion air inlet is shown at 51. In the air inlet 51 is located a damper 53. The secondary combustion air inlet is shown as 52. A damper for the secondary air inlet 52 is shown at 54. The burner is monitored by ultraviolet scanner 46.

The incinerator plant may have a modular frame construction as in Fig. 20 to facilitate maintenance, also removing modules without unduly interrupting the operation of the incinerator. A back cover 59 as shown in Fig. 22 is removably attached by bolts 67 to the burner end of the incinerator. The front wall of the incinerator is indicated at 56.

The incinerator oxidizer modules 27 are attached to the burner modules 101 by front plate 65 secured to the front wall by bolts 66. The combustion area is lined with fire bricks 58. The joint between parts 60 and 61 is insulated by a cast refractory bridge 63.

Mortar and/or anchor studs are used to secure the fire bricks 58 to each other and to the cast refractory

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bridge 63. A gasket 62 is inserted between the parts  
60 and 61 to prevent escape of toxic gases. The burner  
modules 101 are fastened to the pump room modules  
102 by standard container attaching devices, similar  
5 to the device twist lock 32 shown in Fig. 12.

The incinerator operates as follows. The hazardous  
waste will be injected into the vaporizing section 44  
of the burner. The high temperature will allow the  
10 liquids to vaporize prior to entering the primary  
combustion chamber 45. (Fig. 22).

These gases are mixed with sufficient combustion  
air to allow the maximum oxidation. The oxidation  
15 temperature may reach 1600°C. The operation of the  
fuel pumps 64 is controlled and monitored by the  
burner safety control 69 in Fig. 23 and flame safety  
control 82.

20 Similarly, the duplex hazardous waste pumps 42 are  
monitored and controlled by the waste injection control  
unit 68.

In order to enable the incinerator to be operated  
25 and incinerate waste of different viscosities, two  
low viscosity nozzles 70 and 71 and two high  
viscosity nozzles 72 and 73 are provided. A number  
of pressure indicator transmitters 74, 75, 76, 77,  
78, 79 and 80 are provided. The main control panel 83  
30 (fig. 1) incorporates besides others, a monitor for  
the ultraviolet scanner 46. The main control panel

will monitor all sensors and act as a main control system. The waste injection control unit monitors the flow, viscosity, pressure, temperature and pH of the waste material introduced into the  
5 burners. These data transmitted to the main control panel will be compared in the panel with the program.

Appropriate steps are taken by the main control panel to maintain the combustion within the limits  
10 established by the program.

The main control panel 83 located in the forward deck house (Fig. 1) or aft in the incinerator control room includes the main computer containing the program,  
15 disk data storage, disk program storage, multiple CRT display, ship-to-shore communication and will act as a primary monitor and control station for the system.

All data will be converted into a computer code and  
20 fed into a communication system interface. A backup panel will be located remotely and have duplicate control capacity to act as a standby operational unit.

The details of the shock absorber 39 in Fig. 13 and  
25 14 are illustrated in Figs. 17, 18 and 19. The shock absorber is of a type generally referred to as oleo-pneumatic, the oil operating as a damper and the air as a spring. Cylinder 91 is filled on right side of Fig. 18 with air 92. Floating piston 98 separates

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the air space from oil space 94 containing the damping oil and which occupies the remainder of the cylinder space. Piston rod 95 carries on one end the piston 96 provided with valves 97 to regulate the  
5 passage of oil through the piston 96 and thus provide damping of the movement of piston 96 in a conventional manner. The other end of the piston rod contains a device to regulate and control the relative position of the two barges and oscillating movement due to the  
10 action of the waves.

More specifically, the outer end of piston rod 95 is provided with a hook-type extension 99 (Fig. 17) which is placed in an anchoring device 100 of the container  
15 barge 40. Spindle 101, Fig. 18, rotating in the arms 102 of the anchoring device 100 carries a pinion 108 for moving rack 103 to and from friction wheel 104 which in turn presses against the operating portion 106 of hook 99.

20

The operating portion of 106 of Fig. 19 is arcuate and of equal widths over an arc of approximately 45 degrees. The bent portion 106 of hook 99 and the end portion 116 of hook 99 limit the relative movement  
25 of the hook in relation to the anchoring device 100 and, therefore, the relative movement of the two barges. Handle 107 has a splined pinion 108 cooperating with the gears of rack 103. Movement of handle 107 will increase or decrease, as the case may

be, the pressure of rack 103 against friction wheel 104.

A ratchet pawl 109, Fig. 19 is provided to lock handle 107 in its position.

5

Pressure of friction wheel 104 against the operating portion 106 will also press against the inner friction wheel 110 which presses against arc 106. A substantially calibrated reduction of dynamic surge, yet tolerably

10 vertical movement between the two barges is accommodated in this manner. Horizontal movement is restrained by lashing cables between the two vessels at both port and starboard sides.

15 The arrangement in which two support vessels are utilized, one carrying the cargo, the hazardous waste, and the other vessel carrying the incinerator will provide both substantial technological and economical advantages.

20

That is, the sea-going vessel carrying the incinerator can be left at the incinerator station for an indefinite time.

25 The vessel carrying the cargo can be exchanged for the next vessel carrying full cargo when the first carrying vessel has its cargo consumed by incineration.

Substantial uninterrupted incineration is obtained.



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The incinerator itself, at least part of it, is lined with fire bricks which are heated to about 1600°C. The fire bricks are held together and possibly to their outer shell by mortar capable of remaining intact at the operating temperature. A cooling down to a substantial degree will adversely affect the mortar, increase the maintenance work and lead to premature failure of the incinerator. The maintenance work, the expense thereof and the delay of time will be substantially decreased, by keeping the incinerators in continuous service.

The horizontal position of the incinerator will reduce the dispersion of the exhaust gases, including the danger to the crew and passing vessels. Exhaust gases may be even more hazardous and corrosive than the materials in their original liquid state.

Sectional or modular construction of the incinerator promotes the continuous operation of the incineration process, since single modules can be removed for replacement and maintenance, permitting the incinerator to be restored quickly to on-line operation.

Referring now to Figs. 24-29 which illustrate a preferred embodiment of a vessel in accordance with the invention, the vessel is a sea-going barge 200, although it might incorporate its own power plant and propellers

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to be self-propelled. At its forward end or bow 201 the vessel is adapted, as indicated by tow lines 202, for towing by a sea-going tug (not shown).

5 With particular reference to Fig. 24, the vessel 200 has a weatherdeck, in this case a main deck 203, having upwardly projecting cell or container guides 31 (Fig. 26) thereon, appropriately spaced and connected to form cell or container guide structures 90 on and  
10 projecting upwardly from the main deck 203 for receiving and storing intermodal tank shipping containers 12.

When located between the guides, the containers 12 are preferably aligned in the longitudinal direction, and  
15 disposed in longitudinally spaced apart, port and starboard container groups, for example Groups G-1 to G-5, on the vessel 200, as indicated in Figs. 24 and 25. The tank containers 12 may alternatively be disposed at wartship (not shown) with suitable  
20 arrangement of piping systems and cell guides.

A bulwark 204 as seen in Figs. 24-26 projects upwardly from the main deck and surrounds the areas beneath the container groups G-1 to G-5, port and starboard,  
25 to retain any spillage from the containers 12. Because of the camber of the ship's main deck the flow of any such spillage will be outboard to the bulwark 204 which will direct the flow into scuppers 205 which,

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in turn, direct the spillage into an associated one of a pair of port and starboard side, pollution abatement tanks 206, both being situated below the level of the main deck 203.

5

With reference to Fig. 26, individual vertical pipe risers 207, attached to the guide structure 90, service the respective stacks of containers 12 as part of the network of pipe conduits on the ship's  
10 main deck for receiving the flow of liquid wastes from the containers 12 when the waste material is to be incinerated.

The respective branches 207a, from each riser which  
15 extend towards the discharge outlets 12a of the respective containers, are at elevations corresponding to the bottoms of the containers 12 to permit gravity flow from the latter. Each branch 207a has a shutoff valve 208, to which a length of flexible hose  
20 209 is connected. A quick-connect pipe coupling (not shown) connects the other end of each flexible hose 209 to one of the container discharge outlets 12a, as will be understood from Fig. 26. Of course, each container outlet 12a has a shutoff valve (not shown),  
25 as is conventional. During discharge operations containers 12 may be vented through a vacuum release valve installed at the top of the tank shell or, where necessitated by the hazardous characteristics of a particular waste, an inert gas may be admitted to the  
30 interior of the shell through the discharge valve, or

other appropriate pipeline connection of the tank container.

As also seen in Fig. 26, the lower ends of the vertical  
5 pipe risers 207 serving any container group connect  
into a common transverse header pipe 210 which is  
pitched towards the pair of longitudinally extending  
header pipes located amidships on the main deck 203,  
so that gravity flow from the containers can be  
10 maintained. Respective valves 211 and 212 direct the  
flow into either or both of the longitudinal conduits  
213, 214, as will also be understood by reference to  
Fig. 25. As shown in Fig. 25, an identical vertical  
riser pipe and transverse header piping arrangement  
15 is disposed in the longitudinal spacing between each  
of the container groups, and a second, identical system,  
including a second pair of longitudinally extending  
conduits 213, 214, services the container groups  
along the opposite side of the vessel 200.

20

As indicated by the arrows adjacent the longitudinal  
conduits 213, 214, these lines are pitched towards  
the stern end 215 of the vessel 200, to maintain  
gravity flow of the draining liquid waste towards  
25 the incinerators 216, four of which are mounted on  
the main deck 203 at the stern 215 of the ship. Line  
pumps 213c, 214c may be used to assist the flow of  
more viscous liquids. The flow in any of the conduits  
213, 214 is directly into one of the product staging sumps  
30 217 from which it is pumped into the burner portion  
216c of one of the incinerators 216 via the sump

outlet line 218, which includes a pump 219. Each of the staging sumps 217, is located below the main deck 203 as seen in Fig. 24, and is preferably a cylindrical tank approximately 120 mt. in diameter and 2,60 mt. high. Each has overflow piping 220 leading to one of the pollution abatement tanks 206, as shown in Figs. 24 and 25. However, each sump 217 is equipped with both a high level alarm and a low level alarm (not shown). When the high product level alarm is actuated by a full sump 217, the flow of product from one of the lines 213, 214 is reduced or terminated by closing one of the valves 221 or 222 (Fig. 25) until the product level drops as the waste is pumped from the sump to its associated incinerator. When the product level drops and the low level alarm is actuated, as when the emptying container 12 has been completely emptied, in order to keep the associated incinerator burning until the flow of the waste product is resumed, coming from another container 12, diesel fuel from a supply tank 223 is introduced into the low level sump. The diesel oil is introduced by opening one of the diesel oil tank valves 224 and, of course, the incinerator pump 219 will pump the diesel oil into the associated incinerator to maintain its flame.

Any overflow from a sump 217 into an abatement tank 206 can be returned to the sump by pumping, when the sump level is again within normal range.

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It will be noted that the described piping and sump arrangement permits controlled and selective incineration of the several different types of liquid wastes as may be contained in the many containers 12. Moreover, one or more container groups may be dedicated to handle a particular type of waste. For example, container group G-5 might be dedicated to containers having wastes which are flowable only on heating and, therefore, steam lines (not shown) may lead to the container supporting structure 90 of the group, to be introduced into steam chambers (not shown) at the bottoms of the respective containers 12 which are stored in this group. Such particular waste product may then be directed into a particular staging sump 217 which services a particular one of the incinerators 216 which is maintained at an appropriate burn temperature for that cargo, which can remain unblended. However, it will be noted that diesel oil may be added to the product before or while it is burned, if desired for improved burning efficiency, by opening the appropriate diesel fuel valve 224. Or, if desired, the cargo may be blended with more flammable cargo from another container stored in a different group but along the same lines 213, 214, and it will be noted that the blending can take place only when both products reach the sump 217 via separate lines 213 or 214.

The common transverse header pipes 210 and the longitudinal conduits 213, 214 are cleaned by pumping cleaning

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solvent or the like therethrough from a solvent tank 225 (Fig. 25), using the solvent pump 226.

The solvent flows from the pump 226, through the valve 227, into the loop piping 213a along the outboard side of the pipe network, and then via the crossover piping 213b located nearest the bow 201, or via the headers 210 by opening their respective valves 228 into the main longitudinal conduits 213, 214, so that all piping is easily cleaned. It will be noted that the dirty solvent drains into the sump 217, from which it may be pumped into the incinerators 216 to be incinerated.

Turning now to the operation of the horizontal incinerators, from Fig. 24, it will first be noted that their effluent discharge outlets 216a which face in the aft direction of the ship from its stern 215, may be pitched at a downward angle towards the sea by ballasting the ship, as by filling ballast tanks 230 to trim the ship by its stern. Thus, the effluent discharge 216e will reach and impinge upon the ocean or waterway more promptly.

Alternatively, and preferably, the effluent discharge outlet may be shaped to provide a downward sloping angle of discharge of the effluent streams, as illustrated in Fig. 27 and 28. That is, the aft-facing effluent discharge outlet 216a of the oxidizer portion

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216d of each incinerator 216 is canted inwardly in the downward direction of its otherwise vertical plane providing a downward discharge angle of from about 15° to about 25° from the horizontal. In addition  
5 the upper wall portion 216b of the oxidizer 216d is given a downward slope, to turn the gases downwardly as they begin to emerge through the outlet 216a. Thus, the discharging effluent gases 216e from each incinerator are directed at a downward sloping angle towards the  
10 water, to strike the water and be diluted by it in the shortest possible time.

In order to rapidly cool the emerging gases 216e to reduce their temperature and, consequently, their  
15 thermal lift, each incinerator is provided with preferably two sea water scrubbers 231, 232, the two being disposed about 45 to 60 cm apart in the longitudinal direction, and the innermost scrubber 231 being located about 60 cm or so aft of the plane of  
20 the discharge outlet 216a. Water is pumped to the scrubbers 231, 232 via the conduit 231a (Fig. 27).

As illustrated in Fig. 28, each scrubber 231, 232, is preferably a square shaped piping spray rack arrangement  
25 concentrically disposed with reference to the imaginary central longitudinal axis of the incinerator through its discharge opening 216a. As shown, the outer scrubber 232 is somewhat larger than the inner scrubber 231 to accommodate the rapidly expanding gas, stream 216e,



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as will be understood. Each scrubber has a plurality of water spray nozzles 231c, 232c, spaced about 30 cm apart about the interior periphery of the spray rack. The nozzles 231c, 232c, of both spray racks 231, 5 232 are so directed that the water spray cones 231b, 232b overlap to provide complete coverage of the incinerator gas stream with the desired watercurtain, as illustrated in Fig. 27 and shown generally in Figs. 15 and 16. The mid-length nozzles 231d, 232d will 10 impart higher velocities so that the streams of sprayed water 231b, 232b will reach the center of the discharging effluent stream 216e.

As also seen in Fig. 27, below the incinerator outlet 15 216a and extending rearward under the scrubber spray racks is a sheet 240 of stainless steel or similar non-corrosive material coated with a protective coating.

This sheet 240, which slopes downwardly in the aft 20 direction as shown, will minimize contact of the highly corrosive effluent gases 216e and scrubber water with the ship's structure. A continuous spray of sea water, indicated by reference numeral 241 will flush the contaminants towards and over the stern 215 25 via drip caps, downspouts, gutters or the like (not shown).

The use of scrubbers, particularly the illustrated two-phase scrubbers, which scrub the horizontally

emerging effluent stream with cold sea water, causes practical elimination of the thermal lift of the effluent, so that it falls rapidly into the sea. As a result, these highly acid gases will not rise into the higher elevations to subsequently descend as harmful acid rain. Calculations indicate that the temperature of the oxidizer effluents, initially as high as more than  $1100^{\circ}\text{C}$ , will be reduced to approximately  $440^{\circ}\text{C}$  by the two-phase scrubber as described.

10

Referring again to Fig. 27 and also to Fig. 29, a sliding incinerator cap 242 is mounted immediately adjacent to each incinerator outlet 216a to plug the incinerator outlet when the incinerator is shut down, thus to retain the heat within, and reduce the use of fuel during the next startup.

Capping the incinerator also minimizes thermal shock to the incinerator refractory from ambient air temperature, sea spray, rain, etc. Accordingly, a steel curtain door or cap 242 having insulating material 243 on its inner, incinerator-facing side rides on a trolley structure 244 into and laterally out of the path of the discharge outlet 216a. The heavy steel cap 242 hangs vertically as it rolls laterally on its trolley wheels 245, but will be swung upwardly at its lower end, to the angled position shown in Fig. 27 conforming with the angular disposition of the inwardly canted plane of the

20

25

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discharge outlet 216a, Latches (not shown) latch the cap 242 in closed position on the outlet.

Again with reference to Fig. 27, the sprays of sea  
5 water from the scrubbers 231, 232 entrap many emerging fine particulate materials within the gas stream, as well as dissolving much of the gases themselves. Accordingly, the efficiency of incineration may be monitored not only by sampling and  
10 analyzing the gases emerging beyond the stern of the ship, but also by sampling and analyzing the residue scrubber water itself. For such purpose, in Fig. 27 there is a diagrammatic illustration of a stern sampling through 250, located beneath the  
15 falling scrubber sprays, for collecting samples of the spray water after passing through the effluent stream, for subsequent analysis.

Evidently the incinerator as above in detail clarified,  
20 can be mounted also on a fixed structure located on an offshore platform or on the border of an uninhabited island and this structure will be equipped with means for mooring of the vessel carrying the containers and for the pipe connections to transfer the hazardous  
25 waste material from the containers to the incinerator.

Thus, techniques and vessels for offshore incineration of hazardous liquid waste material have been described which achieve all of the objects of the invention.

Claims:

1. A method for disposing of hazardous waste material through offshore incinerator, c h a r a c t e r i- z e d in that this hazardous waste material is transferred through intermodal containers (12) from  
5 the sites (10) where are generated to the offshore burning location where this hazardous waste material is incinerated in an enlogated horizontal incinerator (17) disposed on a supporting base at an elevation above water level and this incinerator directs the  
10 effluent discharge (86) in a generally horizontal stream towards the water, and/or in a downwardly sloping direction towards the water and this effluent discharge is scrubbed by spraying sea water in one or two subsequent stages (85, 231, 232).
- 15 2. A method according to claim 1, c h a r a c t e r i- z e d in that the incinerator (17) is mounted on board a vessel (15) and the effluent discharge outlet of said incinerator (17) faces in a downwardly sloping  
20 direction and this sloping direction is regulated through ballasting to trim the vessel (15).
3. A method according to claim 1, c h a r a c t e r i- z e d in that said waste material is substantially  
25 liquid material and is transported to said burnsite location in liquid-carrying intermodal tank shipping containers (12), and said method further comprises feeding said waste material from said containers (12) into a staging sump (217), and pumping said waste

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material from said staging sump (217) into said incinerator (17).

4. A method according to claim 3, c h a r a c t e r i -  
5 z e d in that further comprises loading said waste material into each of said liquid-carrying intermodal shipping containers (12) at respective land sites (10) and said transporting step comprises transporting said containers from said sites to a dockside (13)  
10 and loading all of said containers on and above a weatherdeck of a sea-going vessel (15), and taking said vessel to said offshore burnsite location.

5. A method according to claim 3, c h a r a c t e r i -  
15 z e d in that said staging sump (217) is mounted on a sea-going vessel (15) at an elevation below a weatherdeck thereof, and said transporting step comprises loading all of said containers (12) on and above said weatherdeck of said vessel, said waste  
20 material being substantially gravity-fed from said containers into each staging sump.

6. A sea-going vessel for incinerating liquid hazardous waste material, c h a r a c t e r i z e d in that said  
25 vessel (15) has a weatherdeck, an incineration (17) mounted substantially on said weatherdeck and has a substantially horizontally directed effluent discharge outlet (216a), a staging sump (217) for accumulating said waste material for feeding to said incinerator,

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and means for feeding said waste material from within said sump to said incinerator for incineration therein, whereby the products of said incineration emerge in a substantially horizontal direction from  
5 said incinerator effluent discharge outlet.

7. A vessel according to claim 6, c h a r a c t e r i-  
z e d in that the liquid-waste type incinerator (17) is horizontally oriented, it presents a burner portion  
10 (26) and an oxidizer portion (27), at last said oxidizer portion (27) having modular construction, and said incinerator is mounted adjacent to the stern end of the vessel (15) and with its said horizontally directed effluent discharge outlet (216a) facing aft.

15

8. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that it further comprises wind generator means (36) mounted for generating and directing wind adjacent to said incinerator discharge outlet to direct  
20 effluent gas emerging therefrom in said aft direction.

9. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that it comprises a downwardly sloping sheet (240) of non-corrosive material beneath and  
25 extending aft of said effluent discharge outlet, and means (241) for spraying sea water on said sheet of material to flush overboard any effluents from said discharge outlet which impinge thereon.

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10. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that said incinerator discharge outlet has  
means for directing discharging effluents at a  
downwardly sloping angle from the horizontal.

5

11. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that it further comprises sea-water scrubber  
means (231, 232) mounted adjacent to said incinerator  
discharge outlet for directing a spray of sea water  
10 into the stream of effluents discharging (216e) therethrough.

12. A vessel according to claim 11, c h a r a c t e r i-  
z e d in that said scrubber means comprises annular  
water conduit means (231) disposed substantially  
15 around the path of said stream of effluents (216e) and  
further comprises a second annular water conduit  
means (232) longitudinally spaced from the first said  
water conduit means and disposed substantially around  
the path of said stream of effluents, and both these  
20 conduits present nozzle means facing substantially  
inwardly with respect to said stream.

13. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that it further comprises incinerator cap  
25 means (242) for covering and closing said incinerator  
discharge outlet and mounted for movement into and  
out of said covering relationship with said discharge  
outlet.

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14. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that it further comprises a liquid fuel  
storage tank (223), and means for feeding liquid  
fuel from said storage tank into said staging sump  
5 (217) for fueling said incinerator therefrom.

15. A vessel according to claim 7, c h a r a c t e r i-  
z e d in that said staging sump (217) has an upper  
end disposed substantially at the elevation of said  
10 weatherdeck, a lower end extending below said weatherdeck,  
and an inlet for said waste material substantially  
adjacent to its said upper end, and which further  
comprises intermodal shipping container retaining means  
on said weatherdeck, and conduit means extending  
15 substantially between said container retaining means  
and said staging sump and including conduit connection  
means (213) for connection to a container retained  
in said container retaining means for conducting waste  
material from said container into said staging sump.

20

16. A vessel according to claim 15, c h a r a c t e r i-  
z e d in that it further comprises a pollution  
abatement tank (206) below said weatherdeck, bulwark  
and scupper means on said weatherdeck for directing  
25 any spilled waste material on said weatherdeck into  
said pollution abatement tank, and conduit means for  
conducting waste material between said pollution aba-  
tement tank and said staging sump.



17. A vessel according to claim 15, c h a r a c t e r i -  
z e d in that said container retainer means comprises  
container storage cells (90) for storing a plurality  
of liquid-carrying type intermodal shipping containers  
5 (12) and said conduit means (210, 213, 214) between said  
container retaining means and said staging sump (217)  
comprises a longitudinally extending conduit mounted  
on said vessel weatherdeck, and conduit means extending  
substantially between said longitudinally extending  
10 conduit and said storage cells and including respective  
conduit connection means (207) for connecting  
respective containers mounted in said storage cells  
to said longitudinally extending conduit for directing  
waste material from said respective containers into  
15 said longitudinally extending conduit, and valve means  
(208) on said conduit means for selectively directing  
said waste material from the respective of said containers  
into said longitudinal conduit.

20 18. A vessel according to claim 17, c h a r a c t e r i -  
z e d in that said container storage cells (90) comprise  
a plurality of vertical container guides (31) for receiving  
a plurality of vertically stacked containers (12)  
therebetween, and said conduit connection means  
25 comprises at least one vertical pipe riser (207), substantially  
adjacent to said container guides and having a plurality  
of flexible hose connectors (209) thereon which are  
respectively substantially adjacent to the outlets (10a) of  
the containers stacked between said guides.

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19. A vessel according to claim 18, c h a r a c t e r i-  
z e d in that it further comprises a plurality of said  
incinerators (17) mounted adjacent to said  
vessel stern end, each said incinerator having a  
5 horizontally directed effluent discharge outlet (216a)  
facing aft, and respective staging sumps (217) below  
said weatherdeck associated with each of said incinerators  
and wherein said container guides are disposed for  
receiving a plurality of longitudinally aligned rows of  
10 vertically stacked containers (12) on and above said  
weatherdeck on each side of said vessel said conduit  
means comprises respective pairs of longitudinally extending  
conduits, each associated with all of said rows of  
containers on each side of said vessel, each of said  
15 longitudinally extending conduits being mounted on  
said weatherdeck and leading into one of said staging  
sumps (217) and said conduit connection means comprises  
a vertical pipe riser (207) substantially adjacent to each  
of said rows of stacked containers on said vessel and  
20 respective, transversely extending conduit means (210)  
mounted on said vessel weatherdeck to extend between  
each of said pipe risers and one of said pairs of said  
longitudinally extending conduits for selectively  
connecting the riser to either of said longitudinally  
25 extending conduits in the pair.

20. A vessel according to claim 19, c h a r a c t e r i-  
z e d in that it further comprises liquid fuel storage  
tank means (223), and means (224) for feeding liquid fuel

from said storage tank means into each of said staging  
sumps (217) and wherein each of said staging sumps has  
means for determining a predetermined maximum level  
and a predetermined minimum level of liquid therein,  
5 means activated by said determining means for terminating  
said feeding of waste material thereto when said  
predetermined maximum liquid level is reached, and  
means activated by said determining means for feeding  
liquid fuel from said storage tank means into said  
10 sump when said predetermined minimum liquid level is  
reached.

21. A vessel according to claim 20, c h a r a c t e r i -  
z e d in that said vessel (200) further comprises a  
15 plurality of pollution abatement tanks (206) below said  
weatherdeck (203) conduit means extending from each of  
said staging sumps (217) at the elevation of said  
maximum liquid level therein into one of said pollution  
abatement tanks, conduit means (220) including pump means for  
20 pumping liquid contained in each of said pollution abatement  
tanks into one of said staging sumps, bulwark means (204) on  
said vessel weatherdeck for containing liquid waste  
material spilled from any of said containers, and conduit means  
(205) for conducting said spilled waste material from  
25 behind said bulwark means into one of said pollution  
abatement tanks.

22. A vessel according to claim 7, c h a r a c t e r i -  
z e d in that said vessel (200) has a pair of parallel

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and horizontal incinerators (17) each having  
a burner end and an effluent discharge (216a) end and  
comprising an oxidizer portion formed by a tandemly  
connected pair of elongated oxidizer modules (60 and  
5 61); an elongated burner module (101) common to said  
pair of incinerators and extending transversely between  
and detachably connected to the respective burner ends  
of said oxidizer portions of the incinerator pair and  
a pump room module (102) common to said pair of  
10 incinerators and detachably connected to said burner  
module (101) in parallel adjacent relation thereto. The  
length, width and height of each of said oxidizer  
modules (60 and 61) said burner module (101), and said  
pump room module (102) being substantially equal to  
15 each other.

AMENDED  
CLAIMS

## Claims:

1. A method for disposing of hazardous waste material through offshore ~~incinerator~~<sup>incineration</sup>, characterized in that this hazardous waste material is loaded into ~~transferred through~~ intermodal containers (12), ~~from~~<sup>at</sup> the sites (10) where ~~it is~~<sup>it is</sup> generated ~~to the offshore~~<sup>and then transported,</sup> burning location where this hazardous waste material ~~led from said containers to, and,~~<sup>is</sup> incinerated in an ~~elongated horizontal~~ incinerator (17) disposed on a supporting base at an elevation above water level, ~~said hazardous waste material remaining in said containers after loading therein until said feeding of the material to said incinerator.~~<sup>said hazardous waste material remaining in said containers after loading therein until said feeding of the material to said incinerator.</sup> ~~stream towards the water, and/or in a downwardly sloping direction towards the water and this effluent discharge is scrubbed by spraying sea water in one or two subsequent stages (85, 231, 232).~~  
10 ~~stream towards the water, and/or in a downwardly sloping direction towards the water and this effluent discharge is scrubbed by spraying sea water in one or two subsequent stages (85, 231, 232).~~
- 15 2. A method according to claim 1, characterized in that the incinerator (17) is mounted on board a vessel (15) and the effluent discharge outlet of said incinerator (17) faces in a ~~downwardly sloping~~<sup>horizontal or</sup> direction ~~to direct the discharging effluent stream (86, 216e)~~<sup>to direct the discharging effluent stream (86, 216e)</sup> ~~generally towards the water.~~  
20 ~~through ballasting to trim the vessel (15).~~
3. A method according to claim <sup>2</sup>~~1~~, characterized in that said waste material is substantially liquid material and is transported to said burnsite location in liquid-carrying intermodal tank shipping containers (12), and said method further comprises feeding said waste material from said containers (12) into a staging sump (217), and pumping said waste

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material from said staging sump (217) into said incinerator (17).

4. A method according to claim <sup>2</sup>3, c h a r a c t e r i -  
 5 z e d in that, ~~Further comprises loading said waste~~ <sup>said discharging effluent stream (86, 216 e)</sup>  
~~from said incinerator (17) is scrubbed by spraying sea~~  
~~material into each of said liquid-carrying intermodal~~  
~~water into the stream in one or more subsequent stages~~  
~~shipping containers (12) at respective land sites (10)~~  
~~(85, 231, 232)-~~  
~~and said transporting step comprises transporting~~  
~~said containers from said sites to a dockside (13)~~  
 10 ~~and loading all of said containers on and above a~~  
~~weatherdeck of a sea-going vessel (15), and taking~~  
~~said vessel to said offshore burnsite location.~~

5. A method according to claim 3, c h a r a c t e r i -  
 15 z e d in that said staging sump (217) is mounted on  
 a sea-going vessel (15) at an elevation below a  
 weatherdeck thereof, and said transporting step  
 comprises loading all of said containers (12) on and  
 above said weatherdeck of said vessel, said waste  
 20 material being substantially gravity-fed from said  
 containers into <sup>said</sup> ~~each~~ staging sump.

6. A sea-going vessel for incinerating liquid hazardous  
 waste material, c h a r a c t e r i z e d in that said  
 25 vessel (15) has a weatherdeck, an <sup>incinerator</sup> ~~incineration~~ (17)  
 mounted substantially on said weatherdeck and has a  
 substantially horizontally directed effluent discharge  
 outlet (216a), a staging sump (217) for accumulating  
 said waste material for feeding to said incinerator,

FIG. 1

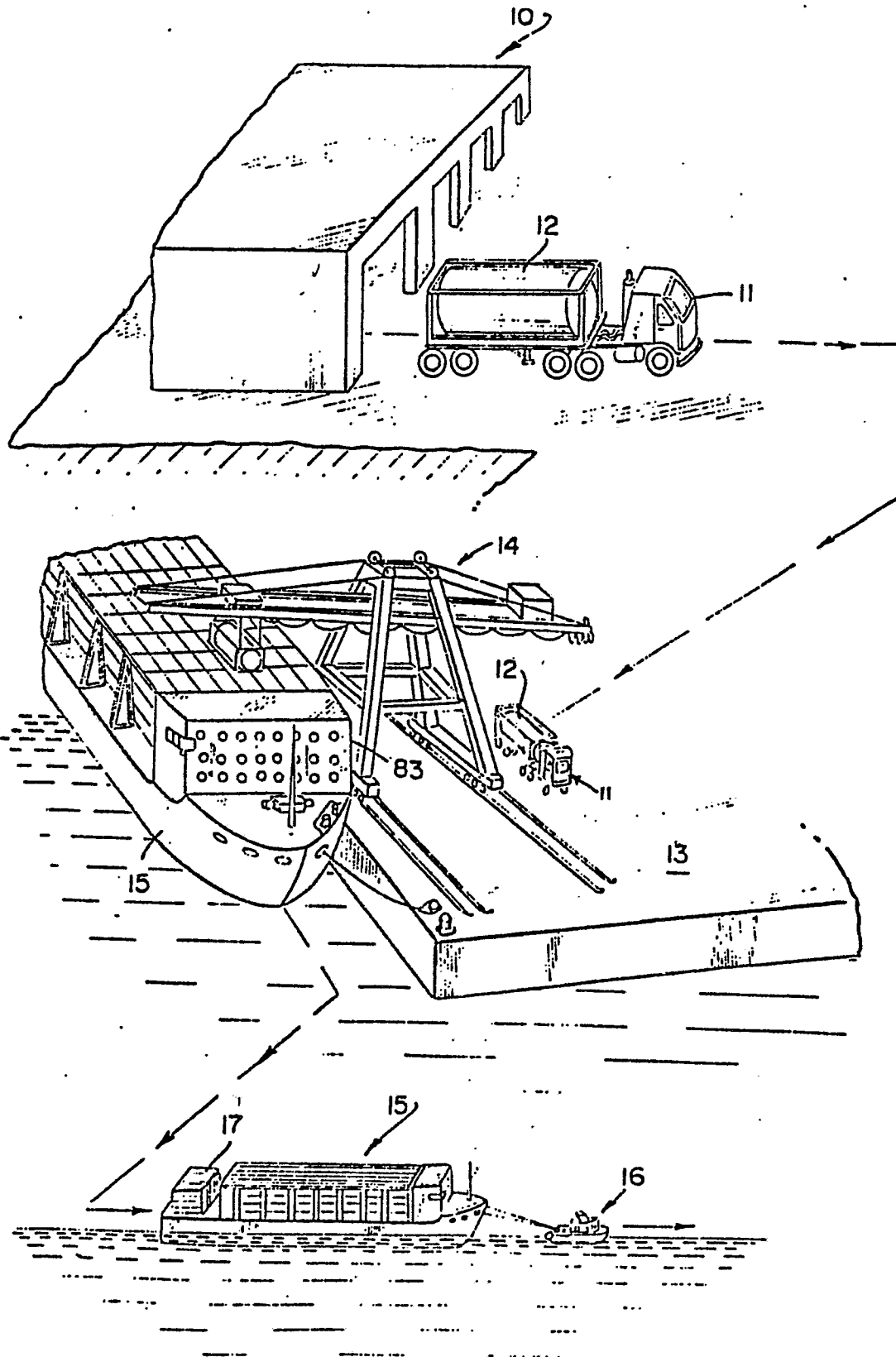


FIG. 2

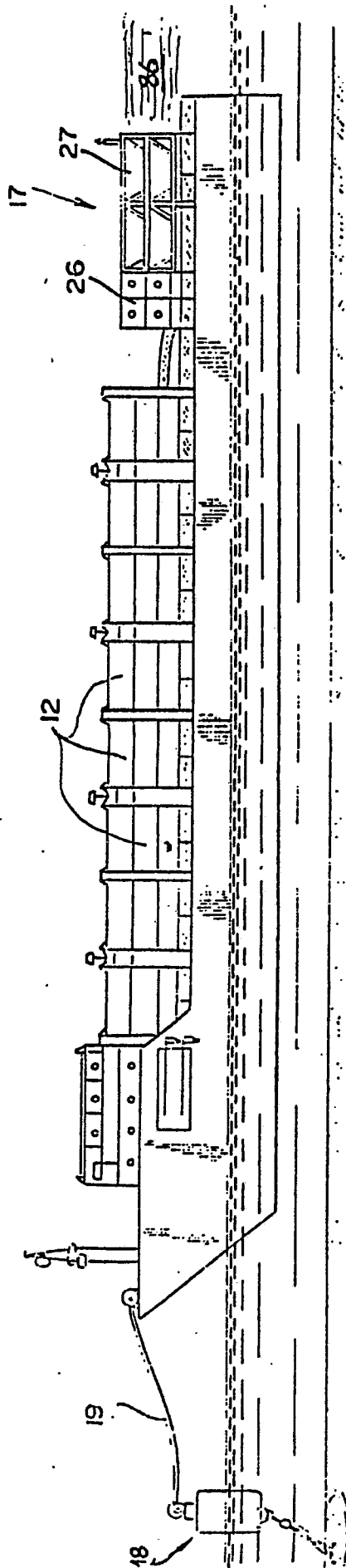


FIG. 3

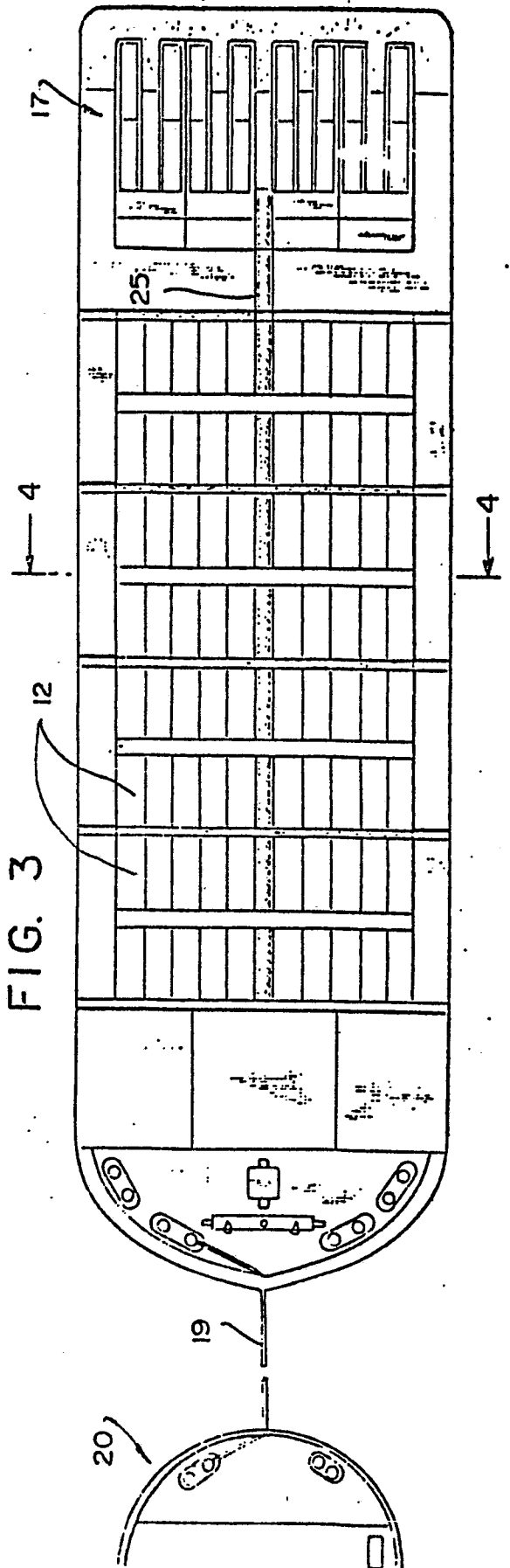




FIG. 4

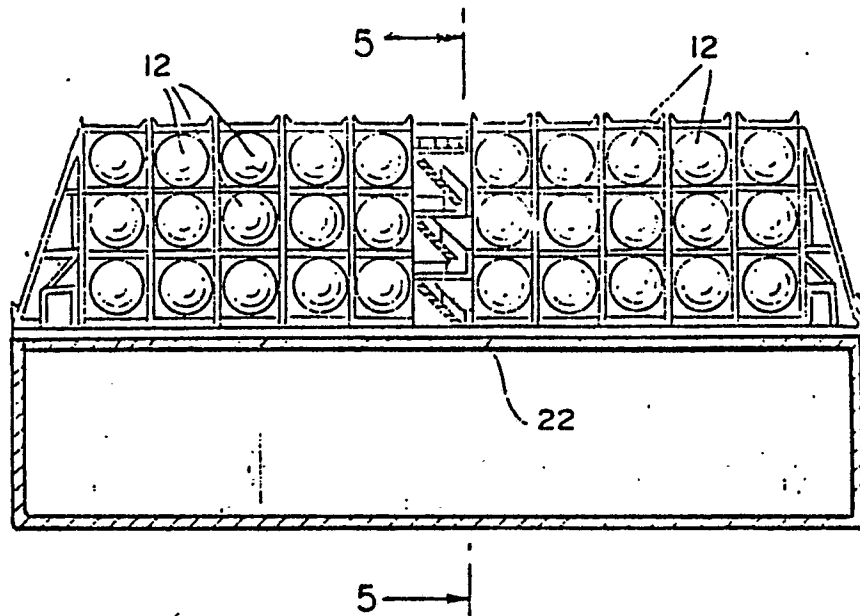


FIG. 5

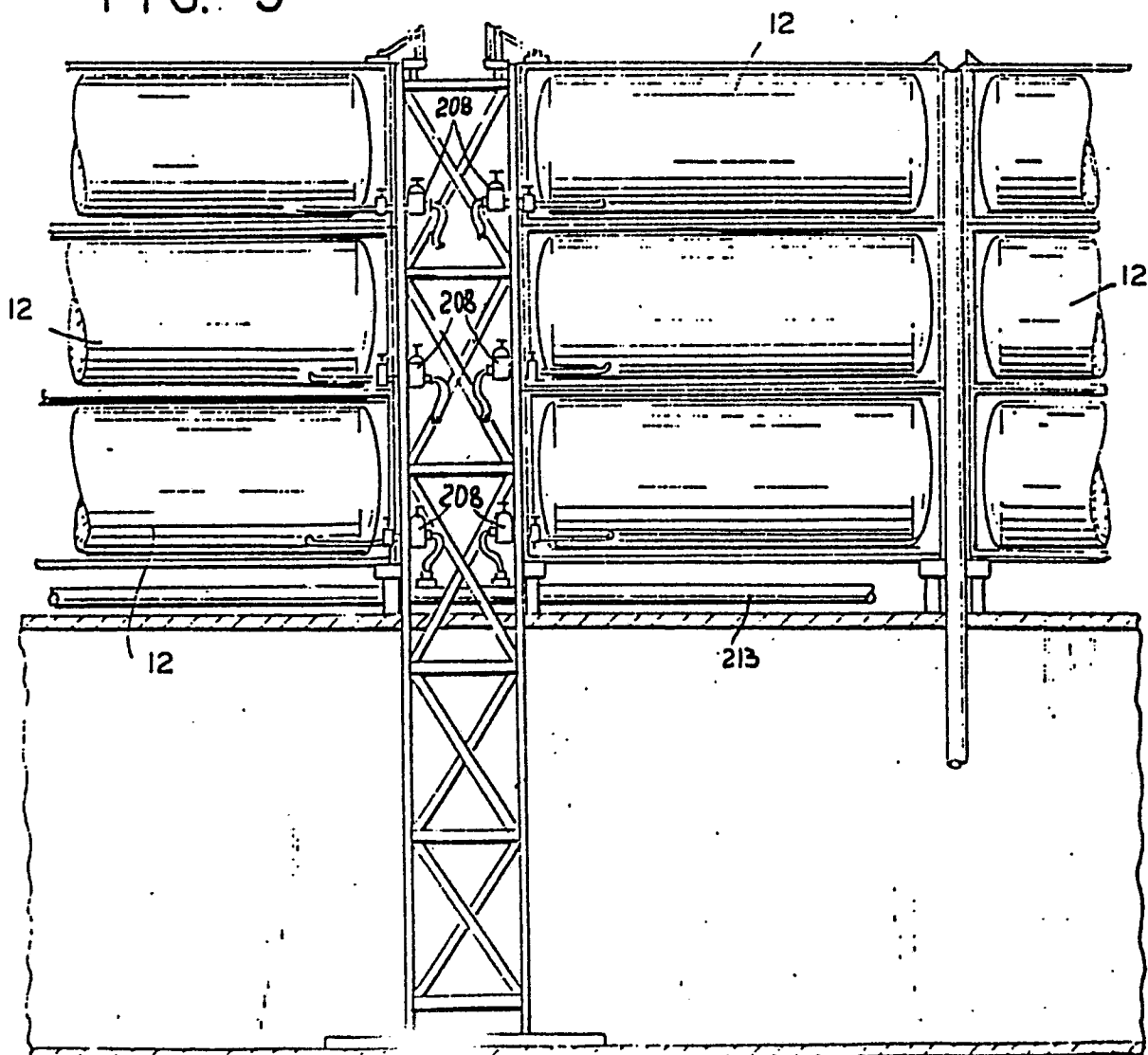


FIG. 7

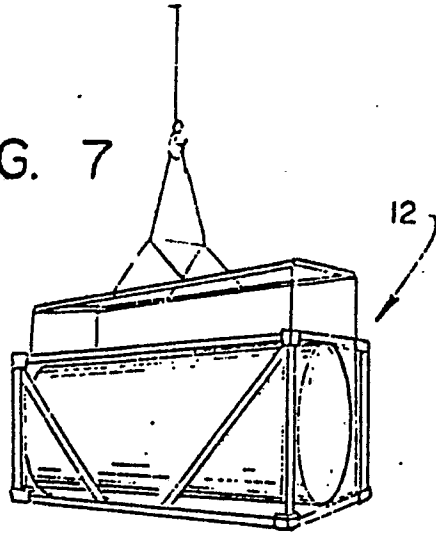


FIG. 12

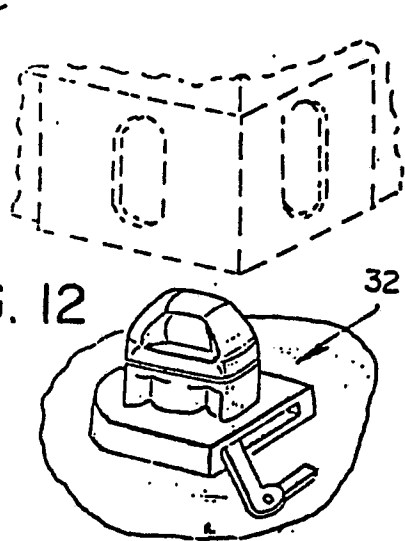


FIG. 6

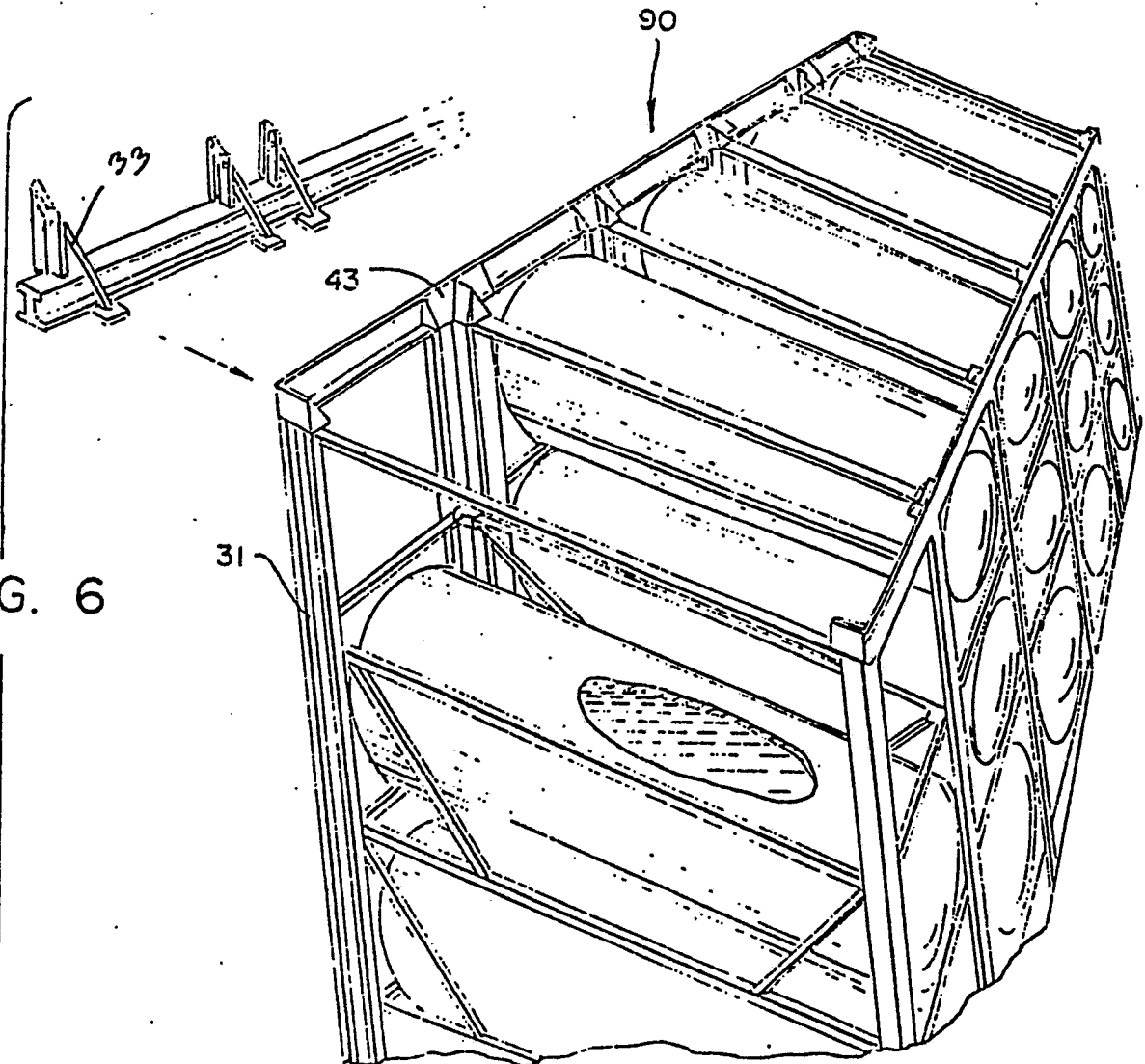


FIG. 8

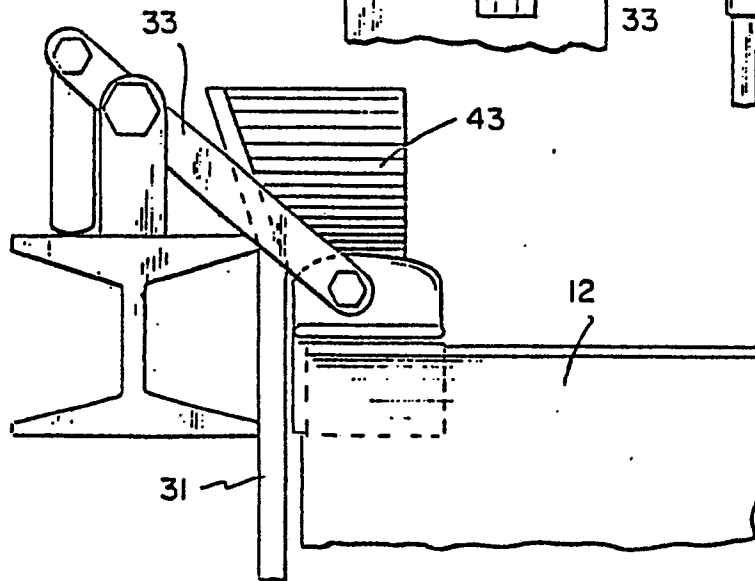


FIG. 9

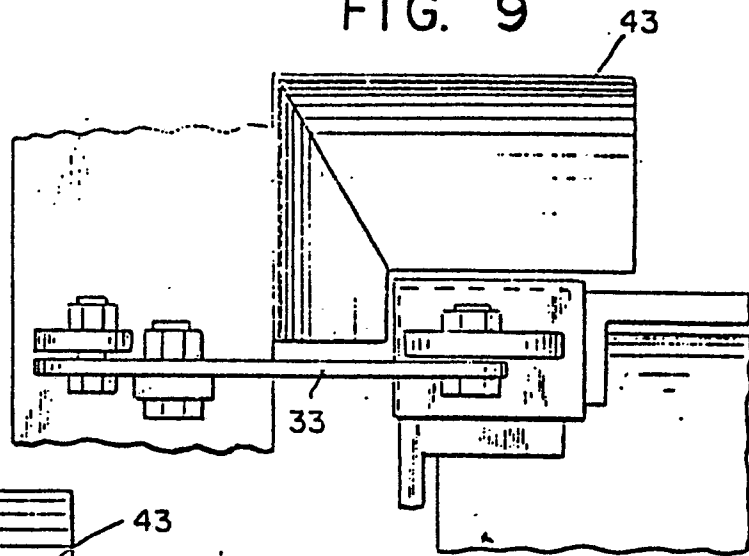


FIG. 15

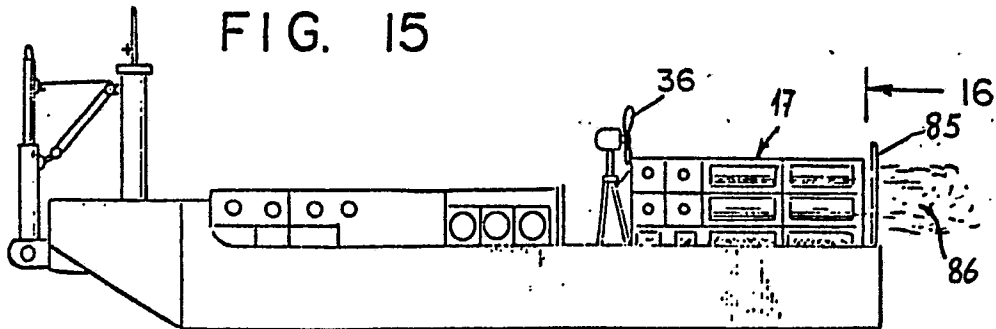


FIG. 16

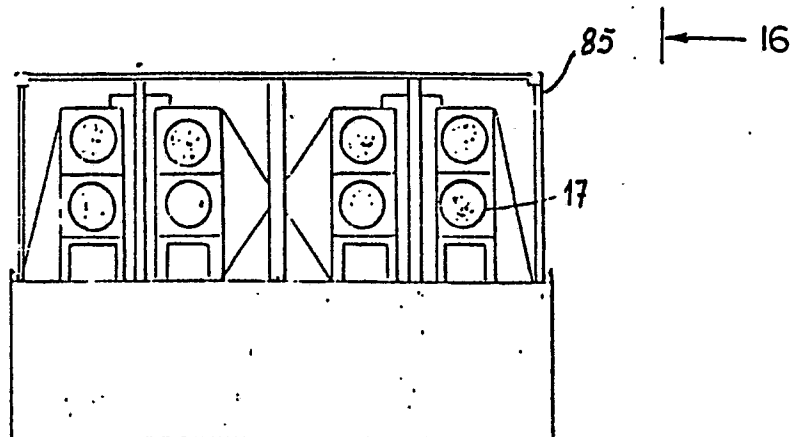


FIG. II

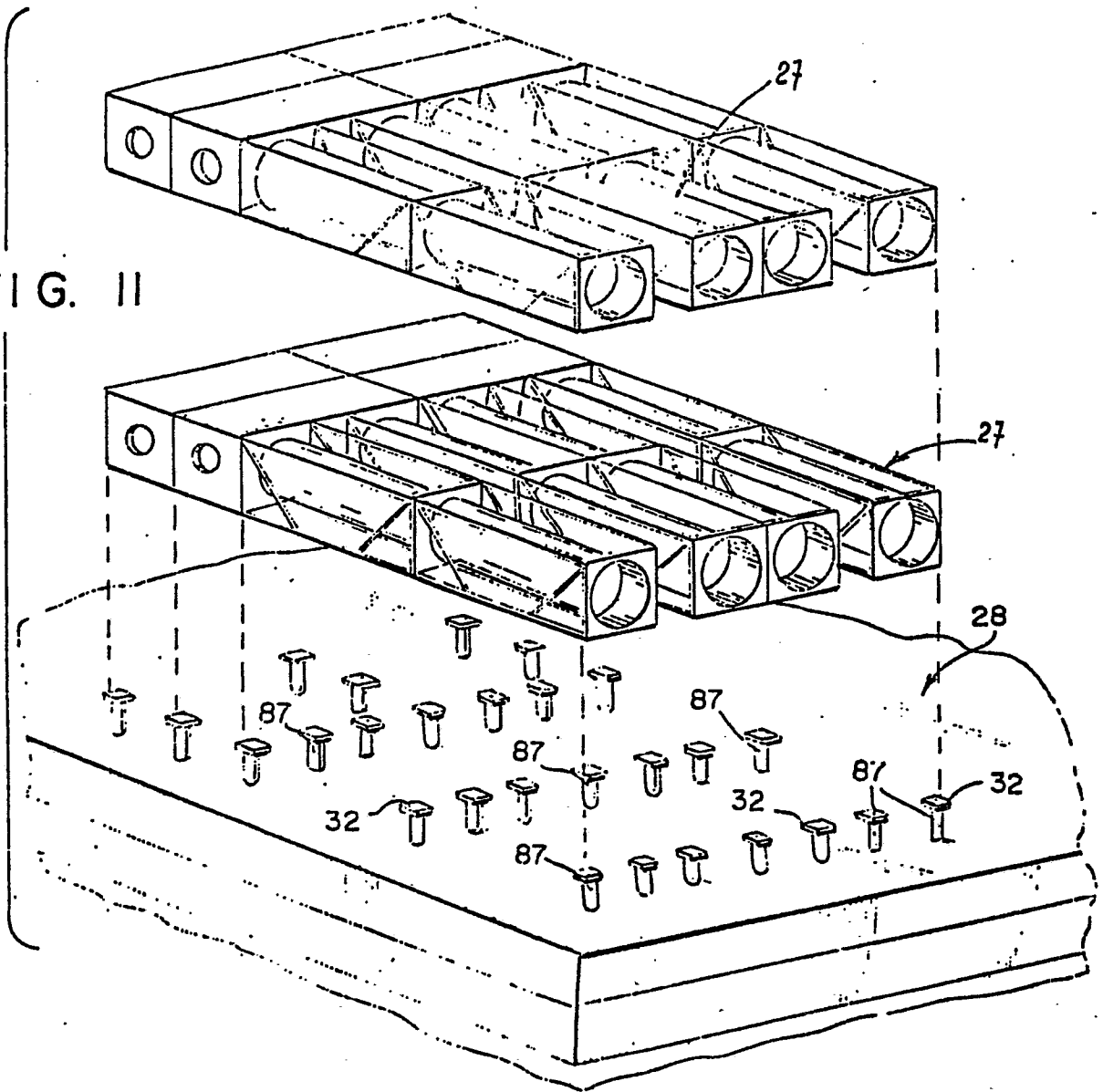


FIG. 10

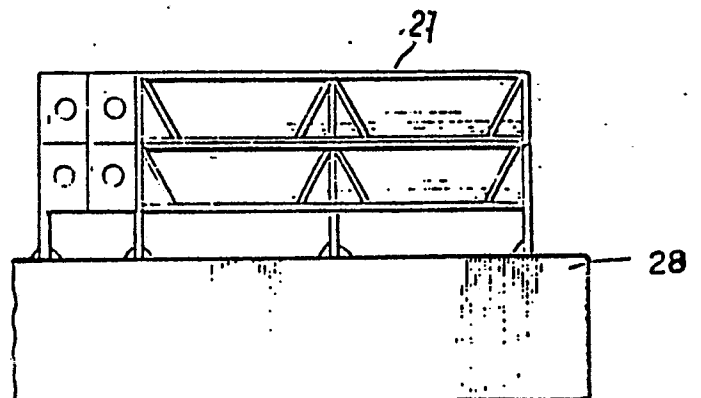


FIG. 13

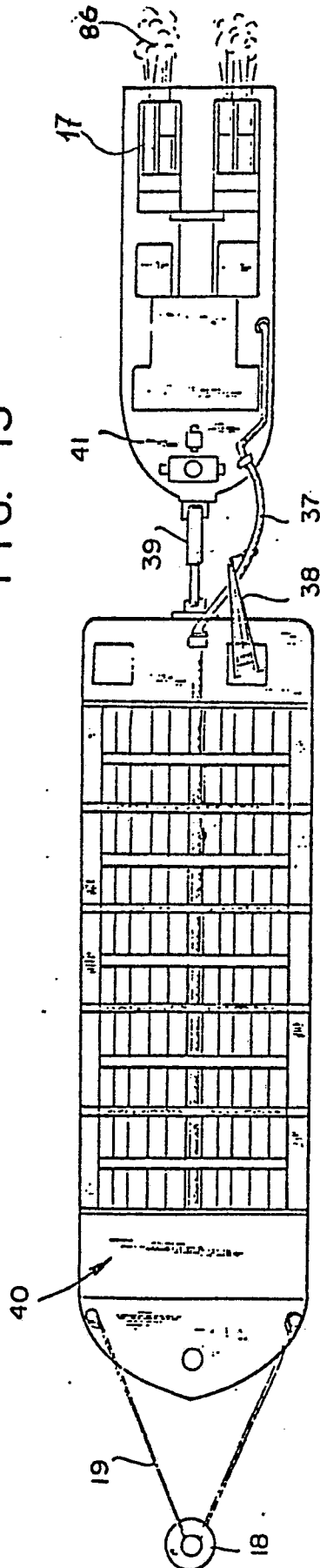


FIG. 14

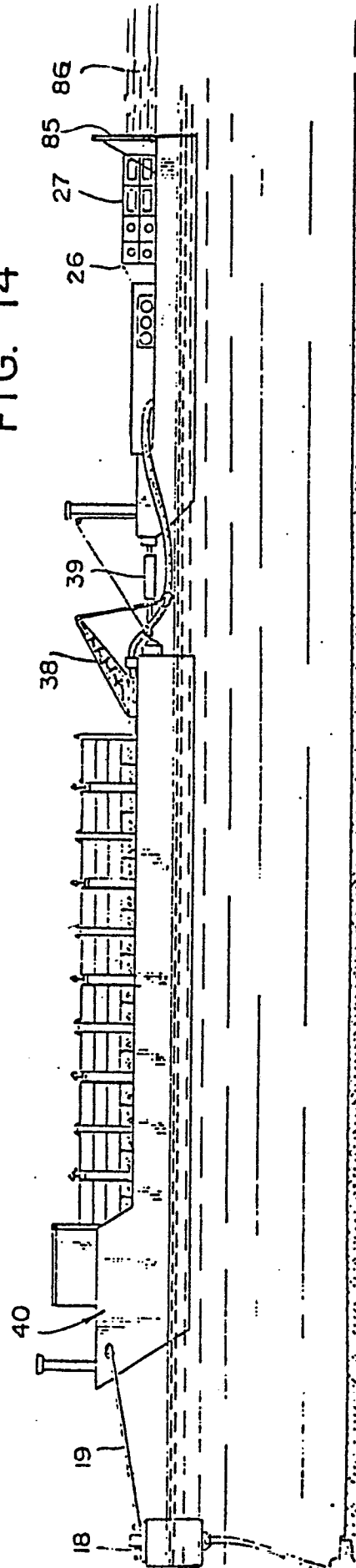


FIG. 17

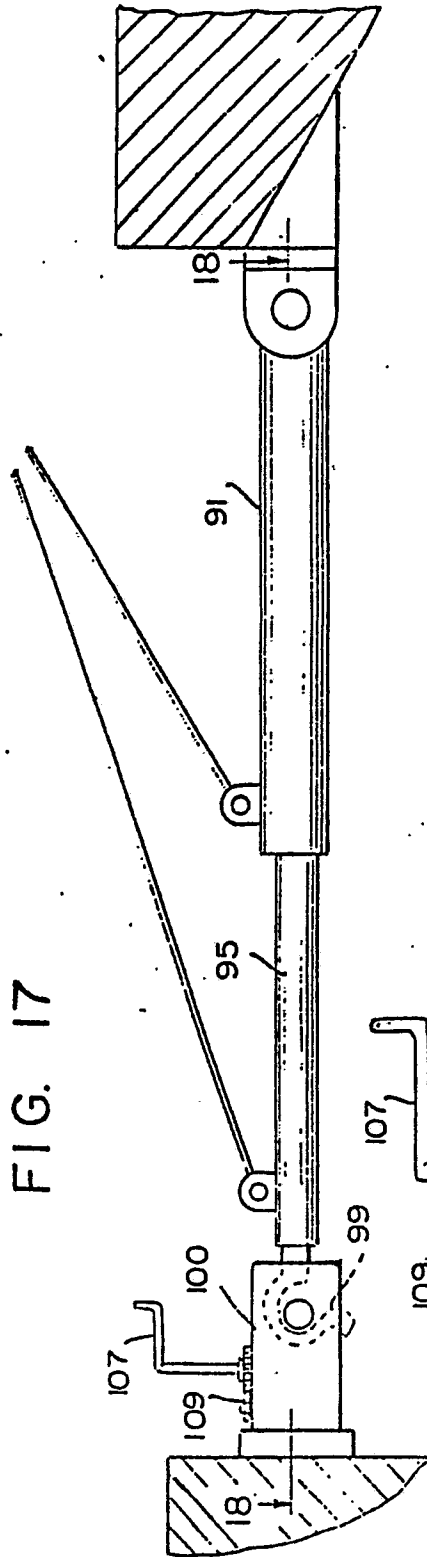


FIG. 19

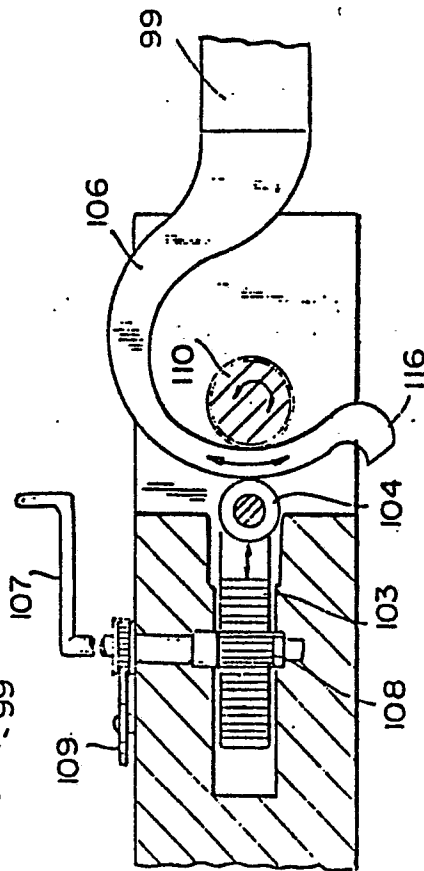


FIG. 18

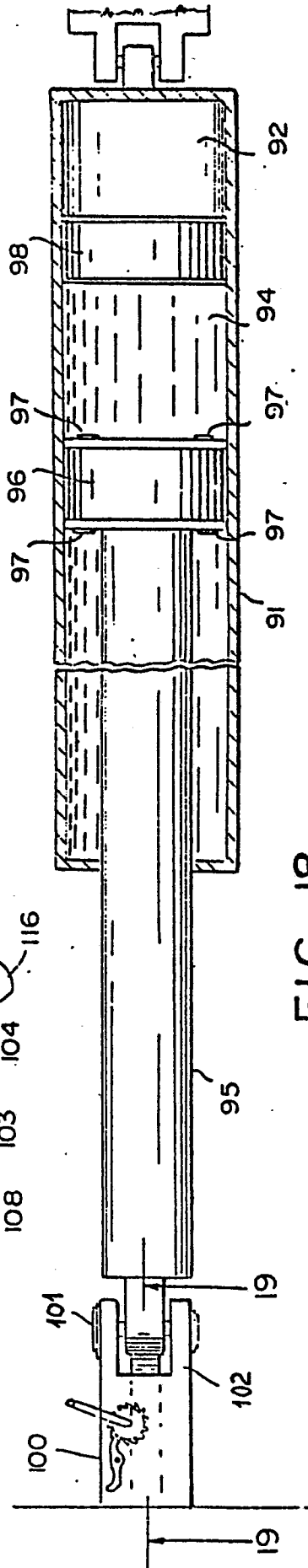


FIG. 20

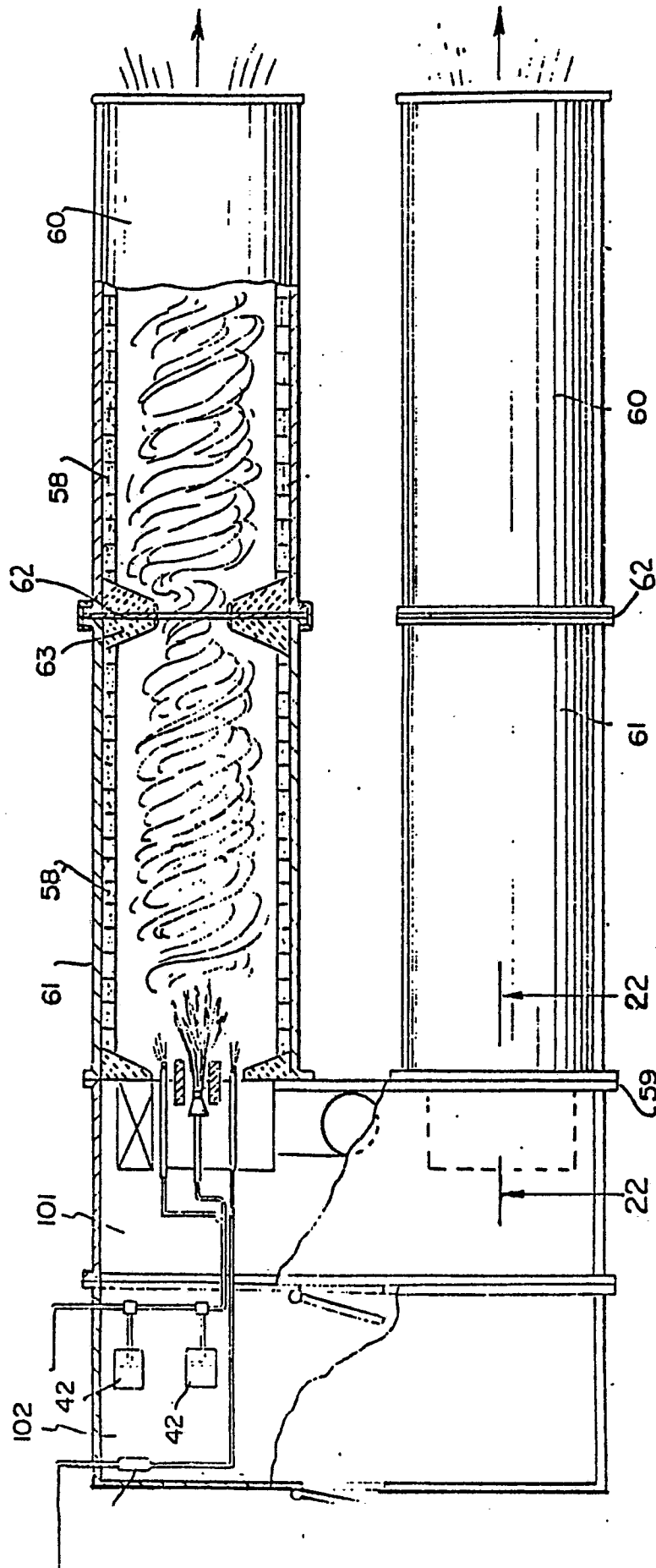


FIG. 21

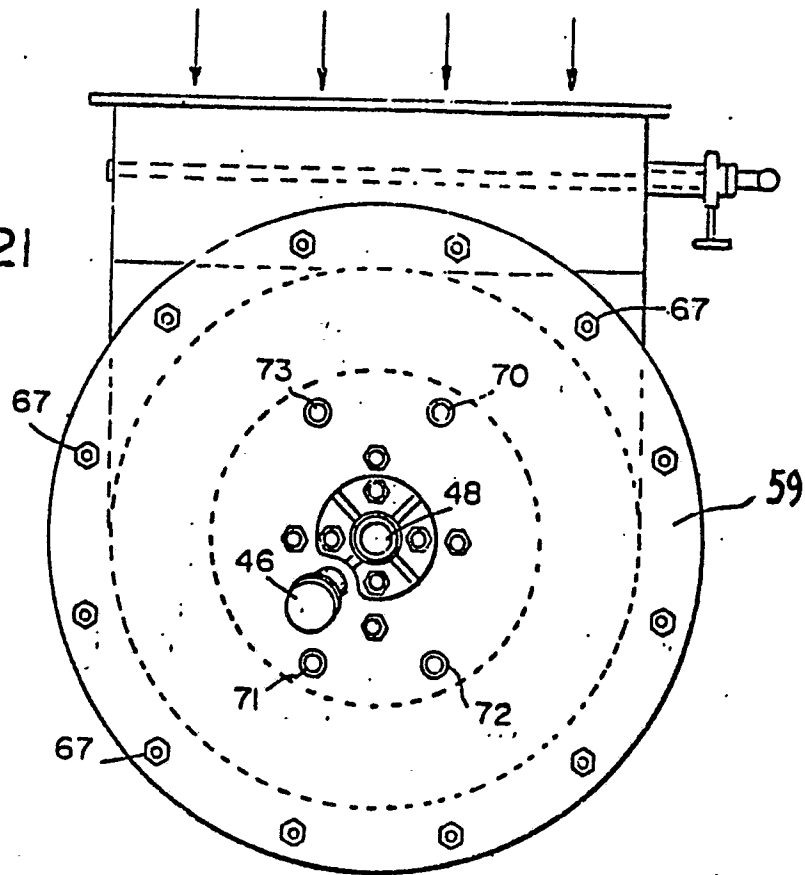


FIG. 22

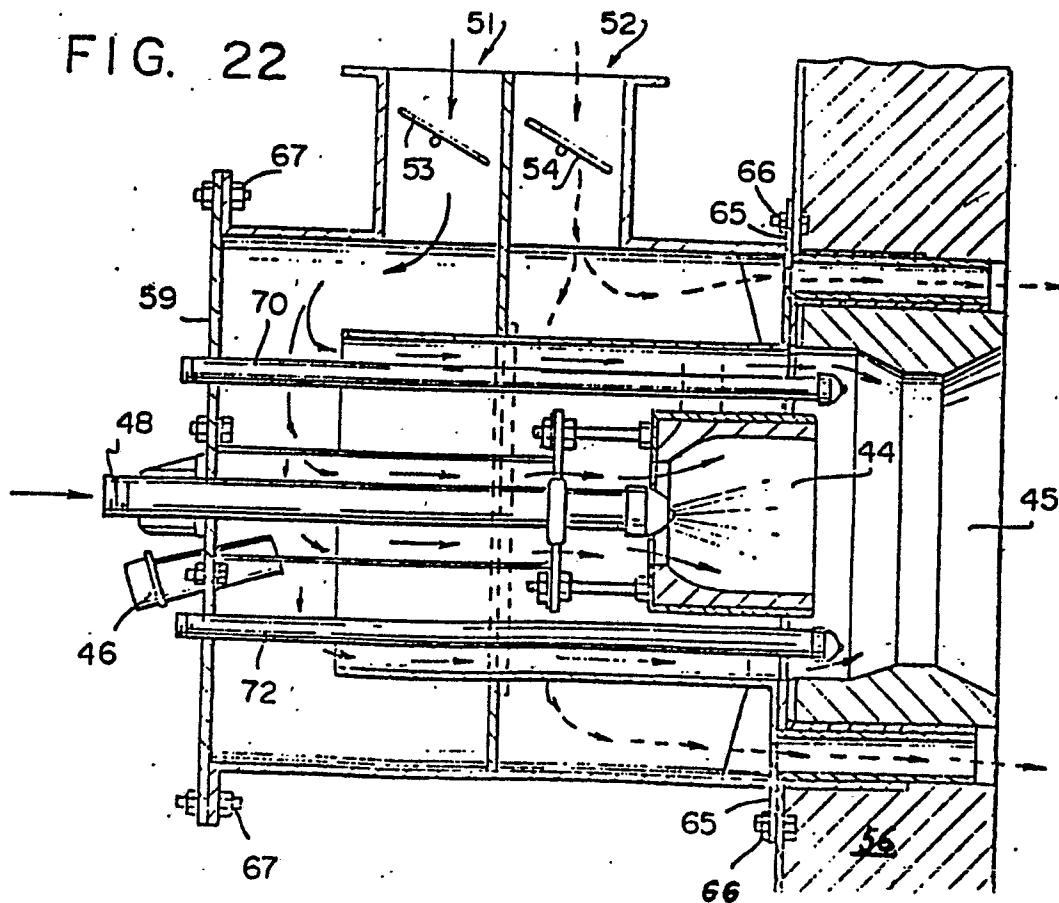
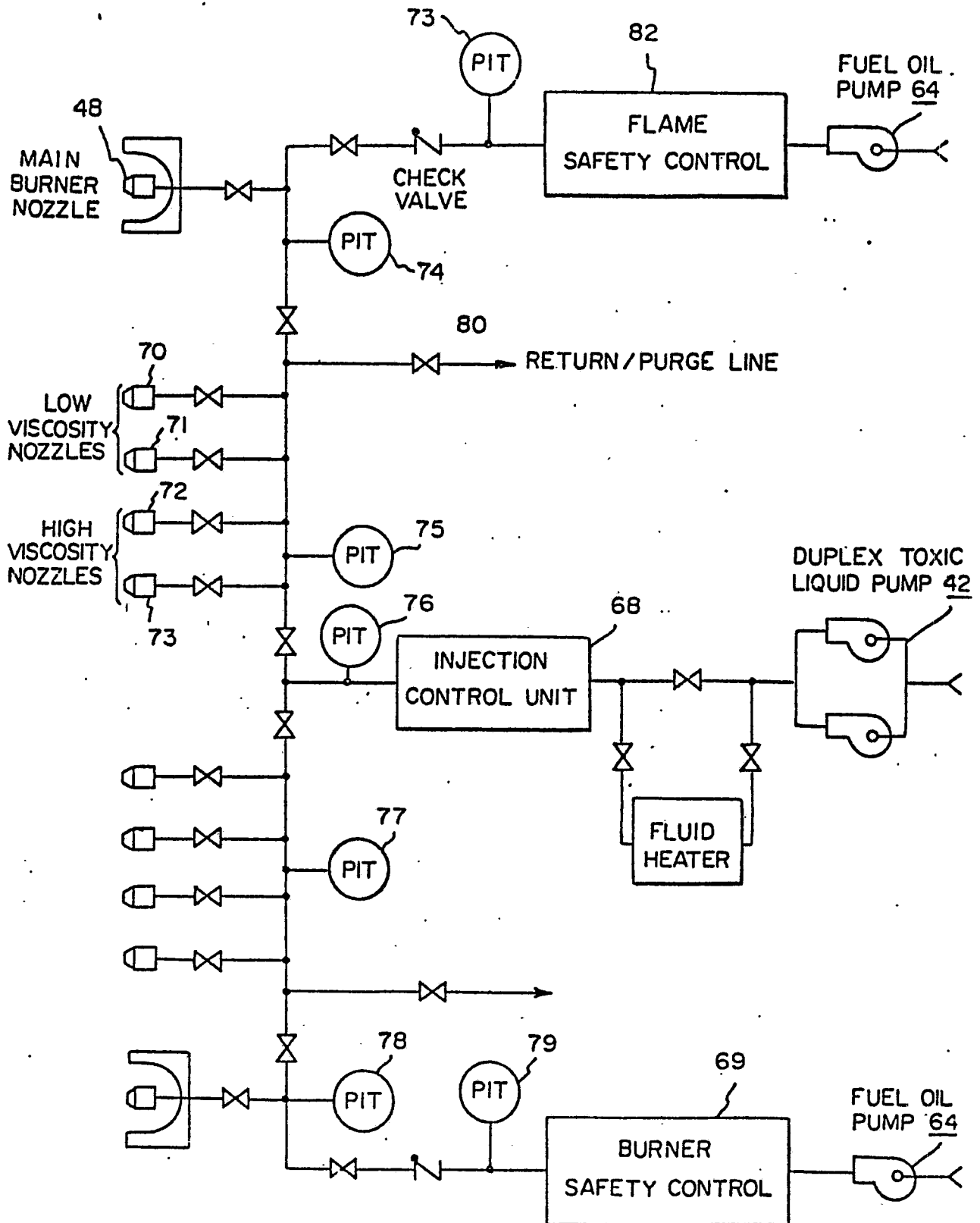




FIG. 23



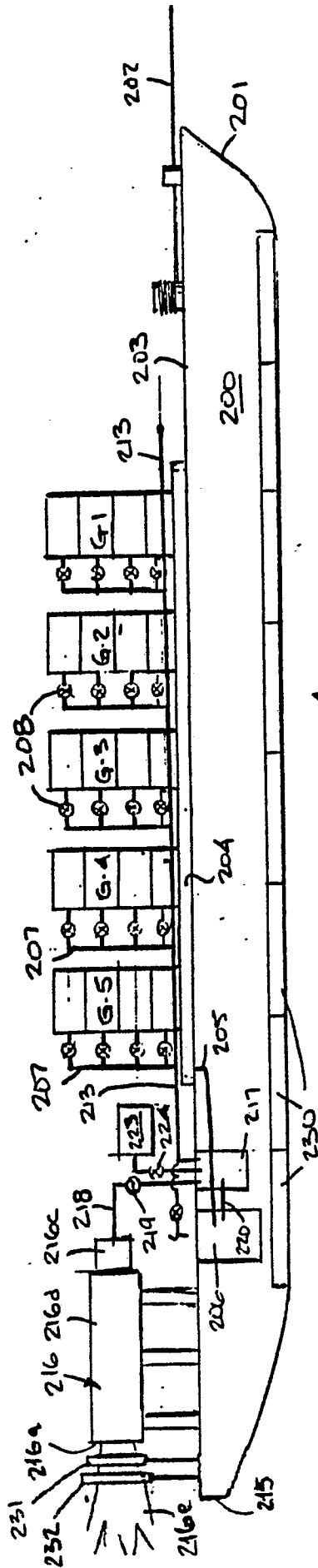


Fig. 24

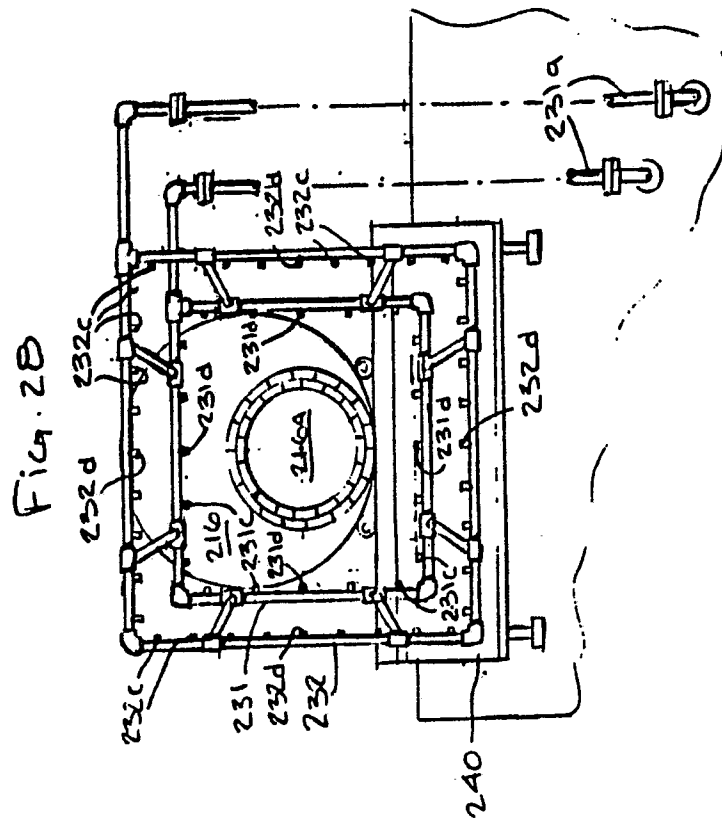


Fig. 28

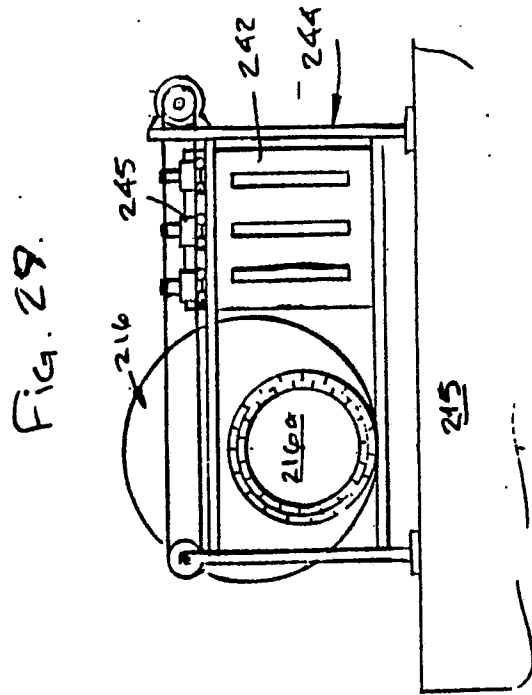


Fig. 29

FIG. 25

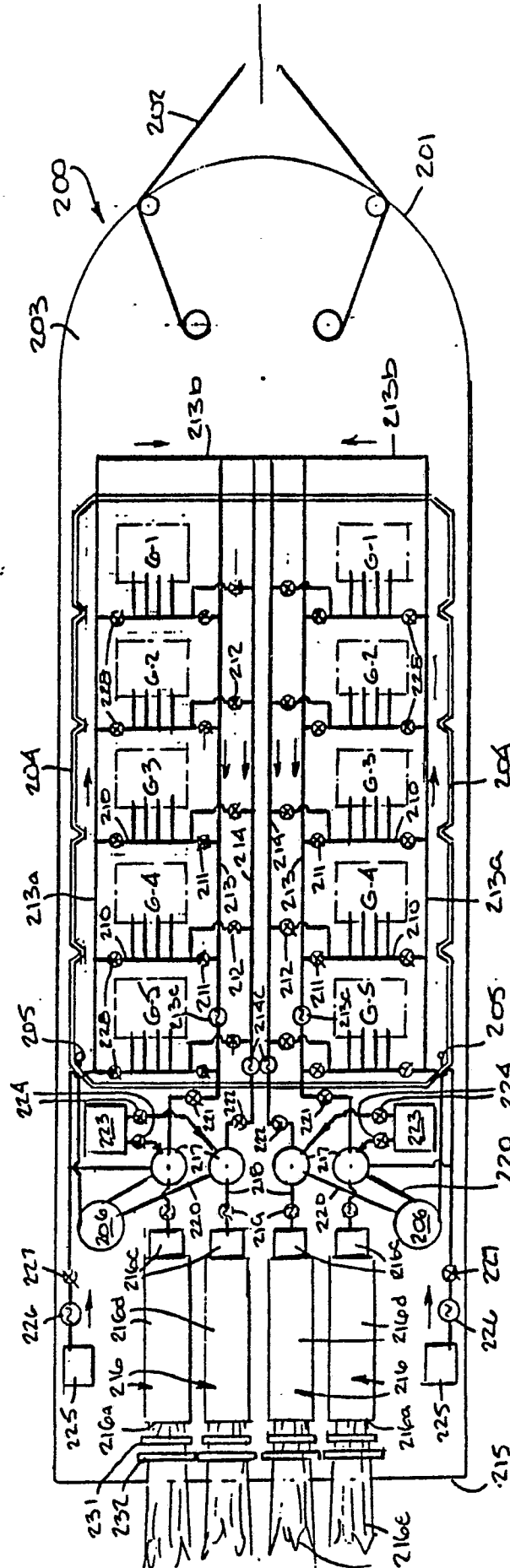


Fig 26

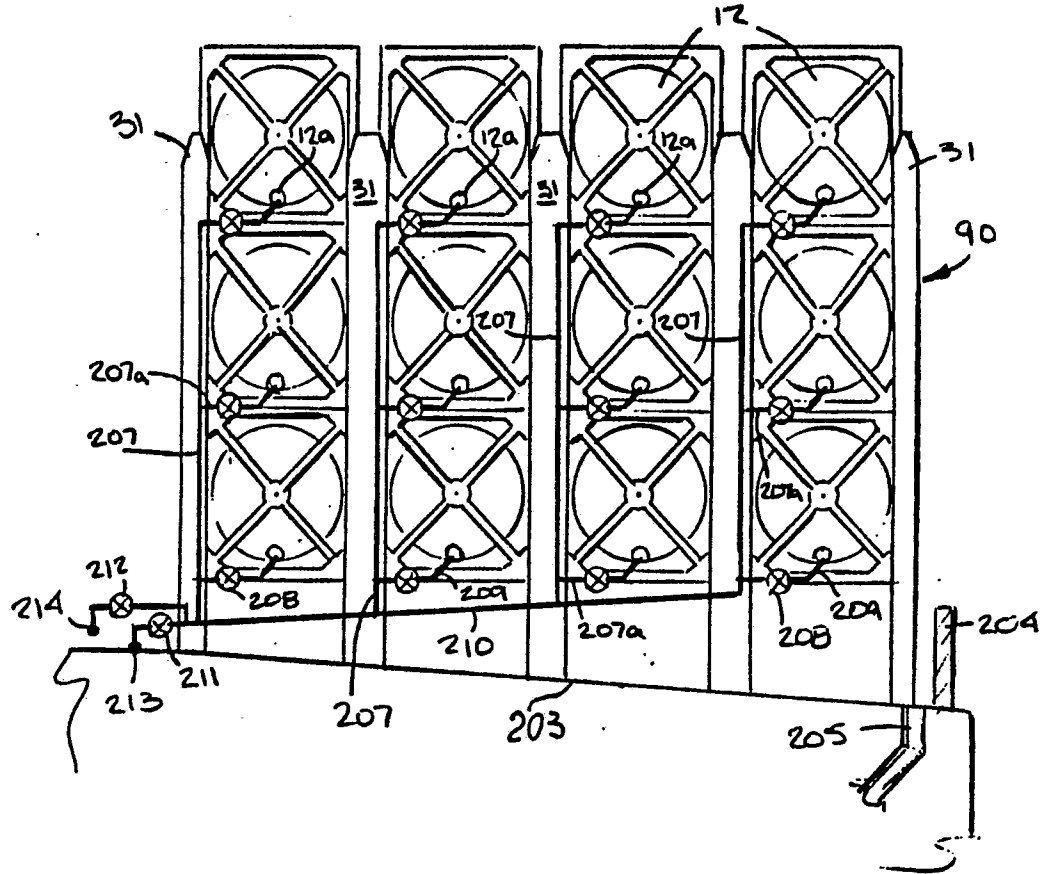
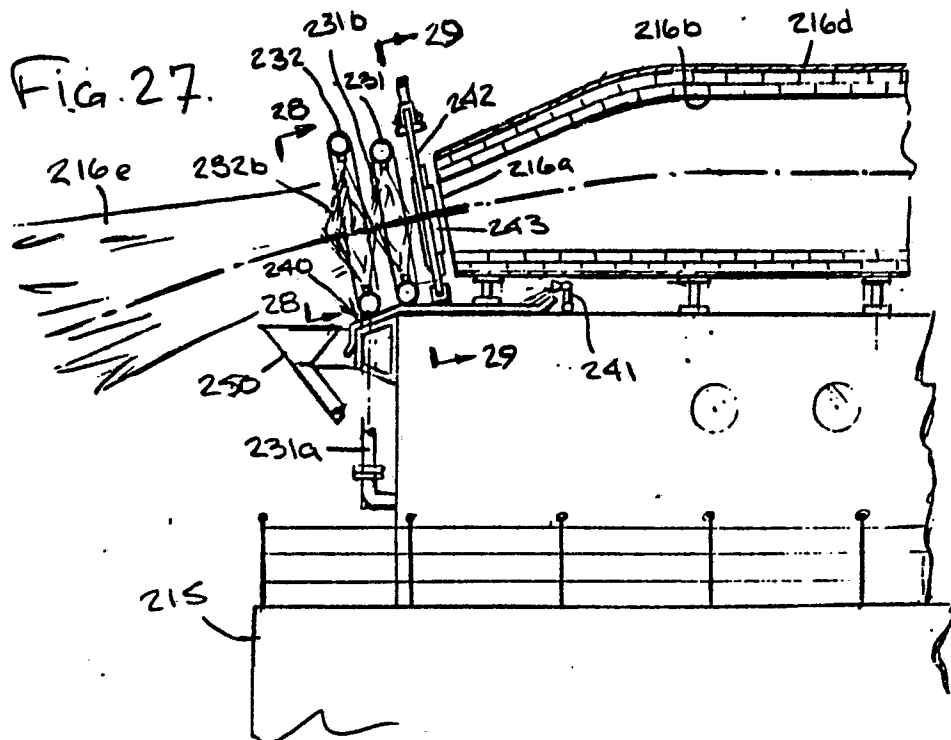


Fig. 27.





European Patent  
Office

# EUROPEAN SEARCH REPORT

0193628

Application number

EP 85 10 2388

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE-A-2 128 376 (RUHNKE)  * Pages 23-25; figures 28-41 *	1,2,6, 7,10, 22	B 63 B 35/44 F 23 G 7/00
A	DE-A-3 325 078 (KREYENBERG)		
A	US-A-2 442 686 (GUERCHOUX)		
A	GB-A-2 018 963 (GROSS)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 63 B B 63 J F 23 G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12-11-1985	Examiner BRUMER A.M.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons  & : member of the same patent family, corresponding document	