United States Patent

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[54] **CONTAINERIZED TRANSPORT DEVICE**
11 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **180/130,** 180/117, 180/119
[51] **Int. Cl.** **B60v 1/00**
[50] **Field of Search** ..... 180/115-—130

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ABSTRACT: This invention relates to a containerized transport apparatus comprising a ground effect vehicle as a carrier, adapted for travel a slight distance above a land or water surface on a supporting air cushion. The vehicle is constructed to provide an internal cavity for receiving one or more cargo holding containers. The latter are removably positioned within the cavity to form a base for the supporting air cushion when the vehicle is elevated by a peripheral air jet system. Removal of the container thereafter permits the ground effect vehicle to operate in a similar manner utilizing at least a portion of the internal cavity as a plenum chamber for confining the supporting air cushion.

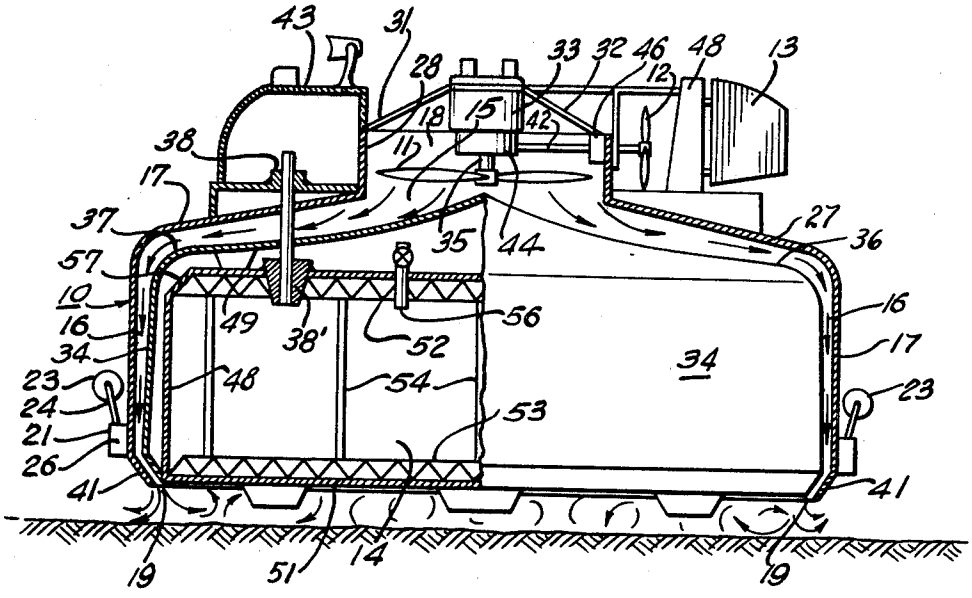
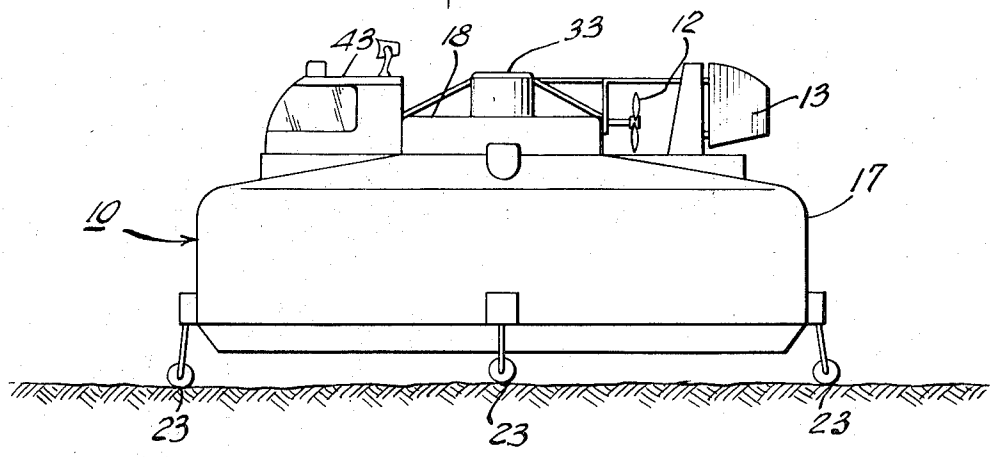


Fig. 1.


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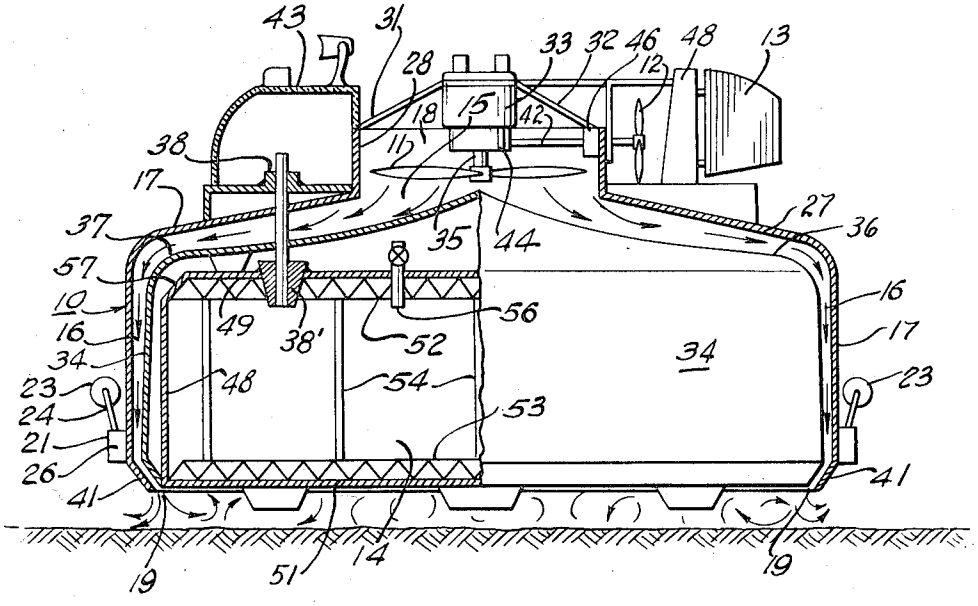

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Fig. 2.

Fig. 3.

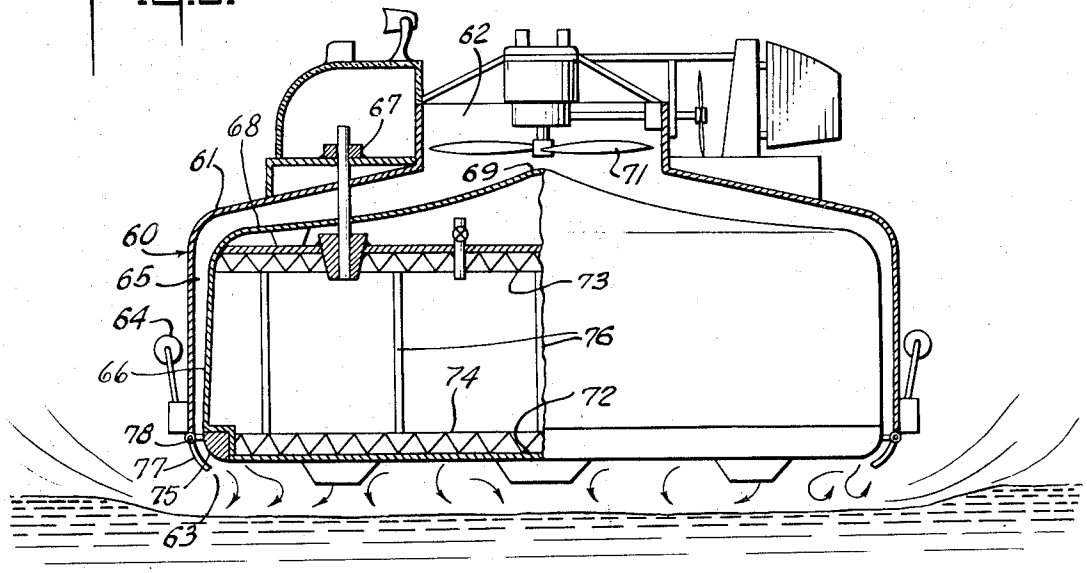


Fig. 4.

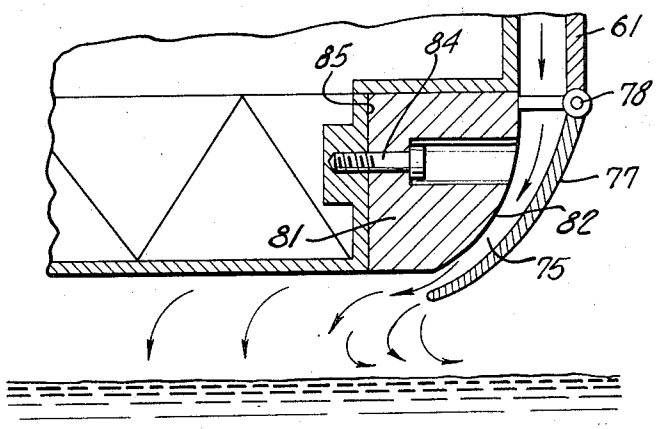
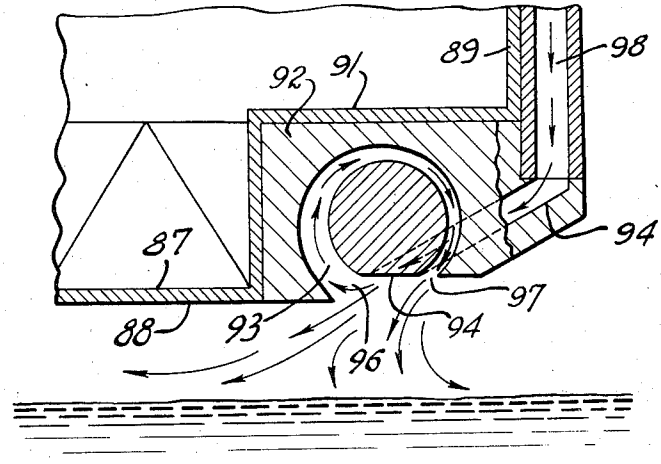


Fig. 5.



CONTAINERIZED TRANSPORT DEVICE

BACKGROUND OF THE INVENTION

The transportation and storage of offshore produced fluids, particularly crude oil, is normally through the facility of pipelines, tankers or individual drums. In the instance of the essential storage of crude, or even refined liquid products, the problem is accentuated to a large scale when the oil bearing well or field is positioned a sufficient distance offshore to be remote from a convenient terminal or refinery. A pipeline connecting such an offshore location with a shore based refinery lacks economic feasibility for smaller quantities of produced oil. It therefore becomes a matter of great expense to hold the oil until such time as it is either by tanker, barge or the like.

Storage of the well production of an offshore field constitutes not only an economic problem but also a serious safety factor. Specifically, because of the flammability of liquid as well as gaseous products, the stored material promotes an increasingly dangerous situation in proportion to the volume of material held.

As in most operations embodying transfer of a liquid or fluid product from a floating vessel to shore, there is often a considerable time requirement necessitated to achieve the unloading. Further, the time is not always invested in actual transfer of the product between points, but rather in the idle period during which the vessel stands-by prior to being unloaded.

The subsequent discussion of the novel apparatus is applicable, as will be appreciated, for storage and transport of numerous species of liquids in that the basic problems are closely related to the storage and transport of petroleum products. For expediency, the discussion will nonetheless be limited to the various facets of the invention as utilized in the storage and transport of crude oil produced at an offshore field or well, and subsequently transferred to a shore based refinery.

It is therefore one of the objects of the invention to provide a transport device for the rapid, efficient storage and movement of oil from an offshore storage area to a land based or remote terminal. Another object is to provide an airborne carrier vehicle adapted for movement across a liquid or solid surface and capable of detachably holding at least one cargo container. A still further object is to provide a transportable storage tank for holding liquid oil, said container being adapted to cooperatively and removably engage a ground effect craft to transfer the tank between storage and refining area.

In achieving the stated objectives, and toward overcoming other problems peculiar to the storage and transportation of crude oil, the present invention provides an effective system and apparatus whereby quantities of oil are stored as well as transferred from an offshore location to another offshore or land based terminal. The transport apparatus includes a ground effect vehicle characterized by a ducted fan which is powered by a suitable source such as an internal combustion, or turbine type engine. The vehicle is further characterized by an elongated upstanding housing having the fan at the upper end positioned in an air inlet duct. The lower end of the housing defines an opening, formed by a peripheral lip which may comprise a series of nozzles or constricted discharge openings. An induced high velocity air stream is directed from the inlet duct to the discharge opening by way of a vertical well at the vehicle outer edge.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. 1 is a side elevation view of a ground effect vehicle as seen in flight, and as presently contemplated in the hereafter described specification and claims. FIG. 2 is a partial cross-sectional view of the apparatus shown in FIG. 1. FIG. 3 is a side view in cross section of an alternate embodiment of the apparatus shown in FIG. 1. FIG. 4 is a segmentary view on an enlarged scale and in cross section of a portion of the alternate embodiment of the apparatus shown in FIG. 3, and FIG. 5 is an alternate construction of the apparatus shown in FIG. 4.

In the basic operation of most ground effect vehicles, the craft itself is raised a few inches to a few feet above the ground or water. Thereafter, the craft is controllably propelled in a horizontal direction over a relatively level although not necessarily flat surface. The lifting effect is achieved by forming within the circle of peripheral jets, a dynamic supporting air cushion beneath the vessel to maintain the latter elevation regardless of the traversed topography.

In principle, operation of the vehicle's ducted fan creates a relatively high velocity flow of air. The latter is in turn directed to the discharge nozzles located at the craft's lower edge. The nozzles are directed generally inwardly and downwardly from the vehicle outer side in achieving the dual purposes of forming the supporting air cushion and replenishing leaked air.

Referring to FIGS. 1 and 2, an exemplary embodiment of the transport apparatus includes a ground effect vehicle **10** horizontally buoyed on an air cushion, and powered by a four bladed fan **11** at the vehicle's upper side. Means for propelling the vehicle laterally includes a power driven propeller **12** mounted adjacent a vertical stabilizer fan **13** for controllably guiding the vehicle across a terrain when in the elevated position.

An elongated central cavity within the vehicle is occupied by a container **14**, the latter having a lower surface disposed adjacent to the vehicle's lower edge. A forced air stream generated by fan **11** is directed through an annular, vertical air well **16** to where it is discharged in high velocity streams at the underside of container **14** to thereby create and sustain the air cushion.

Referring to FIG. 2, ground effect vehicle **10** comprises primarily a housing **17** disposed in a generally upright position and formed with the central longitudinal cavity **15**. The latter includes an air inlet duct **18** at the upper end, and a discharge opening **19** at the lower end. Housing **17** is characterized by a generally smooth inner wall adapted to form a passage to direct the air stream with minimum resistance, and may be formed of relatively thin sheet metal. However, a strength providing structural unit or chassis not specifically shown, is formed of rigid members and provides a frame upon which housing **17**, together with the other components making up the vehicle assembly are supported.

The outer surface of housing **17** carries a circular ring, or circularly spaced pads from which a plurality of support members depend. Each support member is comprised of an inflatable cushion or wheel **23**, carried at the lower end of an arm **24** for supporting the vehicle in an elevated position above ground level, when not supported during flight. Wheels **23** are retractable, or pivotally hinged by arm **24** within the wheel housing **26**, to be pivoted as into a withdrawn position against housing **17** external wall.

The upper surface of housing **17** comprises a generally dish shaped panel **27** connected at its edge to the vertical wall, and its center, to ring **28**. The latter defines a rigid opening forming the air duct or inlet **18**. A superstructure including arms **31** and **32** support the vehicle power plant **33** together with the ducted fan **11**, within the periphery of ring **28**.

A casing **34** fixedly carried within housing cavity **15** includes an upper curved wall **36** connected to a generally cylindrical outer wall **37**. The external contour of the upper and outer walls **36** and **37** respectively is such that when properly positioned within housing cavity **15**, defines the annular air well **16** which communicates the air inlet opening **18** with the discharge opening **19**. Casing **34** is preferably fabricated of reinforced sheet metal construction and provides in essence a center chamber adapted to removably receive container **14**. One or more coupling members **38** depend from housing **17** and extend downward into the casing **34** center chamber. Each coupling engages a corresponding coupling receptacle **38'** in container **14** for fastening the ground effect vehicle **10** and container **14** into a unitary body.

Vertical air well 16 communicating air inlet duct 18 with discharge opening 19, is so formed as to receive a relatively low pressure stream of air generated by fan 11, and direct said stream outwardly and down for discharge beneath container 14. To provide the necessary high velocity discharge of air, well 16 is preferably contoured to define a decreasing cross-sectional area as the passage progresses from the air inlet 18 to the discharge point.

The lower air discharge opening of vehicle 10 may be comprised of any of several means for forming the necessary high velocity inwardly directed air jets toward the vehicle center to confine the supporting air cushion. As presently shown, the discharge opening is of the jet system type and comprises a plurality of peripherally spaced, and inwardly directed constricted nozzles 41. The latter are manifolded at their upper ends to air well 16, and equispaced about housing 17 lower end to provide a uniformity of air flow and lifting effect.

Nozzles or air discharge openings 41 are preferably flexible in nature to best encounter the conditions under which the ground effect vehicle operates. Specifically, air discharge openings 41 may be incorporated into a continuous skirtlike arrangement from a resilient, durable material such as nylon or the like, and constructed to be readily yieldable. Thus, as the vehicle maneuvers while in flight, and the skirt contacts either the land or water surface, air flow to the supporting cushion will be substantially uninterrupted.

An enclosure carried on the upper deck of housing 17 defines a pilot house or station 43 from which the vehicle is controlled. Power plant 33 supported at the air inlet duct 18 and to the rear of station 43, includes a vertically disposed engine axially aligned with the air duct to position fan 11 at the lower end of the main shaft 35. A geared transmission 44 connects the power plant 33 output drive shaft 35 with fan 11 to controllably regulate the speed of the latter in accordance with the load to be carried by the vehicle. A second or jackshaft 42 coupled to transmission 44, extends from the latter and is journaled in bearing 46 at ring 28. Propeller 12 is carried on jackshaft 42 and disposed within a suitable protected enclosure. Horizontal movement of the vehicle is controlled by the adjustable vertical stabilizer 13 hinged to post 48 and connected by cables to the pilot house.

An exemplary embodiment of container 14 carried within the center chamber of casing 34 includes upstanding cylindrical sidewalls 48 connected to an upper panel 49 at a peripheral welded joint. The sidewalls are similarly connected a their lower edge to a base plate 51 thereby to form a fluid holding chamber.

Container 14 conforms in many respects to a standard liquid container with the additional provision of being adapted for connection with the ground effect vehicle 10, to become an integral part thereof, and for being readily transported. Container 14 thus includes an internal rigidizing framework including upper and lower structural members 52 and 53 together with intermediate connecting columns 54. The container further includes liquid transfer means such as one or more ports 56, manifolding, gauges and the like whereby the liquid flow quantity may be readily regulated.

To be readily accommodated within the central cavity of casing 17, the container 14 peripheral sidewalls include a tapered or concave section 57 at the upper end thereof connecting said sidewalls with top panel 39. The function of the tapered or curved section is to facilitate proper positioning of the container within the casing cavity, as vehicle 10 is lowered onto the container, or, as the container is raised into the vehicle. Thus, as the flexible nozzles 41 at the vehicle lower end engage the container upper end, said nozzles will be outwardly deflected by contact with the curved or tapered surface 57 a sufficient amount to avoid damage to the nozzles. Thereafter, as the container becomes fully seated in its coupled position, nozzles 41 will return to their operating position adjacent to the container base plate 51.

Referring to FIG. 3, an alternate embodiment of the containerized transport apparatus is illustrated. The latter embodiment of the structural characteristics shown in FIG. 2 and including a ground effect vehicle 60 including an external housing 61 being similar in general construction to the housing previously described. Housing 61 normally assumes an upright position and comprises essentially a cylindrical member having an air inlet or duct 62 at the upper end and a discharge opening 63 at the lower end. The inner surface of housing 61 upstanding wall forms one guide surface of an air carrying passage 65 communicating inlet 62 with discharge opening 63. The lower end of housing 61 is further provided with external wheels or inflatable support members 64 adapted to extend and maintain the vehicle in a slightly elevated position when not operating in flight. For convenience support members 64 are retractable to the withdrawn position shown in flight operation.

The elongated central cavity defined by cylindrical housing 61 is occupied by removably positioned container 66. The latter is held and supported within the vehicle by two or more coupling members 67. Container 66 upper wall 68 is contoured and provided with a central raised hub 69 having an apex disposed in axial alignment with fan 71, the latter being supported in air inlet duct 62. The upper wall 68 of container 66 is further contoured along its outer surface and vertical sidewalls to be spaced from the adjacent inner surface of housing 61. Thus, the container 66 and housing 61 adjacent walls are spaced sufficiently apart to define a progressively decreasing cross-sectional air well or passage 65. Said passage 65 conducts the induced air stream from the inlet to one or more high velocity discharge streams at the housing 61 lower end.

Referring to FIGS. 3 and 4, internally, container 66 comprises a reinforcing framework such as upper and lower structural members 73 and 74 which are cross braced by upright columns 76. A base plate 72 carried at the container lower side functions as a foundation against which the air cushion acts to support vehicle 60 and container 61 above the ground during in-flight operation. In forming the one or more lower air discharge openings or nozzles 75, the housing 61 includes a flexible member such as a skirt or series of pivotally mounted panels 77. The latter are hinged at 78 to be pivotally displaceable by actuating means 70 that they may be outwardly displaced to permit insertion of the container 61, and thereafter returned to normal place such that the skirt is disposed immediately adjacent to the container lower end thereby defining the constricted discharge jets 75. Thus, as shown in FIG. 3, with the container rigidly received in the housing cavity, the lower peripheral air discharge opening comprises a plurality of inwardly directed jets 75 which issue high velocity of air streams toward the vehicle undersurface to form the required air cushion. However, with container 66 removed from the vehicle, the lower edge of housing 61 defines a circular opening for discharging air from the central plenum chamber in which the supporting air cushion will be formed by the action of the ducted fan 71.

The ability of the ground effect vehicle 60 to operate on either a jet discharge system or the central plenum system for holding the air cushion, permits a greater degree of efficiency in operation since each system is adapted for a particular condition. Further, the character of the ground effect vehicle is such that no adjustment is required for operation under either category, either by the jet or the plenum chamber system.

Referring again to FIGS. 3 and 4, to permit operation of the vehicle for using either jets, or the central plenum chamber, removable container 66 is adapted at the lower end to cooperate with the housing 61 lower end. Container 66 is thus provided with an encircling ring 81 carried on the container lower end in an annular recessed seat 85. The ring 81 may be formed of separate, rigid segments having a relatively smooth arcuate surface 82 which is disposed adjacent to the inner surface of skirt 77 thereby to form the constricted air passage or passages 75. Individual arcuate segments of ring 81 are removably fastened to the container lower surface by a suitable fastening device such as bolts 84 or the like.

Alternately, an embodiment of jet forming container ring 81 rather than being of a rigid construction, assumes the configu-

ration of an inflatable, toruslike member. Said member is likewise similarly fastened into the container peripheral seat 85 outer surface. The encircling inflatable member is thus deflated while tank 61 is being filled or not in use, and subsequently inflated with air at such time as removal of the tank is required. Thus when inflated the external surface of the inflatable ring is disposed contiguous with the adjacent housing skirt thereby to form the plurality of jet discharge openings.

To enhance the operation of the ground effect vehicle when using the peripheral jet system, a supplementary air system may be provided for circulating at least part of the air initially directed into the air cushion. In this embodiment, as shown in FIG. 5, container 87 includes a lower base plate 88 which is connected to a sidewall 89 by an annular recessed section 91. The latter is adapted to receive an insertable ring 92 formed of a plurality of discrete sections cooperatively arranged to define the encircling member about container 87 lower end. Segments 92 are individually grooved and gasketed at adjacent lateral mating surfaces to define a plurality of recirculation channels 93, as well as main jets 94.

Recirculation channels 93, include a relatively large mouth 96 disposed at the container underside. The channel mouth 96 is adapted to receive at least a portion of the air stream discharged to the air cushion by the main jet 94. Air so received in channel 93 is recirculated through the gradually constricted passage and subsequently discharged through supplementary jet 97. The latter discharge is positioned to the outer side of the discharging main air stream from jet 94 thereby reinforcing the formation of the internal air cushion.

In the instance of recirculation arrangement, the cooperating ground effect vehicle is adapted at the lower end to engage container 87 and direct a stream of air through vertical well 98 and into the mouth of main jet 94 disposed within the respective segmental sections.

Other modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. The combination in a containerized transport apparatus including:

a ground effect vehicle having a housing with opposed upper and lower ends and being disposed in a generally upright position to form a central cavity;

means forming an air discharge port at the lowermost of said housing ends, and an air inlet duct at the opposed upper end;

a fan drivingly connected to a source of power and carried in said air inlet duct to provide a forced air stream;

passage means communicating said air inlet duct to said discharge port for directing said forced air stream to the latter;

a fluid holding container removably received in said housing central cavity and including;

upstanding sidewalls connected at the lower edge thereof to a base plate, said base plate being positioned adjacent to said housing discharge port and defining a substantial closure across said cavity; and

whereby said forced air stream directed from said air discharge port at a high velocity will establish and maintain a supporting air cushion beneath said container base plate to sustain said transport apparatus above ground level.

2. In the combination as defined in claim 1 wherein said ground effect vehicle includes coupling means adapted to engage a corresponding coupling member on said container for retaining the latter in said cavity.

3. In the combination as defined in claim 1 wherein said container includes a structural member connected to and extending across said base plate for bracing the same.

4. In the combination as defined in claim 1 wherein said ground effect vehicle includes a skirt carried at the lower periphery of said housing having spaced apart air discharge openings therein, said skirt being outwardly displaceable from a normal operating position to permit entry of said container into said central cavity.

5. In the combination as defined in claim 1 wherein said means forming a discharge port includes a plurality of downwardly directed nozzles spaced about the housing periphery.

6. A containerized transport apparatus including:

a. a ground effect vehicle having a housing with an inner wall forming a longitudinal cavity therethrough a peripheral lip at the lower end of said longitudinal cavity, and an air inlet duct at the upper end thereof;

b. a fan drivingly connected to a power source being positioned in said air inlet duct whereby to form a forced air stream; and

c. a container removably held in said housing cavity including an external side panel connected to a base plate, said external side panel being spaced from said housing in a wall to define an annular well communicating said inlet duct with the cavity lower end, said container panel being cooperatively spaced from said housing peripheral lip to define therewith a constricted nozzle in the cavity lower end whereby said air stream is conducted from said air inlet duct by said annular well for discharge from said peripheral nozzle in a generally inwardly direction thereby to impinge said container base and form an air cushion beneath the latter to elevate said transport device above ground level.

7. In a containerized transport apparatus as defined in claim 6 wherein said container lower edge includes a curved outer nozzle surface spaced from said peripheral lip to form an inwardly directed constricted nozzle.

8. In the apparatus as defined in claim 6 wherein said container includes a ring removably carried at the side panel lower edge thereby to define said nozzle surface.

9. In the apparatus as defined in claim 7 wherein said ring includes a plurality of circularly arranged segments fastened to said side panel.

10. In the apparatus as defined in claim 7 wherein said ring includes an inflatable member removably carried on said container side panel and being adapted to an inflated condition for defining said nozzle surface.

11. In the apparatus as defined in claim 9 wherein said ring member includes a plurality of air recirculation jets having an inlet disposed at the container underside to receive a stream of air from said peripheral nozzle and for redirecting said received air in a downward direction.