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APPLICATION FOR REPUBLIC OF SINGAPORE LETTERS PATENT

FOR

**APPARATUS AND METHOD OF TRANSPORTING HYDROCARBON  
PRODUCTS**

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## **APPARATUS AND METHOD FOR TRANSPORTING HYDROCARBON PRODUCTS**

### **FIELD OF THE INVENTION**

5 The present invention relates to apparatus and method of storing, transporting and delivering nongaseous substances. In particular, the present invention pertains to apparatus and method of storing, transporting and delivering nongaseous hydrocarbon products such as bitumen or asphalt efficiently, safely, and economically.

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### **BACKGROUND OF THE INVENTION**

Reinforced enclosure such as a container is known to be one of the most effective means of transporting and delivering cargoes. Not only is it economical to produce as the fabrication of container is standardised, but it is also well accepted in intermodal (sea and land) transportation. Containers are also constructed to absorb accidental impacts. Above all, containers are stackable thus rendering it efficient and cost effective to move large volume of cargo within the same vertical space.

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With respect to nongaseous cargo such as gasoline, bitumen and others, safety and transportation regulations however prohibit the transportation of such substances in parallelepipedical enclosure. The rationale is straight forward: vehicles or crafts transporting liquid substances in container and in bulk run the risk of turnover. As such, the transportation of nongaseous cargo cannot take full advantage of efficiency and space saving features of container.

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By nongaseous substances the present invention refers to a class of products or solutions which have melting points above ambient temperature. In general, such nongaseous substances are prepared or produced at temperatures above ambient temperature. Nongaseous substances such as bitumen change phase from liquid to solid when their temperature approaches ambient temperature. Conversely nongaseous substances change phase from solid to liquid when their temperature is raised from ambient to their melting points. Nongaseous substances are used interchangeably with nongaseous products in the present invention.

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Traditionally nongaseous substances such as bitumen or asphalt are transported either in drums and/or ISO tanks. An ISO tank is a pressure vessel having a cylindrical shape and multiple heating tubes disposed within its interior and lengthwise for reheating the hydrocarbon products stored therein. While drums are uneconomical, non-recyclable and wasteful, smelter or furnace is required on site to reheat the solidified bitumen therein. ISO tanks on the other hand are costly and difficult to maintain. The cost associated with ISO tanks is directly proportionate to the periodic inspection and testing for certification of pressure vessels.

20 Maintenance of the heating tubes within and insulation over the ISO tank are also major issues.

Recently European Patent No. 0471826 teaches the use of container having a heater and a meandering tube passage underneath the floor section for reheating bitumen stored within the space between the side, end, top and floor walls. The reheatable container is considered an improvement over a drum and an ISO tank because it can transport and deliver bitumen in bulk without having to undergo periodic inspection and

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testing for certification. However, the prohibition of transporting liquid substance in parallelepipedical enclosure such as container applies. It follows that the reheatable container in European Patent No. 0471826 must wait until the bitumen solidifies before it can be transported. It takes on the  
5 average two full days before bitumen in a container changes phase from liquid to solid. The foreseeable temporary storage requirement and expenses render this type of reheatable container impractical and uneconomical. Furthermore, the energy consumption in reheating solidified bitumen in the container of European Patent No. 0471826 is higher than  
10 that of the present invention.

## OBJECT OF THE INVENTION

It is an object of the present invention to store, transport and deliver nongaseous hydrocarbon products efficiently, safely and economically.

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It is an object of the present invention to transport nongaseous hydrocarbon products in enclosures as soon as such products are loaded and without waiting for such products to solidify.

10 It is a further object of the present invention to incorporate the advantages of reinforced enclosures without the disadvantages of prior art means of storing, transporting and delivering nongaseous hydrocarbon products efficiently, safely and economically.

## 15 SUMMARY OF THE INVENTION

The present invention is a tank disposed within a container for storing, transporting and delivering nongaseous hydrocarbon products such as bitumen efficiently, safely and economically. At least one heater is located  
20 at the bottom section of the container for raising and/or maintaining the temperature within the container and around the tank. An inlet is provided for loading liquidified hydrocarbon products into the tank, and an outlet is provided at the bottom of the tank and through the container for unloading the hydrocarbon products. The present invention permits nongaseous  
25 hydrocarbon products to be transported in bulk as soon as they are loaded and without waiting for such products to solidify. The preexisting insulation of the container combined with the trapped air in the container and the hull of the tank provides additional insulation for the present invention. As a

result, reheating of nongaseous products is obviated as heat loss is minimal. At the same time, temperature on the surface of the loaded container is at ambient temperature, thus making it suitable for existing mode of transporting containers. It follows that the present invention is not  
5 only safe but achieves energy efficiency and cost savings not possible under prior art apparatus and methods.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a right side, elevational, perspective view of the preferred embodiment of the present invention.

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Fig. 2 is a right side, elevational, partial cutaway, perspective view of the preferred embodiment of the present invention where the tank for storing fluids is shown partially.

10 Fig. 3 is a front, elevational, cross sectional view of the preferred embodiment of the present invention according to Fig. 1 and where the mouth of the fluid outlet and support of the tank for storing fluids are highlighted.

15 Fig. 4 is a side, elevational perspective view of the preferred embodiment of the present invention according to A-A in Fig. 3 where the duct for connecting to the heater is shown.

20 Fig. 5 is a side, elevational perspective view of the preferred embodiment of the present invention according to B-B in Fig. 4 where the temperature sensors and the fluid outlet are shown.

Fig. 6 is a rear, elevational perspective view of the preferred embodiment of the present invention showing the chimney.

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## DESCRIPTION OF THE EMBODIMENT OF THE INVENTION

Fig. 1 is a right side, elevational, perspective view of the preferred embodiment of the present invention 1. The enclosure 5 has an outward appearance and dimensions substantially similar to one of a specification container. It comprises side walls 10, end walls 12, top wall 14 and base frame 15. Essentially, the walls constitute a parallelepipedical enclosure suitable for transporting cargo in an intermodal (land and sea) manner. With the exception of a pair of doors, heaters 16, inlet 22, inlet cover 24, and outlet 26, the enclosure is identical to that of a specification container. The rationale is straight forward: the present invention incorporates the advantages of the container in storing, transporting and delivering nongaseous cargo.

However, the similarity with prior art container ends with the outward appearance in Fig. 1. Fig. 2 is a right side, elevational, partial cutaway, perspective view of the preferred embodiment of the present invention where the tank for storing fluids is shown partially. A tank 20 is disposed within the interior of the enclosure 5 for receiving, storing and transporting nongaseous hydrocarbon cargo such as liquidified bitumen as soon as the contents are loaded. The tank 20 is supported within the container with a plurality of tank supports 21 and further having the inlet 21, inlet cover 24 and outlet 26. As mentioned briefly in above, safety and transportation prohibits the transportation of any liquid with parallelepipedical enclosure such as a container unless the cargo is solidified. The enclosure 5 incorporating the tank 20 of the present invention addresses the safety issue raised by the prohibition against transporting fluids or liquids in a parallelepipedical enclosure. The tank 20 comprises a cylindrical hull which

is substantially similar to tanks used in transporting liquids such as gasoline. By incorporating the tank 20 into the enclosure, the present invention does not run the risk of turnover even if the contents within the tanks does not solidify. It follows, for instance, one may move the enclosure  
5 1 loaded with bitumen from the refinery without waiting for the contents to solidify. This obviates any storage requirement and expenses on the premises of the refinery or any other intermediate location.

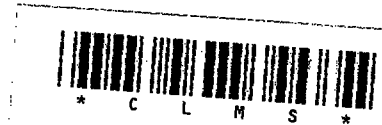
Some of the other advantages of the present invention are illustrated in Fig.  
10 3 where a front, elevational, cross sectional view of the enclosure of the present invention is shown. Here, side walls 10, top wall 14 and base frame 15 are shown enclosing the tank 20. Together with end walls 12 (not shown in Fig. 3) and the insulation 28 between the outer and inner metal sheets, a first layer of thermal insulation is provided for the contents of the  
15 tank 20. As the tank is also fully enclosed within the interior of the enclosure 5, the air between the walls and the hull of the tank provides a second layer of thermal insulation. Finally, the hull of the tank 20 provides yet another layer of thermal insulation. It follows from the construction of the tank 20 within the enclosure 5, temperature of the contents within the tank  
20 can be maintained for a significant length of time. For instance, a tank fully loaded with liquidified bitumen (temperature 160 °C initially) from the refinery using the enclosure of the present invention loses only about 30 °C in two full days. At the same time, the temperature of the outer surfaces of the enclosure 5 remains at ambient temperature. It is clear that the present  
25 invention enables one to deliver nongaseous hydrocarbon products such as bitumen to destinations within short radius from production facility such as a refinery without reheating the cargo. Furthermore, the nongaseous cargo such as bitumen can be used as soon as it arrives on the work site

even without reheating. This is an improvement over prior art bitumen containers which are required to sit idle for at least two days so that the bitumen can solidify before containers can be transported. More importantly, the present invention provides a very cost effective and safe  
5 means of storing, transporting and delivering nongaseous hydrocarbon products.

For work site further away from the production facility, the present invention also provides at least one heater 16 in or near the bottom section of the  
10 enclosure for reheating the cargo within the tank 20 as shown in Figs. 1, 4 and 5 respectively. Referring again to Fig. 1, a pair of heater 16 are disposed at the bottom section of the end wall 12 for raising the temperature within the enclosure 5. Optionally, a plurality of temperature probes 30 are also disposed on any of the walls for verifying the temperature within the  
15 tank 20. See Fig. 5. The heater 16 communicates with a heating tube or duct 23 which directs the flame and heated exhaust towards the bottom of the tank 20. Although the heating tube 23 is shown in Fig. 4 as having a short section, it can run the entire length of the enclosure 5. To facilitate the reheating of the contents in tank 20, the supports 21 as shown in Figs 2 and  
20 3 hve preferably openings 25 for improving the circulation of air therethrough. As the heater 16 is activated, the air between the base frame 15 and the bottom of the tank 20 is initially heated. The hot air then rises along the hulk of the tank before it reaches the top. Thereafter, the colder air at the top is mingled with the hotter air from the bottom. A chimney 18 is  
25 also provided in the end wall 13 for discharging air from within the enclosure 5. Eventually, the temperature within the tank is raised above the melting point of the nongaseous cargo. It has been shown that the present

invention consumes only 6 - 8 litres of diesel fuel to reheat one metric ton of solidified bitumen in the tank.

While the present invention has been described particularly with reference to FIGS. 1 to 6 with emphasis on an apparatus and method for transporting  
5 downstream hydrocarbon products, it should be understood that the figures are for illustration only and should not be taken as a limitation on the invention. In addition, it is clear that the method and apparatus of the present invention has utility in many applications where transportation and delivery of bulk hydrocarbon products is required. It is contemplated that many changes  
10 and modifications may be made by one of ordinary skill in the art without departing from the spirit and the scope of the invention as described.



## CLAIMS

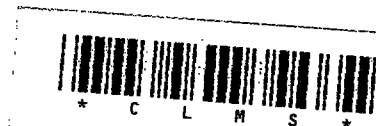
1           1.     An apparatus for storing, transporting and delivering  
2 nongaseous substances , said apparatus comprising:  
3           a parallelepipedic enclosure; and  
4           a tank disposed within the interior space of said enclosure for storing  
5 nongaseous substances, said tank having at least one inlet for receiving  
6 nongaseous substances therein, said tank further having at least one outlet  
7 for discharging nongaseous substances therefrom,

8           whereby nongaseous substances stored within said apparatus are  
9 adapted for transportation as soon as said substances are loaded therein.

1           2.     An apparatus as in claim 1 wherein said parallelepipedic  
2 enclosure is insulated.

1           3.     An apparatus as in claim 1 wherein said tank has a space  
2 between the exterior surfaces of hull and the interior surfaces of said  
3 enclosure so as to provide additional insulation for said apparatus.

1           4.     An apparatus for storing, transporting and delivering  
2 nongaseous substances , said apparatus comprising:  
3           a parallelepipedic enclosure;  
4           a tank disposed within the interior space of said enclosure for storing  
5 nongaseous substances, said tank having at least one inlet for receiving  
6 nongaseous substances therein, said tank further having at least one outlet  
7 for discharging nongaseous substances therefrom; and  
8           at least one heater disposed at the bottom section of said enclosure  
9 for raising the temperature of the air within the space between the interior  
10 surface of said enclosure and the exterior surface of the hull of said tank;  
11           whereby nongaseous substances stored within said apparatus are  
12 adapted for transportation as soon as said substances are loaded therein.



1           5.     An apparatus as in claim 4 wherein said parallelepipedic  
2 enclosure is insulated.

1           6.     An apparatus as in claim 4 wherein said parallelepipedic  
2 enclosure has at least one chimney for discharging air from within said  
3 enclosure.

1           7.     An apparatus as in claim 4 wherein said tank has a space  
2 between the exterior surfaces of hull and the interior surfaces of said  
3 enclosure so as to provide additional insulation for said apparatus.

1           8.     An apparatus as in claim 4 wherein said tank is supported  
2 within said enclosure with a plurality of supports, said supporting having a  
3 plurality of opening for enhancing the circulation of air within said  
4 enclosure.

1           9.     An apparatus as in claim 4 wherein said heater communicates  
2 with at least one duct in the bottom section of said enclosure for enhancing  
3 the heat transfer of heated air within said enclosure.

1           10.    A method for storing, transporting and delivering nongaseous  
2 substances, said method comprising the steps of:

3           insulating a parallelepipedic enclosure; and

4           disposing a tank within the interior space of said enclosure for storing  
5 nongaseous substances, said tank having at least one inlet for receiving  
6 nongaseous substances therein, said tank further having at least one outlet  
7 for discharging nongaseous substances therefrom,

8           whereby nongaseous substances stored within said apparatus are  
9 adapted for transportation as soon as said substances are loaded therein.