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(54) Title: HYDROVAC TANK

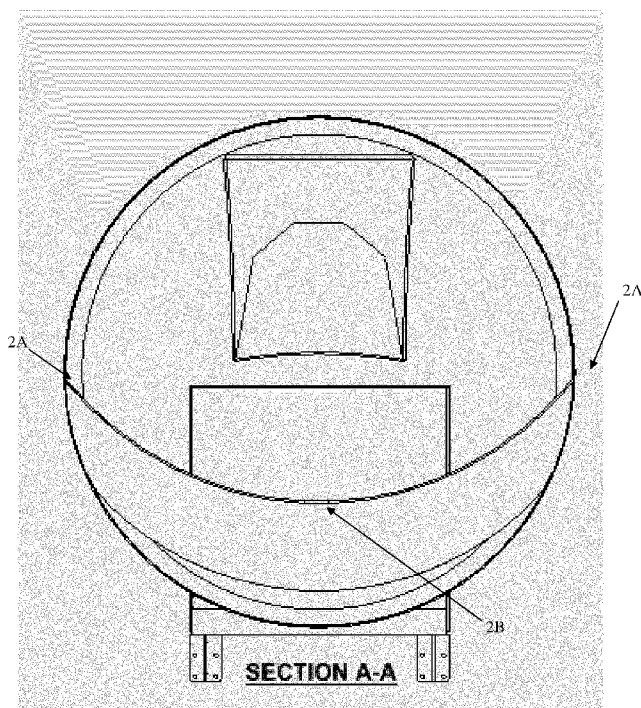


FIG. 3

(57) Abstract: The present invention provides a curved floor barrier design for integration into a hydrovac tank which provides for the separation of the tank into a material storage portion and a water storage portion.





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Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

HYDROVAC TANK

FIELD OF THE INVENTION

[0001] The present invention pertains to the field of hydrovac systems and in particular to a hydrovac tank.

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BACKGROUND

[0002] Hydro-Excavation is a process where high pressure water is used to loosen soil, rocks, clay, gravel and other earth material while it is continually “sucked up” into a debris tank for later disposal.

[0003] As early as 1960 catch basin cleaners were adapted for hydro-excavation but the technology was crude. Many advancements in the technology for hydro-excavation were adapted and refined from industrial scale projects in the oil and gas sector. Because of the cold climate and difficult working conditions “daylighting” buried lines with high pressure hot water and removing the debris by suction was proving an indispensable tool in the field. In the decades of 70’s and 80’s, modified vacuum trucks and sewer cleaners were adapted for use as suction excavators and by the 90’s there was a commercial demand for hydro-excavation machines for industrial, municipal and commercial use. The increasing demand for non-destructive digging and necessary improvements in the field of worker safety are at least some of the driving forces behind the growth of the vacuum excavation sector.

[0004] A typical hydrovac system includes a vacuum source, a debris storage unit and a water storage unit, wherein the vacuum source is interconnected to the debris storage unit. Some hydrovac systems further include filtration systems, for example a cyclone filter which can be used to remove debris from the air travelling with the vacuumed material into the debris storage tank prior to reentry of this air into the vacuum source. In some instances a hydrovac system further includes a water heater which can be necessary for colder applications.

[0005] In a hydrovac equipment context, soil and aggregates are loaded into a storage tank in order to be moved to another location, while a second tank stores water which is

used to cut into the ground. Plural hydrovac systems include separate water and debris storage units which are manufactured as separate entities and mounted onto a vehicle. Other hydrovac systems include a tank device which has been divided into two compartments, wherein in a first compartment water can be stored for use at the excavation location and a second compartment can be used for deposition of the debris upon vacuuming from the excavation location. This configuration of tank is typically referred to as a dual function tank.

[0006] These dual function tanks include a divider wall and/or floor which forms a barrier separating the debris storage from the clean water supply. It is common for these barriers to include a sloped floor section to aid in removal of the debris from the tank. A sloped floor configuration can be used as an alternative to more expensive dumping methods which can include tipping the tank and/or pushing the debris out with a sweep. The separating barrier is typically made with flat sheet metal with adequate reinforcement to withstand the vacuum pressure and debris impact during operation of the hydrovac system. The metal used to reinforce these barriers can clutter the inside of the tank, thus increasing the weight, complexity and cost to fabricate the tank.

[0007] Therefore there is a need for a new hydrovac tank design that overcomes one or more of the problems in the prior art.

[0008] This background information is provided to reveal information believed by the applicant to be of possible relevance to the present invention. No admission is necessarily intended, nor should be construed, that any of the preceding information constitutes prior art against the present invention.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide a hydrovac tank. In accordance with an aspect of the present invention, there is provided hydrovac device comprising a tank having an interior and a curved floor barrier positioned within the tank. The curved floor barrier is configured to divide the tank into a first storage portion and a second storage portion, wherein the curved floor barrier is connected to the interior of the tank and configured to sealingly separate the first storage portion and the second storage portion. The tank further includes an aperture within each of the first storage portion and the second storage portion.

BRIEF DESCRIPTION OF THE FIGURES

[0010] FIG. 1 illustrates a side view of a hydrovac tank in accordance with embodiments of the present invention.

[0011] FIG. 2 illustrates a hydrovac tank according to embodiments of the present invention, mounted on a truck.

[0012] FIG. 3 illustrates a cross sectional view of the hydrovac tank of FIG. 1 taken along Section A-A.

DETAILED DESCRIPTION OF THE INVENTION

[0013] It is noted that there are several deficiencies with dual function tanks used in a hydrovac system. These dual function tanks typically include a divider wall and/or floor which forms a barrier separating the debris storage compartment from the clean water supply compartment. It is known that these separating barriers are typically made with flat sheet metal with adequate reinforcement and structural components to withstand the vacuum pressure generated in the debris storage compartment as well as the impact of debris upon entry into debris storage compartment. It has been appreciated that the structural components used to reinforce these separating barriers can clutter the inside of the tank, increasing the weight, complexity and cost of fabrication of the tank. Moreover, with the additional material located within the tank to provide the required structural integrity of the separating barrier, it is appreciated that there is a reduction in the capacity of the tank, for example a reduction in either one or both of the volume of water and the volume of debris that the tank is capable of holding.

[0014] Accordingly, a new separating barrier configuration is desired that both provides the necessary structural integrity to the separating barrier during operating conditions of the hydrovac system and further provides a substantially minimal reduction in the overall capacity of the tank upon installation.

[0015] The present invention provides a new floor barrier design for integration into a hydrovac tank which provides for the separation of the tank into a material storage portion and a water storage portion. The floor barrier has a curved floor profile which is anchored to the sides of the tank thereby attempting to substantially eliminate structural reinforcement for supporting the floor barrier. In some embodiments, the curved floor

profile is further configured to be sloped such that the floor barrier is at substantially its lowest point proximate to the material exit from the tank. The use of a sloped floor barrier can further enhance the ease of material removal.

[0016] According to embodiments of the present invention, the curved floor is aligned
5 along the central axis of the tank. By curving the floor, the stresses induced by depressurization of the tank during material loading and the impact of the material on the floor during loading can be substantially evenly distributed through the floor to the wall structure of the tank. Due to this distribution of the stresses in the floor barrier during depressurization and impact loading, an auxiliary structural support system is not
10 required to support the floor barrier, thereby providing a significant weight reduction. Moreover, the reduction of material for fabrication of the tank and floor barrier can further provide cost savings. In addition due to the reduction of the material required to be placed in the tank for structural integrity of the floor barrier, the tank is capable of hold more material and/or water when compared to a similar tank with a flat floor
15 barrier and structural reinforcement.

[0017] In some embodiments, the curved floor barrier is concave in geometry and provides the steepest slopes adjacent to the tank walls and substantially parallel to the centre line of the tank. The steep slope adjacent to the tank walls can aid in dumping and cleaning of the material from the debris tank portion as this steep slope tends to
20 direct the material towards the center line of the of the tank. Furthermore, the steep slope adjacent to the tank wall can reduce the likely hood of the material getting hung up or stuck on the side of the tank.

[0018] FIG. 1 illustrates a side view of a hydrovac tank in accordance with embodiments of the present invention. The hydrovac tank **1** includes a turret mount **4**,
25 which defines an opening in the tank through which material can be loaded into the material storage portion **6** of the hydrovac tank. A boom and hose can be attached to the turret mount wherein the hose is guided to the desired excavation location by the boom. During operation, a vacuum source will be activated such that the material storage portion is depressurized causing a suction force to be created at the opening of the hose
30 such that material in the proximity of the opening of the hose will be sucked up and subsequently deposited in the material storage portion. The hydrovac tank further includes a dumping door frame **3** to which a door is pivotally and sealingly connected.

The opening defined by the dumping door frame provides a location from which material can be removed from the material storage portion. The hydrovac tank further includes a water storage portion **5** which provides a volume within which water can be stored and used during the vacuuming process. This water can be pressurized by a water pump fluidically connected to the water storage portion and this pressurized water can be directed at a location for material removal by a spray hose or wand or similar device.

[0019] FIG. 2 illustrates a hydrovac tank according to embodiments of the present invention, mounted onto a truck **26**. As illustrated the hydrovac tank **20** is mounted on the truck **28** which provides transportation of the hydrovac system. The truck can further include a vacuum source and may include other components required for operation of the hydrovac system, for example a filtration system and water heater. The hydrovac tank illustrated in FIG. 2 includes a turrent mount **22** to which is connected a boom and hose system **24** through which material can enter the hydrovac tank. The hydrovac tank further includes a dump door **28** through which collected material can be removed from the hydrovac tank. According to other embodiments, a hydrovac system including a hydrovac tank, a vacuum source and optionally a filtration system and / or water heater can be installed on a trailer which can be connected to a truck for transportation of the hydrovac system.

[0020] With further reference to FIG. 1, the water storage portion and the material storage portion of the tank are divided by a floor barrier **2**, wherein this floor barrier is curved in geometry. The upper dashed line in FIG. 1 defines the edge of the curved floor barrier and thus defines the elevation at which the floor barrier is connected to the interior of the tank. The lower dashed line illustrated in FIG. 1 defines the lower elevation of the curved floor barrier and this lower dashed line can be substantially aligned with a longitudinal centre line of the tank.

[0021] FIG. 3 illustrates a cross sectional view of the hydrovac tank of FIG. 1 taken along Section A-A. The upper dashed line illustrated in FIG. 1 defines location **2A** as illustrated in FIG. 3, which is proximate to the side of the tank. The lower dashed line illustrated in FIG. 1 defines location **2B** illustrated in FIG. 3, which is substantially aligned with the centre line along the length of the tank.

[0022] The curved floor barrier is connected to the interior of the tank via welding or other means that would provide a sealed connection between the tank and the floor barrier to be formed. A sealed connection between the floor barrier and the tank is required in order for the material storage portion to be fluidically separated from the water storage portion. This sealed connection can provide for the desired depressurization of the material storage portion during vacuum loading of the material and can further inhibit ingress of water into the material storage portion and material into the water storage portion.

[0023] During depressurization of the material storage portion, a substantially compressive load can be transferred to the wall of the tank along the length of the curved floor barrier. As such the stresses generated at the connection location between the tank and floor barrier can be substantially distributed evenly along the length of the floor barrier. This curved configuration of the floor barrier may aid in reducing localized loading or stresses within the tank when compared to a flat floor barrier which would further have auxiliary structural reinforcement.

[0024] According to embodiments, the curved floor barrier is formed with a concave shape, such that the curved floor barrier essentially hangs from the interior of the tank. Due to the concave floor shape, material that is contained within the material storage portion results in tensile forces being generated within the floor barrier which are transferred to the tank walls. As these are tensile forces, the floor barrier is inhibited from bending when compared to a substantially flat floor barrier with auxiliary structural reinforcement. Moreover, during the loading of material into the material storage portion, material impact on the floor barrier can be transferred to the tank wall again via tensile forces within the floor barrier.

[0025] According to embodiments of the present invention, the curved floor barrier can have a circular arc shape, parabolic, quadratic, exponential curve shape, or other curved configuration as would be readily understood by a worker skilled in the art.

[0026] According to embodiments of the present invention, the curved floor barrier is configured as a sloped floor, wherein the floor barrier is at its lowest elevation proximate to the opening in the tank from which material can be removed. For example, the sloped curved floor barrier can be aligned with the bottom of the dump door frame.

The slope of the curved floor barrier can be defined based on a desired elevation angle of the floor barrier. This slope may be dependent on the ease of material removal, relative volume within the material storage portion and the water storage portion or other factor as would be readily understood.

5 **[0027]** According to embodiments of the present invention, due to the curved nature of the floor barrier, installation of the floor barrier can be performed in an easier manner when compared to the installation of a substantially flat floor barrier. Due to the curved nature of the floor barrier, the floor barrier can be manufactured from a single piece of material and installed within the tank. As the floor barrier is curved there can be a manipulation of the relative width of the floor barrier during insertion and alignment of the floor barrier within the tank. For example, the curve of the floor barrier can be increased during insertion of the floor barrier into the tank thereby mitigating contact with the sides of the tank for ease of manufacture. By only using a single piece of material, the manufacturing costs may be decreased as in tank fabrication of a multi-part floor barrier assembly is avoided.

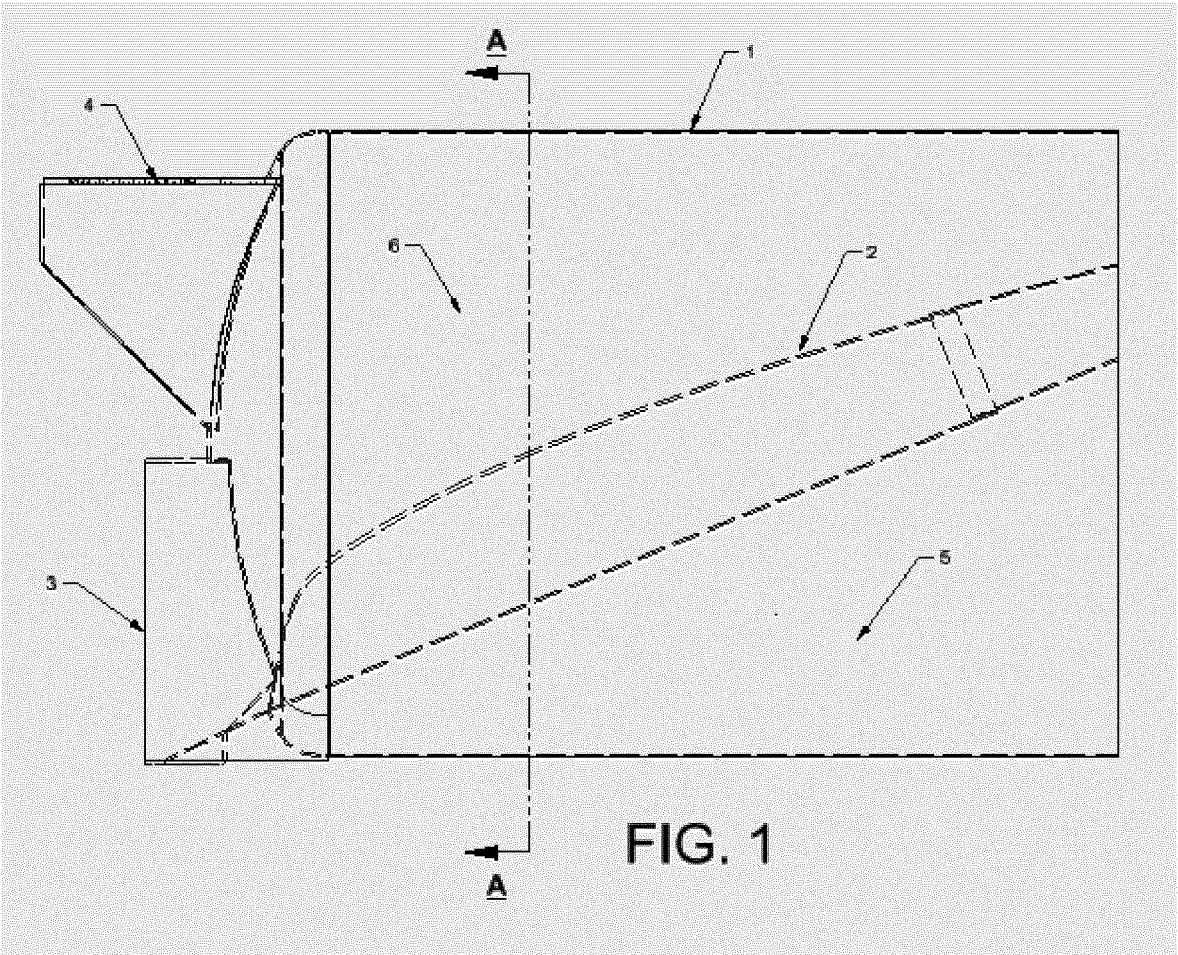
20 **[0028]** By using a curved floor barrier in accordance with embodiments of the present invention, there is substantially an elimination of the auxiliary structural reinforcement which would be required to support a flat floor barrier. By the reduction of structural reinforcement required within the tank, an increase in the volume of one or both of the material storage portion and the water storage portion can be realised, when compared to a same sized tank which includes a substantially flat floor barrier. This increase in material storage and/or water storage capacity of the tank can enable additional hydro excavation to be performed, thus resulting in a potential cost savings.

25 **[0029]** It is obvious that the foregoing embodiments of the invention are examples and can be varied in many ways. Such present or future variations are not to be regarded as a departure from the scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

WE CLAIM:

1. A hydrovac device comprising:
 - a tank having an interior;
 - a curved floor barrier positioned within the tank and configured to divide
 - 5 the tank into a first storage portion and a second storage portion, the curved floor barrier connected to the interior of the tank and configured to sealingly separate the first storage portion and the second storage portion;
 - the tank further including an aperture within each of the first storage portion and the second storage portion.
- 10 2. The hydrovac device according to claim 1, wherein the curved floor barrier is sloped in elevation along a length of the tank, wherein the curved floor barrier has a lowest elevation proximate to the aperture of the first storage portion.
3. The hydrovac device according to claim 1, wherein the curved floor barrier has a curve which is aligned with a central longitudinal axis of the tank.
- 15 4. The hydrovac device according to claim 1, wherein the first storage portion is located above the second storage portion and wherein the curved floor barrier is concave relative to the first storage portion.
5. The hydrovac device according to claim 1, wherein the curved floor barrier has a shape selected from the group consisting of: circular arc curve, parabolic curve,
- 20 quadratic curve and exponential curve.
6. The hydrovac device according to claim 1, wherein the first storage portion is located above the the second storage portion and wherein the first storage portion is configured for material storage and the second storage portion is configured for water storage.
- 25 7. The hydrovac device according to claim 6, wherein the first storage portion has a material loading aperture and a separate material removal aperture.
8. The hydrovac device according to claim 7, wherein the curved floor barrier is sloped in elevation along a length of the tank, wherein the curved floor barrier has a lowest elevation proximate to the material removal aperture.

9. The hydrovac device according to claim 4, wherein the curved floor barrier has a geometry that provides steepest slopes of the curved floor barrier adjacent to walls of the tank which are along a length of tank.
10. The hydrovac device according to claim 1, wherein the hydrovac device is
5 mounted on a truck or trailer.



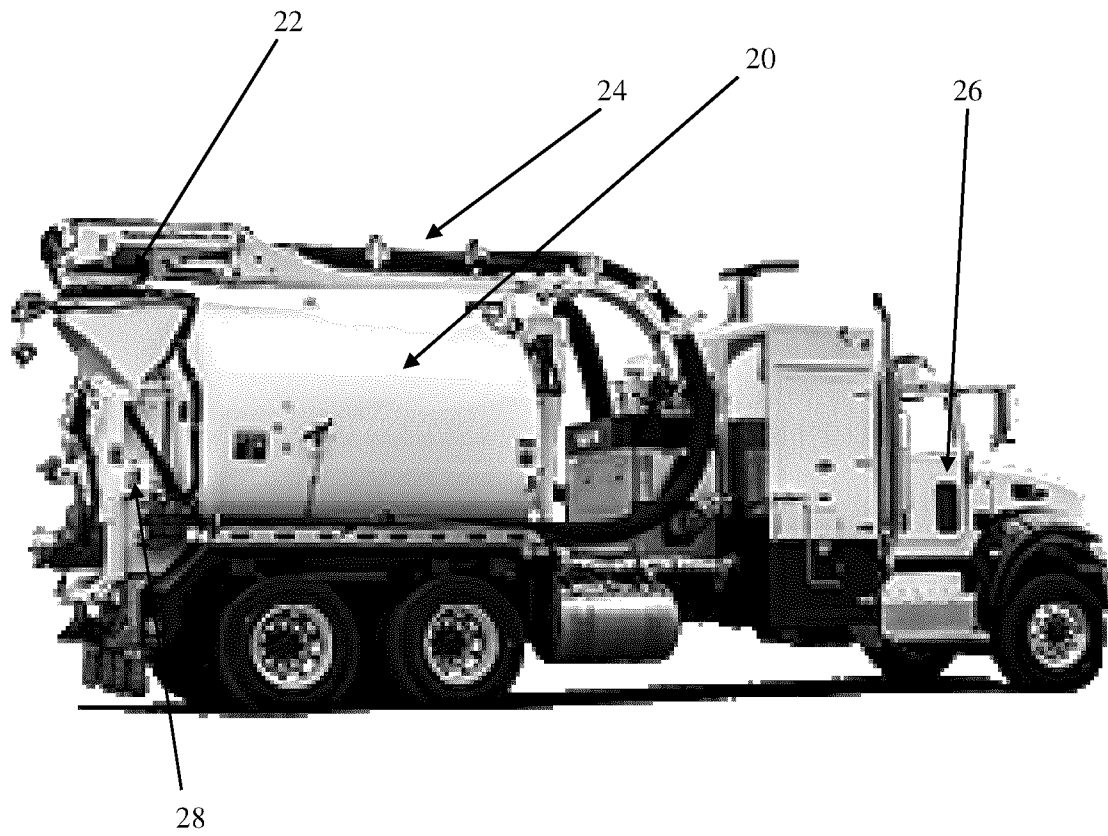


FIG. 2

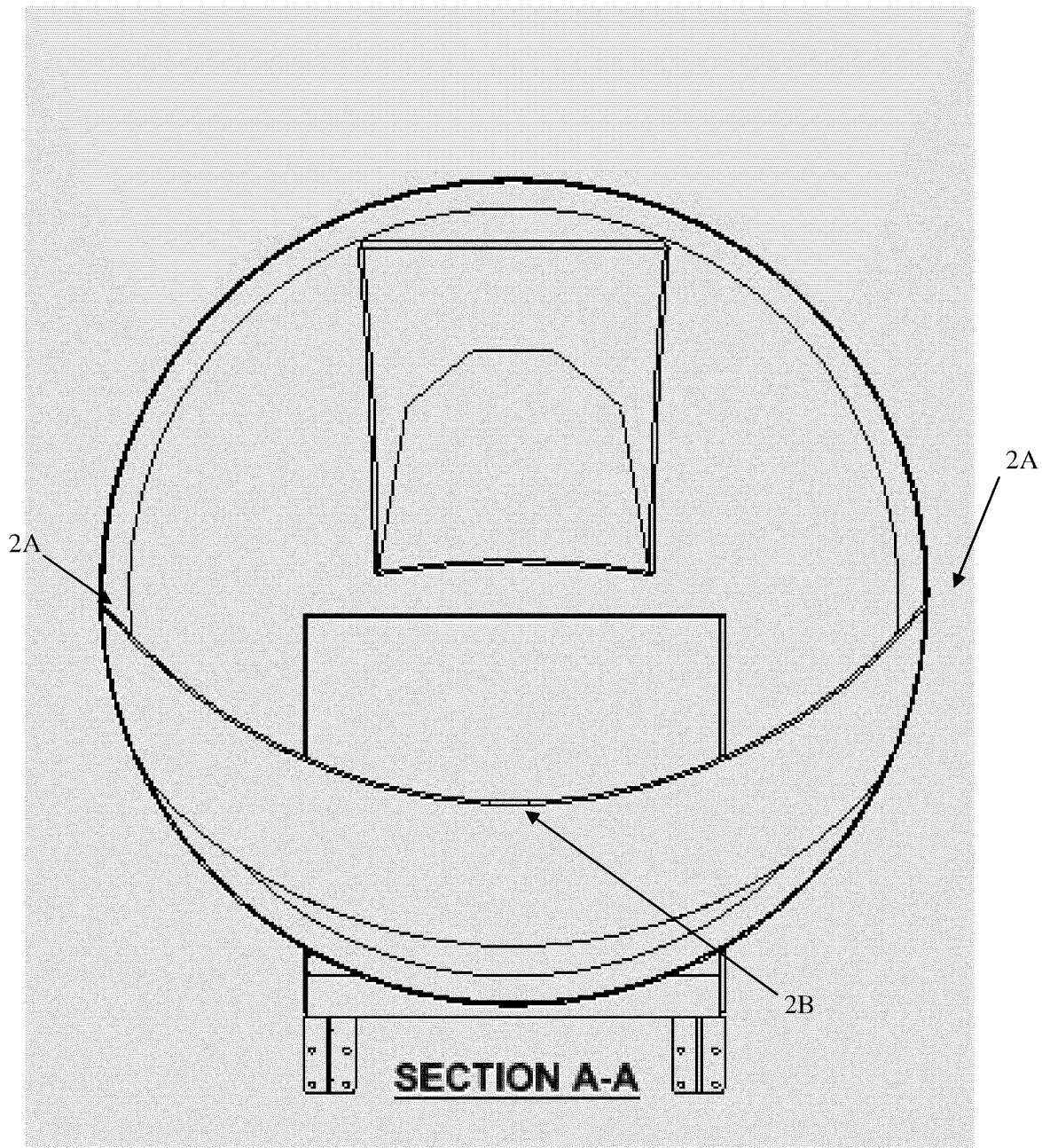


FIG. 3

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
 IPC: **E02F 3/88** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: E02F 3/88 (2006.01), E02F 3/92 (2006.01)

CPC: E02F 3/8816

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Questel Orbit (FAMPAT), Canadian Patent database, Google Patent

Keywords: hydrovac, mud, water, tank, curv*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE102013204201A1, 18 September 2014 (18-09-2014) *Fig. 1 and 5; par. 0048*	1 to 10
X	US2013149089A1, 13 June 2013 (13-06-2013) *Fig. 2, 3 and 8; par. 0027, 0028*	1 to 10
A	US6547964B1, 15 April 2003 (15-04-2003) *Whole document*	1 to 10
A	US6857837B2, 22 February 2005 (22-02-2005) *Whole document*	1 to 10

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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

International application No.

PCT/CA2017/050139

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US5503753A, 02 April 1996 (02-04-1996) *Whole document*	1 to 10
A	US4816167A, 28 March 1989 (28-03-1989) *Whole document*	1 to 10
A	KR20090012899A, 4 February 2009 (04-02-2004) *Whole document*	1 to 10

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2017/050139

Patent Document Cited in Search Report	Date	Publication	Patent Family Member(s)	Publication Date
DE102013204201A1,		18 September 2014 (18-09-2014)	None	
US2013149089A1		13 June 2013 (13-06-2013)	US2013149089A1 CA2761557A1	13 June 2013 (13-06-2013) 12 June 2013 (12-06-2013)
US6547964B1		15 April 2003 (15-04-2003)	US6547964B1 CA2317667A1 CA2317667C	15 April 2003 (15-04-2003) 08 March 2001 (08-03-2001) 06 January 2009 (06-01-2009)
US6857837B2		22 February 2005 (22-02-2005)	US2003133772A1 CA2367805A1	17 July 2003 (17-07-2003) 21 August 2002 (21-08-2002)
US5503753A		02 April 1996 (02-04-1996)	None	
US4816167A		28 March 1989 (28-03-1989)	None	
KR20090012899A		4 February 2009 (04-02-2004)	KR100931392B1	11 December 2009 (11-12-2009)