(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 July 2012 (12.07.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/094562 A1

(51) International Patent Classification:
H02J 7/04 (2006.01)

(21) International Application Number:
PCT/US2012/020425

(22) International Filing Date:
6 January 2012 (06.01.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/430,353 6 January 2011 (06.01.2011) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

WO 2012/094562 A1

(54) Title: METHOD AND SYSTEM FOR DISSOLVING CRYSTALS IN SHIPPING VESSELS

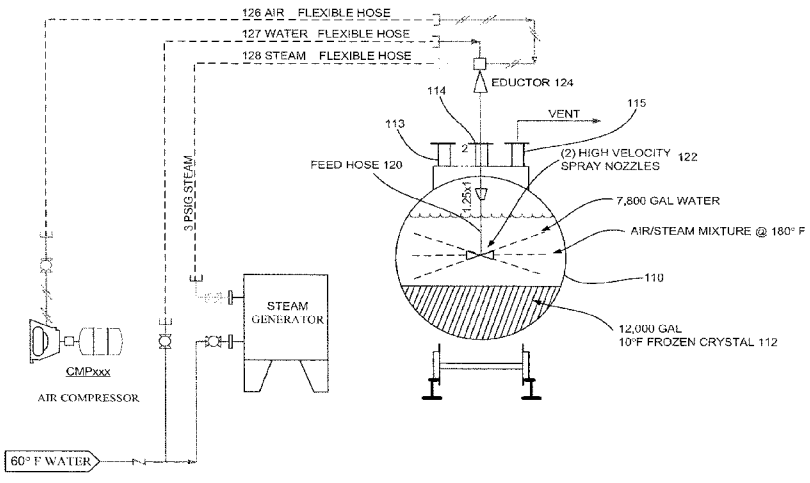


Figure 1

(57) Abstract: An apparatus is provided for dissolving crystals formed in a vessel comprising a first hose for feeding water to an eductor; a second hose for feeding steam to the eductor, wherein the eductor induces flow of the water and the steam into the vessel; a feeding hose coupled to the eductor, the feeding hose for feeding the water and the steam into the vessel; and a spray nozzle coupled to the end of the feeding hose, the spray nozzle for directing the flow of the water and the steam inside the vessel. The apparatus may further comprise a third hose for feeding air to the eductor, the third hose coupled to a compressor.

METHOD AND SYSTEM FOR DISSOLVING CRYSTALS IN SHIPPING VESSELS

BACKGROUND

Whether deliberate or due to circumstances, crystals will be found in shipping vessels such as the vessels found on rail cars. When these materials are required to be in solution form for final use or marketing, there will be a need to solubilize the crystals. In many cases there also will be a need to solubilize the materials in near saturated concentrations. Because these materials and/or solutions may be corrosive, there is a further need to make sure that the systems for solubilizing the crystals are built to safely handle these conditions. To accomplish this there is a need to, within the vessel containing the crystals, add a heated solute (such as water) and provide mixing within the vessel. Due to the configuration of most shipping vessels and the delivery terminals where they are received, this process has required either extensive pre-planning for efficient operations or otherwise the use of inefficient and potentially asset damaging makeshift methods.

One solution for dissolving crystals in shipping vessels is to equip the vessels with built-in devices which may include corrosion resistant dump valves for emptying the vessel for dissolution of the crystals in other places. However, these valves would have to be corrosion resistant and fully secure to avoid release of hazardous material to the environment. Another approach could include installing sparger devices in the vessel which would introduce the solute for recirculation under the level of the crystals. Such methods have a number of disadvantages as they are capital intensive and/or inflexible.

For example, for dump systems, the shipping vessels and supporting infrastructures that are set up for these operations will require significant capital outlays. They also require systems to be in place for each receiving station, multiplying the infrastructure costs by the number of receiving stations.

With respect to sparger systems, sparger devices would need to be mounted in each shipping vessel because they cannot easily be moved from one shipping vessel to the next shipping vessel as needed. Given dozens of shipping vessels, the capital outlay for this method would also be significant.

Another approach that has been used for dissolving crystals in shipping vessels is simply inserting a live steam line into the vessel whereby the line ejects steam into the liquid in which the crystals are present. However, the live steam line does not adequately mix the steam with the contents of the vessel to thoroughly dissolve the crystals. Another disadvantage is that the steam line can be difficult to control and may damage or melt the lining of the vessel if the steam line comes into direct contact with the lining.

In view of the disadvantages associated with prior approaches to dissolving crystals in shipping vessels, and improved method and system is needed.

SUMMARY OF THE INVENTION

An apparatus is provided for dissolving crystals formed in a vessel comprising: a first hose for feeding water to an eductor; a second hose for feeding steam to the eductor, wherein the eductor induces flow of the water and the steam into the vessel; a feeding hose coupled to the eductor, the feeding hose for feeding the water and the steam into the vessel; and a spray nozzle coupled to the end of the feeding hose, the spray nozzle for directing the flow of the water and the steam inside the vessel.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 illustrates a side view of a shipping vessel 110 such as those found on rail cars.

Figure 2 illustrates the rail car plan view of the shipping vessel 110.

DETAILED DESCRIPTION OF THE INVENTION

The present invention resolves the foregoing problems by using a system and method that solubilizes the crystals within the shipping vessel without requiring significant adjustments to existing shipping vessels or receiving stations. The present invention involves inserting a corrosion resistant solubilizing device into the existing loading/unloading ports on shipping vessels. The solubilizing device is designed such that it will not damage the shipping vessel. Furthermore, the solubilizing device can be relatively compact so that it can be easily moved from one vessel to another and easily inserted into the ports of the vessels. The solubilizing device provides for

improved mixing within the vessel to better dissolve the crystals within the solution in the vessel.

A preferred embodiment of the invention is illustrated in Figures 1 and 2 attached hereto. As exemplary shipping vessel is depicted in Figure 1. Those of skill in the art should understand that the present invention is applicable to a variety of vessels containing crystals that need to be dissolved including vessels mounted on trucks and storage vessels such as those located at ports and manufacturing sites. The shipping vessel 110 holds crystals 112 and has ports 113, 114 and 115 located at the top of the shipping vessel.

The solubilizing device includes a feed hose 120 that extends through port 114 and into the vessel 110. In the preferred embodiment, the feed hose 120 is comprised of a generally rigid material such as fiberglass that is also designed to withstand corrosion. In alternate embodiments of the invention, the feed hose can be manufactured from a variety of materials and have other configurations such as multiple branches. The feed hose 120 also can be adjustable in length so that it fits properly within a variety of vessel sizes and can be used in a variety of mixing configurations.

In the preferred embodiment, a spray nozzle 122 is attached to the distal end of the feed hose 120. As shown in the embodiment in Figures 1 and 2, the spray nozzle 122 can be set at an angle to the longitudinal axis of the vessel so that the fluid exiting the spray nozzle 122 creates a circular-like rotation of fluid within the vessel. Causing the fluid to rotate within the vessel enhances mixing by increasing the solute/ crystal mass exchanges and promotes more efficient dissolution rates for the crystals within the vessel. The spray nozzle 122 illustrated in the exemplary embodiments shown in Figures 1 and 2 is a two-headed nozzle which emits fluid from two opposite sides of the nozzle. Nozzles with other configurations can be used in alternate embodiments of the invention. Furthermore, the spray nozzle 122 illustrated in Figures 1 and 2 is positioned so that each nozzle head is at an angle of 45 degrees from the longitudinal axis of the vessel. In alternate embodiments and other vessel configurations, the position of the nozzle can be adjusted to other angles.

In the preferred embodiment, the spray nozzle 122 is of a size that will permit it to fit through ports typically found in shipping vessels such as port 114. In other

embodiments, the spray nozzle can be coupled to the feed hose 120 such that it pivots in order to fit through port 114.

The exemplary solubilizing device shown in Figure 1 also includes an eductor 124 coupled to the proximal end of the feed hose 120. Also coupled to the eductor 124 are an air hose 126, a water hose 127, and a steam hose 128. In the preferred embodiment illustrated in Figure 1, the eductor entrains the water with air or steam for emitting from the nozzle 122. In alternate embodiments of the invention, the air supply can be omitted.

In the preferred mode of operation, the solubilizing device is first used to fill the vessel 110 with water to a level above the crystals as shown in the exemplary embodiment in Figure 1. Once the water reaches a desired level within the tank, steam is added to the water flow using the eductor 124. The steam and water flow exit the nozzle 122 and create a circular-like flow within the vessel for dissolving the crystals. Air fed into the eductor 124 from the air hose 126 can also be mixed with the water at different stages of the process if it is desired to increase the velocity of the flow.

The solubilizing device allows one to dissolve the crystals in the shipping vessel by achieving sufficient mixing within the vessel. The solubilizing device is also advantageous because it is designed so that it will not damage the interior of the shipping vessels and does not require modification of existing shipping vessels or receiving stations.

Those of skill in the art will recognize that the preferred embodiment described above and illustrated in Figures 1 and 2 may be modified and remain within the scope of the invention. For example, in alternate embodiments the eductor can be removed and replaced with other types of valves. Moreover, in alternate embodiments the air hose may be removed or other fluids may be used in place of water. In yet other embodiments, the solubilizing device can be adapted to connect to local water and portable air and portable steam sources.

In one embodiment, an apparatus is provided for dissolving crystals formed in a vessel comprising a first hose for feeding water to an eductor; a second hose for feeding steam to the eductor, wherein the eductor induces flow of the water and the steam into the vessel; a feeding hose coupled to the eductor, the feeding hose for

feeding the water and the steam into the vessel; and a spray nozzle coupled to the end of the feeding hose, the spray nozzle for directing the flow of the water and the steam inside the vessel. In certain embodiments, the apparatus further comprises a third hose for feeding air to the eductor, the third hose coupled to a compressor.

In a particular embodiment, the air is fed into the vessel via the eductor and the feeding hose. In another particular embodiment, the length of the feeding hose is adjustable. In certain embodiments, the spray nozzle can be set at an angle to the longitudinal axis of the vessel.

We claim:

1. An apparatus for dissolving crystals formed in a vessel comprising:

a first hose for feeding water to an eductor;

a second hose for feeding steam to the eductor, wherein the eductor induces flow of the water and the steam into the vessel;

a feeding hose coupled to the eductor, the feeding hose for feeding the water and the steam into the vessel; and

a spray nozzle coupled to the end of the feeding hose, the spray nozzle for directing the flow of the water and the steam inside the vessel.

2. The apparatus of Claim 1, further comprising:

a third hose for feeding air to the eductor, the third hose coupled to a compressor.

3. The apparatus of Claim 2, wherein the air is fed into the vessel via the eductor and the feeding hose.

4. The apparatus of Claim 1, wherein the length of the feeding hose is adjustable.

5. The apparatus of Claim 1, wherein the spray nozzle can be set at an angle to the longitudinal axis of the vessel.

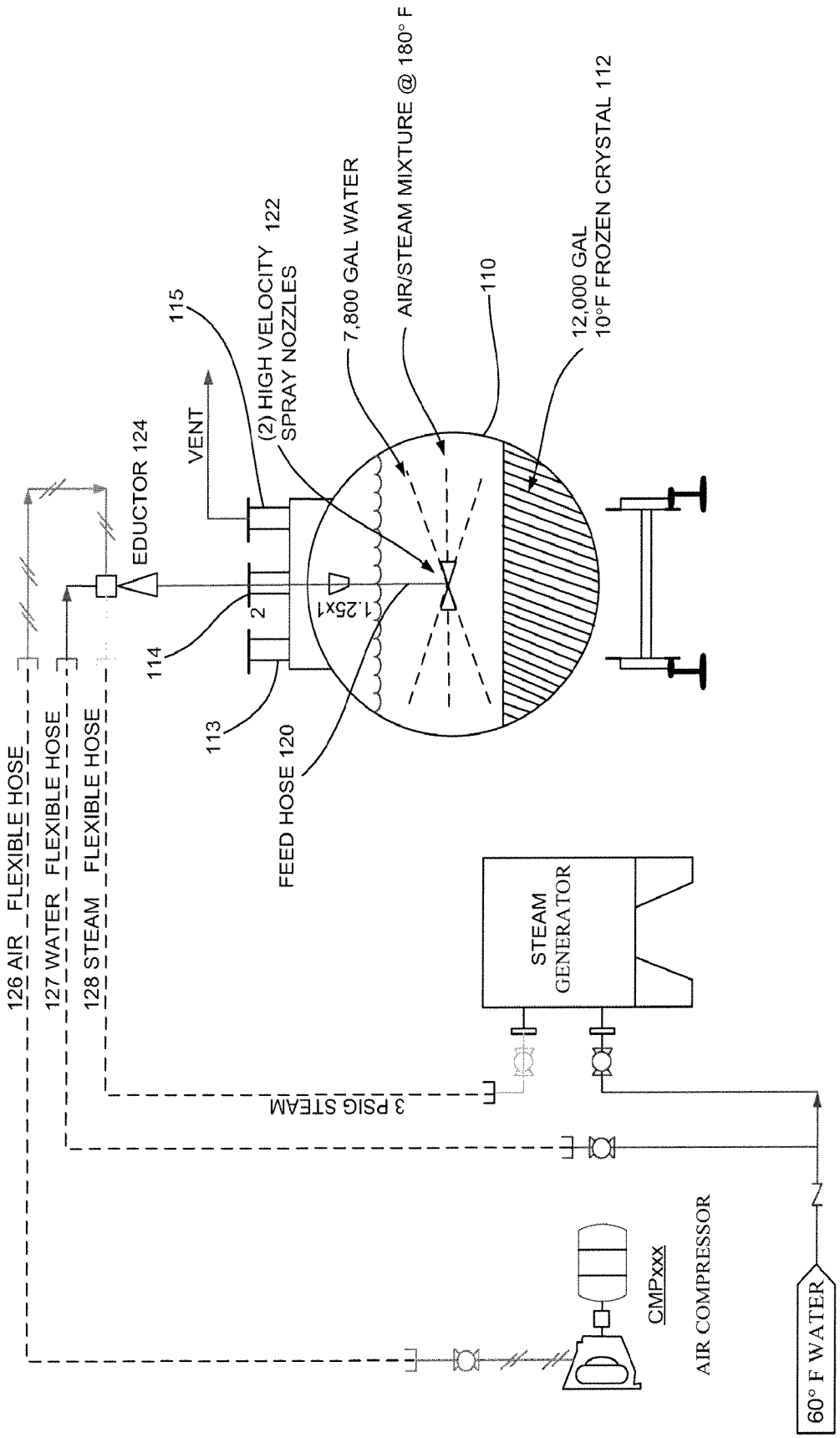

12,000 GAL
10°F FROZEN CRYSTAL 112
110
AIR/STEAM MIXTURE @ 180° F
7,800 GAL WATER
(2) HIGH VELOCITY
SPRAY NOZZLES
122
115
VENT
EDUCTOR 124
2
1.25X1
114
113
FEED HOSE 120
126 AIR FLEXIBLE HOSE
127 WATER FLEXIBLE HOSE
128 STEAM FLEXIBLE HOSE
STEAM
GENERATOR
3 PSIG STEAM
CMPxxx
AIR COMPRESSOR
60° F WATER

Figure 1

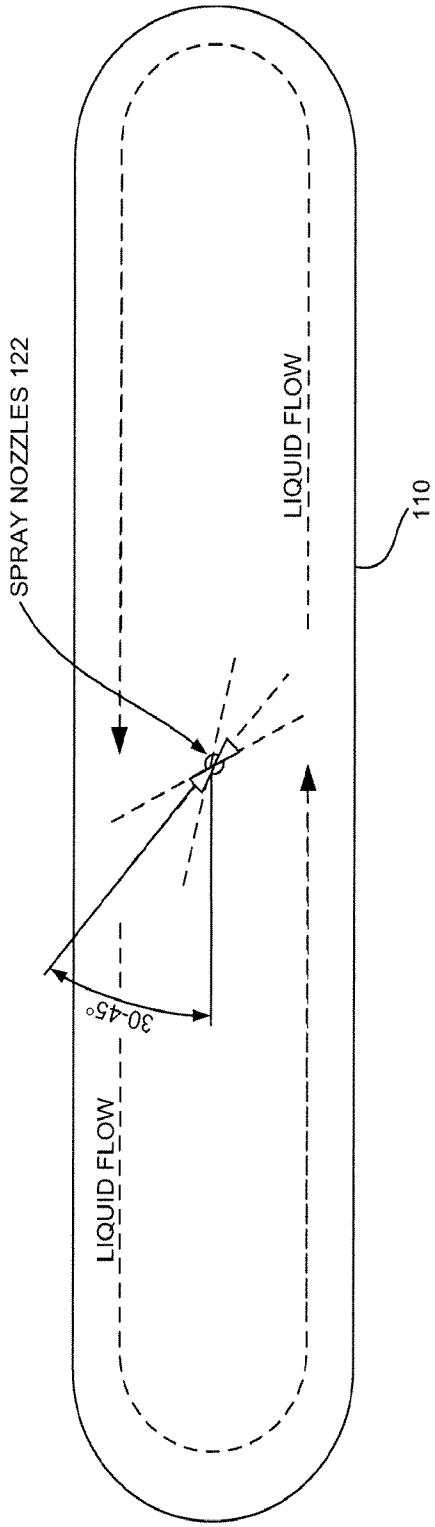


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/20425

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/04 (2012.01)
USPC - 320/107; 320/139
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(8): H02J 7/04 (2012.01); USPC: 320/107; 320/139

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 320/107; 320/139

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Google Scholar, Google Patents, PubWEST (PGPB,USPT,EPAB,JPAB) (Crystal, dissolve, hose, water, eductor, steam, spray, hose, nozzle, feed, air, compressor)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0229586 A1 (NICODEM) 16 Sep 2010 (16.09.2010) Figure 4A, paragraphs [0013], [0037]-[0041]	1-5
Y	US 4,492,186 A (HELM) 08 Jan 1985 (08.01.1985) Figures 6, 7, column 4, line 40-45, line 67-68, column 5, line 1-2, column 6, line 67-68, column 7, line 1-6	1-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" 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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" 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
"X" 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
"Y" 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

Date of the actual completion of the international search	Date of mailing of the international search report
15 Apr 2012 (15.04.2012)	03 MAY 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)