



- (51) International Patent Classification:  
C10J 3/30 (2006.01)
- (21) International Application Number:  
PCT/EP2013/066638
- (22) International Filing Date:  
8 August 2013 (08.08.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
102012107486.0 15 August 2012 (15.08.2012) DE
- (71) Applicant: L'AIR LIQUIDE, SOCIÉTÉ ANONYME  
POUR L'ETUDE ET L'EXPLOITATION DES  
PROCÉDÉS GEORGES CLAUDE [FR/FR]; 75, quai  
d'Orsay, F-75007 Paris (FR).
- (72) Inventors: LATH, Erhard; Eichendorffstraße 16, 64347  
Griesheim (DE). JUDAS, Frederic; Starenweg 16, 60440  
Oberursel (DE).
- (74) Agent: KAHLHÖFER, Hermann; KNH Patentanwälte  
Kahlhöfer Neumann Rößler Heine, Postfach 103363,  
40024 Düsseldorf (DE).
- (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, BN, 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, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,  
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.

[Continued on next page]

(54) Title: METHOD FOR OPERATING A BULK MATERIAL LOCK

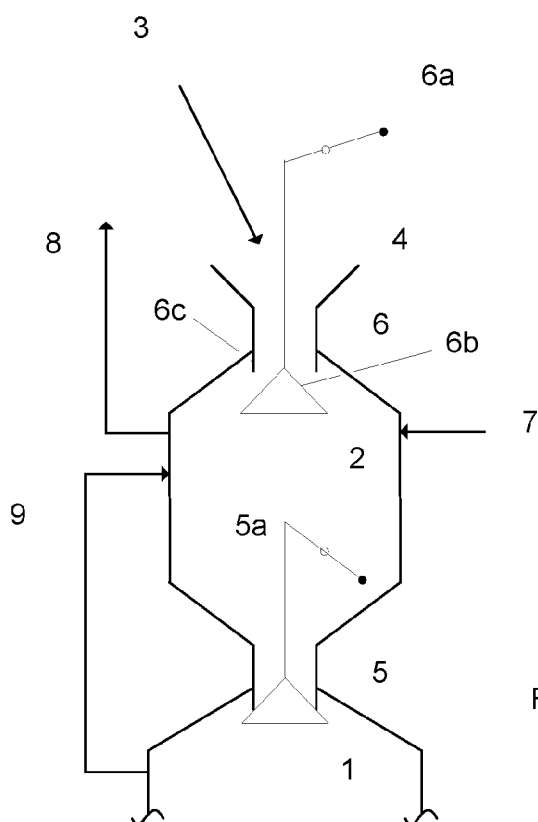


Fig. 1

(57) Abstract: A method for operating bulk material locks equipped with a self-sealing closure, which for filling the connected process apparatus with process gas are pressurized to its operating pressure, in which the pressurization until adjustment of the gas tightness of the closure is effected with inert gas, in order to avoid an escape of process gas.



(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, 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, KM, ML, MR, NE, SN, TD, TG).

**Published:**

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

## Method for Operating a Bulk Material Lock

## 5 Field of the Invention

This invention relates to a method for operating a bulk material lock whose opening for filling with bulk material is equipped with a self-sealing closure, which lock serves for filling a process apparatus which is under the excess pressure of a process gas, wherein before being emptied the lock is pressurized with process  
10 gas to the pressure existing in the apparatus, and before being filled it is depressurized to ambient pressure.

This invention also relates to the use of this method during operation of the bulk material locks of fixed-bed coal gasifiers.

15

## Prior art

Self-sealing closures have long since been used in the art, in order to close openings, such as container openings, in a gas- or liquid-tight manner. In general, they are equipped with a mechanism with which the closure is placed before the  
20 opening, so that the sealing surfaces of closure and opening lie one on top of the other or are slightly pressed onto each other. The principle of self-sealing consists in that the essential part of the force which is necessary to press the sealing surfaces onto each other in a gas- or liquid-tight manner is not provided by the closure mechanism, but by the gas or liquid pressure existing in the respective  
25 process apparatus.

For example, the bulk material locks for filling fixed-bed coal gasifiers frequently are equipped with self-sealing openings, wherein a round opening equipped with a sealing surface is closed by a conical or cone-shaped closure, see also  
30 Ullmann's Encyclopedia of Industrial Chemistry, Sixth Edition, Vol. 15, Gas Production, Chap. 4.4.

For filling the gasifier with coal, the empty bulk material lock initially is depressurized to ambient pressure, the filling opening then is opened, and coal is filled into the lock. Subsequently, the filling opening of the lock is closed by mechanically pressing the closure into the round filling opening. The lock then is  
5 pressurized with process gas, until a pressure corresponding to the process pressure of the gas generator is reached.

It is disadvantageous that in the initial phase of pressurizing, in which a sufficient pressure for completely sealing the self-sealing filling opening in the interior of the  
10 lock has not yet been reached, process gas escapes from the lock through the filling opening. This escape of the process gas is problematic in the case of the fixed-bed coal gasification, since the escaping synthesis gas is toxic and, when it mixes with atmospheric oxygen, also is explosive.

15 So far, this problem generally has been solved by attempting to collect the escaping process gas as far as possible and securely dispose of the same, for example via a flare system.

This can be accomplished, for example, in that the chute which for filling the lock  
20 is put onto the filling opening is equipped with a jacket which is formed such that it completely encloses the filling opening of the lock and collects the escaping gas. The jacket then is connected with an extraction system, which safely removes the gas.

DD 239000 A1 describes another method for the safe disposal of this gas.  
25 Upstream of the bulk material lock, a firmly installed dosing tank referred to as filling basket has been provided. The gas escaping from the lock is collected by the filling basket. By purging with inert gas, the dangerous process gas is expelled from the filling basket and disposed of via a conduit connected to the filling basket.

A disadvantage of these methods consists in that they require a relatively expensive equipment. Therefore, it has been the object to provide a method for operating bulk material locks, which avoids this disadvantage.

## 5 Description of the Invention

The object is solved by a method according to the entirety of the features of claim 1. After the lock has been filled with bulk material and the opening has been closed mechanically, the lock initially is pressurized with an inert gas, until the necessary internal pressure is reached, which is required by the self-sealing  
10 closure for reaching the gas tightness. The escape of gas occurring to this point is not dangerous, since the gas is an inert gas. Only when the gas tightness of the self-sealing closure is reached, process gas is used in the lock for the further pressure increase, in general up to the process pressure existing in the connected apparatus.

15

In an advantageous aspect of the invention, nitrogen is used as inert gas. Nitrogen is non-toxic and generally available at low cost.

In a further advantageous aspect of the invention, the lock emptied of bulk  
20 material is purged with inert gas after it has been depressurized to ambient pressure and before it is again filled with bulk material. In the process, i.e. during depressurization and during purging, the discharge of the gas from the lock is effected via a special conduit connected to the lock and not via the opening for filling the lock with bulk material. By purging the lock with inert gas it is avoided  
25 that when filling the lock with bulk material, process gas escapes through the filling opening of the lock into the surroundings.

In a further advantageous aspect of the invention, the pressure in the lock, after the self-sealing closure has been closed in a gas-tight manner by the inert gas  
30 introduced, is lowered by draining gas to an extent as it is possible for maintaining the gas tightness of the closure, before the lock is pressurized further with process gas. Closing a self-sealing closure generally requires a pressure higher

than subsequently necessary for maintaining the tightness of the closure, as for closing the closure body must be pressed into the optimum position in the closure seat with great force. When this position has been reached, the pressure can be lowered, since the closure only must be maintained in this position. By draining  
5 inert gas from the lock as far as is possible for maintaining the tightness, it is achieved that when handing over the bulk material from the lock into the reactor less inert gas enters into the reactor and contaminates the process gas.

How far the pressure in the lock can be lowered without impairing the tightness of  
10 the closure can easily be determined by the skilled person by carrying out routine experiments.

Particularly advantageously, the method according to the invention can be used during operation of fixed-bed coal gasifiers. The process gas produced thereby is  
15 particularly toxic and explosive because of its carbon monoxide and hydrogen content, so that the escape of this gas particularly endangers the safety of the operating personnel and the plant. Due to the large overall sizes prevailing with this technology, the gas tightness of the closures generally is only reached at pressures above 4 bar(g). This means that until reaching this pressure, large  
20 amounts of process gas escape from the lock.

The use of the method according to the invention prevents the exit of these dangerous gases in a simple way, and apparatuses which are designed to collect and discharge process gas exiting from the filling opening are made superfluous.

#### 25 Exemplary embodiment

Further developments, advantages and possible applications of the invention can also be taken from the following description of exemplary embodiments and the drawings. All features described and/or illustrated form the invention per se or in  
30 any combination, independent of their inclusion in the claims or their back-reference.

In the only Figure

Fig. 1 shows a bulk material lock for a fixed-bed coal gasifier operated by the method according to the invention.

- 5 Fig. 1 shows the upper part of a reactor 1 which is filled with bulk material, e.g. coal, via a bulk material lock 2. The bulk material 3 is filled into the bulk material lock 2 by means of a hopper 4. The reactor 1 can be sealed against the lock 2 via the self-sealing closure 5 and said lock in turn can be sealed against the atmosphere via the self-sealing closure 6. The closures 5, 6 each are equipped
- 10 with a mechanical closure actuator 5a, 6a.
- The lock 2 is filled with bulk material 3 via the hopper 4 and the open closure 6. The closure 5 is closed. The closure 6 then is mechanically closed by means of the device 6a. The closure body 6b is placed before the closure seat 6c. The lock 2 then is pressurized with inert gas via conduit 7, wherein initially gas escapes
- 15 from the lock through the closure 6, until the gas pressure building up in the lock presses the closure body 6b into the closure seat 6c so firmly that no open gap is left between the same. Via conduit 8, inert gas can then be drained from the lock, so that when subsequently emptying the lock 2 into the reactor 1, the gas atmosphere of the reactor is not loaded with inert gas to an unnecessary extent.
- 20 By draining the inert gas from the lock, the pressure in the lock should only be lowered to such an extent that the tightness of the closure 6 is not impaired.
- Via conduits 7 and 8, the lock 2 also can be purged with inert gas, before the closure 6 is opened, with the process or purge gas being discharged via conduit 8.
- 25 After the closure 6 has been closed in a gas-tight manner, the lock 2 is pressurized further via conduit 9 with process gas from the reactor 1. After a pressure compensation thus has been achieved between lock 2 and reactor 1, the closure 5 is opened mechanically and the bulk material is drained from the lock into the reactor.

## List of Reference Numerals

5	1	upper part of reactor
	2	bulk material lock
	3	bulk material
	4	hopper
	5, 6	self-sealing closure
10	5a, 6a	mechanical closure actuator
	6b	closure body
	6c	closure seat
	7	conduit inert gas
	8	conduit for draining gas
15	9	conduit for pressurizing the lock with process gas



## Claims

1. A method for operating a bulk material lock whose opening for filling with bulk material is equipped with a self-sealing closure, which opening serves for filling a process apparatus which is under the excess pressure of a process gas, wherein before being emptied the lock is pressurized with process gas to the pressure existing in the apparatus and before being filled it is depressurized to ambient pressure, characterized in that after filling the lock with bulk material and after mechanically closing the opening, the lock is pressurized with an inert gas up to such a pressure, until the self-sealing closure closes the opening in a gas-tight manner and only after reaching this condition the lock is pressurized further with process gas.
2. The method according to claim 1, characterized in that the inert gas substantially consists of nitrogen.
3. The method according to any of the preceding claims, characterized in that the lock emptied of bulk material is purged with inert gas, after it has been depressurized to ambient pressure, before it is again filled with bulk material.
4. The method according to any of the preceding claims, characterized in that after the self-sealing closure is closed in a gas-tight manner, the pressure in the lock is lowered to such an extent as it is possible for maintaining the gas tightness of the closure and the lock then is further pressurized with process gas.
5. Use of the invention according to any of the preceding claims during operation of the bulk material locks of fixed-bed coal gasifiers.

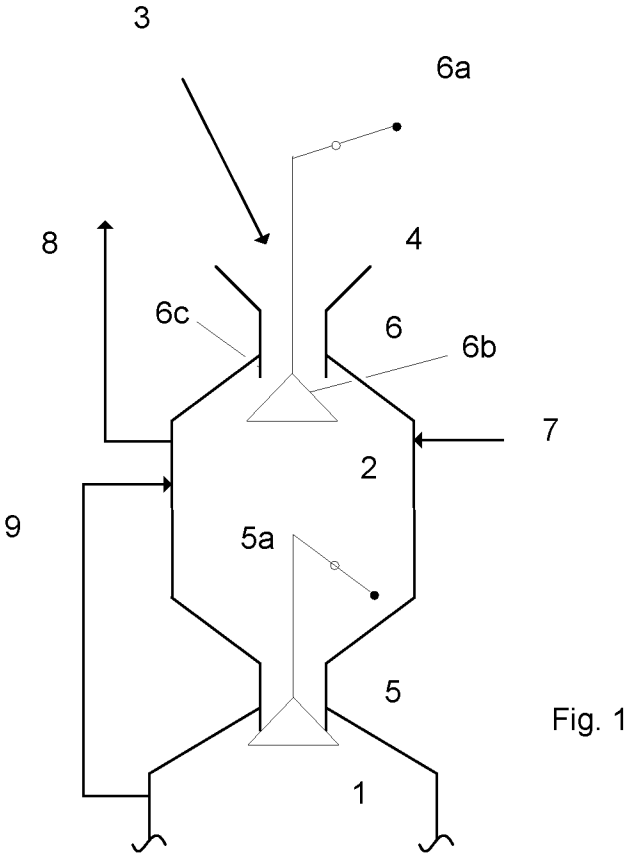


Fig. 1

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2013/066638

A. CLASSIFICATION OF SUBJECT MATTER  
INV. C10J3/30  
ADD.

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)  
C10J

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

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

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DD 239 001 A1 (SCHWARZE PUMPE GAS VEB [DD]) 10 September 1986 (1986-09-10) figure 1 page 2	1-5
X	DE 809 226 C (RUHRGAS AG) 26 July 1951 (1951-07-26) figure B page 2, lines 74-109	1-5
A	GB 2 131 448 A (RUHRGAS AG) 20 June 1984 (1984-06-20) figure 1	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* 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

24 September 2013

Date of mailing of the international search report

04/10/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

Authorized officer

Lachmann, Richard

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/066638

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DD 239001	A1	10-09-1986	NONE
DE 809226	C	26-07-1951	NONE
GB 2131448	A	20-06-1984	AU 557140 B2 04-12-1986
		AU 2185483 A	14-06-1984
		DE 3245567 A1	14-06-1984
		FR 2537592 A1	15-06-1984
		GB 2131448 A	20-06-1984
		JP S59115388 A	03-07-1984
		US 4599092 A	08-07-1986
		ZA 8308758 A	30-01-1985