



(51) International Patent Classification:
F25D 17/06 (2006.01)

(21) International Application Number:
PCT/US2017/067476

(22) International Filing Date:
20 December 2017 (20.12.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/439,537 28 December 2016 (28.12.2016) US

(71) Applicant: **LINDE AKTIENGESELLSCHAFT**
[DE/DE]; Klosferhofstr. 1, 80331 Munich (DE).

(72) Inventor; and

(71) Applicant (for US only): **NEWMAN, Michael, D.**
[US/US]; 51 Woods Road, Hillsborough, New Jersey 08844 (US).

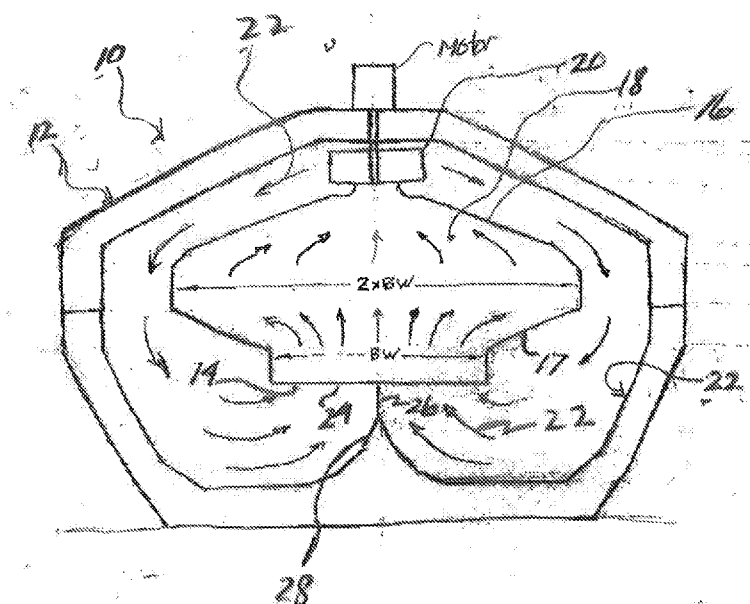
(72) Inventor: **MCCORMICK, Stephen**; 24 Pebble Ridge Road, Warrington, Pennsylvania 18976 (US).

(74) Agent: **COHEN, Joshua, L.**; Linde LLC, 200 Somerset Corporate Boulevard, Suite 7000, Bridgewater, New Jersey 08807 (US).

(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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.

(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, ST, 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).

(54) Title: CRYOGENIC FLUIDIZED BED FREEZER WITH GAS FLOW PATH



(57) Abstract: A cryogenic freezer apparatus is provided which includes a housing; a fluidized bed belt movable within the housing; a shroud positioned within the housing for providing a zone above the belt, the shroud angled outward from the belt within the housing; and a least one blower positioned within the housing in fluid communication with the zone and centrally located above the zone and the shroud. A related method is also provided.



Published:

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

SPECIFICATION

TITLE: CRYOGENIC FLUIDIZED BED FREEZER WITH GAS FLOW PATH

BACKGROUND

[0001] The present embodiments relate to fluidized bed freezers for food products.

[0002] Known cryogenic fluidized bed freezers utilize blowers to pressurize a bed of the freezer, and to provide gas flow to drive heat transfer from the product to the gas. The known blowers are offset to a side of the fluidized bed zone of the freezer. The blowers force the gas downward, where the gas impacts and is driven across the floor of the freezer whereupon the gas then impacts a sidewall of the freezer to then be turned upward and through the fluid bed belt transporting the product. Unfortunately, the plurality of turns that the gas is required to make causes the gas flow and therefore the gas velocity to vary dramatically throughout the fluid bed belt length and width. In order to reduce this variation, baffles are positioned below the bed, but this baffle placement causes pressure drop in the freezer and therefore, more power is required to drive the blowers to maintain acceptable heat transfer rates.

[0003] An additional problem is that fluidization velocity is limited to no more than approximately 1000 feet per minute (1000'/min.) in order to prevent and at least minimize product carry-over into the blower zone when peak velocities are used.

SUMMARY OF THE INVENTION

[0004] There is provided herein a cryogenic freezer apparatus embodiment which includes a housing; a fluidized bed belt movable within the housing; a shroud positioned within the housing for providing a zone above the belt, the shroud angled outward from the belt within the housing; and at least one blower positioned within the housing in fluid communication with the zone and centrally located above the zone and the shroud.

[0005] There is also provided herein a method embodiment of moving cryogenic gas to a fluidized bed belt in a freezer which includes shrouding a zone within the freezer having a first pressure above the belt; positioning at least one blower centrally located above the zone and the belt; directing a flow of cryogenic gas from the at least one blower to an underside of the belt at a second pressure greater than the first pressure; and moving the flow of cryogenic gas through the belt into the zone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] For a more complete understanding of the present invention, reference may be had to the following description of exemplary embodiments considered in connection with the accompanying drawing Figure, of which:

[0007] The Figure shows a cryogenic fluidized bed freezer with gas flow path embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0008] Before explaining the inventive embodiments in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, if any, since the invention is capable of other embodiments and being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

[0009] In the following description, terms such as a horizontal, upright, vertical, above, below, beneath and the like, are to be used solely for the purpose of clarity illustrating the invention and should not be taken as words of limitation. The drawings are for the purpose of illustrating the invention and are not intended to be to scale.

[0010] An improved flow pattern can be seen in the attached schematic of the Figure for the present cryogenic fluidized bed freezer apparatus embodiment 10 that will provide a more even and uniform gas flow and velocity to the bed by placing the blowers centered and directly above the fluid bed zone. Such an arrangement provides higher fluid bed velocities in the bed by doubling cross-sectional area above the fluid bed zone and therefore, reducing by one half (1/2) a velocity in the zone which will prevent product carry-over, prevent lower pressure drop throughout the system and thereby reduce specific blower power and improving system efficiency.

[0011] The cryogenic fluidized bed freezer 10 of the present embodiments includes a housing 12, a fluidized bed belt 14 with a width ("BW") of 1 x BW, and a shroud 16 attached above the belt that angles outward 17 at fifteen degrees

(15°) on both sides of the belt to a width of $2 \times BW$ in order to provide a zone 18 above the belt wherein a velocity of one-half ($\frac{1}{2}$) that of the velocity through the fluidized bed belt in order to prevent carry-over of food product into the blower area.

[0012] Blowers 20 are mounted centrally above the fluidized bed shroud 16, so that half of the flow generated is sent to each side of the fluidized bed providing a substantially constant velocity throughout the bed length and width. An inner surface 22 of the housing 12 also directs the gas flow 22 to an underside 24 of the belt 14.

[0013] A belt divider 26 and gas flow guide 28 are mounted below the fluid bed belt 14 to provide uniform and constant gas flow and velocity across the fluid bed zone.

[0014] Another embodiment of the apparatus includes the belt comprising a first width within the housing, and the zone comprises a second width within the housing greater than the first width.

[0015] Another embodiment of the apparatus includes the second width is twice as wide as the first width.

[0016] Another embodiment of the apparatus includes the shroud angled outward fifteen degrees (15°) from the belt.

[0017] Another embodiment of the apparatus further includes a divider positioned below the belt for guiding gas flow to the belt.

[0018] Another embodiment of the apparatus includes the housing comprising an inner surface having a construction which directs gas flow within the housing to an underside of the belt.

[0019] Another embodiment of the method further includes reducing a velocity of the flow upon the flow entering into the zone from the belt.

[0020] Another embodiment of the method further includes comprising angling outward the flow upon entry into the zone for the reducing of the velocity of the flow.

[0021] Another embodiment of the method further includes directing the flow of cryogenic gas with an interior surface of the freezer toward the underside of the belt.

[0022] Another embodiment of the method further includes dividing the flow of the cryogenic gas at the underside of the belt before moving the flow through the belt.

[0023] Another embodiment of the method includes the moving the flow of the cryogenic gas through the belt is at a substantially constant velocity throughout a length and width of the belt.

[0024] It will be understood that the embodiments described herein are merely exemplary, and that a person skilled in the art may make variations and modifications without departing from the spirit and scope of the invention. All such variations and modifications are intended to be included within the scope of the invention as described and claimed herein. It should be understood that the embodiments described above are not only in the alternative, but can be combined.

CLAIMS

What is claimed is:

1. A cryogenic freezer apparatus, comprising:

a housing;

a fluidized bed belt movable within the housing;

a shroud positioned within the housing for providing a zone above the belt, the shroud angled outward from the belt within the housing; and

a least one blower positioned within the housing in fluid communication with the zone and centrally located above the zone and the shroud.

2. The apparatus of claim 1, wherein the belt comprises a first width within the housing, and the zone comprises a second width within the housing greater than the first width.

3. The apparatus of claim 2, wherein the second width is twice as wide as the first width.

4. The apparatus of claim 1, wherein the shroud is angled outward fifteen degrees (15°) from the belt.

5. The apparatus of claim 1, further comprising a divider positioned below the belt for guiding gas flow to the belt.

6. The apparatus of claim 1, wherein the housing comprises an inner surface having a construction which directs gas flow within the housing to an underside of the belt.

7. A method of moving cryogenic gas to a fluidized bed belt in a freezer, comprising:

shrouding a zone within the freezer having a first pressure above the belt;

positioning at least one blower centrally located above the zone and the belt;

directing a flow of cryogenic gas from the at least one blower to an underside of the belt at a second pressure greater than the first pressure; and

moving the flow of cryogenic gas through the belt into the zone.

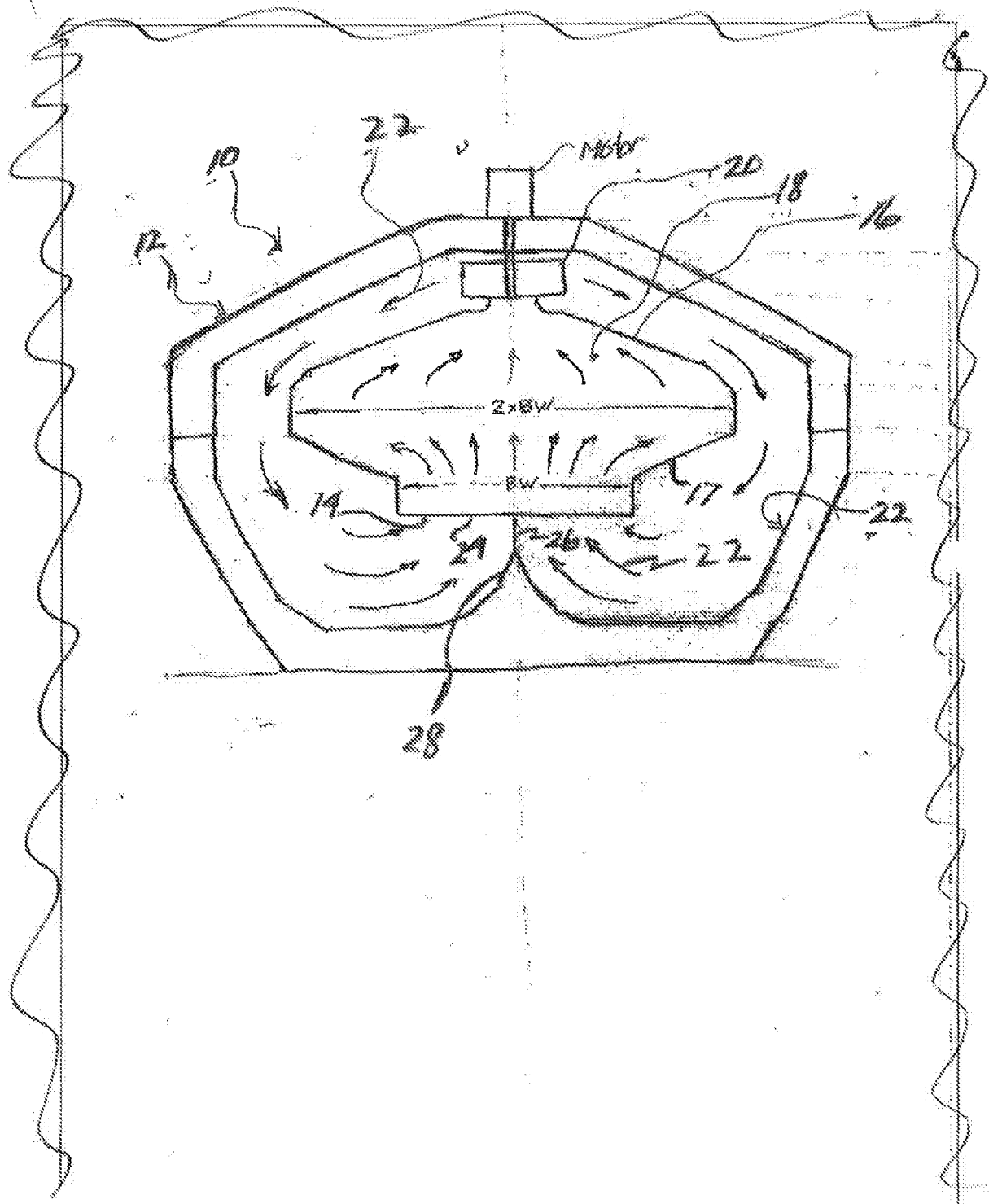
8. The method of claim 7, further comprising reducing a velocity of the flow upon the flow entering into the zone from the belt.

9. The method of claim 8, further comprising angling outward the flow upon entry into the zone for the reducing of the velocity of the flow.

10. The method of claim 7, further comprising directing the flow of cryogenic gas with an interior surface of the freezer toward the underside of the belt.

11. The method of claim 7, further comprising dividing the flow of the cryogenic gas at the underside of the belt before moving the flow through the belt.

12. The method of claim 7, wherein the moving the flow of the cryogenic gas through the belt is at a substantially constant velocity throughout a length and width of the belt.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 17/67476

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F25D 17/06 (2018.01)

CPC - F25D 17/06

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)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,229,947 A (KLEE) 28 October 1980 (28.10.1980) entire document	1-4, 6-10, 12
--		-----
Y		5, 11
Y	US 5,444,985 A (LANG et al) 29 August 1995 (29.08.1995) entire document	5, 11
A	US 2014/0130525 A1 (NEWMAN et al) 15 May 2014 (15.05.2014) entire document	1-6
A	US 2014/0096543 A1 (LEE et al) 10 April 2014 (10.04.2014) entire document	1-6
A	US 2010/0319365 A1 (NEWMAN) 23 December 2010 (23.12.2010) entire document	1-6



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

27 March 2018

Date of mailing of the international search report

12 APR 2018

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. 571-273-8300

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 17/67476

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
--SEE EXTRA SHEET--

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 17/67476

.*-Continuation of: Box No III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)-.*

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-6, directed to a cryogenic freezer apparatus including a fluidized bed belt, a shroud angled outward, and at least one blower in fluid communication with the zone.

Group II: Claims 7-12 directed to a method of moving cryogenic gas to a fluidized bed belt in a freezer including shrouding a zone having a first pressure, directing a flow of cryogenic gas from the at least one blower to an underside of the belt at a second pressure greater than the first pressure; and moving the flow of cryogenic gas through the belt into the zone.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

SPECIAL TECHNICAL FEATURES

The invention of Group I includes the special technical feature of
a fluidized bed belt movable within the housing;
the shroud angled outward from the belt within the housing
a least one blower positioned within the housing in fluid communication with the zone;
not required by the claims of Group II.

The invention of Group II includes the special technical feature of a method of moving cryogenic gas to a fluidized bed belt in a freezer, comprising:
shrouding a zone within the freezer having a first pressure above the belt;
directing a flow of cryogenic gas from the at least one blower to an underside of the belt at a second pressure greater than the first pressure; and
moving the flow of cryogenic gas through the belt into the zone;
not required by the claims of Group I.

COMMON TECHNICAL FEATURES

Groups I-II share the common technical features of a cryogenic freezer apparatus, comprising:

- a shroud positioned within the housing for providing a zone above the belt;
- at least one blower centrally located above the zone and the shroud.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 4,229,947 A to Klee (hereinafter referred to as Klee), which discloses a cryogenic freezer apparatus (Abstract; Fig. 1), comprising:

- a shroud (plates 62 and 64 and baffles 66 and 68; Col. 3, Lines 11-16; Fig. 1) positioned within the housing for providing a zone (chambers 70-72; Fig. 1) above the belt (Col. 3, lines 20-24);
- at least one blower (44; Col. 2, Lines 55-57; Fig. 1) centrally located above the zone and the shroud (as shown in Fig. 3).

As the common technical features were known in the art at the time of the invention, these cannot be considered special technical feature that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.