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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 April 2020 (23.04.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/081286 A1

(51) International Patent Classification:
A22C 29/02 (2006.01) *A22C 25/04* (2006.01)
A22C 29/00 (2006.01)

(21) International Application Number:
PCT/US2019/055152

(22) International Filing Date:
08 October 2019 (08.10.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
16/163,030 17 October 2018 (17.10.2018) 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, 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).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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

(54) Title: METHOD FOR INSPECTING SHRIMP

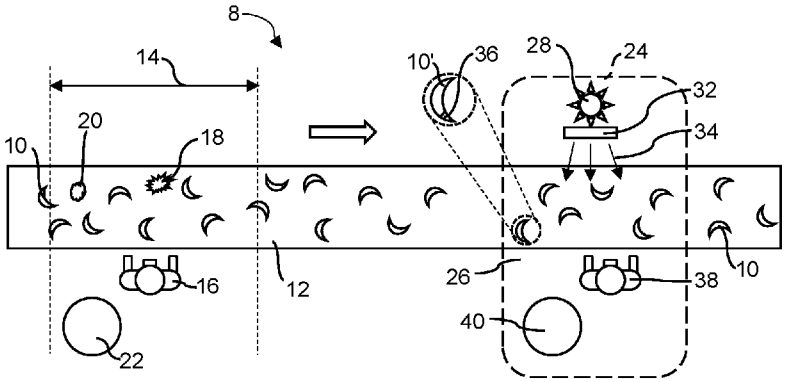

FIG. 1

(57) Abstract: A method for inspecting peeled shrimp by human operators in a culling station illuminated by ambient visible light and in a dark shell-detection booth illuminated by ultraviolet (UV) lamps. The UV radiation emitted by the lamps is filtered to remove visible light from the filtered UV irradiating the shrimp in the dark booth. Irradiated shrimp shell fluoresces and is detectable by the naked eye. A human operator in the dark booth detects the fluorescing shell and removes those shrimps.

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METHOD FOR INSPECTING SHRIMP

BACKGROUND

The invention relates generally to a method for inspecting peeled shrimps.

In the bulk processing of shrimp, automated shrimp peelers remove heads, appendages, and shells from the shrimp. Although the peeling process is generally thorough, some shrimps are left with residual shell. To improve the quality of the final product, shrimps with residual shell are culled from the completely peeled shrimp. Detection of residual shell is often done by visual inspection. But transparent residual shell is not always easy to notice.

SUMMARY

One method embodying features of the invention for inspecting peeled shrimps comprises: (a) providing a dark booth that blocks outside visible light from entering the booth's interior; (b) emitting ultraviolet (UV) radiation directed toward a group of peeled shrimps in the interior of the dark booth; (c) filtering out visible light in the UV radiation to produce filtered UV radiation; (d) irradiating the group of peeled shrimps in the interior of the dark booth with the filtered UV radiation to cause residual shell to fluoresce with visible light; and (e) providing a human operator in the dark booth to visually detect the visible light of fluorescing shell with the naked eye.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan schematic of an inspection system for inspecting peeled shrimp in culling and shell-detection stations embodying features of the invention;

FIG. 2 is a block diagram of a UV source and a filter usable in the shell-detection station of FIG. 1;

FIG. 3A is the spectrum of the UV radiation emitted by the UV source of FIG. 2, and FIG. 3B is the spectrum of the UV radiation of FIG. 3A after passing through a filter blocking visible light; and

FIG. 4A is the spectrum of the reflected radiation of a completely shelled shrimp, and FIG. 4B is the spectrum of the reflected radiation of shrimp shell.

DETAILED DESCRIPTION

Manual culling and shell-detection stations in a peeled-shrimp inspection system 8 are shown in FIG. 1 in a continuous system. Peeled shrimps 10 loaded onto a conveyor 12, such as a conveyor belt, are conveyed through a culling station 14. A human operator 16 manning the culling station 14 in ambient lighting culls unwanted shrimp bits and debris 18, 20 from the supply of shrimps 10 passing by and deposits the debris 18, 20 in a collection receptacle 22. The conveyor 12, which may be one or more conveyor belts or a water trough, as just two examples, then conveys the peeled shrimps 10 into and through a dark booth 24.

The dark booth 24 prevents ambient visible light from entering the booth's interior 26. A UV lamp 28 emits UV radiation 30 directed at the group of shrimps 10 in the booth 24 as also shown in FIG. 2. The UV radiation 30 is filtered by a band-pass filter 32 to filter out visible light and produce filtered UV radiation 34 that irradiates the group of shrimps 10 in the dark booth 24. The filtered UV radiation 34 irradiating the shrimps 10 causes residual shell 36 to fluoresce by shifting some of the UV radiation into the visible-light region of the spectrum. The visible light from the fluorescing shell is visible to the naked human eye and so is detectable by a human operator 38 in the dark booth 24. The human operator 38 in the dark booth removes those shrimps 10' with residual shell 36 from the group of shrimps 10 and deposits them in a reject receptacle 40 from which they can be returned to the peeler. The shrimps 10 exiting the dark booth 24 are free of residual shell.

As an alternative, the dark booth 24 can be operated as a stand-alone quality-control station, in which samples of peeled shrimps are placed on a stationary support surface and inspected by the naked eye of an operator to detect fluorescing shell.

The dark booth 24 blocks enough ambient visible light from entering its interior 26 to ensure that the fluorescence of the shells is detectable by the naked eye. And it has been found that inexpensive UVa lamps, better known as black lights, cause enough fluorescence of the shells to be detectable. Besides being inexpensive, UVa lamps do not subject the human operator 38 in the dark booth 24 to unsafe levels of higher-frequency UV radiation.

FIG. 3A shows the spectrum of an unfiltered UVa lamp. The spectrum is shown as a function of wavelength (λ) rather than frequency. So, the longer wavelengths and lower frequencies are to the right in the graphs of the spectrum in FIGS. 3A–4B. The unfiltered UVa radiation has a main band concentrated around 350 nm and some longer-wavelength

bands in the visible light region of the spectrum. The maximum energy of the UVa lamp in the main band occurs over a range 42 of ultraviolet wavelengths concentrated at about 350 nm just below the visible-light region 44 (about 380 nm to 740 nm). The band-pass filter 32 (FIGS. 1 and 2) filters out the visible light above about 400 nm, as well as shorter-wavelength radiation below about 310 nm, as shown in the spectrum of the filtered UVa radiation in FIG. 3B to make the fluorescence of shell easier to see. The filter also affects the spectrum of the main UVa lamp energy 42 with its peak at about 350 nm by shifting the spectral peak of the filtered UVa irradiating the shrimps to about 365 nm.

FIG. 4A shows the spectrum of reflected radiation from completely shelled shrimps irradiated by the filtered UVa radiation of FIG. 3B. FIG. 4B shows the spectrum of reflected radiation from shell irradiated by the filtered UVa radiation of FIG. 3B. The level 46 of the reflected radiation in the visible light region for completely shelled shrimp is lower than the level 48 of the reflected and fluorescent radiation from fluorescing shell, which is detectable by the naked eye in the dark booth. The peak energy of the main band of reflected UVa radiation from shrimp shell as shown in FIG. 4B is much lower than the reflected UVa radiation from completely shelled shrimps as shown in FIG. 4A indicating that much of the main band of incident UVa energy is absorbed by the shell and converted into higher-wavelength fluorescent light easily visible to the naked eye.

WHAT IS CLAIMED IS:

1. A method for inspecting peeled shrimps comprising:

providing a dark booth blocking outside visible light from entering the interior of the dark booth;

emitting UV radiation directed toward a group of peeled shrimps in the interior of the dark booth;

filtering out visible light in the UV radiation to produce filtered UV radiation;

irradiating the group of peeled shrimps in the interior of the dark booth with the filtered UV radiation to cause residual shell on the peeled shrimps to fluoresce with visible light;

providing a human operator in the dark booth to visually detect the visible light of fluorescing shell with the naked eye.

2. The method as claimed in claim 1 wherein the human operator removes peeled shrimps with residual shell from the group of peeled shrimps in the dark booth.

3. The method as claimed in claim 1 comprising conveying peeled shrimps through the interior of the dark booth on a conveyor belt.

4. The method as claimed in claim 1 comprising conveying peeled shrimps through the interior of the dark booth in a water trough.

5. The method as claimed in claim 1 comprising supporting the group of peeled shrimps in the interior of the dark booth on a stationary support surface.

6. The method as claimed in claim 1 wherein the UV radiation is UVa radiation.

7. The method as claimed in claim 1 comprising a culling station outside the dark booth wherein unwanted shrimp parts and other debris are visually detected by human eye under ambient visible light and manually removed from peeled shrimps before the peeled shrimps enter the dark booth.

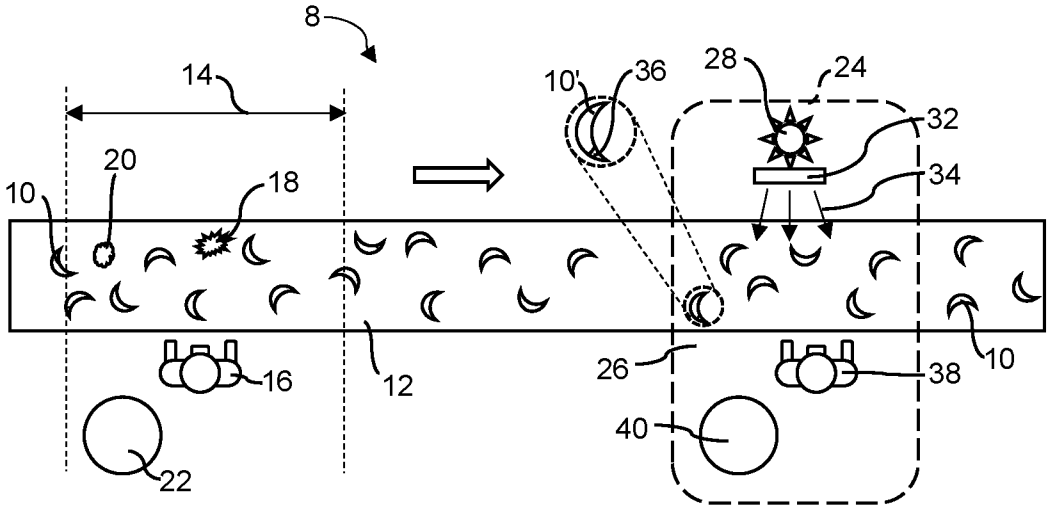

FIG. 1

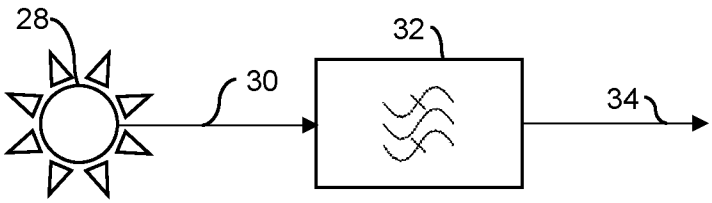

FIG. 2

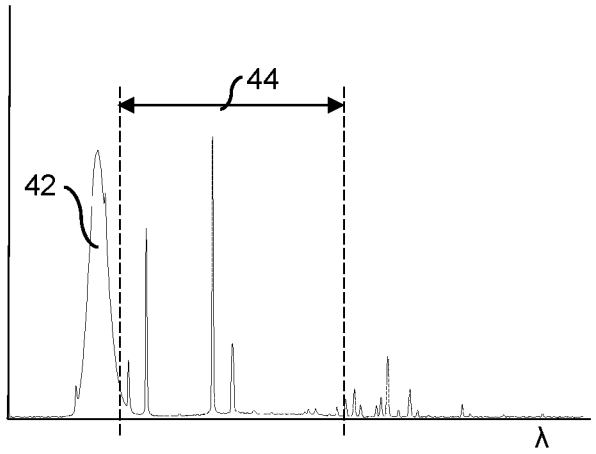

FIG. 3A

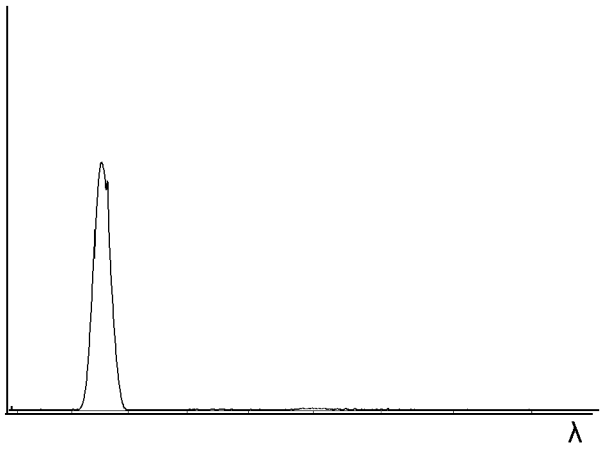

FIG. 3B

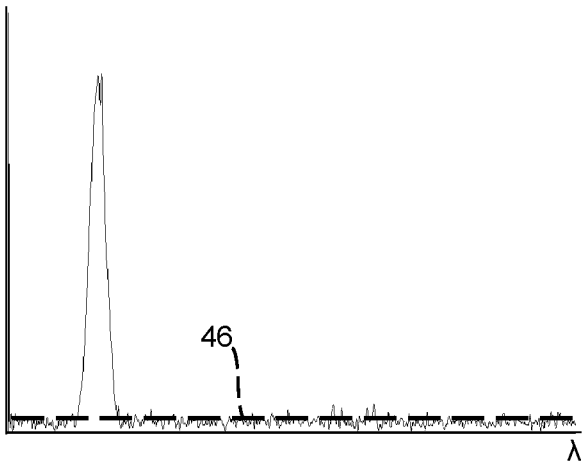

FIG. 4A

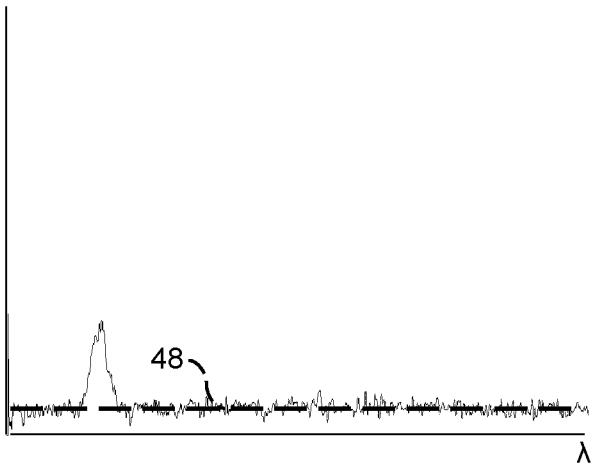

FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/055152

A. CLASSIFICATION OF SUBJECT MATTER

A22C 29/02(2006.01)i, A22C 29/00(2006.01)i, A22C 25/04(2006.01)i

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)
A22C 29/02; A01K 11/00; A22C 18/00; A22C 25/04; A22C 2902; G06K 9/00; A22C 29/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords:peeled shrimps, UV radiation, visible light, dark booth

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6736716 B1 (SUGIYAMA, H.) 18 May 2004 abstrat; claims 1, 4	1-7
A	US 8033898 B2 (MCNAUGHTON, J. L. et al.) 11 October 2011 abstract; claim 1	1-7
A	US 7195551 B2 (SHEFET, S. M.) 27 March 2007 abstract; claim 1	1-7
A	US 9930896 B2 (LAITRAM, L.L.C.) 03 April 2018 abstract; claim 1	1-7
A	US 6808448 B1 (KANAYA, M. et al.) 26 October 2004 abstrat; claim 1	1-7

☐ 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
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"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
31 January 2020 (31.01.2020)	**03 February 2020 (03.02.2020)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/055152

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6736716 B1	18/05/2004	AU 6022800 A	13/02/2001
		AU 777052 B2	30/09/2004
		CA 2345144 A1	01/02/2001
		CA 2345144 C	23/05/2006
		CN 1317936 A	17/10/2001
		EP 1116442 A1	18/07/2001
		EP 1116442 A4	16/02/2005
		JP 3726059 B2	14/12/2005
		KR 10-0450338 B1	30/09/2004
		WO 01-06861 A1	01/02/2001
US 8033898 B2	11/10/2011	AR 044897 A1	05/10/2005
		AR 051862 A1	14/02/2007
		AU 2004-255532 A1	20/01/2005
		AU 2004-255532 B2	20/05/2010
		AU 2004-255532 B8	08/07/2010
		AU 2004-326211 A1	06/07/2006
		AU 2004-326211 B2	08/12/2011
		BR PI0411737 A	08/08/2006
		BR PI0419260 A	18/12/2007
		CA 2591197 A1	06/07/2006
		CA 2591197 C	06/10/2015
		CN 101115396 A	30/01/2008
		CN 101115396 B	25/07/2012
		CN 1809279 A	26/07/2006
		CN 1809279 B	24/11/2010
		EP 1827119 A1	05/09/2007
		JP 2008-525021 A	17/07/2008
		KR 10-2006-0088479 A	04/08/2006
		MX 2007007371 A	14/08/2007
		MX PA05013737 A	13/03/2006
		NZ 556599 A	31/05/2009
		US 2004-0265446 A1	30/12/2004
		US 2009-0110768 A1	30/04/2009
		US 2011-0189338 A1	04/08/2011
		US 7901276 B2	08/03/2011
		WO 2005-004614 A1	20/01/2005
		WO 2006-071224 A1	06/07/2006
US 7195551 B2	27/03/2007	AU 2003-251903 A1	19/03/2004
		AU 2003-251903 A8	19/03/2004
		US 2004-0043717 A1	04/03/2004
		US 2007-0072529 A1	29/03/2007
		WO 2004-019697 A2	11/03/2004
		WO 2004-019697 A3	10/03/2005
US 9930896 B2	03/04/2018	CA 2833488 A1	19/06/2014
		CN 103878122 A	25/06/2014
		CN 103878122 B	23/03/2018

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/055152

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		DK 178532 B1	06/06/2016
		DK 201370785 A	20/06/2014
		EP 2745699 A1	25/06/2014
		EP 2745699 B1	19/08/2015
		EP 2957176 A1	23/12/2015
		EP 2957176 B1	05/04/2017
		US 2014-0168411 A1	19/06/2014
US 6808448 B1	26/10/2004	AU 6873800 A	10/04/2001
		CA 2383726 A1	15/03/2001
		CA 2383726 C	06/09/2005
		CN 1240295 C	08/02/2006
		CN 1387406 A	25/12/2002
		DE 60019445 T2	23/02/2006
		DK 1219175 T3	30/05/2005
		EP 1219175 A1	03/07/2002
		EP 1219175 A4	21/05/2003
		EP 1219175 B1	13/04/2005
		JP 2001-078659 A	27/03/2001
		JP 3587745 B2	10/11/2004
		KR 10-0434741 B1	04/06/2004
		NO 20021136 L	08/05/2002
		NO 321844 B1	10/07/2006
		TW 440430 B	16/06/2001
		WO 01-17361 A1	15/03/2001