TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER 088000-006700US U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
INTERNATIONAL APPLICATION NO. PCT/EP2008/007567	INTERNATIONAL FILING DATE September 12, 2008	PRIORITY DATE CLAIMED October 24, 2007
TITLE OF INVENTION FAT COVER MEASUREMENT DEVICE		
APPLICANT(S) FOR DO/EO/US GUENTHER WEBER		

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A preliminary amendment.
14. ☒ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.2 and 37 CFR 1.821 – 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

Provisur EX1002
U.S. Patent No. 8,529,321

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
	PCT/EP2008/007567	088000-006700US

20. Other items or information:

The following fees have been submitted	CALCULATIONS	PTO USE ONLY
21. ☒ Basic national fee (37 CFR 1.492(a)) **$330**	$ 330	
22. ☒ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** All other situations..... **$220**	$ 220	
23. ☒ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority..... **$100** International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB ..... **$430** All other situations..... **$540**	$ 430	
TOTAL OF 21, 22 and 23 =	$ 980	

☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) or computer program listing in an electronic medium) (37 CFR 1.492(j)).
The fee is **$270** for each additional 50 sheets of paper or fraction thereof.

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round **up** to a whole number)	RATE	
- 100 =	/50 =		x **$270**	$

Surcharge of **$130.00** for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).	$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	21 - 20 =	1	x **$ 52**	$ 52	
Independent claims	- 3 =		x **$220**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$390**	$	
			TOTAL OF ABOVE CALCULATIONS =	$ 1032	
☐ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.				$	
			SUBTOTAL =	$ 1032	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
			TOTAL NATIONAL FEE =	$ 1032	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
			TOTAL FEES ENCLOSED =	$ 1032	
			Amount to be refunded:	$	
			Amount to be charged:	$ 1032	

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
	PCT/EP2008/007567	088000-006700US

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 20-1430 in the amount of $ 1032 to cover the above fees.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 20-1430 .

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do **NOT** attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is **not** recommended and by doing so your **credit card information may be displayed via PAIR.** To protect your information, it is recommended paying fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

SEND ALL CORRESPONDENCE TO:

J. Georg Seka
TOWNSEND AND TOWNSEND AND CREW LLP
Two Embarcadero Center, Eighth Floor
San Francisco, CA 94111-3834

SIGNATURE

J. Georg Seka
NAME

24,491 Date: 4/20/2010
REGISTRATION NUMBER

62573665 v1

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
088000-006700US	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP2008/007567	September 12, 2008	October 24, 2007

TITLE OF INVENTION: FAT COVER MEASUREMENT DEVICE

APPLICANT(S) FOR DO/EO/US: GUENTHER WEBER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

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Independent claims	- 3 =		x **$220**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$390**	$	
			TOTAL OF ABOVE CALCULATIONS =	$ 1032	
☐ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.				$	
			SUBTOTAL =	$ 1032	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
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			TOTAL FEES ENCLOSED =	$ 1032	
			Amount to be refunded:	$	
			Amount to be charged:	$ 1032	

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
	PCT/EP2008/007567	088000-006700US

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 20-1430 in the amount of $ 1032 to cover the above fees.

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SEND ALL CORRESPONDENCE TO:

J. Georg Seka
TOWNSEND AND TOWNSEND AND CREW LLP
Two Embarcadero Center, Eighth Floor
San Francisco, CA 94111-3834

SIGNATURE

J. Georg Seka
NAME

24,491 Date: 4/20/2010
REGISTRATION NUMBER

62573665 v1

Application Data Sheet

Application Information

Application number::	
Filing Date::	
Application Type::	Filing Under 35 U.S.C. 371
Subject Matter::	Utility
Suggested classification::	
Suggested Group Art Unit::	
CD-ROM or CD-R??::	
Number of CD disks::	
Number of copies of CDs::	
Sequence Submission::	
Computer Readable Form (CRF)?::	
Number of copies of CRF::	
Title::	Fat Cover Measurement Device
Attorney Docket Number::	088000-006700US
Request for Early Publication::	No
Request for Non-Publication::	No
Suggested Drawing Figure::	
Total Drawing Sheets::	1
Small Entity?::	No
Latin name::	
Variety denomination name::	
Petition included?::	No
Petition Type::	
Licensed US Govt. Agency::	
Contract or Grant Numbers One::	
Secrecy Order in Parent Appl.::	No

Applicant Information

Applicant Authority Type::	Inventor
Primary Citizenship Country::	Germany
Status::	Full Capacity
Given Name::	Guenther
Middle Name::	
Family Name::	Weber
Name Suffix::	
City of Residence::	Gross Nemerow
State or Province of Residence::	
Country of Residence::	Germany
Street of Mailing Address::	Zachow 5
City of Mailing Address::	Gross Nemerow
State or Province of mailing address::	
Country of mailing address::	Germany
Postal or Zip Code of mailing address::	17094

Correspondence Information

Correspondence Customer Number::	20350

Representative Information

Representative Customer Number::	20350

Domestic Priority Information

Application::	Continuity Type::	Parent Application::	Parent Filing Date::

Foreign Priority Information

Country::	Application number::	Filing Date::
PCT	PCT/EP2008/007567	09/12/08
Germany	10 2007 050 857.5	10/24/07

Initial 4/17/10

Assignee Information

Assignee Name::	Weber Maschinenbau GmbH Breidenbach
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City of mailing address::	Breidenbach
State or Province of mailing address::	
Country of mailing address::	Germany
Postal or Zip Code of mailing address::	35236

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on April 20, 2010.

TOWNSEND and TOWNSEND and CREW LLP

By: William Chinn

PATENT
Attorney Docket No. 088000-006700US
Client Ref. No. W10078PWOUS – Jr/Sh/Ru

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No.
GUENTHER WEBER	Examiner:
Application No. (not yet assigned)	Art Unit:
Int'l Application No. PCT/EP08/007567	PRELIMINARY AMENDMENT
Filed: (herewith)	
For: FAT COVER MEASUREMENT DEVICE	
Customer No. 20350	

April 20, 2010
San Francisco, CA 94111

Mail Stop PCT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

Prior to examination of the above-referenced application, please enter the following amendments and remarks:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Abstract begin on page 3 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 4 of this paper.

Remarks/Arguments begin on page 8 of this paper.

Amendments to the Specification:

Please add the following new heading and paragraph *after* the Title and *before* the first paragraph:

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a National Stage of International Application No. PCT/EP2008/007567 filed September 12, 2008, and which claims the benefit of German Patent Application No. 10 2007 050 857.5, filed October 24, 2007, the disclosures of which are incorporated herein by reference.

Amendments to the Abstract:

Please add the following:

The invention relates to a measuring device (18) for determining the thickness of a layer of fat of a meat product (12) comprising a premium cut part and a layer of fat, wherein the thickness of the layer of fat is determined in a contact-free manner. The invention also relates to a device for separating the layer of fat of a meat product from a premium cut part of a meat product by means of said type of measuring device, and to a method for determining the thickness of a layer of fat of a meat product and to a method for separating a layer of fat of a meat product.

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claim 1 (original): A measurement device (18) for the determination of the thickness of a fat cover of a meat product (12) comprising a flesh component and a fat cover,

characterized in that

the determination of the thickness of the fat cover takes place in a contactless manner.

Claim 2 (original): A measurement device (18) in accordance with claim 1, characterized in that the determination of the thickness of the fat cover takes place optically.

Claim 3 (currently amended): A measurement device (18) in accordance with claim 1 ~~or claim 2~~, characterized by a light detector, in particular a camera, for the detection of light reflected at the meat product (12).

Claim 4 (currently amended): A measurement device (18) in accordance with ~~any one of the preceding claims~~ claim 1, characterized by a light source illuminating a region of the meat product (12).

Claim 5 (original): A measurement device (18) in accordance with claim 4, characterized in that the light source includes at least one light emitting diode, in particular a light emitting diode emitting in the blue wavelength spectrum.

Claim 6 (currently amended): A measurement device (18) in accordance with ~~any one of the preceding claims~~ claim 1, characterized in that a transport device (20) is provided to transport the meat product (12), in particular continuously, through the measurement device (18).

Claim 7 (currently amended): A measurement device (18) in accordance with claim 6, characterized in that a light source and a light detector are arranged[[,]] laterally next to the transport device (20) viewed in the transport direction.

Claim 8 (currently amended): An apparatus for the separation of a fat cover of a meat product (12) from a flesh component of the meat product (12) having a measurement device (18), in particular a measurement device (18) in accordance with ~~any one of the preceding claims~~ claim 1, for the automatic determination of the thickness of the fat cover and having a cutting device (10) coupled to the measurement device (18) for the automatic separation of the fat cover from the flesh component in dependence on the measured data determined by the measurement device (18).

Claim 9 (original): An apparatus in accordance with claim 8, characterized in that a transport device (14, 20) is provided to transport the meat product (12), in particular continuously, through the measurement device (18) and to supply it to the cutting device (10).

Claim 10 (currently amended): An apparatus in accordance with claim 8 ~~or claim 9~~, characterized in that the cutting device (10) includes a cutting blade, in particular a cutter bar, whose position, and in particular whose height, is variable relative to a product support.

Claim 11 (original): An apparatus in accordance with claim 10, characterized in that the cutting device (10) has a control unit for the control of the position or height of the cutting blade in dependence on the measured data determined by the measurement device (18).

Claim 12 (original): An apparatus in accordance with claim 11, characterized in that at least one travel profile is stored in the control unit in accordance with which the position and in particular the height of the cutting blade relative to a product support is to be set in dependence on a product feed.

Claim 13 (original): A method for the determination of the thickness of a fat cover of a meat product (12) comprising a flesh component and a fat cover,

characterized in that

the thickness of the fat cover is determined in a contactless manner.

Claim 14 (original): A method in accordance with claim 13, characterized in that the thickness of the fat cover is determined by means of an optical measurement.

Claim 15 (currently amended): A method in accordance with claim 13 ~~or claim 14~~, characterized in that the thickness of the fat cover is determined during a transport movement, in particular a continuous transport movement, of the meat product 12.

Claim 16 (currently amended): A method in accordance with ~~any one of the claims 13 to 15~~ claim 13, characterized in that only a part section of the meat product (12), in particular a front part section viewed in a transport direction, is measured for the determination of the thickness of the fat cover.

Claim 17 (currently amended): A method in accordance with ~~any one of the claims 13 to 16~~ claim 13, characterized in that the shape of the fat cover is determined over the total meat product (12) by a measurement of the meat product (12) at characteristic measurement points and by subsequent interpolation or extrapolation.

Claim 18 (currently amended): A method in accordance with ~~any one of the claims 13 to 17~~ claim 13, characterized in that the determined measured values are compared with measured values experience has shown are to be expected for the meat product (12) and an error message is displayed on a deviation of the determined measured values from the measured values to be expected.

Claim 19 (currently amended): A method for the separation of a fat cover of a meat product (12) from a flesh component of the meat product (12) in which the thickness of the fat cover is determined, in particular by means of a method in accordance with ~~any one of the claims 13 to 18~~ claim 13, and the fat cover is separated from the flesh component in dependence on the determined thickness of the fat cover.

Claim 20 (currently amended): A method in accordance with claim 19, characterized in that the position of a cutting blade for the separation of the fat cover is set in accordance with a preset travel profile in dependence on a feed of the [[meet]] meat product (12) in a direction ~~transversely~~ transverse to the feed direction.

Claim 21 (currently amended): A method in accordance with claim 19 ~~or claim 20~~, characterized in that only a part section of the meat product (12), in particular a front part section viewed in a transport direction, is measured for the determination of the thickness of the fat cover and a stored travel profile is selected in dependence on the measured result in accordance with which the position, and in particular the height, of the cutting blade relative to a product support is set in dependence on a product feed.

REMARKS/ARGUMENTS

Claims 1-21 are presently pending. Claims 3-4, 6, 8, 10, 15-19 and 20-21 have been amended. This Amendment is submitted to eliminate all multiple dependencies from the claims, thereby avoiding the need to pay the multiple dependent surcharge. This Amendment is also submitted to add the priority claim to the presently filed application.

CONCLUSION

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-576-0200.

Respectfully submitted,



J. George Seka
Reg. No. 24,491

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, Eighth Floor
San Francisco, California 94111-3834
Tel: 415-576-0200
Fax: 415-576-0300
Attachments
JGS:w1c
62573498 v1

WO 2009/052905 PCT/EP2008/007567

FAT COVER MEASUREMENT DEVICE

The invention relates to a measurement device for the determination of the thickness of a fat cover of a meat product comprising a flesh component and a fat cover.

Meat products essentially comprise three components, namely rind, fat and flesh. The pieces of meat to be processed are carved into these three components depending on demand in the meat processing industry.

To be able to separate the rind and the fat, i.e. the fat cover, from the flesh component of a meat product in an automated process, it is necessary to know the thickness of the fat cover, in other words its size or height. Known measurement devices provide a sensor for the determination of the thickness of a fat cover of a meat product which is inserted into the product and detects the environmental brightness during the insertion. A conclusion can be drawn on the consistency of the material pierced by the sensor or at least a change in the consistency can be detected by an evaluation of the different brightness values occurring during the insertion and detected by the sensor, from which ultimately the thickness of a fat cover can be determined.

It is disadvantageous in this connection that the meat product is damaged by the insertion of the sensor, in particular since the sensor has to be inserted at multiple sites of the product for a reliable determination of the thickness of the fat cover or a plurality of sensors arranged in a distributed manner have to be inserted into the product simultaneously.

It is the underlying object of the invention to provide a measurement device which allows a determination of the thickness of a fat cover of a meat product without damaging the meat product in so doing.

The object is satisfied by a measurement device having the features of claim 1 and in particular in that the determination of the thickness of the fat cover takes place in a non-contact manner.

The determination of the thickness of the fat cover advantageously takes place optically. The measurement device can for this purpose have a light detector for the detection of light reflected at the meat product. The light detector can include a camera, for example a CCD camera whose field of vision is preferably selected to be so large that a region of the meat product is detected which includes a boundary surface between the fat cover and the flesh component.

A conclusion can be drawn on the consistency of the detected product material with reference to the determined reflectivity of the regions of the meat product detected by the light detector so that a transition from one component to another component of the meat product can be recognized or even different components of the meat product and in particular the fat cover of the meat product can be identified from which ultimately the thickness of the fat cover can be determined.

To improve the detection result, a light source can be provided which illuminates a region of the meat product and in particular the region detected by the light detector. In accordance with a preferred embodiment, the light source includes at least one light emitting diode, in particular a light emitting diode emitting in the blue wavelength spectrum. Since the reflection properties of the fat component and of the flesh component of a

meat product in particular differ considerably from one another in the blue wavelength spectrum, the use of blue light allows a particularly reliable determination of the fat cover thickness.

In accordance with a further embodiment, a transport device is provided to transport the meat product, in particular continuously, through the measurement device. In this way, the measurement of the meat product can easily be integrated into a process for the processing of the meat product. The transport device preferably includes a conveying means which is provided to supply the meat product to a cutting device for the separation of the fat cover from the flesh component.

The light detector and the light source are advantageously arranged laterally next to the transport device viewed in the transport direction.

A further subject of the invention is an apparatus for the separation of a fat cover of a meat product from a flesh component of the meat product having a measurement device for the automatic measurement of the fat cover, in particular a measurement device of the above-described kind, and having a cutting device coupled to the measurement device for the automatic separation of the fat cover from the flesh component in dependence on the measured data determined by the measurement device.

The coupling of the cutting device to the measurement device allows a completely automated separation of the fat cover from the flesh component of the meat product. In particular no manual measurement of the fat cover or manual adaptation of the cutting device to the measured fat cover thickness is required since both the determination of the fat cover thickness and the corresponding setting of the cutting device takes

place automatically. This ultimately allows a separation of a fat cover from a flesh component of a meat product with a significantly lower economic effort.

If the determination of the fat cover thickness takes place in a non-contact manner, as described above, the fat cover can be separated from the flesh part without the fat cover and/or the flesh component being pierced, incised or damaged in any other manner.

A transport device is advantageously provided to transport the meat product, in particular continuously, through the measurement device and to supply it to the cutting device.

The cutting device can include a cutting blade, in particular a cutter bar, whose position, and in particular whose height, is variable relative to a product support. In this manner, the cutting device and in particular the cutting blade position can be adapted to differently thick fat covers or the thickness can be set with which the fat cover is separated from the flesh component.

The cutting device preferably has control unit for the control of the operation of the cutting blade in dependence on the measured data determined by the measurement device.

In addition, a travel profile can be stored in the control device in accordance with which the position, and in particular the height of the cutting blade, is to be set relative to a product support in dependence on a product feed. The travel profile makes it possible to take account so-to-say of the anatomy of the meat product on the separation of the fat cover from

the flesh component and to follow the natural shape, that is the anatomically induced shape, of the fat cover.

A further subject of the invention is a method for the determination of the thickness of a fat cover of a meat product including a flesh component and a fat cover having the features of claim 13 by which the advantages already explained in connection with the measurement device in accordance with the invention can be realized correspondingly.

In accordance with a preferred embodiment of the method, only a part section of the meat product is measured for the determination of the thickness of the fat cover, in particular a front part section viewed in a transport direction. The measurement of a part section enables a sufficiently precise prediction on the shape of the fat cover over the total extent of the meat product in particular with such meat products in which the fat cover shape varies from product to product in a known manner or only slightly since the measured part section can be unambiguously associated with one of a plurality of known "anatomies" of the meat product. A cutting program can thus be selected in dependence on the measured result or on the associated "anatomy" by which the fat cover can be separated in the desired manner.

Alternatively or additionally, the shape of the fat cover can be determined by a measurement of the meat product at characteristic measurement points and a subsequent interpolation or extrapolation over the total meat product. This allows, on the one hand, a check whether the "anatomy" of the meat product was correctly determined from the measurement of a part section and, optionally, a modification of the cutting program. On the other hand, the fat cover shape over the total extent of the meat product can also be determined with those meat products in which experience has

shown that the shape of the fat cover varies so much from product to product that the measurement in a part section is not sufficient for the precise determination of the fat cover shape.

In accordance with a further embodiment, the determined measured values are compared with measured values experience has shown are to be expected for the meat product and an error message is displayed on a deviation of the determined measured values from the measured values to be expected. In this way, unusual product deviations and/or miscuts can be detected and reported, whereby an incorrect processing of the product can be avoided, in particular with a fully automatic processing of the meat product.

If a camera system is used for the determination of the fat cover thickness, it cannot only be determined whether the meat product is located in a correct position for a further processing, but also whether a contamination of the camera objective is present by a corresponding evaluation of the taken camera images and in particular by a comparison of the taken camera images with statistical reference images. If the former or latter should be the case, a corresponding error message can be output and a processing of the meat product can optionally be stopped to avoid incorrect processing of the meat product.

A further object of the invention is furthermore a method for the separation of a fat cover of a mat product from a flesh component of the meat product having the features of claim 19 by which the advantages explained in connection with the separating apparatus can be achieved correspondingly.

The invention will be described in the following purely by way of example with reference to an advantageous embodiment and to the enclosed drawing. There are shown:

Fig. 1 an apparatus in accordance with the invention for the separation of a fat cover of a meat product from a flesh component of the meat product with a measurement device and a cutting device; and

Fig. 2 a perspective view of the measurement device of Fig. 1.

The apparatus shown in Fig. 1 includes a cutting device 10 for the separation of a fat cover from a flesh component of a meat product 12. Such a cutting device 10 is also called a derinding machine or a defatting machine.

The meat product 12 is supplied to the cutting device 10 by means of a transport device which has a first conveyor belt 14 for this purpose. An upper side 16 of the first conveyor belt 14 defines a support plane for the meat product 12.

The cutting device 10 includes, in a manner known per se, a cutter bar not shown in the Figure for the separation of the fat cover. The position of the knife bar relative to the first conveyor belt 14 and in particular the height of the cutter bar above the upper side 16 of the first conveyor belt 14 can be set in dependence on the thickness of the fat cover layer to be separated or on the thickness of the fat cover layer which should remain on the flesh component.

To enable a fully automatic defatting or derinding of the meat product 12, a measurement device 18 for the measurement of the meat product 12 is positioned in front of the cutting device 10 viewed in the transport or supply direction of the meat product 12.

The measurement of the meat product 12 takes place in a continuous running process while the meat product 12 moves through the measurement device 18. A second conveyor belt which is likewise part of the already named transport device and which adjoins the first conveyor belt 14 is provided for the transport of the meat product 12 through the measurement device 18.

The measurement of the meat product 12 is a contactless optical measurement. For this purpose an LED illuminator and a camera, for example a CCD camera, are provided behind a viewing window 22 arranged laterally next to the second conveyor belt 20.

The LED illuminator includes at least one light emitting diode emitting in the blue wavelength spectrum and is designed so that it illuminates a part region of the meat product 12 at least including the fat cover of the meat product 12. The use of blue light is particularly advantageous because the contrast between flesh and fat cover is particularly striking under blue light so that the course of the boundary between flesh and fat cover can be recognized particularly easily.

Images of the region of the meat product 12 illuminated by the LED illuminator are taken by means of the camera. The images taken are evaluated in an evaluation unit to determine the thickness of the fat cover, in other words that is the size of fat and rind.

In addition, it can be determined by a comparison of the taken images with statistical reference images stored in the evaluation unit whether the meat product 12 is located in a correct position for the processing in the cutting device 10, i.e. that it is correctly aligned, and/or whether a contamination of a camera objective and/or of the viewing window 22 is present.

On a detected misalignment of the meat product 12 or contamination of the viewing window 22, an optical and/or acoustic error message can be displayed via an output means 24 connected to the evaluation unit so that an operator of the apparatus can take corresponding measures to remedy the error or errors. Alternatively or additionally, the evaluation unit can in such a case also stop the second conveyor belt 20 and/or the first conveyor belt 14 to prevent an erroneous further processing of the meat product 12.

It is generally possible to measure the meat product 12 over its total length viewed in the transport direction. In view of the data quantities which arise in this process, it is, however, more favorable to measure a part section of the meat product 12, for example a front part section viewed in the transport direction.

Specifically, the measurement of the meat product 12 can, for example, take place such that a plurality of flashes, e.g. 10 to 20 flashes, are emitted by the LED illuminator shortly after one another at short time intervals of e.g. a few 10 ms, while the meat product 12 moves past the viewing window 22. A respective value for the thickness of the fat cover is determined from the camera images associated with the respective flashes and a mean value is calculated from these determined values which is

considered as the actual value of the fat cover thickness in the detected region.

It is generally sufficient to carry out this measurement procedure once per meat product 12. If the measurement procedure is, however, carried out several time over a length of the meat product 12 of a plurality of centimeters, e.g. 10 to 15 cm, the actual thickness of the fat cover can be determined with a higher accuracy or an indication can already be obtained on the shape of the fat cover.

It can generally be assumed that the shape of the fat cover does not change significantly due to the anatomy of the meat product with similar meat products 12 so that it is sufficient, with knowledge of the anatomy of the meat product 12, to measure a part section of the meat product 12, e.g. to measure a front section in order to predict the shape of the fat cover and in particular its thickness over the total meat product 12. The measurement of the part region thus allows a clear determination of the shape of the fat cover.

The thickness of the fat cover determined in the part section by the measurement device 18 is transferred from the evaluation unit of the measurement device 18 to a control unit of the cutting device 10 which determines the anatomy of the meat product 12 from the measurement result.

Product-dependent or anatomy-dependent travel profiles are stored in the control unit of the cutting device 10 which effect a change in the setting of the cutter bar in dependence on the feed of the meat product 12 to be processed while taking account of the determined anatomy of the respective meat product 12 to be processed.

The control device selects a suitable travel profile with respect to the measured result of the determined anatomy of the meat product 12 and the height of the cutter bar is set by said travel profile in dependence on the thickness and on the shape of the fat cover and in dependence on the product feed so that a fat cover layer of a desired thickness is separated from the meat product 12 or so that a fat cover layer of a desired thickness remains at the flesh component of the meat product 12.

If meat products 12 are processed, which e.g. differ more from one another, it is also possible to determine the shape of the fat cover by a measurement of the meat product 12 at a plurality of characteristic measurement points which are in particular arranged distributed over the length of the meat product 12 and by a subsequent interpolation or extrapolation of the measured result over the total meat product 12.

The shape of the fat cover thus determined is in turn transferred from the evaluation unit of the measurement device 18 to the control unit of the cutting device 10 so that it can set the height of the cutter bar in dependence on the determined shape of the fat cover and in dependence on the product feed so that a fat cover layer of a desired thickness is separated from the meat product 12 or so that a fat cover layer of a desired thickness remains at the flesh component of the meat product 12.

Optionally, the measurement of the meat product 12 at a plurality of characteristic measurement points which are in particular arranged distributed over the length of the meat product 12 and the subsequent interpolation or extrapolation of the measured results over the total meat product 12 can be used not only instead of a stored travel profile, but also

additionally to a stored travel profile, so-to-say in the form of a fine setting, to control the setting of the cutter bar.

As a result, the apparatus in accordance with the invention allows a fully automatic separation of a fat cover from a flesh component of a meat product 12, with an incorrect processing of the meat product 12 being avoided by the mentioned error recognition and thus the process security being increased and in addition a piercing or incision of the fat cover and/or of the flesh component being avoided by the contactless measurement of the meat product 12.

Reference numeral list

10	cutting device
12	meat product
14	first conveyor belt
16	upper side
18	measurement device
20	second conveyor belt
22	viewing window
24	output means

Claims

1. A measurement device (18) for the determination of the thickness of a fat cover of a meat product (12) comprising a flesh component and a fat cover,
characterized in that
the determination of the thickness of the fat cover takes place in a contactless manner.

2. A measurement device (18) in accordance with claim 1, characterized in that the determination of the thickness of the fat cover takes place optically.

3. A measurement device (18) in accordance with claim 1 or claim 2, characterized by a light detector, in particular a camera, for the detection of light reflected at the meat product (12).

4. A measurement device (18) in accordance with any one of the preceding claims, characterized by a light source illuminating a region of the meat product (12).

5. A measurement device (18) in accordance with claim 4, characterized in that the light source includes at least one light emitting diode, in particular a light emitting diode emitting in the blue wavelength spectrum.

6. A measurement device (18) in accordance with any one of the preceding claims, characterized in that a transport device (20) is

provided to transport the meat product (12), in particular continuously, through the measurement device (18).

7. A measurement device (18) in accordance with claim 6, characterized in that a light source and a light detector are arranged, laterally next to the transport device (20) viewed in the transport direction.

8. An apparatus for the separation of a fat cover of a meat product (12) from a flesh component of the meat product (12) having a measurement device (18), in particular a measurement device (18) in accordance with any one of the preceding claims, for the automatic determination of the thickness of the fat cover and having a cutting device (10) coupled to the measurement device (18) for the automatic separation of the fat cover from the flesh component in dependence on the measured data determined by the measurement device (18).

9. An apparatus in accordance with claim 8, characterized in that a transport device (14, 20) is provided to transport the meat product (12), in particular continuously, through the measurement device (18) and to supply it to the cutting device (10).

10. An apparatus in accordance with claim 8 or claim 9, characterized in that the cutting device (10) includes a cutting blade, in particular a cutter bar, whose position, and in particular whose height, is variable relative to a product support.

11. An apparatus in accordance with claim 10, characterized in that the cutting device (10) has a control unit for the control of the

position or height of the cutting blade in dependence on the measured data determined by the measurement device (18).

12. An apparatus in accordance with claim 11, characterized in that at least one travel profile is stored in the control unit in accordance with which the position and in particular the height of the cutting blade relative to a product support is to be set in dependence on a product feed.

13. A method for the determination of the thickness of a fat cover of a meat product (12) comprising a flesh component and a fat cover, characterized in that
the thickness of the fat cover is determined in a contactless manner.

14. A method in accordance with claim 13, characterized in that the thickness of the fat cover is determined by means of an optical measurement.

15. A method in accordance with claim 13 or claim 14, characterized in that the thickness of the fat cover is determined during a transport movement, in particular a continuous transport movement, of the meat product 12.

16. A method in accordance with any one of the claims 13 to 15, characterized in that only a part section of the meat product (12), in particular a front part section viewed in a transport direction, is measured for the determination of the thickness of the fat cover.

17. A method in accordance with any one of the claims 13 to 16, characterized in that the shape of the fat cover is determined over

the total meat product (12) by a measurement of the meat product (12) at characteristic measurement points and by subsequent interpolation or extrapolation.

18. A method in accordance with any one of the claims 13 to 17, characterized in that the determined measured values are compared with measured values experience has shown are to be expected for the meat product (12) and an error message is displayed on a deviation of the determined measured values from the measured values to be expected.

19. A method for the separation of a fat cover of a meat product (12) from a flesh component of the meat product (12) in which the thickness of the fat cover is determined, in particular by means of a method in accordance with any one of the claims 13 to 18, and the fat cover is separated from the flesh component in dependence on the determined thickness of the fat cover.

20. A method in accordance with claim 19, characterized in that the position of a cutting blade for the separation of the fat cover is set in accordance with a preset travel profile in dependence on a feed of the meet product (12) in a direction transversely to the feed direction.

21. A method in accordance with claim 19 or claim 20, characterized in that only a part section of the meat product (12), in particular a front part section viewed in a transport direction, is measured for the determination of the thickness of the fat cover and a stored travel profile is selected in dependence on the measured result in accordance with which the position, and in particular the height, of

the cutting blade relative to a product support is set in dependence on a product feed.

Fig. 1

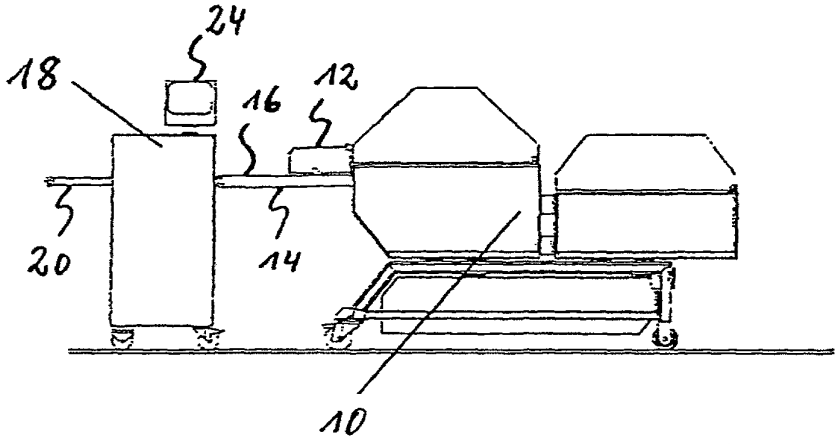
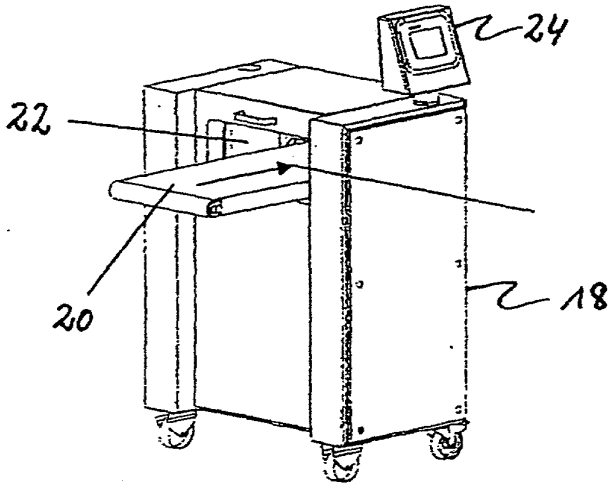


Fig. 2



(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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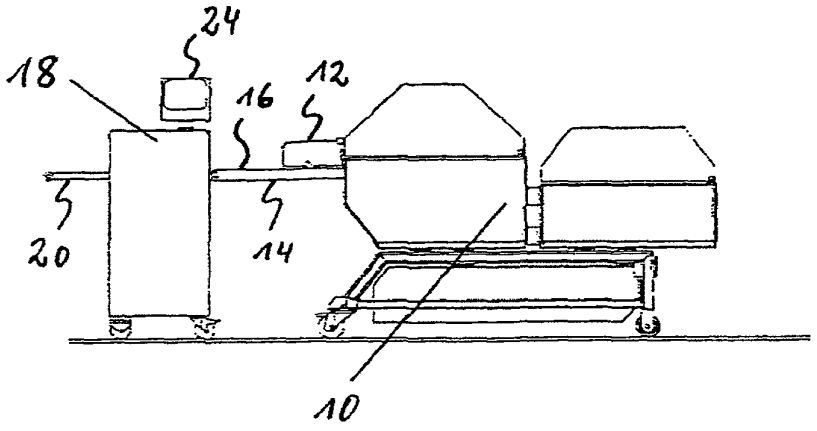
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[Fortsetzung auf der nächsten Seite]

(54) **Title:** FAT LAYER MEASURING DEVICE

(54) **Bezeichnung:** FETTAUFLAGENVERMESSUNGSEINRICHTUNG

Fig. 1



(57) **Abstract:** The invention relates to a measuring device (18) for determining the thickness of a layer of fat of a meat product (12) comprising a premium cut part and a layer of fat, wherein the thickness of the layer of fat is determined in a contact-free manner. The invention also relates to a device for separating the layer of fat of a meat product from a premium cut part of a meat product by means of said type of measuring device, and to a method for determining the thickness of a layer of fat of a meat product and to a method for separating a layer of fat of a meat product.

[Fortsetzung auf der nächsten Seite]

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(57) Zusammenfassung: Die Erfindung betrifft eine Vermessungseinrichtung (18) zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12), bei welcher die Ermittlung der Stärke der Fettauflage berührungslos erfolgt. Ferner betrifft die Erfindung eine Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer solchen Vermessungseinrichtung sowie ein Verfahren zur Ermittlung der Stärke einer Fettauflage eines Fleischprodukts und ein Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts.

FETTAUFLAGENVERMESSUNGSEINRICHTUNG

Die Erfindung betrifft eine Vermessungseinrichtung zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts.

Fleischprodukte bestehen im Wesentlichen aus drei Bestandteilen, nämlich Schwarte, Fett und Edelfleisch. In der Fleisch verarbeitenden Industrie werden zu verarbeitende Fleischstücke je nach Anforderung in diese drei Bestandteile zerlegt.

Um die Schwarte und das Fett, d.h. also die Fettauflage, in einem automatisierten Prozess von dem Edelfleischbestandteil eines Fleischprodukts trennen zu können, ist es erforderlich, die Stärke der Fettauflage, mit anderen Worten also deren Dicke oder Höhe, zu kennen. Bekannte Vermessungseinrichtungen sehen zur Ermittlung der Stärke einer Fettauflage eines Fleischprodukts einen Sensor vor, welcher in das Produkt eingestochen wird und während des Einstechens die Umgebungshelligkeit erfasst. Durch eine Auswertung der während des Einstechens auftretenden und durch den Sensor erfassten unterschiedlichen Helligkeitswerte kann auf die Konsistenz des von dem Sensor durchstoßenen Materials geschlossen oder zumindest eine Änderung der Konsistenz detektiert werden, woraus sich letztlich die Stärke einer Fettauflage ermitteln lässt.

Nachteilig ist hierbei, dass das Fleischprodukt durch das Einstechen des Sensors beschädigt wird, insbesondere da der Sensor für eine zuverlässige Ermittlung der Stärke der Fettauflage an mehreren Stellen des Produkts

eingestochen werden muss oder mehrere verteilt angeordnete Sensoren gleichzeitig in das Produkt eingestochen werden müssen.

Der Erfindung liegt die Aufgabe zugrunde, eine Vermessungseinrichtung zu schaffen, welche eine Ermittlung der Stärke einer Fettauflage eines Fleischprodukts ermöglicht, ohne das Fleischprodukt dabei zu beschädigen.

Die Aufgabe wird durch eine Vermessungseinrichtung mit den Merkmalen des Anspruchs 1 und insbesondere dadurch gelöst, dass die Ermittlung der Stärke der Fettauflage berührungslos erfolgt.

Vorteilhafterweise erfolgt die Ermittlung der Stärke der Fettauflage optisch. Die Vermessungseinrichtung kann zu diesem Zweck einen Lichtdetektor zum Detektieren von an dem Fleischprodukt reflektiertem Licht aufweisen. Der Lichtdetektor kann eine Kamera, beispielsweise eine CCD-Kamera, umfassen, deren Blickwinkel vorzugsweise so groß gewählt ist, dass ein Bereich des Fleischprodukts erfasst wird, welcher eine Grenzfläche zwischen der Fettauflage und dem Edelfleischbestandteil umfasst.

Anhand der ermittelten Reflektivität der durch den Lichtdetektor erfassten Bereiche des Fleischprodukts lässt sich auf die Konsistenz des erfassten Produktmaterials schließen, so dass ein Übergang von einem Bestandteil zu einem anderen Bestandteil des Fleischprodukts erkannt werden kann oder sogar unterschiedliche Bestandteile des Fleischprodukts und insbesondere die Fettauflage des Fleischprodukts identifiziert werden können, woraus letztlich die Stärke der Fettauflage ermittelbar ist.

Zur Verbesserung des Detektionsergebnisses kann eine einen Bereich des Fleischprodukts und insbesondere den durch den Lichtdetektor erfassten

Bereich ausleuchtende Lichtquelle vorgesehen sein. Gemäß einer bevorzugten Ausführungsform umfasst die Lichtquelle wenigstens eine Leuchtdiode, insbesondere eine im blauen Wellenlängenbereich emittierende Leuchtdiode. Da sich die Reflexionseigenschaften der Fett- und Edelfleischbestandteile eines Fleischprodukts insbesondere im blauen Wellenlängenbereich deutlich voneinander unterscheiden, ermöglicht die Verwendung von blauem Licht eine besonders zuverlässige Ermittlung der Fettauflagenstärke.

Gemäß einer weiteren Ausführungsform ist eine Transporteinrichtung vorgesehen, um das Fleischprodukt, insbesondere kontinuierlich, durch die Vermessungseinrichtung hindurch zu transportieren. Auf diese Weise kann die Vermessung des Fleischprodukts leicht in einen Prozess zur Verarbeitung des Fleischprodukts integriert werden. Bevorzugt umfasst die Transporteinrichtung ein Fördermittel, welches dazu vorgesehen ist, das Fleischprodukt einer Schneideinrichtung zur Abtrennung der Fettauflage von dem Edelfleischbestandteil zuzuführen.

Vorteilhafterweise sind der Lichtdetektor und die Lichtquelle in Transportrichtung gesehen seitlich neben der Transporteinrichtung angeordnet.

Weiterer Gegenstand der Erfindung ist eine Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer Vermessungseinrichtung zur automatischen Vermessung der Fettauflage, insbesondere einer Vermessungseinrichtung der voranstehend beschriebenen Art, und einer mit der Vermessungseinrichtung gekoppelten Schneideinrichtung zur automatischen Abtrennung der Fettauflage von dem Edelfleischbestandteil in Abhängigkeit von den durch die Vermessungseinrichtung ermittelten Messdaten.

Die Kopplung der Schneideinrichtung mit der Vermessungseinrichtung ermöglicht eine vollständig automatisierte Abtrennung der Fettauflage von dem Edelfleischbestandteil des Fleischprodukts. Insbesondere ist keine manuelle Vermessung der Fettauflage oder manuelle Anpassung der Schneideinrichtung an die gemessene Fettauflagenstärke erforderlich, da sowohl die Bestimmung der Fettauflagenstärke als auch die entsprechende Einstellung der Schneideinrichtung automatisch erfolgt. Letztlich ermöglicht dies eine Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts mit einem signifikant geringeren wirtschaftlichen Aufwand.

Erfolgt die Ermittlung der Fettauflagenstärke wie voranstehend beschrieben berührungslos, so lässt sich die Fettauflage von dem Edelfleischbestandteil trennen, ohne dass die Fettauflage und/oder der Edelfleischbestandteil dabei eingestochen oder eingeschnitten oder anderweitig beschädigt wird.

Vorteilhafterweise ist eine Transporteinrichtung vorgesehen, um das Fleischprodukt, insbesondere kontinuierlich, durch die Vermessungseinrichtung hindurch zu transportieren und der Schneideinrichtung zuzuführen.

Die Schneideinrichtung kann ein Schneidmesser, insbesondere einen Messerbalken, umfassen, dessen Lage und insbesondere Höhe relativ zu einer Produktauflage variierbar ist. Auf diese Weise lassen sich die Schneideinrichtung und insbesondere die Schneidmesserposition an unterschiedlich starke Fettauflagen anpassen, bzw. es kann die Dicke eingestellt werden, mit welcher die Fettauflage von dem Edelfleischbestandteil abgetrennt wird.

Bevorzugt weist die Schneideinrichtung eine Steuereinheit zur Steuerung des Betriebs des Schneidmessers in Abhängigkeit von den durch die Vermessungseinrichtung ermittelten Messdaten auf.

Außerdem kann ein Verfahrprofil in der Steuereinrichtung abgespeichert sein, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub einzustellen ist. Das Fahrprofil ermöglicht es, sozusagen die Anatomie des Fleischprodukts bei der Abtrennung der Fettauflage von dem Edelfleischbestandteil zu berücksichtigen und mit dem Schneidmesser dem natürlichen, also anatomiebedingten Verlauf der Fettauflage zu folgen.

Weiterer Gegenstand der Erfindung ist ein Verfahren zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts mit den Merkmalen des Anspruchs 13, durch welches sich die in Verbindung mit der erfindungsgemäßen Vermessungseinrichtung bereits erläuterten Vorteile entsprechend realisieren lassen.

Gemäß einer bevorzugten Ausführungsform des Verfahrens wird zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts vermessen, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt. Die Vermessung eines Teilabschnitts ermöglicht eine ausreichend genaue Vorhersage über den Verlauf der Fettauflage über die gesamte Ausdehnung des Fleischprodukts insbesondere bei solchen Fleischprodukten, bei denen der Fettauflagenverlauf von Produkt zu Produkt in bekannter Weise oder nur geringfügig variiert, da sich der vermessene Teilabschnitt einer von mehreren bekannten "Anatomien" des Fleischprodukts eindeutig zuordnen lässt. In Abhängigkeit von dem Mess-

ergebnis bzw. der zugeordneten "Anatomie" kann somit ein Schneidprogramm ausgewählt werden, durch welches sich die Fettauflage in der gewünschten Weise abtrennen lässt.

Alternativ oder zusätzlich kann der Verlauf der Fettauflage durch eine Vermessung des Fleischprodukts an charakteristischen Messpunkten und anschließende Inter- oder Extrapolation über das gesamte Fleischprodukt ermittelt werden. Dies ermöglicht zum einen eine Überprüfung, ob die "Anatomie" des Fleischprodukts aus der Vermessung eines Teilabschnitts korrekt bestimmt wurde sowie gegebenenfalls eine Modifikation des Schneidprogramms. Zum anderen lässt sich der Fettauflagenverlauf über die gesamte Ausdehnung des Fleischprodukts auch bei solchen Fleischprodukten ermitteln, bei denen der Verlauf der Fettauflage erfahrungsgemäß von Produkt zu Produkt so stark variiert, dass die Vermessung in einem Teilabschnitt zur genauen Ermittlung des Fettauflagenverlaufs nicht ausreicht.

Gemäß einer weiteren Ausführungsform werden die ermittelten Messwerte mit für das Fleischprodukt erfahrungsgemäß zu erwartenden Messwerten verglichen, und bei einer Abweichung der ermittelten von den zu erwartenden Messwerten wird eine Fehlermeldung angezeigt. Auf diese Weise können ungewöhnliche Produktabweichungen und/oder Fehlschnitte detektiert und gemeldet werden, wodurch sich insbesondere bei einer vollautomatischen Verarbeitung des Fleischprodukts eine Fehlverarbeitung des Produkts vermeiden lässt.

Wird zur Ermittlung der Fettauflagenstärke ein Kamerasystem verwendet, so lässt sich durch eine entsprechende Auswertung der aufgenommenen Kamerabilder und insbesondere durch einen Vergleich der aufgenommenen Kamerabilder mit statistischen Referenzbildern nicht nur feststellen,

ob sich das Fleischprodukt in einer für eine weitere Verarbeitung korrekten Lage befindet, sondern auch, ob eine Verschmutzung des Kameraobjektivs vorliegt. Sollte ersteres oder letzteres der Fall sein, so kann eine entsprechende Fehlermeldung ausgegeben und eine Verarbeitung des Fleischprodukts gegebenenfalls gestoppt werden, um Fehlverarbeitungen des Fleischprodukts zu vermeiden.

Weiterer Gegenstand der Erfindung ist ferner ein Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit den Merkmalen des Anspruchs 19, durch welches sich die in Verbindung mit der Trennvorrichtung erläuterten Vorteile entsprechend erreichen lassen.

Nachfolgend wird die Erfindung rein beispielhaft anhand einer vorteilhaften Ausführungsform unter Bezugnahme auf die beigefügte Zeichnung beschrieben. Es zeigen:

Fig. 1 eine erfindungsgemäße Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer Vermessungseinrichtung und einer Schneideinrichtung; und

Fig. 2 eine perspektivische Ansicht der Vermessungseinrichtung von Fig. 1.

Die in Fig. 1 dargestellte Vorrichtung umfasst eine Schneideinrichtung 10 zur Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts 12. Eine derartige Schneideinrichtung 10 wird auch als Entschwartungs- oder Entfettungsmaschine bezeichnet.

Das Fleischprodukt 12 wird der Schneideinrichtung 10 mittels einer Transporteinrichtung zugeführt, die zu diesem Zweck ein erstes Förderband 14 aufweist. Eine Oberseite 16 des ersten Förderbands 14 definiert eine Auflageebene für das Fleischprodukt 12.

Die Schneideinrichtung 10 umfasst in an sich bekannter Weise einen in der Figur nicht dargestellten Messerbalken zum Abtrennen der Fettauflage. Die Lage des Messerbalkens relativ zu dem ersten Förderband 14 und insbesondere die Höhe des Messerbalkens über der Oberseite 16 des ersten Förderbands 14 ist je nach Dicke der abzutrennenden Fettauflagenschicht bzw. Dicke der Fettauflagenschicht, die an dem Edelfleischbestandteil verbleiben soll, einstellbar.

Um eine vollautomatische Entfettung bzw. Entschwartung des Fleischprodukts 12 zu ermöglichen, ist der Schneideinrichtung 10 in Transport- bzw. Zuführrichtung des Fleischprodukts 12 gesehen eine Vermessungseinrichtung 18 zur Vermessung des Fleischprodukts 12 vorgelagert.

Die Vermessung des Fleischprodukts 12 erfolgt in einem kontinuierlichen Durchlaufprozess, während sich das Fleischprodukt 12 durch die Vermessungseinrichtung 18 hindurch bewegt. Für den Transport des Fleischprodukts 12 durch die Vermessungseinrichtung 18 ist ein sich an das erste Förderband 14 anschließendes zweites Förderband 20 vorgesehen, welches ebenfalls Teil der bereits genannten Transporteinrichtung ist.

Bei der Vermessung des Fleischprodukts 12 handelt es sich um eine berührungslose, optische Vermessung. Zu diesem Zweck sind hinter einem seitlich neben dem zweiten Förderband 20 angeordneten Sichtfenster 22

eine LED-Beleuchtung und eine Kamera, beispielsweise eine CCD-Kamera, vorgesehen.

Die LED-Beleuchtung umfasst wenigstens eine im blauen Wellenlängenbereich emittierende Leuchtdiode und ist so ausgebildet, dass sie einen zumindest die Fettauflage des Fleischprodukts 12 umfassenden Teilbereich des Fleischprodukts 12 ausleuchtet. Die Verwendung von blauem Licht ist besonders vorteilhaft, weil der Kontrast zwischen Edelfleisch und Fettauflage unter blauem Licht besonders deutlich ausfällt, so dass der Verlauf der Grenze zwischen Edelfleisch und Fettauflage besonders gut zu erkennen ist.

Mittels der Kamera werden Bilder des durch die LED-Beleuchtung ausgeleuchteten Bereichs des Fleischprodukts 12 aufgenommen. Die aufgenommenen Bilder werden in einer Auswerteeinheit ausgewertet, um die Stärke der Fettauflage, mit anderen Worten also die Dicke von Fett und Schwarte, zu ermitteln.

Zusätzlich kann durch einen Vergleich der aufgenommenen Bilder mit in der Auswerteeinheit hinterlegten statistischen Referenzbildern festgestellt werden, ob das Fleischprodukt 12 sich in einer für die Verarbeitung in der Schneideinrichtung 10 richtigen Lage befindet, d.h. also korrekt ausgerichtet ist, und/oder ob eine Verschmutzung eines Kameraobjektivs und/oder des Sichtfensters 22 vorliegt.

Bei einer detektierten Fehlausrichtung des Fleischprodukts 12 oder Verschmutzung des Sichtfensters 22 kann eine optische und/oder akustische Fehlermeldung über ein mit der Auswerteeinheit verbundenes Ausgabemittel 24 angezeigt werden, damit ein Bediener der Vorrichtung entsprechende Maßnahmen zur Behebung des Fehlers bzw. der Fehler ergreifen

kann. Alternativ oder zusätzlich kann die Auswerteeinheit in einem solchen Fall auch das zweite Förderband 20 und/oder das erste Förderband 14 anhalten, um eine fehlerhafte Weiterverarbeitung des Fleischprodukts 12 zu verhindern.

Grundsätzlich ist es möglich, das Fleischprodukt 12 über seine in Transportrichtung gesehen gesamte Länge zu vermessen. Angesichts der dabei anfallenden Datenmengen ist es jedoch günstiger, lediglich einen Teilabschnitt des Fleischprodukts 12, beispielsweise einen in Transportrichtung gesehenen vorderen Teilabschnitt, zu vermessen.

Konkret kann die Vermessung des Fleischprodukts 12 beispielsweise so erfolgen, dass mehrere, z.B. 10 bis 20, Lichtblitze in kurzen zeitlichen Abständen von z.B. einigen 10 ms durch die LED-Beleuchtung kurz nacheinander ausgesandt werden, während sich das Fleischprodukt 12 an dem Sichtfenster 22 vorbei bewegt. Aus den den jeweiligen Lichtblitzen zugeordneten Kamerabildern wird jeweils ein Wert für die Stärke der Fettauflage ermittelt, und aus diesen ermittelten Werten wird ein Mittelwert errechnet, welcher als tatsächlicher Wert der Fettauflagenstärke in dem erfassten Bereich angesehen wird.

Grundsätzlich ist es ausreichend, diesen Messvorgang nur einmal pro Fleischprodukt 12 durchzuführen. Wird der Messvorgang über eine Länge des Fleischprodukts 12 von mehreren Zentimetern, z.B. 10 bis 15 cm, jedoch mehrmals durchgeführt, so lässt sich die tatsächliche Stärke der Fettauflage mit einer höheren Genauigkeit ermitteln bzw. bereits ein Hinweis auf den Verlauf der Fettauflage gewinnen.

Grundsätzlich kann davon ausgegangen werden, dass sich der Verlauf der Fettauflage bei gleichartigen Fleischprodukten 12 bedingt durch die Ana-

tomie des Fleischprodukts nicht signifikant ändert, so dass es bei Kenntnis der Anatomie des Fleischprodukts 12 ausreicht, einen Teilabschnitt des Fleischprodukts 12, z.B. einen vorderen Abschnitt, zu vermessen, um daraus den Verlauf der Fettauflage und insbesondere deren Stärke über das gesamte Fleischprodukt 12 hinweg vorherzusagen. Die Vermessung des Teilbereichs ermöglicht somit eine eindeutige Bestimmung des Verlaufs der Fettauflage.

Die durch die Vermessungseinrichtung 18 in dem Teilabschnitt ermittelte Stärke der Fettauflage wird von der Auswerteeinheit der Vermessungseinrichtung 18 an eine Steuereinheit der Schneideinrichtung 10 übermittelt, welche aus dem Messergebnis die Anatomie des Fleischprodukts 12 ermittelt.

In der Steuereinheit der Schneideinrichtung 10 sind produkt- bzw. anatomieabhängige Verfahrprofile hinterlegt, welche unter Berücksichtigung der ermittelten Anatomie des jeweils zu verarbeitenden Fleischprodukts 12 eine Veränderung der Einstellung des Messerbalkens in Abhängigkeit von dem Vorschub des zu verarbeitenden Fleischprodukts 12 bewirken.

Anhand des Messergebnisses bzw. der ermittelten Anatomie des Fleischprodukts 12 wählt die Steuereinrichtung ein geeignetes Verfahrprofil aus, durch welches die Höhe des Messerbalkens in Abhängigkeit von der Stärke und dem Verlauf der Fettauflage und in Abhängigkeit von dem Produktvorschub so eingestellt wird, dass eine Fettauflagenschicht einer gewünschten Dicke von dem Fleischprodukt 12 abgetrennt wird bzw. dass eine Fettauflagenschicht einer gewünschten Dicke an dem Edelfleischbestandteil des Fleischprodukts 12 verbleibt.

Werden Fleischprodukte 12 verarbeitet, die sich z.B. stärker voneinander unterscheiden, so ist es auch möglich, den Verlauf der Fettauflage durch eine Vermessung des Fleischprodukts 12 an mehreren, insbesondere über die Länge des Fleischprodukts 12 verteilt angeordneten, charakteristischen Messpunkten sowie durch eine anschließende Inter- oder Extrapolation des Messergebnisses über das gesamte Fleischprodukt 12 hinweg zu ermitteln.

Der so ermittelte Verlauf der Fettauflage wird wiederum von der Auswerteeinheit der Vermessungseinrichtung 18 an die Steuereinheit der Schneideinrichtung 10 übermittelt, damit diese die Höhe des Messerbalkens in Abhängigkeit von dem ermittelten Verlauf der Fettauflage und in Abhängigkeit von dem Produktvorschub so einstellen kann, dass eine Fettauflagenschicht einer gewünschten Dicke von dem Fleischprodukt 12 abgetrennt wird bzw. dass eine Fettauflagenschicht einer gewünschten Dicke an dem Edelfleischbestandteil des Fleischprodukts 12 verbleibt.

Gegebenenfalls kann die Vermessung des Fleischprodukts 12 an mehreren, insbesondere über die Länge des Fleischprodukts 12 verteilt angeordneten, charakteristischen Messpunkten und die anschließende Inter- oder Extrapolation des Messergebnisses über das gesamte Fleischprodukt 12 hinweg dazu verwendet werden, nicht nur anstelle eines abgespeicherten Verfahrprofils, sondern zusätzlich zu einem abgespeicherten Verfahrprofil, gewissermaßen in Form einer Feineinstellung, die Einstellung des Messerbalkens zu steuern.

Im Ergebnis ermöglicht die erfindungsgemäße Vorrichtung eine vollautomatische Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts 12, wobei durch die erwähnte Fehlererkennung eine Fehlverarbeitung des Fleischprodukts 12 vermieden und somit die Pro-

zesssicherheit erhöht wird und außerdem durch die berührungslose Vermessung des Fleischprodukts 12 ein Einstechen oder Einschneiden der Fettauflage und/oder des Edelfleischbestandteils vermieden wird.

Bezugszeichenliste

10	Schneideinrichtung
12	Fleischprodukt
14	erstes Förderband
16	Oberseite
18	Vermessungseinrichtung
20	zweites Förderband
22	Sichtfenster
24	Ausgabemittel

Patentansprüche

1. Vermessungseinrichtung (18) zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12),
dadurch g e k e n n z e i c h n e t, dass
die Ermittlung der Stärke der Fettauflage berührungslos erfolgt.

2. Vermessungseinrichtung (18) nach Anspruch 1,
dadurch g e k e n n z e i c h n e t, dass
die Ermittlung der Stärke der Fettauflage optisch erfolgt.

3. Vermessungseinrichtung (18) nach Anspruch 1 oder 2,
g e k e n n z e i c h n e t durch
einen Lichtdetektor, insbesondere eine Kamera, zum Detektieren von an dem Fleischprodukt (12) reflektiertem Licht.

4. Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche,
g e k e n n z e i c h n e t durch
eine einen Bereich des Fleischprodukts (12) ausleuchtende Lichtquelle.

5. Vermessungseinrichtung (18) nach Anspruch 4,
dadurch g e k e n n z e i c h n e t, dass
die Lichtquelle wenigstens eine Leuchtdiode, insbesondere eine im blauen Wellenlängenbereich emittierende Leuchtdiode, umfasst.

6. Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche,
dadurch g e k e n n z e i c h n e t, dass
eine Transporteinrichtung (20) vorgesehen ist, um das Fleischprodukt (12), insbesondere kontinuierlich, durch die Vermessungseinrichtung (18) hindurch zu transportieren.

7. Vermessungseinrichtung (18) nach Anspruch 6,
dadurch g e k e n n z e i c h n e t, dass
eine Lichtquelle und ein Lichtdetektor in Transportrichtung gesehen seitlich neben der Transporteinrichtung (20) angeordnet sind.

8. Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts (12) von einem Edelfleischbestandteil des Fleischprodukts (12) mit einer Vermessungseinrichtung (18), insbesondere einer Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche, zur automatischen Ermittlung der Stärke der Fettauflage und einer mit der Vermessungseinrichtung (18) gekoppelten Schneideinrichtung (10) zur automatischen Abtrennung der Fettauflage von dem Edelfleischbestandteil in Abhängigkeit von den durch die Vermessungseinrichtung (18) ermittelten Messdaten.

9. Vorrichtung nach Anspruch 8,
dadurch g e k e n n z e i c h n e t, dass
eine Transporteinrichtung (14, 20) vorgesehen ist, um das Fleischprodukt (12), insbesondere kontinuierlich, durch die Vermessungseinrichtung (18) hindurch zu transportieren und der Schneideinrichtung (10) zuzuführen.

10. Vorrichtung nach Anspruch 8 oder 9,
dadurch g e k e n n z e i c h n e t, dass
die Schneideinrichtung (10) ein Schneidmesser, insbesondere einen Messerbalken, umfasst, dessen Lage und insbesondere Höhe relativ zu einer Produktauflage variierbar ist.

11. Vorrichtung nach Anspruch 10,
dadurch g e k e n n z e i c h n e t, dass
die Schneideinrichtung (10) eine Steuereinheit zur Steuerung der Lage bzw. Höhe des Schneidmessers in Abhängigkeit von den durch die Vermessungseinrichtung (18) ermittelten Messdaten aufweist.

12. Vorrichtung nach Anspruch 11,
dadurch g e k e n n z e i c h n e t, dass
wenigstens ein Verfahrprofil in der Steuereinheit abgespeichert ist, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub einzustellen ist.

13. Verfahren zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12),
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage berührungslos ermittelt wird.

14. Verfahren nach Anspruch 13,
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage mittels optischer Vermessung ermittelt wird.

15. Verfahren nach Anspruch 13 oder 14,
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage während einer, insbesondere kontinuierlichen, Transportbewegung des Fleischprodukts (12) ermittelt wird.

16. Verfahren nach einem der Ansprüche 13 bis 15,
dadurch g e k e n n z e i c h n e t, dass
zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts (12) vermessen wird, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt.

17. Verfahren nach einem der Ansprüche 13 bis 16,
dadurch g e k e n n z e i c h n e t, dass
der Verlauf der Fettauflage über das gesamte Fleischprodukt (12) durch eine Vermessung des Fleischprodukts (12) an charakteristischen Messpunkten und anschließende Inter- oder Extrapolation ermittelt wird.

18. Verfahren nach einem der Ansprüche 13 bis 17,
dadurch g e k e n n z e i c h n e t, dass
die ermittelten Messwerte mit für das Fleischprodukt (12) erfahrungsgemäß zu erwartenden Messwerten verglichen werden und bei einer Abweichung der ermittelten von den zu erwartenden Messwerten eine Fehlermeldung angezeigt wird.

19. Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts (12) von einem Edelfleischbestandteil des Fleischprodukts (12), bei dem die Stärke der Fettauflage, insbesondere mittels eines Verfahrens nach einem der Ansprüche 13 bis 18, ermittelt wird und die

Fettauflage in Abhängigkeit von der ermittelten Stärke der Fettauflage von dem Edelfleischbestandteil abgetrennt wird.

20. Verfahren nach Anspruch 19,
dadurch g e k e n n z e i c h n e t, dass
die Position eines Schneidmessers zum Abtrennen der Fettauflage gemäß einem vorgegebenen Verfahrprofil in Abhängigkeit von einem Vorschub des Fleischprodukts (12) in einer Richtung quer zur Vorschubrichtung verstellt wird.

21. Verfahren nach Anspruch 19 oder 20,
dadurch g e k e n n z e i c h n e t, dass
zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts (12) vermessen wird, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt, und in Abhängigkeit von dem Messergebnis ein abgespeichertes Verfahrprofil ausgewählt wird, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub eingestellt wird.

Fig. 1

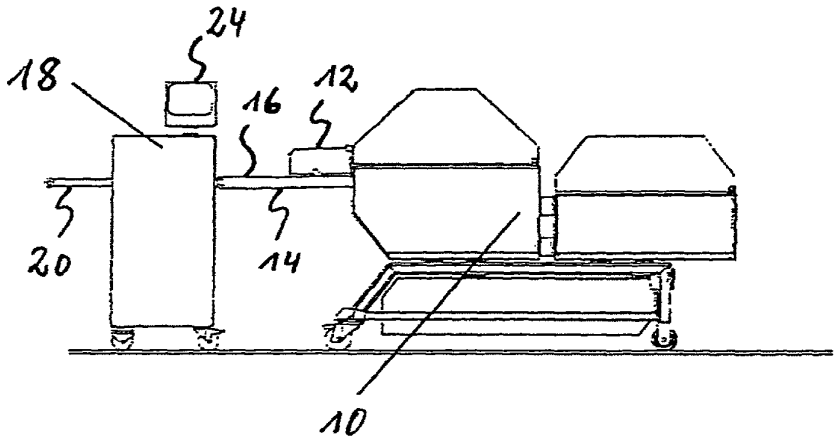
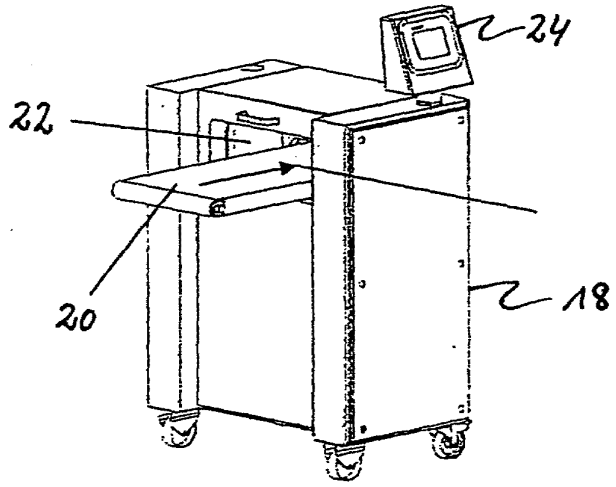


Fig. 2



Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Filer:	J. Georg Seka/William Chinn
Attorney Docket Number:	088000-006700US

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U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	330	330
Natl Stage Search Fee - Report provided	1642	1	430	430
National Stage Exam - all other cases	1633	1	220	220
Pages:				
Claims:				
Claims in excess of 20	1615	1	52	52
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1032**

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Application Number:	12738969
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Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Manitz_088000_006700US_National_Phase_Appln_Filing_Transmttals.PDF	2305337 8b09e6d55417c623ab263f1d51eb9fffa74ba2f2	yes	55

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal of New Application	1	3
Application Data Sheet	4	6
Preliminary Amendment	7	7
Specification	8	8
Abstract	9	9
Claims	10	13
Applicant Arguments/Remarks Made in an Amendment	14	14
Specification	15	27
Claims	28	32
Drawings-only black and white line drawings	33	33
Abstract	34	35
Specification - Not in English	36	54
Drawings-only black and white line drawings	55	55

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2	Fee Worksheet (PTO-875)	fee-info.pdf	36481 fa2a528c54edaf24318e274cf06c5d20403f3151	no	2

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New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

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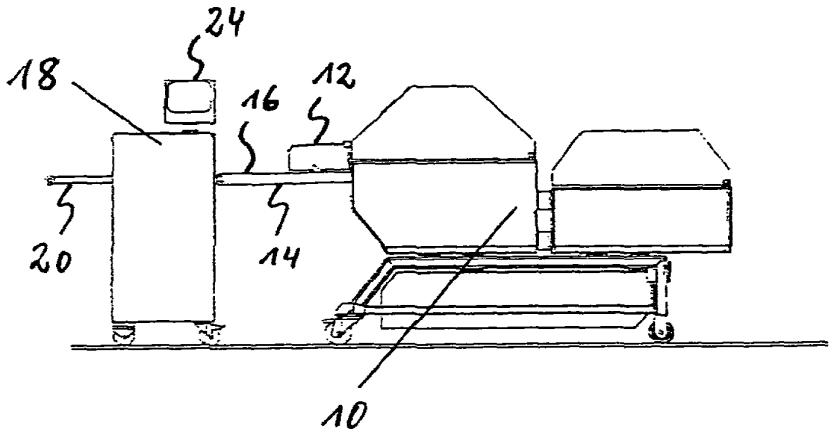
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[Fortsetzung auf der nächsten Seite]

(54) **Title:** FAT LAYER MEASURING DEVICE

(54) **Bezeichnung:** FETTAUFLAGENVERMESSUNGSEINRICHTUNG

Fig. 1



(57) **Abstract:** The invention relates to a measuring device (18) for determining the thickness of a layer of fat of a meat product (12) comprising a premium cut part and a layer of fat, wherein the thickness of the layer of fat is determined in a contact-free manner. The invention also relates to a device for separating the layer of fat of a meat product from a premium cut part of a meat product by means of said type of measuring device, and to a method for determining the thickness of a layer of fat of a meat product and to a method for separating a layer of fat of a meat product.

[Fortsetzung auf der nächsten Seite]

WO 2009/052905 A1

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(57) Zusammenfassung: Die Erfindung betrifft eine Vermessungseinrichtung (18) zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12), bei welcher die Ermittlung der Stärke der Fettauflage berührungslos erfolgt. Ferner betrifft die Erfindung eine Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer solchen Vermessungseinrichtung sowie ein Verfahren zur Ermittlung der Stärke einer Fettauflage eines Fleischprodukts und ein Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts.

FETTAUFLAGENVERMESSUNGSEINRICHTUNG

Die Erfindung betrifft eine Vermessungseinrichtung zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts.

Fleischprodukte bestehen im Wesentlichen aus drei Bestandteilen, nämlich Schwarte, Fett und Edelfleisch. In der Fleisch verarbeitenden Industrie werden zu verarbeitende Fleischstücke je nach Anforderung in diese drei Bestandteile zerlegt.

Um die Schwarte und das Fett, d.h. also die Fettauflage, in einem automatisierten Prozess von dem Edelfleischbestandteil eines Fleischprodukts trennen zu können, ist es erforderlich, die Stärke der Fettauflage, mit anderen Worten also deren Dicke oder Höhe, zu kennen. Bekannte Vermessungseinrichtungen sehen zur Ermittlung der Stärke einer Fettauflage eines Fleischprodukts einen Sensor vor, welcher in das Produkt eingestochen wird und während des Einstechens die Umgebungshelligkeit erfasst. Durch eine Auswertung der während des Einstechens auftretenden und durch den Sensor erfassten unterschiedlichen Helligkeitswerte kann auf die Konsistenz des von dem Sensor durchstoßenen Materials geschlossen oder zumindest eine Änderung der Konsistenz detektiert werden, woraus sich letztlich die Stärke einer Fettauflage ermitteln lässt.

Nachteilig ist hierbei, dass das Fleischprodukt durch das Einstechen des Sensors beschädigt wird, insbesondere da der Sensor für eine zuverlässige Ermittlung der Stärke der Fettauflage an mehreren Stellen des Produkts

eingestochen werden muss oder mehrere verteilt angeordnete Sensoren gleichzeitig in das Produkt eingestochen werden müssen.

Der Erfindung liegt die Aufgabe zugrunde, eine Vermessungseinrichtung zu schaffen, welche eine Ermittlung der Stärke einer Fettauflage eines Fleischprodukts ermöglicht, ohne das Fleischprodukt dabei zu beschädigen.

Die Aufgabe wird durch eine Vermessungseinrichtung mit den Merkmalen des Anspruchs 1 und insbesondere dadurch gelöst, dass die Ermittlung der Stärke der Fettauflage berührungslos erfolgt.

Vorteilhafterweise erfolgt die Ermittlung der Stärke der Fettauflage optisch. Die Vermessungseinrichtung kann zu diesem Zweck einen Lichtdetektor zum Detektieren von an dem Fleischprodukt reflektiertem Licht aufweisen. Der Lichtdetektor kann eine Kamera, beispielsweise eine CCD-Kamera, umfassen, deren Blickwinkel vorzugsweise so groß gewählt ist, dass ein Bereich des Fleischprodukts erfasst wird, welcher eine Grenzfläche zwischen der Fettauflage und dem Edelfleischbestandteil umfasst.

Anhand der ermittelten Reflektivität der durch den Lichtdetektor erfassten Bereiche des Fleischprodukts lässt sich auf die Konsistenz des erfassten Produktmaterials schließen, so dass ein Übergang von einem Bestandteil zu einem anderen Bestandteil des Fleischprodukts erkannt werden kann oder sogar unterschiedliche Bestandteile des Fleischprodukts und insbesondere die Fettauflage des Fleischprodukts identifiziert werden können, woraus letztlich die Stärke der Fettauflage ermittelbar ist.

Zur Verbesserung des Detektionsergebnisses kann eine einen Bereich des Fleischprodukts und insbesondere den durch den Lichtdetektor erfassten

Bereich ausleuchtende Lichtquelle vorgesehen sein. Gemäß einer bevorzugten Ausführungsform umfasst die Lichtquelle wenigstens eine Leuchtdiode, insbesondere eine im blauen Wellenlängenbereich emittierende Leuchtdiode. Da sich die Reflexionseigenschaften der Fett- und Edelfleischbestandteile eines Fleischprodukts insbesondere im blauen Wellenlängenbereich deutlich voneinander unterscheiden, ermöglicht die Verwendung von blauem Licht eine besonders zuverlässige Ermittlung der Fettauflagenstärke.

Gemäß einer weiteren Ausführungsform ist eine Transporteinrichtung vorgesehen, um das Fleischprodukt, insbesondere kontinuierlich, durch die Vermessungseinrichtung hindurch zu transportieren. Auf diese Weise kann die Vermessung des Fleischprodukts leicht in einen Prozess zur Verarbeitung des Fleischprodukts integriert werden. Bevorzugt umfasst die Transporteinrichtung ein Fördermittel, welches dazu vorgesehen ist, das Fleischprodukt einer Schneideinrichtung zur Abtrennung der Fettauflage von dem Edelfleischbestandteil zuzuführen.

Vorteilhafterweise sind der Lichtdetektor und die Lichtquelle in Transportrichtung gesehen seitlich neben der Transporteinrichtung angeordnet.

Weiterer Gegenstand der Erfindung ist eine Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer Vermessungseinrichtung zur automatischen Vermessung der Fettauflage, insbesondere einer Vermessungseinrichtung der voranstehend beschriebenen Art, und einer mit der Vermessungseinrichtung gekoppelten Schneideinrichtung zur automatischen Abtrennung der Fettauflage von dem Edelfleischbestandteil in Abhängigkeit von den durch die Vermessungseinrichtung ermittelten Messdaten.

Die Kopplung der Schneideinrichtung mit der Vermessungseinrichtung ermöglicht eine vollständig automatisierte Abtrennung der Fettauflage von dem Edelfleischbestandteil des Fleischprodukts. Insbesondere ist keine manuelle Vermessung der Fettauflage oder manuelle Anpassung der Schneideinrichtung an die gemessene Fettauflagenstärke erforderlich, da sowohl die Bestimmung der Fettauflagenstärke als auch die entsprechende Einstellung der Schneideinrichtung automatisch erfolgt. Letztlich ermöglicht dies eine Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts mit einem signifikant geringeren wirtschaftlichen Aufwand.

Erfolgt die Ermittlung der Fettauflagenstärke wie voranstehend beschrieben berührungslos, so lässt sich die Fettauflage von dem Edelfleischbestandteil trennen, ohne dass die Fettauflage und/oder der Edelfleischbestandteil dabei eingestochen oder eingeschnitten oder anderweitig beschädigt wird.

Vorteilhafterweise ist eine Transporteinrichtung vorgesehen, um das Fleischprodukt, insbesondere kontinuierlich, durch die Vermessungseinrichtung hindurch zu transportieren und der Schneideinrichtung zuzuführen.

Die Schneideinrichtung kann ein Schneidmesser, insbesondere einen Messerbalken, umfassen, dessen Lage und insbesondere Höhe relativ zu einer Produktauflage variierbar ist. Auf diese Weise lassen sich die Schneideinrichtung und insbesondere die Schneidmesserposition an unterschiedlich starke Fettauflagen anpassen, bzw. es kann die Dicke eingestellt werden, mit welcher die Fettauflage von dem Edelfleischbestandteil abgetrennt wird.

Bevorzugt weist die Schneideinrichtung eine Steuereinheit zur Steuerung des Betriebs des Schneidmessers in Abhängigkeit von den durch die Vermessungseinrichtung ermittelten Messdaten auf.

Außerdem kann ein Verfahrprofil in der Steuereinrichtung abgespeichert sein, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub einzustellen ist. Das Fahrprofil ermöglicht es, sozusagen die Anatomie des Fleischprodukts bei der Abtrennung der Fettauflage von dem Edelfleischbestandteil zu berücksichtigen und mit dem Schneidmesser dem natürlichen, also anatomiebedingten Verlauf der Fettauflage zu folgen.

Weiterer Gegenstand der Erfindung ist ein Verfahren zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts mit den Merkmalen des Anspruchs 13, durch welches sich die in Verbindung mit der erfindungsgemäßen Vermessungseinrichtung bereits erläuterten Vorteile entsprechend realisieren lassen.

Gemäß einer bevorzugten Ausführungsform des Verfahrens wird zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts vermessen, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt. Die Vermessung eines Teilabschnitts ermöglicht eine ausreichend genaue Vorhersage über den Verlauf der Fettauflage über die gesamte Ausdehnung des Fleischprodukts insbesondere bei solchen Fleischprodukten, bei denen der Fettauflagenverlauf von Produkt zu Produkt in bekannter Weise oder nur geringfügig variiert, da sich der vermessene Teilabschnitt einer von mehreren bekannten "Anatomien" des Fleischprodukts eindeutig zuordnen lässt. In Abhängigkeit von dem Mess-

ergebnis bzw. der zugeordneten "Anatomie" kann somit ein Schneidprogramm ausgewählt werden, durch welches sich die Fettauflage in der gewünschten Weise abtrennen lässt.

Alternativ oder zusätzlich kann der Verlauf der Fettauflage durch eine Vermessung des Fleischprodukts an charakteristischen Messpunkten und anschließende Inter- oder Extrapolation über das gesamte Fleischprodukt ermittelt werden. Dies ermöglicht zum einen eine Überprüfung, ob die "Anatomie" des Fleischprodukts aus der Vermessung eines Teilabschnitts korrekt bestimmt wurde sowie gegebenenfalls eine Modifikation des Schneidprogramms. Zum anderen lässt sich der Fettauflagenverlauf über die gesamte Ausdehnung des Fleischprodukts auch bei solchen Fleischprodukten ermitteln, bei denen der Verlauf der Fettauflage erfahrungsgemäß von Produkt zu Produkt so stark variiert, dass die Vermessung in einem Teilabschnitt zur genauen Ermittlung des Fettauflagenverlaufs nicht ausreicht.

Gemäß einer weiteren Ausführungsform werden die ermittelten Messwerte mit für das Fleischprodukt erfahrungsgemäß zu erwartenden Messwerten verglichen, und bei einer Abweichung der ermittelten von den zu erwartenden Messwerten wird eine Fehlermeldung angezeigt. Auf diese Weise können ungewöhnliche Produktabweichungen und/oder Fehlschnitte detektiert und gemeldet werden, wodurch sich insbesondere bei einer vollautomatischen Verarbeitung des Fleischprodukts eine Fehlverarbeitung des Produkts vermeiden lässt.

Wird zur Ermittlung der Fettauflagenstärke ein Kamerasystem verwendet, so lässt sich durch eine entsprechende Auswertung der aufgenommenen Kamerabilder und insbesondere durch einen Vergleich der aufgenommenen Kamerabilder mit statistischen Referenzbildern nicht nur feststellen,

ob sich das Fleischprodukt in einer für eine weitere Verarbeitung korrekten Lage befindet, sondern auch, ob eine Verschmutzung des Kameraobjektivs vorliegt. Sollte ersteres oder letzteres der Fall sein, so kann eine entsprechende Fehlermeldung ausgegeben und eine Verarbeitung des Fleischprodukts gegebenenfalls gestoppt werden, um Fehlverarbeitungen des Fleischprodukts zu vermeiden.

Weiterer Gegenstand der Erfindung ist ferner ein Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit den Merkmalen des Anspruchs 19, durch welches sich die in Verbindung mit der Trennvorrichtung erläuterten Vorteile entsprechend erreichen lassen.

Nachfolgend wird die Erfindung rein beispielhaft anhand einer vorteilhaften Ausführungsform unter Bezugnahme auf die beigefügte Zeichnung beschrieben. Es zeigen:

Fig. 1 eine erfindungsgemäße Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer Vermessungseinrichtung und einer Schneideinrichtung; und

Fig. 2 eine perspektivische Ansicht der Vermessungseinrichtung von Fig. 1.

Die in Fig. 1 dargestellte Vorrichtung umfasst eine Schneideinrichtung 10 zur Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts 12. Eine derartige Schneideinrichtung 10 wird auch als Entschwartungs- oder Entfettungsmaschine bezeichnet.

Das Fleischprodukt 12 wird der Schneideinrichtung 10 mittels einer Transporteinrichtung zugeführt, die zu diesem Zweck ein erstes Förderband 14 aufweist. Eine Oberseite 16 des ersten Förderbands 14 definiert eine Auflageebene für das Fleischprodukt 12.

Die Schneideinrichtung 10 umfasst in an sich bekannter Weise einen in der Figur nicht dargestellten Messerbalken zum Abtrennen der Fettauflage. Die Lage des Messerbalkens relativ zu dem ersten Förderband 14 und insbesondere die Höhe des Messerbalkens über der Oberseite 16 des ersten Förderbands 14 ist je nach Dicke der abzutrennenden Fettauflagenschicht bzw. Dicke der Fettauflagenschicht, die an dem Edelfleischbestandteil verbleiben soll, einstellbar.

Um eine vollautomatische Entfettung bzw. Entschwartung des Fleischprodukts 12 zu ermöglichen, ist der Schneideinrichtung 10 in Transport- bzw. Zuführrichtung des Fleischprodukts 12 gesehen eine Vermessungseinrichtung 18 zur Vermessung des Fleischprodukts 12 vorgelagert.

Die Vermessung des Fleischprodukts 12 erfolgt in einem kontinuierlichen Durchlaufprozess, während sich das Fleischprodukt 12 durch die Vermessungseinrichtung 18 hindurch bewegt. Für den Transport des Fleischprodukts 12 durch die Vermessungseinrichtung 18 ist ein sich an das erste Förderband 14 anschließendes zweites Förderband 20 vorgesehen, welches ebenfalls Teil der bereits genannten Transporteinrichtung ist.

Bei der Vermessung des Fleischprodukts 12 handelt es sich um eine berührungslose, optische Vermessung. Zu diesem Zweck sind hinter einem seitlich neben dem zweiten Förderband 20 angeordneten Sichtfenster 22

eine LED-Beleuchtung und eine Kamera, beispielsweise eine CCD-Kamera, vorgesehen.

Die LED-Beleuchtung umfasst wenigstens eine im blauen Wellenlängenbereich emittierende Leuchtdiode und ist so ausgebildet, dass sie einen zumindest die Fettauflage des Fleischprodukts 12 umfassenden Teilbereich des Fleischprodukts 12 ausleuchtet. Die Verwendung von blauem Licht ist besonders vorteilhaft, weil der Kontrast zwischen Edelfleisch und Fettauflage unter blauem Licht besonders deutlich ausfällt, so dass der Verlauf der Grenze zwischen Edelfleisch und Fettauflage besonders gut zu erkennen ist.

Mittels der Kamera werden Bilder des durch die LED-Beleuchtung ausgeleuchteten Bereichs des Fleischprodukts 12 aufgenommen. Die aufgenommenen Bilder werden in einer Auswerteeinheit ausgewertet, um die Stärke der Fettauflage, mit anderen Worten also die Dicke von Fett und Schwarte, zu ermitteln.

Zusätzlich kann durch einen Vergleich der aufgenommenen Bilder mit in der Auswerteeinheit hinterlegten statistischen Referenzbildern festgestellt werden, ob das Fleischprodukt 12 sich in einer für die Verarbeitung in der Schneideinrichtung 10 richtigen Lage befindet, d.h. also korrekt ausgerichtet ist, und/oder ob eine Verschmutzung eines Kameraobjektivs und/oder des Sichtfensters 22 vorliegt.

Bei einer detektierten Fehlausrichtung des Fleischprodukts 12 oder Verschmutzung des Sichtfensters 22 kann eine optische und/oder akustische Fehlermeldung über ein mit der Auswerteeinheit verbundenes Ausgabemittel 24 angezeigt werden, damit ein Bediener der Vorrichtung entsprechende Maßnahmen zur Behebung des Fehlers bzw. der Fehler ergreifen

kann. Alternativ oder zusätzlich kann die Auswerteeinheit in einem solchen Fall auch das zweite Förderband 20 und/oder das erste Förderband 14 anhalten, um eine fehlerhafte Weiterverarbeitung des Fleischprodukts 12 zu verhindern.

Grundsätzlich ist es möglich, das Fleischprodukt 12 über seine in Transportrichtung gesehen gesamte Länge zu vermessen. Angesichts der dabei anfallenden Datenmengen ist es jedoch günstiger, lediglich einen Teilabschnitt des Fleischprodukts 12, beispielsweise einen in Transportrichtung gesehenen vorderen Teilabschnitt, zu vermessen.

Konkret kann die Vermessung des Fleischprodukts 12 beispielsweise so erfolgen, dass mehrere, z.B. 10 bis 20, Lichtblitze in kurzen zeitlichen Abständen von z.B. einigen 10 ms durch die LED-Beleuchtung kurz nacheinander ausgesandt werden, während sich das Fleischprodukt 12 an dem Sichtfenster 22 vorbei bewegt. Aus den den jeweiligen Lichtblitzen zugeordneten Kamerabildern wird jeweils ein Wert für die Stärke der Fettauflage ermittelt, und aus diesen ermittelten Werten wird ein Mittelwert errechnet, welcher als tatsächlicher Wert der Fettauflagenstärke in dem erfassten Bereich angesehen wird.

Grundsätzlich ist es ausreichend, diesen Messvorgang nur einmal pro Fleischprodukt 12 durchzuführen. Wird der Messvorgang über eine Länge des Fleischprodukts 12 von mehreren Zentimetern, z.B. 10 bis 15 cm, jedoch mehrmals durchgeführt, so lässt sich die tatsächliche Stärke der Fettauflage mit einer höheren Genauigkeit ermitteln bzw. bereits ein Hinweis auf den Verlauf der Fettauflage gewinnen.

Grundsätzlich kann davon ausgegangen werden, dass sich der Verlauf der Fettauflage bei gleichartigen Fleischprodukten 12 bedingt durch die Ana-

tomie des Fleischprodukts nicht signifikant ändert, so dass es bei Kenntnis der Anatomie des Fleischprodukts 12 ausreicht, einen Teilabschnitt des Fleischprodukts 12, z.B. einen vorderen Abschnitt, zu vermessen, um daraus den Verlauf der Fettauflage und insbesondere deren Stärke über das gesamte Fleischprodukt 12 hinweg vorherzusagen. Die Vermessung des Teilbereichs ermöglicht somit eine eindeutige Bestimmung des Verlaufs der Fettauflage.

Die durch die Vermessungseinrichtung 18 in dem Teilabschnitt ermittelte Stärke der Fettauflage wird von der Auswerteeinheit der Vermessungseinrichtung 18 an eine Steuereinheit der Schneideinrichtung 10 übermittelt, welche aus dem Messergebnis die Anatomie des Fleischprodukts 12 ermittelt.

In der Steuereinheit der Schneideinrichtung 10 sind produkt- bzw. anatomieabhängige Verfahrprofile hinterlegt, welche unter Berücksichtigung der ermittelten Anatomie des jeweils zu verarbeitenden Fleischprodukts 12 eine Veränderung der Einstellung des Messerbalkens in Abhängigkeit von dem Vorschub des zu verarbeitenden Fleischprodukts 12 bewirken.

Anhand des Messergebnisses bzw. der ermittelten Anatomie des Fleischprodukts 12 wählt die Steuereinrichtung ein geeignetes Verfahrprofil aus, durch welches die Höhe des Messerbalkens in Abhängigkeit von der Stärke und dem Verlauf der Fettauflage und in Abhängigkeit von dem Produktvorschub so eingestellt wird, dass eine Fettauflagenschicht einer gewünschten Dicke von dem Fleischprodukt 12 abgetrennt wird bzw. dass eine Fettauflagenschicht einer gewünschten Dicke an dem Edelfleischbestandteil des Fleischprodukts 12 verbleibt.

Werden Fleischprodukte 12 verarbeitet, die sich z.B. stärker voneinander unterscheiden, so ist es auch möglich, den Verlauf der Fettauflage durch eine Vermessung des Fleischprodukts 12 an mehreren, insbesondere über die Länge des Fleischprodukts 12 verteilt angeordneten, charakteristischen Messpunkten sowie durch eine anschließende Inter- oder Extrapolation des Messergebnisses über das gesamte Fleischprodukt 12 hinweg zu ermitteln.

Der so ermittelte Verlauf der Fettauflage wird wiederum von der Auswerteeinheit der Vermessungseinrichtung 18 an die Steuereinheit der Schneideinrichtung 10 übermittelt, damit diese die Höhe des Messerbalkens in Abhängigkeit von dem ermittelten Verlauf der Fettauflage und in Abhängigkeit von dem Produktvorschub so einstellen kann, dass eine Fettauflagenschicht einer gewünschten Dicke von dem Fleischprodukt 12 abgetrennt wird bzw. dass eine Fettauflagenschicht einer gewünschten Dicke an dem Edelfleischbestandteil des Fleischprodukts 12 verbleibt.

Gegebenenfalls kann die Vermessung des Fleischprodukts 12 an mehreren, insbesondere über die Länge des Fleischprodukts 12 verteilt angeordneten, charakteristischen Messpunkten und die anschließende Inter- oder Extrapolation des Messergebnisses über das gesamte Fleischprodukt 12 hinweg dazu verwendet werden, nicht nur anstelle eines abgespeicherten Verfahrprofils, sondern zusätzlich zu einem abgespeicherten Verfahrprofil, gewissermaßen in Form einer Feineinstellung, die Einstellung des Messerbalkens zu steuern.

Im Ergebnis ermöglicht die erfindungsgemäße Vorrichtung eine vollautomatische Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts 12, wobei durch die erwähnte Fehlererkennung eine Fehlverarbeitung des Fleischprodukts 12 vermieden und somit die Pro-

zesssicherheit erhöht wird und außerdem durch die berührungslose Vermessung des Fleischprodukts 12 ein Einstechen oder Einschneiden der Fettauflage und/oder des Edelfleischbestandteils vermieden wird.

Bezugszeichenliste

10	Schneideinrichtung
12	Fleischprodukt
14	erstes Förderband
16	Oberseite
18	Vermessungseinrichtung
20	zweites Förderband
22	Sichtfenster
24	Ausgabemittel

Patentansprüche

1. Vermessungseinrichtung (18) zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12),
dadurch g e k e n n z e i c h n e t, dass
die Ermittlung der Stärke der Fettauflage berührungslos erfolgt.

2. Vermessungseinrichtung (18) nach Anspruch 1,
dadurch g e k e n n z e i c h n e t, dass
die Ermittlung der Stärke der Fettauflage optisch erfolgt.

3. Vermessungseinrichtung (18) nach Anspruch 1 oder 2,
g e k e n n z e i c h n e t durch
einen Lichtdetektor, insbesondere eine Kamera, zum Detektieren von an dem Fleischprodukt (12) reflektiertem Licht.

4. Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche,
g e k e n n z e i c h n e t durch
eine einen Bereich des Fleischprodukts (12) ausleuchtende Lichtquelle.

5. Vermessungseinrichtung (18) nach Anspruch 4,
dadurch g e k e n n z e i c h n e t, dass
die Lichtquelle wenigstens eine Leuchtdiode, insbesondere eine im blauen Wellenlängenbereich emittierende Leuchtdiode, umfasst.

6. Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche,
dadurch g e k e n n z e i c h n e t, dass
eine Transporteinrichtung (20) vorgesehen ist, um das Fleischprodukt (12), insbesondere kontinuierlich, durch die Vermessungseinrichtung (18) hindurch zu transportieren.

7. Vermessungseinrichtung (18) nach Anspruch 6,
dadurch g e k e n n z e i c h n e t, dass
eine Lichtquelle und ein Lichtdetektor in Transportrichtung gesehen seitlich neben der Transporteinrichtung (20) angeordnet sind.

8. Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts (12) von einem Edelfleischbestandteil des Fleischprodukts (12) mit einer Vermessungseinrichtung (18), insbesondere einer Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche, zur automatischen Ermittlung der Stärke der Fettauflage und einer mit der Vermessungseinrichtung (18) gekoppelten Schneideinrichtung (10) zur automatischen Abtrennung der Fettauflage von dem Edelfleischbestandteil in Abhängigkeit von den durch die Vermessungseinrichtung (18) ermittelten Messdaten.

9. Vorrichtung nach Anspruch 8,
dadurch g e k e n n z e i c h n e t, dass
eine Transporteinrichtung (14, 20) vorgesehen ist, um das Fleischprodukt (12), insbesondere kontinuierlich, durch die Vermessungseinrichtung (18) hindurch zu transportieren und der Schneideinrichtung (10) zuzuführen.

10. Vorrichtung nach Anspruch 8 oder 9,
dadurch g e k e n n z e i c h n e t, dass
die Schneideinrichtung (10) ein Schneidmesser, insbesondere einen Messerbalken, umfasst, dessen Lage und insbesondere Höhe relativ zu einer Produktauflage variierbar ist.

11. Vorrichtung nach Anspruch 10,
dadurch g e k e n n z e i c h n e t, dass
die Schneideinrichtung (10) eine Steuereinheit zur Steuerung der Lage bzw. Höhe des Schneidmessers in Abhängigkeit von den durch die Vermessungseinrichtung (18) ermittelten Messdaten aufweist.

12. Vorrichtung nach Anspruch 11,
dadurch g e k e n n z e i c h n e t, dass
wenigstens ein Verfahrprofil in der Steuereinheit abgespeichert ist, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub einzustellen ist.

13. Verfahren zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12),
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage berührungslos ermittelt wird.

14. Verfahren nach Anspruch 13,
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage mittels optischer Vermessung ermittelt wird.

15. Verfahren nach Anspruch 13 oder 14,
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage während einer, insbesondere kontinuierlichen, Transportbewegung des Fleischprodukts (12) ermittelt wird.

16. Verfahren nach einem der Ansprüche 13 bis 15,
dadurch g e k e n n z e i c h n e t, dass
zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts (12) vermessen wird, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt.

17. Verfahren nach einem der Ansprüche 13 bis 16,
dadurch g e k e n n z e i c h n e t, dass
der Verlauf der Fettauflage über das gesamte Fleischprodukt (12) durch eine Vermessung des Fleischprodukts (12) an charakteristischen Messpunkten und anschließende Inter- oder Extrapolation ermittelt wird.

18. Verfahren nach einem der Ansprüche 13 bis 17,
dadurch g e k e n n z e i c h n e t, dass
die ermittelten Messwerte mit für das Fleischprodukt (12) erfahrungsgemäß zu erwartenden Messwerten verglichen werden und bei einer Abweichung der ermittelten von den zu erwartenden Messwerten eine Fehlermeldung angezeigt wird.

19. Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts (12) von einem Edelfleischbestandteil des Fleischprodukts (12), bei dem die Stärke der Fettauflage, insbesondere mittels eines Verfahrens nach einem der Ansprüche 13 bis 18, ermittelt wird und die

Fettauflage in Abhängigkeit von der ermittelten Stärke der Fettauflage von dem Edelfleischbestandteil abgetrennt wird.

20. Verfahren nach Anspruch 19,
dadurch g e k e n n z e i c h n e t, dass
die Position eines Schneidmessers zum Abtrennen der Fettauflage gemäß einem vorgegebenen Verfahrprofil in Abhängigkeit von einem Vorschub des Fleischprodukts (12) in einer Richtung quer zur Vorschubrichtung verstellt wird.

21. Verfahren nach Anspruch 19 oder 20,
dadurch g e k e n n z e i c h n e t, dass
zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts (12) vermessen wird, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt, und in Abhängigkeit von dem Messergebnis ein abgespeichertes Verfahrprofil ausgewählt wird, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub eingestellt wird.

Fig. 1

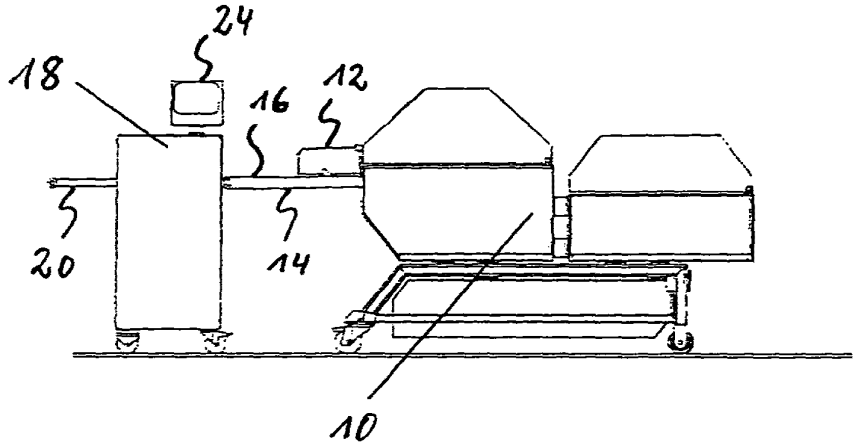
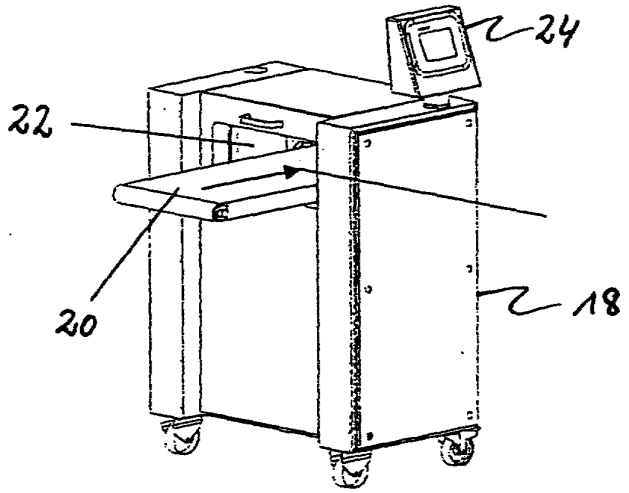


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/007567

A. CLASSIFICATION OF SUBJECT MATTER
INV. A22C17/00

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

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 937 080 A (VOGELEY JR ARTHUR W [US] ET AL) 10 August 1999 (1999-08-10) abstract; claims 1-74; figures 1-7 column 1, line 5 - column 8, line 12	1-4,6-9, 13-21
X	WO 2004/106020 A (SCANVAEGT INT AS [DK]; GRUNDTVIG LARS [DK]; NIELSEN ULRICH CARLIN [DK]) 9 December 2004 (2004-12-09) abstract; claims 1-10; figures 1-7 page 1, line 3 - page 11, line 19	1,6, 8-13,15, 19-21
X	WO 2006/136814 A (AEW DELFORD SYSTEMS [GB]; BURTON MICHAEL COLIN [GB]) 28 December 2006 (2006-12-28) abstract; claims 1-28; figures 1-16 pages 1-22	1-7, 13-16

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 Dezember 2008	12/12/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Rojo Galindo, Ángel

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/007567

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 324 522 A (BOEKEL CORNELIS DIRK BOEKEL CORNELIS DIRK [NL]) 19 July 1989 (1989-07-19) abstract; claims 1-6; figures 1,2 column 1, line 1 - column 3, line 24	1,6, 8-10,13, 15-17, 19-21
X	EP 0 848 308 A (MEAT AND LIVESTOCK COMMISSION [GB]) 17 June 1998 (1998-06-17) page 1, line 3 - page 7, line 17; claims 1-14; figures 1-10 abstract	1-4, 6-11, 13-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/007567

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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP2008/007567

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
INV. A22C17/00

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
A22C

Recherchierte, aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)
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C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	US 5 937 080 A (VOGELEY JR ARTHUR W [US] ET AL) 10. August 1999 (1999-08-10) Zusammenfassung; Ansprüche 1-74; Abbildungen 1-7 Spalte 1, Zeile 5 - Spalte 8, Zeile 12	1-4,6-9, 13-21
X	WO 2004/106020 A (SCANVAEGT INT AS [DK]; GRUNDTVIG LARS [DK]; NIELSEN ULRICH CARLIN [DK]) 9. Dezember 2004 (2004-12-09) Zusammenfassung; Ansprüche 1-10; Abbildungen 1-7 Seite 1, Zeile 3 - Seite 11, Zeile 19	1,6, 8-13,15, 19-21

-/--

[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen [X] Siehe Anhang Patentfamilie

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2. Dezember 2008	12/12/2008

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Rojo Galindo, Ángel

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP2008/007567

C. (Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	WO 2006/136814 A (AEW DELFORD SYSTEMS [GB]; BURTON MICHAEL COLIN [GB]) 28. Dezember 2006 (2006-12-28) Zusammenfassung; Ansprüche 1-28; Abbildungen 1-16 Seiten 1-22	1-7, 13-16
X	EP 0 324 522 A (BOEKEL CORNELIS DIRK BOEKEL CORNELIS DIRK [NL]) 19. Juli 1989 (1989-07-19) Zusammenfassung; Ansprüche 1-6; Abbildungen 1,2 Spalte 1, Zeile 1 - Spalte 3, Zeile 24	1,6, 8-10,13, 15-17, 19-21
X	EP 0 848 308 A (MEAT AND LIVESTOCK COMMISSION [GB]) 17. Juni 1998 (1998-06-17) Seite 1, Zeile 3 - Seite 7, Zeile 17; Ansprüche 1-14; Abbildungen 1-10 Zusammenfassung	1-4, 6-11, 13-21

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
PCT/EP2008/007567

Im Recherchenbericht angeführtes Patentdokument		Datum der Veröffentlichung	Mitglied(er) der Patentfamilie		Datum der Veröffentlichung
US 5937080	A	10-08-1999	KEINE		
WO 2004106020	A	09-12-2004	KEINE		
WO 2006136814	A	28-12-2006	EP	1915240 A1	30-04-2008
			GB	2427913 A	10-01-2007
			GB	2428182 A	24-01-2007
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			ES	2075032 T3	01-10-1995
			NL	8800063 A	01-08-1989
			US	4947517 A	14-08-1990
EP 0848308	A	17-06-1998	KEINE		

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Filing date: 24 October 2007 (24.10.2007)

Date of receipt at the International Bureau: 03 November 2008 (03.11.2008)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

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Prioritätsbescheinigung
DE 10 2007 050 857.5
über die Einreichung einer Patentanmeldung

Aktenzeichen:	10 2007 050 857.5
Anmeldetag:	24. Oktober 2007
Anmelder/Inhaber:	Weber Maschinenbau GmbH Breidenbach, 35236 Breidenbach/DE (vormals: Weber Maschinenbau GmbH & Co. KG, 35236 Breidenbach/DE)
Bezeichnung:	Fettauflagenvermessungseinrichtung
IPC:	G 01 B 11/06

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der Teile der am 24. Oktober 2007 eingereichten Unterlagen dieser Patentanmeldung unabhängig von gegebenenfalls durch das Kopierverfahren bedingten Farbabweichungen.

München, den 14. Oktober 2008
Deutsches Patent- und Markenamt
Der Präsident
Im Auftrag

Wunder

Weber Maschinenbau GmbH & Co. KG W10078PDE - Jr/Sh

FETTAUFLAGENVERMESSUNGSEINRICHTUNG

Die Erfindung betrifft eine Vermessungseinrichtung zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts.

Fleischprodukte bestehen im Wesentlichen aus drei Bestandteilen, nämlich Schwarte, Fett und Edelfleisch. In der Fleisch verarbeitenden Industrie werden zu verarbeitende Fleischstücke je nach Anforderung in diese drei Bestandteile zerlegt.

Um die Schwarte und das Fett, d.h. also die Fettauflage, in einem automatisierten Prozess von dem Edelfleischbestandteil eines Fleischprodukts trennen zu können, ist es erforderlich, die Stärke der Fettauflage, mit anderen Worten also deren Dicke oder Höhe, zu kennen. Bekannte Vermessungseinrichtungen sehen zur Ermittlung der Stärke einer Fettauflage eines Fleischprodukts einen Sensor vor, welcher in das Produkt eingestochen wird und während des Einstechens die Umgebungshelligkeit erfasst. Durch eine Auswertung der während des Einstechens auftretenden und durch den Sensor erfassten unterschiedlichen Helligkeitswerte kann auf die Konsistenz des von dem Sensor durchstoßenen Materials geschlossen oder zumindest eine Änderung der Konsistenz detektiert werden, woraus sich letztlich die Stärke einer Fettauflage ermitteln lässt.

Nachteilig ist hierbei, dass das Fleischprodukt durch das Einstechen des Sensors beschädigt wird, insbesondere da der Sensor für eine zuverlässige Ermittlung der Stärke der Fettauflage an mehreren Stellen des Produkts

eingestochen werden muss oder mehrere verteilt angeordnete Sensoren gleichzeitig in das Produkt eingestochen werden müssen.

Der Erfindung liegt die Aufgabe zugrunde, eine Vermessungseinrichtung zu schaffen, welche eine Ermittlung der Stärke einer Fettauflage eines Fleischprodukts ermöglicht, ohne das Fleischprodukt dabei zu beschädigen.

Die Aufgabe wird durch eine Vermessungseinrichtung mit den Merkmalen des Anspruchs 1 und insbesondere dadurch gelöst, dass die Ermittlung der Stärke der Fettauflage berührungslos erfolgt.

Vorteilhafterweise erfolgt die Ermittlung der Stärke der Fettauflage optisch. Die Vermessungseinrichtung kann zu diesem Zweck einen Lichtdetektor zum Detektieren von an dem Fleischprodukt reflektiertem Licht aufweisen. Der Lichtdetektor kann eine Kamera, beispielsweise eine CCD-Kamera, umfassen, deren Blickwinkel vorzugsweise so groß gewählt ist, dass ein Bereich des Fleischprodukts erfasst wird, welcher eine Grenzfläche zwischen der Fettauflage und dem Edelfleischbestandteil umfasst.

Anhand der ermittelten Reflektivität der durch den Lichtdetektor erfassten Bereiche des Fleischprodukts lässt sich auf die Konsistenz des erfassten Produktmaterials schließen, so dass ein Übergang von einem Bestandteil zu einem anderen Bestandteil des Fleischprodukts erkannt werden kann oder sogar unterschiedliche Bestandteile des Fleischprodukts und insbesondere die Fettauflage des Fleischprodukts identifiziert werden können, woraus letztlich die Stärke der Fettauflage ermittelbar ist.

Zur Verbesserung des Detektionsergebnisses kann eine einen Bereich des Fleischprodukts und insbesondere den durch den Lichtdetektor erfassten

Bereich ausleuchtende Lichtquelle vorgesehen sein. Gemäß einer bevorzugten Ausführungsform umfasst die Lichtquelle wenigstens eine Leuchtdiode, insbesondere eine im blauen Wellenlängenbereich emittierende Leuchtdiode. Da sich die Reflexionseigenschaften der Fett- und Edelfleischbestandteile eines Fleischprodukts insbesondere im blauen Wellenlängenbereich deutlich voneinander unterscheiden, ermöglicht die Verwendung von blauem Licht eine besonders zuverlässige Ermittlung der Fettauflagenstärke.

Gemäß einer weiteren Ausführungsform ist eine Transporteinrichtung vorgesehen, um das Fleischprodukt, insbesondere kontinuierlich, durch die Vermessungseinrichtung hindurch zu transportieren. Auf diese Weise kann die Vermessung des Fleischprodukts leicht in einen Prozess zur Verarbeitung des Fleischprodukts integriert werden. Bevorzugt umfasst die Transporteinrichtung ein Fördermittel, welches dazu vorgesehen ist, das Fleischprodukt einer Schneideinrichtung zur Abtrennung der Fettauflage von dem Edelfleischbestandteil zuzuführen.

Vorteilhafterweise sind der Lichtdetektor und die Lichtquelle in Transportrichtung gesehen seitlich neben der Transporteinrichtung angeordnet.

Weiterer Gegenstand der Erfindung ist eine Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer Vermessungseinrichtung zur automatischen Vermessung der Fettauflage, insbesondere einer Vermessungseinrichtung der voranstehend beschriebenen Art, und einer mit der Vermessungseinrichtung gekoppelten Schneideinrichtung zur automatischen Abtrennung der Fettauflage von dem Edelfleischbestandteil in Abhängigkeit von den durch die Vermessungseinrichtung ermittelten Messdaten.

Die Kopplung der Schneideinrichtung mit der Vermessungseinrichtung ermöglicht eine vollständig automatisierte Abtrennung der Fettauflage von dem Edelfleischbestandteil des Fleischprodukts. Insbesondere ist keine manuelle Vermessung der Fettauflage oder manuelle Anpassung der Schneideinrichtung an die gemessene Fettauflagenstärke erforderlich, da sowohl die Bestimmung der Fettauflagenstärke als auch die entsprechende Einstellung der Schneideinrichtung automatisch erfolgt. Letztlich ermöglicht dies eine Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts mit einem signifikant geringeren wirtschaftlichen Aufwand.

Erfolgt die Ermittlung der Fettauflagenstärke wie voranstehend beschrieben berührungslos, so lässt sich die Fettauflage von dem Edelfleischbestandteil trennen, ohne dass die Fettauflage und/oder der Edelfleischbestandteil dabei eingestochen oder eingeschnitten oder anderweitig beschädigt wird.

Vorteilhafterweise ist eine Transporteinrichtung vorgesehen, um das Fleischprodukt, insbesondere kontinuierlich, durch die Vermessungseinrichtung hindurch zu transportieren und der Schneideinrichtung zuzuführen.

Die Schneideinrichtung kann ein Schneidmesser, insbesondere einen Messerbalken, umfassen, dessen Lage und insbesondere Höhe relativ zu einer Produktauflage variierbar ist. Auf diese Weise lassen sich die Schneideinrichtung und insbesondere die Schneidmesserposition an unterschiedlich starke Fettauflagen anpassen, bzw. es kann die Dicke eingestellt werden, mit welcher die Fettauflage von dem Edelfleischbestandteil abgetrennt wird.

Bevorzugt weist die Schneideinrichtung eine Steuereinheit zur Steuerung des Betriebs des Schneidmessers in Abhängigkeit von den durch die Vermessungseinrichtung ermittelten Messdaten auf.

Außerdem kann ein Verfahrprofil in der Steuereinrichtung abgespeichert sein, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub einzustellen ist. Das Fahrprofil ermöglicht es, sozusagen die Anatomie des Fleischprodukts bei der Abtrennung der Fettauflage von dem Edelfleischbestandteil zu berücksichtigen und mit dem Schneidmesser dem natürlichen, also anatomiebedingten Verlauf der Fettauflage zu folgen.

Weiterer Gegenstand der Erfindung ist ein Verfahren zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts mit den Merkmalen des Anspruchs 13, durch welches sich die in Verbindung mit der erfindungsgemäßen Vermessungseinrichtung bereits erläuterten Vorteile entsprechend realisieren lassen.

Gemäß einer bevorzugten Ausführungsform des Verfahrens wird zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts vermessen, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt. Die Vermessung eines Teilabschnitts ermöglicht eine ausreichend genaue Vorhersage über den Verlauf der Fettauflage über die gesamte Ausdehnung des Fleischprodukts insbesondere bei solchen Fleischprodukten, bei denen der Fettauflagenverlauf von Produkt zu Produkt in bekannter Weise oder nur geringfügig variiert, da sich der vermessene Teilabschnitt einer von mehreren bekannten "Anatomien" des Fleischprodukts eindeutig zuordnen lässt. In Abhängigkeit von dem Mess-

ergebnis bzw. der zugeordneten "Anatomie" kann somit ein Schneidprogramm ausgewählt werden, durch welches sich die Fettauflage in der gewünschten Weise abtrennen lässt.

Alternativ oder zusätzlich kann der Verlauf der Fettauflage durch eine Vermessung des Fleischprodukts an charakteristischen Messpunkten und anschließende Inter- oder Extrapolation über das gesamte Fleischprodukt ermittelt werden. Dies ermöglicht zum einen eine Überprüfung, ob die "Anatomie" des Fleischprodukts aus der Vermessung eines Teilabschnitts korrekt bestimmt wurde sowie gegebenenfalls eine Modifikation des Schneidprogramms. Zum anderen lässt sich der Fettauflagenverlauf über die gesamte Ausdehnung des Fleischprodukts auch bei solchen Fleischprodukten ermitteln, bei denen der Verlauf der Fettauflage erfahrungsgemäß von Produkt zu Produkt so stark variiert, dass die Vermessung in einem Teilabschnitt zur genauen Ermittlung des Fettauflagenverlaufs nicht ausreicht.

Gemäß einer weiteren Ausführungsform werden die ermittelten Messwerte mit für das Fleischprodukt erfahrungsgemäß zu erwartenden Messwerten verglichen, und bei einer Abweichung der ermittelten von den zu erwartenden Messwerten wird eine Fehlermeldung angezeigt. Auf diese Weise können ungewöhnliche Produktabweichungen und/oder Fehlschnitte detektiert und gemeldet werden, wodurch sich insbesondere bei einer vollautomatischen Verarbeitung des Fleischprodukts eine Fehlverarbeitung des Produkts vermeiden lässt.

Wird zur Ermittlung der Fettauflagenstärke ein Kamerasystem verwendet, so lässt sich durch eine entsprechende Auswertung der aufgenommenen Kamerabilder und insbesondere durch einen Vergleich der aufgenommenen Kamerabilder mit statistischen Referenzbildern nicht nur feststellen,

ob sich das Fleischprodukt in einer für eine weitere Verarbeitung korrekten Lage befindet, sondern auch, ob eine Verschmutzung des Kameraobjektivs vorliegt. Sollte ersteres oder letzteres der Fall sein, so kann eine entsprechende Fehlermeldung ausgegeben und eine Verarbeitung des Fleischprodukts gegebenenfalls gestoppt werden, um Fehlverarbeitungen des Fleischprodukts zu vermeiden.

Weiterer Gegenstand der Erfindung ist ferner ein Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit den Merkmalen des Anspruchs 19, durch welches sich die in Verbindung mit der Trennvorrichtung erläuterten Vorteile entsprechend erreichen lassen.

Nachfolgend wird die Erfindung rein beispielhaft anhand einer vorteilhaften Ausführungsform unter Bezugnahme auf die beigefügte Zeichnung beschrieben. Es zeigen:

Fig. 1 eine erfindungsgemäße Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer Vermessungseinrichtung und einer Schneideinrichtung; und

Fig. 2 eine perspektivische Ansicht der Vermessungseinrichtung von Fig. 1.

Die in Fig. 1 dargestellte Vorrichtung umfasst eine Schneideinrichtung 10 zur Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts 12. Eine derartige Schneideinrichtung 10 wird auch als Entschwartungs- oder Entfettungsmaschine bezeichnet.

Das Fleischprodukt 12 wird der Schneideinrichtung 10 mittels einer Transporteinrichtung zugeführt, die zu diesem Zweck ein erstes Förderband 14 aufweist. Eine Oberseite 16 des ersten Förderbands 14 definiert eine Auflageebene für das Fleischprodukt 12.

Die Schneideinrichtung 10 umfasst in an sich bekannter Weise einen in der Figur nicht dargestellten Messerbalken zum Abtrennen der Fettauflage. Die Lage des Messerbalkens relativ zu dem ersten Förderband 14 und insbesondere die Höhe des Messerbalkens über der Oberseite 16 des ersten Förderbands 14 ist je nach Dicke der abzutrennenden Fettauflagenschicht bzw. Dicke der Fettauflagenschicht, die an dem Edelfleischbestandteil verbleiben soll, einstellbar.

Um eine vollautomatische Entfettung bzw. Entschwartung des Fleischprodukts 12 zu ermöglichen, ist der Schneideinrichtung 10 in Transport- bzw. Zuführrichtung des Fleischprodukts 12 gesehen eine Vermessungseinrichtung 18 zur Vermessung des Fleischprodukts 12 vorgelagert.

Die Vermessung des Fleischprodukts 12 erfolgt in einem kontinuierlichen Durchlaufprozess, während sich das Fleischprodukt 12 durch die Vermessungseinrichtung 18 hindurch bewegt. Für den Transport des Fleischprodukts 12 durch die Vermessungseinrichtung 18 ist ein sich an das erste Förderband 14 anschließendes zweites Förderband 20 vorgesehen, welches ebenfalls Teil der bereits genannten Transporteinrichtung ist.

Bei der Vermessung des Fleischprodukts 12 handelt es sich um eine berührungslose, optische Vermessung. Zu diesem Zweck sind hinter einem seitlich neben dem zweiten Förderband 20 angeordneten Sichtfenster 22

eine LED-Beleuchtung und eine Kamera, beispielsweise eine CCD-Kamera, vorgesehen.

Die LED-Beleuchtung umfasst wenigstens eine im blauen Wellenlängenbereich emittierende Leuchtdiode und ist so ausgebildet, dass sie einen zumindest die Fettauflage des Fleischprodukts 12 umfassenden Teilbereich des Fleischprodukts 12 ausleuchtet. Die Verwendung von blauem Licht ist besonders vorteilhaft, weil der Kontrast zwischen Edelfleisch und Fettauflage unter blauem Licht besonders deutlich ausfällt, so dass der Verlauf der Grenze zwischen Edelfleisch und Fettauflage besonders gut zu erkennen ist.

Mittels der Kamera werden Bilder des durch die LED-Beleuchtung ausgeleuchteten Bereichs des Fleischprodukts 12 aufgenommen. Die aufgenommenen Bilder werden in einer Auswerteeinheit ausgewertet, um die Stärke der Fettauflage, mit anderen Worten also die Dicke von Fett und Schwarte, zu ermitteln.

Zusätzlich kann durch einen Vergleich der aufgenommenen Bilder mit in der Auswerteeinheit hinterlegten statistischen Referenzbildern festgestellt werden, ob das Fleischprodukt 12 sich in einer für die Verarbeitung in der Schneideinrichtung 10 richtigen Lage befindet, d.h. also korrekt ausgerichtet ist, und/oder ob eine Verschmutzung eines Kameraobjektivs und/oder des Sichtfensters 22 vorliegt.

Bei einer detektierten Fehlausrichtung des Fleischprodukts 12 oder Verschmutzung des Sichtfensters 22 kann eine optische und/oder akustische Fehlermeldung über ein mit der Auswerteeinheit verbundenes Ausgabemittel 24 angezeigt werden, damit ein Bediener der Vorrichtung entsprechende Maßnahmen zur Behebung des Fehlers bzw. der Fehler ergreifen

kann. Alternativ oder zusätzlich kann die Auswerteeinheit in einem solchen Fall auch das zweite Förderband 20 und/oder das erste Förderband 14 anhalten, um eine fehlerhafte Weiterverarbeitung des Fleischprodukts 12 zu verhindern.

Grundsätzlich ist es möglich, das Fleischprodukt 12 über seine in Transportrichtung gesehen gesamte Länge zu vermessen. Angesichts der dabei anfallenden Datenmengen ist es jedoch günstiger, lediglich einen Teilabschnitt des Fleischprodukts 12, beispielsweise einen in Transportrichtung gesehenen vorderen Teilabschnitt, zu vermessen.

Konkret kann die Vermessung des Fleischprodukts 12 beispielsweise so erfolgen, dass mehrere, z.B. 10 bis 20, Lichtblitze in kurzen zeitlichen Abständen von z.B. einigen 10 ms durch die LED-Beleuchtung kurz nacheinander ausgesandt werden, während sich das Fleischprodukt 12 an dem Sichtfenster 22 vorbei bewegt. Aus den den jeweiligen Lichtblitzen zugeordneten Kamerabildern wird jeweils ein Wert für die Stärke der Fettauflage ermittelt, und aus diesen ermittelten Werten wird ein Mittelwert errechnet, welcher als tatsächlicher Wert der Fettauflagenstärke in dem erfassten Bereich angesehen wird.

Grundsätzlich ist es ausreichend, diesen Messvorgang nur einmal pro Fleischprodukt 12 durchzuführen. Wird der Messvorgang über eine Länge des Fleischprodukts 12 von mehreren Zentimetern, z.B. 10 bis 15 cm, jedoch mehrmals durchgeführt, so lässt sich die tatsächliche Stärke der Fettauflage mit einer höheren Genauigkeit ermitteln bzw. bereits ein Hinweis auf den Verlauf der Fettauflage gewinnen.

Grundsätzlich kann davon ausgegangen werden, dass sich der Verlauf der Fettauflage bei gleichartigen Fleischprodukten 12 bedingt durch die Ana-

tomie des Fleischprodukts nicht signifikant ändert, so dass es bei Kenntnis der Anatomie des Fleischprodukts 12 ausreicht, einen Teilabschnitt des Fleischprodukts 12, z.B. einen vorderen Abschnitt, zu vermessen, um daraus den Verlauf der Fettauflage und insbesondere deren Stärke über das gesamte Fleischprodukt 12 hinweg vorherzusagen. Die Vermessung des Teilbereichs ermöglicht somit eine eindeutige Bestimmung des Verlaufs der Fettauflage.

Die durch die Vermessungseinrichtung 18 in dem Teilabschnitt ermittelte Stärke der Fettauflage wird von der Auswerteeinheit der Vermessungseinrichtung 18 an eine Steuereinheit der Schneideinrichtung 10 übermittelt, welche aus dem Messergebnis die Anatomie des Fleischprodukts 12 ermittelt.

In der Steuereinheit der Schneideinrichtung 10 sind produkt- bzw. anatomieabhängige Verfahrprofile hinterlegt, welche unter Berücksichtigung der ermittelten Anatomie des jeweils zu verarbeitenden Fleischprodukts 12 eine Veränderung der Einstellung des Messerbalkens in Abhängigkeit von dem Vorschub des zu verarbeitenden Fleischprodukts 12 bewirken.

Anhand des Messergebnisses bzw. der ermittelten Anatomie des Fleischprodukts 12 wählt die Steuereinrichtung ein geeignetes Verfahrprofil aus, durch welches die Höhe des Messerbalkens in Abhängigkeit von der Stärke und dem Verlauf der Fettauflage und in Abhängigkeit von dem Produktvorschub so eingestellt wird, dass eine Fettauflagenschicht einer gewünschten Dicke von dem Fleischprodukt 12 abgetrennt wird bzw. dass eine Fettauflagenschicht einer gewünschten Dicke an dem Edelfleischbestandteil des Fleischprodukts 12 verbleibt.

Werden Fleischprodukte 12 verarbeitet, die sich z.B. stärker voneinander unterscheiden, so ist es auch möglich, den Verlauf der Fettauflage durch eine Vermessung des Fleischprodukts 12 an mehreren, insbesondere über die Länge des Fleischprodukts 12 verteilt angeordneten, charakteristischen Messpunkten sowie durch eine anschließende Inter- oder Extrapolation des Messergebnisses über das gesamte Fleischprodukt 12 hinweg zu ermitteln.

Der so ermittelte Verlauf der Fettauflage wird wiederum von der Auswerteeinheit der Vermessungseinrichtung 18 an die Steuereinheit der Schneideinrichtung 10 übermittelt, damit diese die Höhe des Messerbalkens in Abhängigkeit von dem ermittelten Verlauf der Fettauflage und in Abhängigkeit von dem Produktvorschub so einstellen kann, dass eine Fettauflagenschicht einer gewünschten Dicke von dem Fleischprodukt 12 abgetrennt wird bzw. dass eine Fettauflagenschicht einer gewünschten Dicke an dem Edelfleischbestandteil des Fleischprodukts 12 verbleibt.

Gegebenenfalls kann die Vermessung des Fleischprodukts 12 an mehreren, insbesondere über die Länge des Fleischprodukts 12 verteilt angeordneten, charakteristischen Messpunkten und die anschließende Inter- oder Extrapolation des Messergebnisses über das gesamte Fleischprodukt 12 hinweg dazu verwendet werden, nicht nur anstelle eines abgespeicherten Verfahrprofils, sondern zusätzlich zu einem abgespeicherten Verfahrprofil, gewissermaßen in Form einer Feineinstellung, die Einstellung des Messerbalkens zu steuern.

Im Ergebnis ermöglicht die erfindungsgemäße Vorrichtung eine vollautomatische Abtrennung einer Fettauflage von einem Edelfleischbestandteil eines Fleischprodukts 12, wobei durch die erwähnte Fehlererkennung eine Fehlverarbeitung des Fleischprodukts 12 vermieden und somit die Pro-

zesssicherheit erhöht wird und außerdem durch die berührungslose Vermessung des Fleischprodukts 12 ein Einstechen oder Einschneiden der Fettauflage und/oder des Edelfleischbestandteils vermieden wird.

Bezugszeichenliste

10	Schneideinrichtung
12	Fleischprodukt
14	erstes Förderband
16	Oberseite
18	Vermessungseinrichtung
20	zweites Förderband
22	Sichtfenster
24	Ausgabemittel

Patentansprüche

1. Vermessungseinrichtung (18) zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12),
dadurch g e k e n n z e i c h n e t, dass
die Ermittlung der Stärke der Fettauflage berührungslos erfolgt.

2. Vermessungseinrichtung (18) nach Anspruch 1,
dadurch g e k e n n z e i c h n e t, dass
die Ermittlung der Stärke der Fettauflage optisch erfolgt.

3. Vermessungseinrichtung (18) nach Anspruch 1 oder 2,
g e k e n n z e i c h n e t durch
einen Lichtdetektor, insbesondere eine Kamera, zum Detektieren von an dem Fleischprodukt (12) reflektiertem Licht.

4. Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche,
g e k e n n z e i c h n e t durch
eine einen Bereich des Fleischprodukts (12) ausleuchtende Lichtquelle.

5. Vermessungseinrichtung (18) nach Anspruch 4,
dadurch g e k e n n z e i c h n e t, dass
die Lichtquelle wenigstens eine Leuchtdiode, insbesondere eine im blauen Wellenlängenbereich emittierende Leuchtdiode, umfasst.

6. Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche,
dadurch g e k e n n z e i c h n e t, dass
eine Transporteinrichtung (20) vorgesehen ist, um das Fleischprodukt (12), insbesondere kontinuierlich, durch die Vermessungseinrichtung (18) hindurch zu transportieren.

7. Vermessungseinrichtung (18) nach Anspruch 6,
dadurch g e k e n n z e i c h n e t, dass
eine Lichtquelle und ein Lichtdetektor in Transportrichtung gesehen seitlich neben der Transporteinrichtung (20) angeordnet sind.

8. Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts (12) von einem Edelfleischbestandteil des Fleischprodukts (12) mit einer Vermessungseinrichtung (18), insbesondere einer Vermessungseinrichtung (18) nach einem der vorherigen Ansprüche, zur automatischen Ermittlung der Stärke der Fettauflage und einer mit der Vermessungseinrichtung (18) gekoppelten Schneideinrichtung (10) zur automatischen Abtrennung der Fettauflage von dem Edelfleischbestandteil in Abhängigkeit von den durch die Vermessungseinrichtung (18) ermittelten Messdaten.

9. Vorrichtung nach Anspruch 8,
dadurch g e k e n n z e i c h n e t, dass
eine Transporteinrichtung (14, 20) vorgesehen ist, um das Fleisch-

produkt (12), insbesondere kontinuierlich, durch die Vermessungseinrichtung (18) hindurch zu transportieren und der Schneideinrichtung (10) zuzuführen.

10. Vorrichtung nach Anspruch 8 oder 9,
dadurch g e k e n n z e i c h n e t, dass
die Schneideinrichtung (10) ein Schneidmesser, insbesondere einen Messerbalken, umfasst, dessen Lage und insbesondere Höhe relativ zu einer Produktauflage variierbar ist.

11. Vorrichtung nach Anspruch 10,
dadurch g e k e n n z e i c h n e t, dass
die Schneideinrichtung (10) eine Steuereinheit zur Steuerung der Lage bzw. Höhe des Schneidmessers in Abhängigkeit von den durch die Vermessungseinrichtung (18) ermittelten Messdaten aufweist.

12. Vorrichtung nach Anspruch 11,
dadurch g e k e n n z e i c h n e t, dass
wenigstens ein Verfahrprofil in der Steuereinheit abgespeichert ist, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub einzustellen ist.

13. Verfahren zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts (12),
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage berührungslos ermittelt wird.

14. Verfahren nach Anspruch 13,
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage mittels optischer Vermessung ermittelt wird.

15. Verfahren nach Anspruch 13 oder 14,
dadurch g e k e n n z e i c h n e t, dass
die Stärke der Fettauflage während einer, insbesondere kontinuierlichen, Transportbewegung des Fleischprodukts (12) ermittelt wird.

16. Verfahren nach einem der Ansprüche 13 bis 15,
dadurch g e k e n n z e i c h n e t, dass
zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts (12) vermessen wird, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt.

17. Verfahren nach einem der Ansprüche 13 bis 16,
dadurch g e k e n n z e i c h n e t, dass
der Verlauf der Fettauflage über das gesamte Fleischprodukt (12) durch eine Vermessung des Fleischprodukts (12) an charakteristischen Messpunkten und anschließende Inter- oder Extrapolation ermittelt wird.

18. Verfahren nach einem der Ansprüche 13 bis 17,
dadurch g e k e n n z e i c h n e t, dass
die ermittelten Messwerte mit für das Fleischprodukt (12) erfahrungsgemäß zu erwartenden Messwerten verglichen werden und bei einer Abweichung der ermittelten von den zu erwartenden Messwerten eine Fehlermeldung angezeigt wird.

19. Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts (12) von einem Edelfleischbestandteil des Fleischprodukts (12), bei dem die Stärke der Fettauflage, insbesondere mittels eines Verfahrens nach einem der Ansprüche 13 bis 18, ermittelt wird und die Fettauflage in Abhängigkeit von der ermittelten Stärke der Fettauflage von dem Edelfleischbestandteil abgetrennt wird.

20. Verfahren nach Anspruch 19,
dadurch g e k e n n z e i c h n e t, dass
die Position eines Schneidmessers zum Abtrennen der Fettauflage gemäß einem vorgegebenen Verfahrprofil in Abhängigkeit von einem Vorschub des Fleischprodukts (12) in einer Richtung quer zur Vorschubrichtung verstellt wird.

21. Verfahren nach Anspruch 19 oder 20,
dadurch g e k e n n z e i c h n e t, dass
zur Ermittlung der Stärke der Fettauflage lediglich ein Teilabschnitt des Fleischprodukts (12) vermessen wird, insbesondere ein in einer Transportrichtung gesehen vorderer Teilabschnitt, und in Abhängigkeit von dem Messergebnis ein abgespeichertes Verfahrprofil ausgewählt wird, gemäß dem die Lage und insbesondere die Höhe des Schneidmessers relativ zu einer Produktauflage in Abhängigkeit von einem Produktvorschub eingestellt wird.

Zusammenfassung

Die Erfindung betrifft eine Vermessungseinrichtung zur Ermittlung der Stärke einer Fettauflage eines einen Edelfleischbestandteil und eine Fettauflage umfassenden Fleischprodukts, bei welcher die Ermittlung der Stärke der Fettauflage berührungslos erfolgt. Ferner betrifft die Erfindung eine Vorrichtung zur Abtrennung einer Fettauflage eines Fleischprodukts von einem Edelfleischbestandteil des Fleischprodukts mit einer solchen Vermessungseinrichtung sowie ein Verfahren zur Ermittlung der Stärke einer Fettauflage eines Fleischprodukts und ein Verfahren zur Abtrennung einer Fettauflage eines Fleischprodukts.

Fig. 1

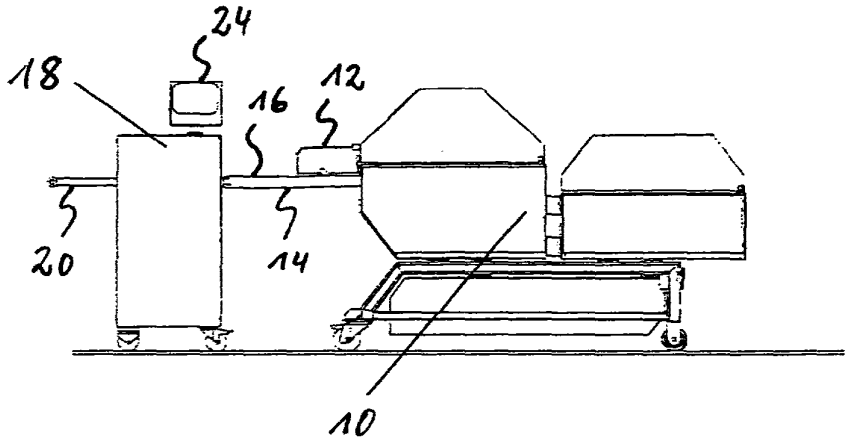
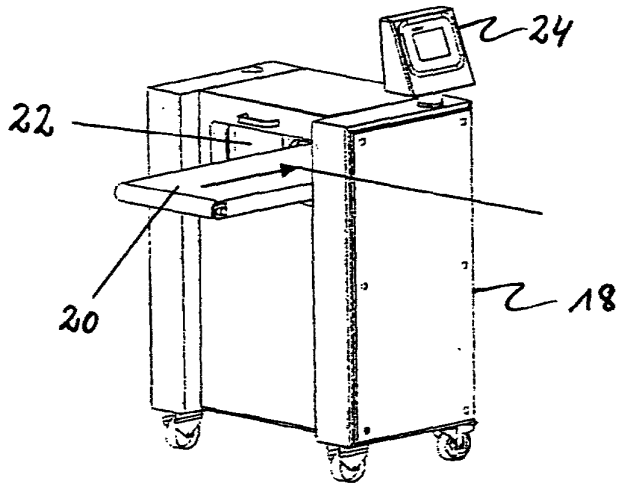


Fig. 2



PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/738,969	Filing Date 06/30/2010	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☒ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☒ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☒ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 04/20/2010

	(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 21	Minus	** 21	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	* 2	Minus	***2	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT

	(Column 1)		(Column 2)	(Column 3)					
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/ROBERT SHERMAN/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 2, 2008

Application or Docket Number: 12/738,969

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	LARGE ENTITY RATE	LARGE ENTITY FEE
U.S. NATIONAL STAGE FEES							
BASIC FEE	SMALL ENT.=$165	LARGE ENT.=$330	BASIC FEE		OR	BASIC FEE	330
EXAMINATION FEE	SMALL ENT. = $110	LARGE ENT. = $220	EXAM. FEE			EXAM. FEE	220
SEARCH FEE	U.S. is ISA = $50/$100 ALL other countries = $215/$430	ALL other situations = $270/$550	SEARCH FEE			SEARCH FEE	430
FEE FOR EXTRA SPEC. PGS.	minus 100 =	/ 50 =	X $ 135 =			X $ 270 =	—
TOTAL CHARGEABLE CLAIMS	21 minus 20 =	1	X $ 26 =		OR	X $ 52 =	52
INDEPENDENT CLAIMS	2 minus 3 =	—	X $ 110 =		OR	X $ 220 =	—
MULTIPLE DEPENDENT CLAIM PRESENT			+ $ 195 =		OR	+ $ 390 =	—
* If the difference in column 1 is less than zero, enter "0" in column 2			TOTAL		OR	TOTAL	1032

CLAIMS AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
AMENDMENT A	Total	*	Minus	**	=	X $ 26 =		OR	X $ 52 =	
	Independent	*	Minus	***	=	X $ 110 =		OR	X $ 220 =	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+ $ 195 =		OR	+ $ 390 =	
						TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
AMENDMENT B	Total	*	Minus	**	=	X $ 26 =		OR	X $ 52 =	
	Independent	*	Minus	***	=	X $ 110 =		OR	X $ 220 =	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+ $ 195 =		OR	+ $ 390 =	
						TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than '20', enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than '3', enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET (FOR USE WITH FORM PTO-875)	SERIAL NO. 10/738969	FILING DATE
	APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1		1			
2		1		1		
3		2		1		
4		(1)		1		
5		(2)		1		
6		(1)		1		
7		(1)		1		
8		(1)		1		
9		1		1		
10		2		1		
11		2		1		
12		2		1		
13	1		1			
14		1		1		
15		2		1		
16		(1)		1		
17		(2)		1		
18		(3)		1		
19		(4)		1		
20		(1)		1		
21		(1)		1		
22						
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50						
TOTAL IND.	[illegible]	⬇	2	⬇		⬇
TOTAL DEP.	29	⬅	19	⬅		⬅
TOTAL CLAIMS	26		21			

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
51						
52						
53						
54						
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99						
100						
TOTAL IND.		⬇		⬇		⬇
TOTAL DEP.		⬅		⬅		⬅
TOTAL CLAIMS						

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/738,969	Guenther Weber	088000-006700US

20350
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

INTERNATIONAL APPLICATION NO.	
PCT/EP2008/007567	
I.A. FILING DATE	PRIORITY DATE
09/12/2008	10/24/2007

CONFIRMATION NO. 6367
371 FORMALITIES LETTER

OC000000041575170

Date Mailed: 05/12/2010

NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as a Designated Office (37 CFR 1.494):

- Priority Document
- Copy of the International Application filed on 04/20/2010
- English Translation of the IA filed on 04/20/2010
- Copy of the International Search Report filed on 04/20/2010
- Preliminary Amendments filed on 04/20/2010
- U.S. Basic National Fees filed on 04/20/2010
- Assignee Statement for PGPUB filed on 04/20/2010
- Priority Documents filed on 04/20/2010

The applicant needs to satisfy supplemental fees problems indicated below.

The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), identifying the application by the International application number and international filing date.
- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.492(h) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fees required for this application is $**130** for a Large Entity:

- $**130** Surcharge.

ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 32 MONTHS FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

CATHERINE D SHORT

Telephone: (703) 756-1406

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
088000-006700US	12/738,969

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP2008/007567	September 12, 2008	October 24, 2007

TITLE OF INVENTION: FAT COVER MEASUREMENT DEVICE

APPLICANT(S) FOR DO/EO/US: GUENTHER WEBER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☐ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☒ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected (Article 31).
5. ☐ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A preliminary amendment.
14. ☐ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☒ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.2 and 37 CFR 1.821 – 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
12/738,969	PCT/EP2008/007567	088000-006700US

20. Other items or information: Statement Under 37 CFR 3.73(b) with true copy of Assignment

The following fees have been submitted	CALCULATIONS	PTO USE ONLY
21. ☐ Basic national fee (37 CFR 1.492(a)) **$330**	$	
22. ☐ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** All other situations **$220**	$	
23. ☐ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority ..... **$100** International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB ..... **$430** All other situations **$540**	$	
TOTAL OF 21, 22 and 23 =	$	

☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) or computer program listing in an electronic medium) (37 CFR 1.492(j)).
The fee is **$270** for each additional 50 sheets of paper or fraction thereof.

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round **up** to a whole number)	RATE	
- 100 =	/50 =		x **$270**	$

Surcharge of **$130.00** for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).	$ 130	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	- 20 =		x **$ 52**	$	
Independent claims	- 3 =		x **$220**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$390**	$	
			TOTAL OF ABOVE CALCULATIONS =	$ 130	
☐ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.				$	
			SUBTOTAL =	$ 130	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
			TOTAL NATIONAL FEE =	$ 130	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
			TOTAL FEES ENCLOSED =	$ 130	
			Amount to be refunded:	$	
			Amount to be charged:	$ 130	

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
12/738,969	PCT/EP2008/007567	088000-006700US

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 20-1430 in the amount of $ 130 to cover the above fees.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 20-1430 .

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do **NOT** attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is **not** recommended and by doing so your **credit card information may be displayed via PAIR**. To protect your information, it is recommended paying fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

SEND ALL CORRESPONDENCE TO:

J. Georg Seka
TOWNSEND AND TOWNSEND AND CREW LLP
Two Embarcadero Center, Eighth Floor
San Francisco, CA 94111-3834

SIGNATURE

J. Georg Seka
NAME

24,491 Date: 6/30/2010
REGISTRATION NUMBER

62742060 v1

DECLARATION

As a below-named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: FAT COVER MEASUREMENT DEVICE the specification of which ____ is attached hereto or _X_ was filed as International Application No. PCT/EP2008/007567, International Filing Date September 12, 2008 on April 20, 2010 as U.S. Application No. 12/738,969.

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56. I claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Country	Application No.	Date of Filing	Priority Claimed Under 35 USC 119
PCT	PCT/EP2008/007567	09/12/08	Yes
Germany	10 2007 050 857.5	10/24/07	Yes

Full Name of Inventor 1:	Last Name: **WEBER**	Suffix:	First Name: **GUENTHER**	Middle Name or Initial:	
Residence & Citizenship:	City: **Gross Nemerow**		State/Foreign Country: **Germany**	Country of Citizenship: **Germany**	
Post Office Address:	Post Office Address: **Zachow 5**		City: **Gross Nemerow**	State/Country: **Germany**	Postal Code: **17094**

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 1

Guenther Weber
Date 28/04/2010

62582360 v1

POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	12/738,969
Int'l Appln Number	PCT/EP2008/007567
Filing Date	April 20, 2010
First Named Inventor	Weber, Guenther
Title	FAT COVER MEASUREMENT DEVICE
Art Unit	
Examiner Name	
Attorney Docket	088000-006700US

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

20350

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

I further authorize any of the above-identified practitioners to execute a Statement Under 37 CFR 3.73(b) on my/our behalf to certify the chain of title and establish my/our ownership in the application identified above.

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number:

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.

Statement under 37 CFR 3.73(b) (Form PTO/SB/96 submitted herewith or filed on _____.

SIGNATURE of Applicant or Assignee of Record

Signature		Date	27/04/2010
Name	Guenther Weber	Telephone	+49/6465/918-0
Title and Company	President	Weber Maschinenbau GmbH Breidenbach	

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of _____ forms are submitted.

Attorney Docket No. 088000-006700US

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Guenther Weber

Application No./Patent No.: 12/738,969 Filed/Issue Date: April 20, 2010

Titled: FAT COVER MEASUREMENT DEVICE

Weber Maschinenbau GmbH Breidenbach, a corporation
(Name of Assignee) (Type of Assignee: corporation, partnership, university, government agency, etc.)

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in (The extent (by percentage) of its ownership interest is _____%); or

3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

OR

B. ☒ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet (s).

☒ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature	27/04/2010 Date
Guenther Weber Printed or Typed Name	President Title

Attorney Docket No. 088000-006700US
Client Reference No. W10078PWOUS - Jr/Sh/Ru

ASSIGNMENT OF PATENT APPLICATION

SOLE

WHEREAS, **Guenther Weber** of Zachow 5, Gross Nemerow, 17094 Germany, hereinafter referred to as "Assignor," is the inventor of the invention described and set forth in the below-identified application for United States Letters Patent:

Title of Invention:	FAT COVER MEASUREMENT DEVICE
Date(s) of Execution:	April 28, 2010
Filing Date:	April 20, 2010
Int'l Application No.:	PCT/EP2008/007567
Application No.:	12/738,969

WHEREAS, **Weber Maschinenbau GmbH Breidenbach** of Guenther-Weber-Strasse 3, Breidenbach, Germany, 35236, hereinafter referred to as "Assignee," is desirous of acquiring Assignor's interest in the said invention and application and in any U.S. Letters Patent which may be granted on the same;

NOW, THEREFORE, TO ALL WHOM IT MAY CONCERN: Be it known that, for good and valuable consideration, receipt of which is hereby acknowledged by Assignor, Assignor has sold, assigned and transferred, and by these presents does sell, assign and transfer unto the said Assignee, and Assignee's successors and assigns, all their right, title and interest in and to said invention and application, and in and to any Letters Patent which may hereafter be granted on the same in the United States, the said interest to be held and enjoyed by said Assignee as fully and exclusively as it would have been held and enjoyed by said Assignor had this Assignment and transfer not been made, to the full end and term of any Letters Patent which may be granted thereon, or of any division, renewal, continuation in whole or in part, substitution, conversion, reissue, prolongation or extension thereof.

Assignor further agrees that Assignor will, without charge to said Assignor, but at Assignee's expense, cooperate with Assignee in the prosecution of said application and/or applications, execute, verify, acknowledge and deliver all such further papers, including applications for Letters Patent and for the reissue thereof, and instruments of assignment and transfer thereof, and will perform such other acts as Assignee lawfully may request, to obtain or maintain Letters Patent for said invention and improvement, and to vest title thereto in said Assignee, or Assignee's successors and assigns.

IN TESTIMONY WHEREOF, Assignor has signed his/her name on the date indicated.

Dated: 28/04/2010

Guenther Weber

62582466 v1

COPY

Electronic Patent Application Fee Transmittal

Application Number:	12738969
Filing Date:	
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Filer:	J. Georg Seka/William Chinn
Attorney Docket Number:	088000-006700US

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Oath/decl > 30 months from priority date	1617	1	130	130
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**130**

Electronic Acknowledgement Receipt

EFS ID:	7932869
Application Number:	12738969
International Application Number:	
Confirmation Number:	6367
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Customer Number:	20350
Filer:	J. Georg Seka/William Chinn
Filer Authorized By:	J. Georg Seka
Attorney Docket Number:	088000-006700US
Receipt Date:	30-JUN-2010
Filing Date:	
Time Stamp:	19:32:06
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$130
RAM confirmation Number	7676
Deposit Account	201430
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Manitz_088000_006700US_Response_Notification_Missing_Requirements_Transmittals.PDF	402047 6be4d52537527d8927b7c75f60a77dee3c4e8cbb	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Response to Pre-Exam Formalities Notice	1	3
	Oath or Declaration filed	4	4
	Power of Attorney	5	5
	Assignee showing of ownership per 37 CFR 3.73(b).	6	7

Warnings:

Information:

2	Fee Worksheet (PTO-875)	fee-info.pdf	29925 f8df20f80c40206ca2cdb035dccba112d4a0c1b6	no	2

Warnings:

Information:

Total Files Size (in bytes):	431972

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/738,969	06/30/2010		1162	088000-006700US	21	2

CONFIRMATION NO. 6367

20350
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

FILING RECEIPT



Date Mailed: 07/16/2010

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Guenther Weber, Gross Nemerow, GERMANY;

Assignment For Published Patent Application

Weber Maschinenbau GmbH Breidenbach, Breidenbach, GERMANY

Power of Attorney: The patent practitioners associated with Customer Number 20350

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/EP2008/007567 09/12/2008

Foreign Applications

GERMANY 10 2007 050 857.5 10/24/2007

If Required, Foreign Filing License Granted: 07/14/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/738,969**

Projected Publication Date: 10/21/2010

Non-Publication Request: No

Early Publication Request: No

Title

Fat Cover Measurement Device

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier

license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/738,969	Guenther Weber	088000-006700US

20350
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

INTERNATIONAL APPLICATION NO.	
PCT/EP2008/007567	
I.A. FILING DATE	PRIORITY DATE
09/12/2008	10/24/2007

CONFIRMATION NO. 6367
371 ACCEPTANCE LETTER

OC000000042565273

Date Mailed: 07/16/2010

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

06/30/2010	06/30/2010
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 04/20/2010
- English Translation of the IA filed on 04/20/2010
- Copy of the International Search Report filed on 04/20/2010
- Preliminary Amendments filed on 04/20/2010
- Oath or Declaration filed on 06/30/2010
- U.S. Basic National Fees filed on 04/20/2010
- Assignee Statement for PGPUB filed on 04/20/2010
- Priority Documents filed on 04/20/2010
- Power of Attorney filed on 06/30/2010

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

DARLENE PROCTOR

Telephone: (571) 272-0400

Substitute for form 1449/PTO				Complete if Known	
				Application Number	12/738,969
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Filing Date	April 20, 2010
				First Named Inventor	Weber, Guenther
				Art Unit	
(Use as many sheets as necessary)				Examiner Name	
Sheet	1	of	2	Attorney Docket Number	088000-006700US

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No.[1]	Document Number Number Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	AA	US-7,110,572 B1	09-19-2006	Alan Benn	
	AB	US-5,937,080 A	08-10-1999	Arthur W. Vogeley, Jr., et al.	
	AC	US-5,944,598 A	08-31-1999	Alan Kwai-Wah Tong, et al.	
	AD	US-6,104,827 A	08-15-2000	Alan Benn, et al.	

FOREIGN PATENT DOCUMENTS								
Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]	Number[4]	Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	AE	DE	10 2006 007 490	A1	08-17-2006	Weber Maschinenbau GmbH & Co. KG		☐
	AF	DE	10 2004 017 037	A1	10-21-2004	MAJA-Maschinenfabrik Hermann Schill GmbH & Co. KG		☐
	AG	DE	100 50 836	A1	06-27-2002	Axel Hinz; Horst Eger		☐
	AH	EP	1 174 034	A1	01-23-2002	FMC		☐
	AI	WO	2006/136818	A1	12-28-2006	AEW Delford Systems		☐
	AJ	WO	2004/106020	A1	12-09-2004	Scanvaegt International A/S		☐
	AK	GB	2 364 894	A	02-13-2002	FMC		☐
	AL	WO	2006/136814	A1	12-28-2006	AEW Delford Systems		☐
	AM	EP	0 324 522	A1	07-19-1989	Boekel, Cornells Dirk		☐
	AN	EP	0 848 308	A1	06-17-1998	Meat and Livestock Commission		☐

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of U.S. Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO				*Complete if Known*	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				**Application Number**	12/738,969
				Filing Date	April 20, 2010
				First Named Inventor	Weber, Guenther
				Art Unit	
(Use as many sheets as necessary)				Examiner Name	
Sheet	2	of	2	Attorney Docket Number	088000-006700US

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.
[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/007567

A. CLASSIFICATION OF SUBJECT MATTER
INV. A22C17/00

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

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 937 080 A (VOGELEY JR ARTHUR W [US] ET AL) 10 August 1999 (1999-08-10) abstract; claims 1-74; figures 1-7 column 1, line 5 - column 8, line 12	1-4,6-9, 13-21
X	WO 2004/106020 A (SCANVAEGT INT AS [DK]; GRUNDTVIG LARS [DK]; NIELSEN ULRICH CARLIN [DK]) 9 December 2004 (2004-12-09) abstract; claims 1-10; figures 1-7 page 1, line 3 - page 11, line 19	1,6, 8-13,15, 19-21
X	WO 2006/136814 A (AEW DELFORD SYSTEMS [GB]; BURTON MICHAEL COLIN [GB]) 28 December 2006 (2006-12-28) abstract; claims 1-28; figures 1-16 pages 1-22	1-7, 13-16

-/--

[X] Further documents are listed in the continuation of Box C.

[X] 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 document 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
2 Dezember 2008	12/12/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Rojo Galindo, Ángel

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/007567

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 324 522 A (BOEKEL CORNELIS DIRK BOEKEL CORNELIS DIRK [NL]) 19 July 1989 (1989-07-19) abstract; claims 1-6; figures 1,2 column 1, line 1 - column 3, line 24	1,6, 8-10,13, 15-17, 19-21
X	EP 0 848 308 A (MEAT AND LIVESTOCK COMMISSION [GB]) 17 June 1998 (1998-06-17) page 1, line 3 - page 7, line 17; claims 1-14; figures 1-10 abstract	1-4, 6-11, 13-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/007567

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5937080 A	10-08-1999	NONE	
WO 2004106020 A	09-12-2004	NONE	
WO 2006136814 A	28-12-2006	EP 1915240 A1	30-04-2008
		GB 2427913 A	10-01-2007
		GB 2428182 A	24-01-2007
		WO 2006136818 A1	28-12-2006
EP 0324522 A	19-07-1989	DE 68922914 D1	13-07-1995
		DE 68922914 T2	26-10-1995
		ES 2075032 T3	01-10-1995
		NL 8800063 A	01-08-1989
		US 4947517 A	14-08-1990
EP 0848308 A	17-06-1998	NONE	

(19) Bundesrepublik Deutschland
Deutsches Patent- und Markenamt

(10) **DE 10 2006 007 490 A1** 2006.08.17

(12) # Offenlegungsschrift

(21) Aktenzeichen: **10 2006 007 490.4**
(22) Anmeldetag: **17.02.2006**
(43) Offenlegungstag: **17.08.2006**

(51) Int Cl.[8]: ***B26D 7/30*** (2006.01)

Mit Einverständnis des Anmelders offengelegte Anmeldung gemäß § 31 Abs. 2 Ziffer 1 PatG

(71) Anmelder:
Weber Maschinenbau GmbH & Co. KG, 35236 Breidenbach, DE

(74) Vertreter:
Manitz, Finsterwald & Partner GbR, 80336 München

(72) Erfinder:
Antrag auf Nichtnennung

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: **Aufschneiden von Lebensmittelprodukten**

(57) Zusammenfassung: Die Erfindung betrifft ein Verfahren zum Aufschneiden von Lebensmittelprodukten wie Schinken, Wurst, Käse und dergleichen, bei dem einem insbesondere rotierend angetriebenen Schneidmesser ein aufzuschneidendes Produkt in einer Förderrichtung zugeführt wird und von dem Produkt mittels des Schneidmessers Scheiben abgetrennt werden und bei dem sowohl die äußere Form des Produktes als auch die innere Struktur des Produktes bestimmt und bei der Produktzufuhr berücksichtigt werden.

Beschreibung

[0001] Die vorliegende Erfindung betrifft ein Verfahren sowie eine Vorrichtung zum Aufschneiden von Lebensmittelprodukten wie Schinken, Wurst, Käse und dergleichen.

Stand der Technik

[0002] Beim Aufschneiden von Lebensmittelprodukten wird einem insbesondere rotierend angetriebenen Schneidmesser ein aufzuschneidendes Produkt in einer Förderrichtung zugeführt und werden von dem Produkt mittels des Schneidmessers Scheiben abgetrennt.

[0003] Aus den abgetrennten Scheiben können eine gestapelte oder geschindelte Form aufweisende Portionen gebildet werden. In vielen Fällen werden die Portionen abtransportiert und direkt einer Verpackungsmaschine zugeführt. Für eine effiziente Abwicklung ist es erforderlich, dass dieser Prozess vollautomatisch abläuft und keine korrigierenden Eingriffe erforderlich sind. Das Aufschneiden der Lebensmittelprodukte muss also derart erfolgen, dass die gebildeten Portionen unverändert verpackt werden können.

[0004] An die Eigenschaften der Portionen werden immer höhere Anforderungen gestellt. So sollen die Portionen nicht nur ein ansprechendes Äußeres aufweisen. Es ist außerdem notwendig, dass die Portionen innerhalb relativ enger Toleranzen ein vorgegebenes Gesamtgewicht einhalten. Insbesondere Unterfüllungen sind auf Grund gesetzlicher Bestimmungen zu vermeiden. Dabei kann es auch erforderlich sein, ein vorgegebenes Gesamtgewicht mit einer ebenfalls entweder genau oder innerhalb enger Grenzen vorgegebenen Anzahl von Produktscheiben zu erzielen. Ferner ist es möglich, dass jede einzelne Produktscheibe ein vorgegebenes Gesamtgewicht aufzuweisen hat.

[0005] Zur Erzielung gewichtskonstanter Portionen oder Scheiben ist es bereits bekannt, vor dem Aufschneiden die äußere Form oder Außenkontur des Produktes zu bestimmen und bei der Produktzufuhr zu berücksichtigen. Schwankungen im Scheibengewicht auf Grund eines nicht-konstanten Produktquerschnittprofils können so durch Variieren der Scheibendicke mittels der Produktzufuhr ausgeglichen werden. Bei dieser Vorgehensweise wird eine konstante Produktdichte bzw. homogene Dichteverteilung innerhalb des Produktes vorausgesetzt.

[0006] Es ist ebenfalls bereits bekannt, durch eine Analyse der Schnittflächen der abzutrennenden Produktscheiben eine automatische Klassierung bzw. ein automatisches so genanntes Grading zu erreichen. Auf diese Weise können die auf die Schnittfläche bezogenen Anteile von unterschiedlichen Produkt-Bestandteilen erfasst und auch bewertet werden. Als Bestandteile können beispielsweise Fleisch- bzw. Mageranteile einerseits und Fettanteile andererseits gewählt werden. Ferner können so Hohlräume innerhalb des Produktes identifiziert werden.

Aufgabenstellung

[0007] Aufgabe der Erfindung ist es, das Aufschneiden von Lebensmittelprodukten hinsichtlich einer höheren Vielseitigkeit und größeren Flexibilität zu verbessern und insbesondere eine möglichst hohe Genauigkeit bei der Erzeugung von gewichtskonstanten Portionen bzw. Scheiben zu erzielen.

[0008] Bei dem erfindungsgemäßen Verfahren zum Aufschneiden von Lebensmittelprodukten wird sowohl die äußere Form des Produktes als auch die innere Struktur des Produktes bestimmt und bei der Produktzufuhr berücksichtigt. Die Aufschneidevorrichtung zeichnet sich dadurch aus, dass Messeinrichtungen zum Bestimmen sowohl der äußeren Form des Produktes als auch der inneren Struktur des Produktes vorgesehen sind und Auswerte- und Steuereinrichtungen dazu dienen, die Zuführeinrichtung, mit der ein aufzuschneidendes Produkt dem Schneidmesser in einer Förderrichtung zugeführt wird, in Abhängigkeit von der mittels der Messeinrichtungen bestimmten äußeren Form und inneren Struktur des Produktes zu betreiben.

[0009] Die Erfindung basiert folglich auf dem Gedanken, Informationen über die äußere Form bzw. Außenkontur des Produktes einerseits und Informationen über die Produkt-Innenstruktur andererseits für die Ansteuerung der Produktzufuhr miteinander zu kombinieren. Anders als bisher wird folglich das Produkt nicht nur entweder lediglich hinsichtlich seiner äußeren Form oder seiner inneren Struktur analysiert, sondern es erfolgt eine vollständige Produkterfassung insofern, als das Produkt gewissermaßen sowohl von außen als auch von innen "betrachtet" und die Produktzufuhr entsprechend angesteuert, d. h. der Aufschneidevorgang entsprechend dynamisch geregelt wird.

[0010] Durch die erfindungsgemäße zusätzliche Analyse der Produkt-Innenstruktur ist man nicht mehr auf Annahmen über die Dichteverteilung des Produktes angewiesen. Hohlräume oder andere Dichteanomalien innerhalb eines Produktes wirken sich nicht mehr nachteilig auf das einzuhaltende Gesamtgewicht der Portionen bzw. das vorgegebene Scheibengewicht aus, da während des Aufschneidevorgangs sofort durch entsprechende Ansteuerung der Produktzufuhr korrigierend eingegriffen werden kann.

[0011] Der Betrieb der Produktzufuhr kann alleine auf der Basis der Informationen erfolgen, die durch

die Bestimmung der äußeren Form des Produktes und der Produkt-Innenstruktur erhalten werden. Zusätzlich kann eine Wiegeeinrichtung vorgesehen sein, mit welcher die gebildeten Portionen bzw. die während des Aufschneidevorgangs im Entstehen befindlichen Portionen gewogen werden. Die mit der Waage während des Aufschneidevorgangs fortlaufend ermittelten Gewichtsdaten können bei der Ansteuerung der Zuführeinrichtung berücksichtigt werden. Alternativ kann die Waage lediglich Kontrollzwecken dienen.

[0012] Konkret kann die erfindungsgemäße Vorgehensweise darin bestehen, aus der äußeren Form und der inneren Struktur des Produktes das auf eine bestimmte Scheibendicke bezogene Gewicht einer Produktscheibe zu berechnen und die Produktzufuhr derart anzusteuern, (i) dass die abzutrennenden Produktscheiben jeweils ein vorgegebenes Scheibengewicht aufweisen, oder (ii) dass Portionen aus mehreren Produktscheiben jeweils ein vorgegebenes Gesamtgewicht aufweisen.

[0013] Dabei ist es möglich, dass für die jeweils vorgegebenen Werte bestimmte Toleranzen vorgesehen sind. Bei der Vorgabe eines Gesamtgewichtes für Portionen kann zusätzlich eine vorgegebene Anzahl von Produktscheiben gefordert werden.

[0014] Bevorzugt ist eine scheibenbezogene gleichzeitige Berücksichtigung der äußeren Form des Produktes und der Produkt-Innenstruktur. Diese Gesamt-Analyse kann für jede einzelne abzutrennende Produktscheibe erfolgen. Alternativ ist es möglich, dies nur für einige Produktscheiben durchzuführen, beispielsweise für jede n-te Produktscheibe, wobei n in Abhängigkeit von der jeweils gewünschten Genauigkeit bzw. von den speziellen Eigenschaften des jeweiligen Produktes gewählt wird.

[0015] Die äußere Form des Produktes kann an einer in Förderrichtung vor dem Schneidmesser gelegenen Messstelle bestimmt werden. Dies kann unmittelbar vor dem Aufschneiden des Produktes und insbesondere während der Produktzufuhr erfolgen. Grundsätzlich ist es aber auch möglich, eine Produktvermessung räumlich und zeitlich vom eigentlichen Aufschneidevorgang getrennt durchzuführen.

[0016] Dabei ist es nicht erforderlich, das gesamte Produkt hinsichtlich seiner Außenkontur zu vermessen. Auch hier sind Näherungslösungen möglich, bei denen beispielsweise das Produkt nur über bestimmte Teilbereiche in Längs- und/oder Umfangsrichtung vermessen wird.

[0017] Eine konkrete Möglichkeit zur Produktkonturbestimmung bildet das so genannte Lichtschnittverfahren, bei dem in einer insbesondere senkrecht zur Förderrichtung verlaufenden Messebene, durch die das Produkt insbesondere unmittelbar vor dem Aufschneidevorgang hindurch geführt wird, kontinuierlich oder intermittierend hinsichtlich seiner Außenkontur vermessen wird. Hierzu kann eine Messeinrichtung vorgesehen sein, die wenigstens eine Strahlungsquelle, beispielsweise einen Laser, mit dem eine Linie auf das Produkt projiziert werden kann, sowie einen Strahlungsdetektor insbesondere in Form einer Videokamera umfasst. Aus den mittels des Strahlungsdetektors aufgenommenen Bildern der auf das Produkt projizierten Linie lässt sich durch grundsätzlich bekannte Verfahren zur Bildverarbeitung die Außenkontur des Produktes bestimmen.

[0018] Da der Ort, an dem die Produktkontur ermittelt wird, bezogen auf die Schneidebene des Schneidmessers bekannt ist, stehen den Auswerteeinrichtungen alle Informationen zur Verfügung, die erforderlich sind, um den Zeitpunkt zu bestimmen, an dem der bezüglich der Kontur vermessene Produktbereich die Schneidebene erreicht, so dass eine exakte, gewissermaßen zeitversetzte Steuerung der Produktzufuhr auf der Basis der vorher ermittelten Produktkonturdaten erfolgen kann. Alternativ oder zusätzlich ist es möglich, mit so genannten Produktanfangssensoren zu arbeiten, die sowohl im Bereich der Messstelle als auch im Bereich der Schneidebene angeordnet und dazu ausgebildet sind, den in Förderrichtung vorneliegenden Produktanfang zu detektieren, der dann den ein richtiges "Timing" sicherstellenden Bezug für die Auswerte- und Steuereinrichtungen bildet.

[0019] Die Bestimmung der Produkt-Innenstruktur kann insbesondere durch eine so genannte Schnittflächen-Analyse erfolgen. Hierbei wird mittels einer optoelektronischen Einrichtung, insbesondere eine Videokamera, ein Bild der Schnittfläche einer abzutrennenden Scheibe aufgenommen und das Bild hinsichtlich der Produkt-Innenstruktur untersucht. Fettanteile des Produktes beispielsweise lassen sich so von Fleisch- bzw. Mageranteilen unterscheiden, und unter Berücksichtigung bekannter absoluter oder relativer Dichtewerte kann ein Maß für das auf eine bestimmte Scheibendicke bezogene Gewicht der betreffenden Produktscheibe berechnet und bei der Produktzufuhr berücksichtigt werden. Durch den Einsatz ausreichend schneller Hardware und entsprechend leistungsfähiger Software lassen sich auch bei hohen Schnittgeschwindigkeiten, wie sie mit modernen Hochleistungs-Slicern möglich sind, problemlos die gewünschten Ergebnisse erzielen.

[0020] Der Videokamera können Beleuchtungseinrichtungen zur Ausleuchtung der Schnittflächen bzw. der Produktumgebung im Bereich der Schnittflächen zugeordnet sein, die beispielsweise durch Verwendung unterschiedlicher Wellenlängen oder anderer Ausleuchtparameter für eine optimale Kontrastierung der Schnittflächen gegenüber der Umgebung sorgen.

[0021] Eine alternative oder zusätzliche Möglichkeit zur Bestimmung der äußeren Form des Produktes besteht darin, mittels einer optoelektronischen Erfassungseinrichtung, insbesondere einer Videokamera, die Schnittfläche einer abzutrennenden Produktscheibe sowie die Produktumgebung im Bereich dieser Schnittfläche zu erfassen und durch Unterscheidung zwischen Schnittfläche und Produktumgebung den Umriss der betreffenden Produktscheibe zu bestimmen.

[0022] Diese Methode kann insbesondere im Rahmen der zuvor erläuterten Schnittflächen-Analyse zur Bestimmung der Produkt-Innenstruktur durchgeführt werden.

[0023] Unabhängig davon, welche Methoden zur Bestimmung der Außenkontur und der Innenstruktur des Produktes zum Einsatz kommen, ist es erfindungsgemäß möglich, für jede abzutrennende Produktscheibe deren Außenkontur und Innenstruktur zu bestimmen und für die Ansteuerung der Produktzufuhr zu benutzen, um auf diese Weise den Aufschneidevorgang mit einem Höchstmaß an Genauigkeit und Flexibilität zu steuern.

Patentansprüche

1. Verfahren zum Aufschneiden von Lebensmittelprodukten wie Schinken, Wurst, Käse und dergleichen,
bei dem einem insbesondere rotierend angetriebenen Schneidmesser ein aufzuschneidendes Produkt in einer Förderrichtung zugeführt wird und von dem Produkt mittels des Schneidmessers Scheiben abgetrennt werden, und
bei dem sowohl die äußere Form des Produktes als auch die innere Struktur des Produktes bestimmt und bei der Produktzufuhr berücksichtigt werden.

2. Verfahren nach Anspruch 1,
dadurch gekennzeichnet,
dass aus der äußeren Form und der inneren Struktur des Produktes das auf eine bestimmte Scheibendicke bezogene Gewicht einer Produktscheibe berechnet und die Produktzufuhr derart angesteuert wird, dass
– die abzutrennenden Produktscheiben jeweils ein vorgegebenes Scheibengewicht aufweisen, oder
– Portionen aus mehreren Produktscheiben jeweils ein vorgegebenes Gesamtgewicht aufweisen, insbesondere unter Berücksichtigung einer vorgegebenen Anzahl von Produktscheiben, insbesondere jeweils innerhalb vorgegebener Toleranzen.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass zumindest für einige Produktscheiben, insbesondere für jede Produktscheibe, jeweils sowohl deren äußere Form als auch deren innere Struktur für die Produktzufuhr berücksichtigt wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die äußere Form des Produktes an einer in Förderrichtung vor dem Schneidmesser gelegenen Messstelle bestimmt wird.

5. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die äußere Form des Produktes bestimmt wird, während das Produkt dem Schneidmesser zugeführt wird.

6. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die äußere Form des Produktes in einer Messebene bestimmt wird, durch die das Produkt hindurch bewegt wird.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, dass die Messebene senkrecht zur Förderrichtung verläuft.

8. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die innere Struktur des Produktes durch Schnittflächen-Analyse bestimmt wird.

9. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Schnittflächen zumindest einiger, insbesondere aller, Produktscheiben jeweils vor dem Abtrennen der Produktscheibe analysiert werden.

10. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Schnittflächen mittels einer optoelektronischen Einrichtung, insbesondere einer Kamera, erfasst werden und die dabei erhaltenen Schnittflächenbilder hinsichtlich der Produkt-Innenstruktur ausgewertet werden.

11. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass zur Bestimmung der äußeren Form des Produktes jeweils die Kontur einer abzutrennenden Produktscheibe mittels einer optoelektronischen Erfassungseinrichtung, insbesondere einer Kamera, erfasst wird, indem in den mittels der Kamera aufgenommenen Bildern die Schnittfläche der Produktscheibe von der Produktumgebung unterschieden wird.

12. Vorrichtung zum Aufschneiden von Lebensmittelprodukten wie Schinken, Wurst, Käse und dergleichen,
mit einem insbesondere rotierend antreibbaren Schneidmesser, einer Zuführeinrichtung, mit der ein aufzuschneidendes Produkt dem Schneidmesser in einer Förderrichtung zuführbar ist, um von dem Produkt Scheiben abzutrennen,
Messeinrichtungen zum Bestimmen sowohl der äu-

ßeren Form des Produktes als auch der inneren Struktur des Produktes, und
Auswerte- und Steuereinrichtungen zum Betreiben der Zuführeinrichtung in Abhängigkeit von der mittels der Messeinrichtungen bestimmten äußeren Form und inneren Struktur des Produktes.

13. Vorrichtung nach Anspruch 12, dadurch gekennzeichnet, dass die Mess-, Auswerte- und Steuereinrichtungen dazu ausgebildet sind, zumindest für einige Produktscheiben, insbesondere für jede Produktscheibe, jeweils sowohl deren äußere Form als auch deren innere Struktur für die Produktzufuhr zu berücksichtigen.

14. Vorrichtung nach Anspruch 12 oder 13, dadurch gekennzeichnet, dass wenigstens eine Messeinrichtung zur Bestimmung der äußeren Form des Produktes an einer in Förderrichtung vor dem Schneidmesser gelegenen Messstelle angeordnet ist.

15. Vorrichtung nach einem der Ansprüche 12 bis 14, dadurch gekennzeichnet, dass die Messeinrichtungen dazu ausgebildet sind, die äußere Form des Produktes durch Messen der Produktkontur in einer Messebene zu bestimmen, durch die das Produkt hindurch bewegbar ist.

16. Vorrichtung nach einem der Ansprüche 12 bis 15, dadurch gekennzeichnet, dass die Messeinrichtung wenigstens eine Strahlungsquelle, insbesondere einen Laser, mit dem eine Linie auf das Produkt projizierbar ist, und einen Strahlungsdetektor, insbesondere eine Kamera, umfasst, wobei mit den Auswerteeinrichtungen aus einem mittels des Strahlungsdetektors aufgenommen Bild der auf das Produkt projizierten Linie die Außenkontur des Produktes bestimmbar ist.

17. Vorrichtung nach einem der Ansprüche 12 bis 16, dadurch gekennzeichnet, dass die Mess-, Auswerte- und Steuereinrichtungen zur Schnittflächen-Analyse ausgebildet sind.

18. Vorrichtung nach einem der Ansprüche 12 bis 17, dadurch gekennzeichnet, dass die Messeinrichtungen wenigstens eine optoelektronische Erfassungseinrichtung, insbesondere eine Kamera, umfassen, die in dem dem Schneidmesser in Förderrichtung nachgelagerten Halbraum angeordnet und zur Erfassung der Schnittflächen der abzutrennenden Produktscheiben ausgebildet ist.

19. Vorrichtung nach einem der Ansprüche 12 bis 18, dadurch gekennzeichnet, dass die Auswerteeinrichtungen dazu ausgebildet sind, die erfassten Schnittflächenbilder hinsichtlich der Produkt-Innenstruktur auszuwerten.

20. Vorrichtung nach einem der Ansprüche 12 bis 19, dadurch gekennzeichnet, dass die Auswerteeinrichtungen dazu ausgebildet sind, die erfassten Schnittflächenbilder hinsichtlich der Produktkontur auszuwerten.

21. Vorrichtung nach einem der Ansprüche 12 bis 20, dadurch gekennzeichnet, dass auf die Messeinrichtungen abgestimmte Beleuchtungseinrichtungen zur Ausleuchtung der Schnittflächen und/oder der Produktumgebung im Bereich der Schnittflächen vorgesehen sind.

Es folgt kein Blatt Zeichnungen

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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: **Vorrichtung und Verfahren zum Entschwarten oder Trimmen eines Fleischstücks oder eines Stücks Schlachttier**

(57) Zusammenfassung: Es werden eine Vorrichtung und ein Verfahren zum Entschwarten oder Trimmen eines Fleischstücks oder eines Stücks Schlachttier vorgeschlagen, bei dem eine Anordnungsvorrichtung zum Anordnen des Stücks, ein Industrieroboter mit einem Manipulatorarm und ein Sensorsystem, welches den abzutrennenden Teil erkennt, vorgesehen ist. Das Sensorsystem umfasst eine Kamera und ein Bildverarbeitungssystem sowie gegebenenfalls zusätzlich ein Abstandsmesssystem, welches den Abstand zwischen einem vorgegebenen Nullpunkt und einem Messpunkt an der Oberfläche des Stücks bestimmt. Ferner ist ein Schneidwerkzeug vorgesehen, welches das Teil von dem Stück abtrennt.

Beschreibung

Stand der Technik

[0001] Die Erfindung geht aus von einer Vorrichtung und einem Verfahren zum Entschwarten oder Trimmen eines Fleischstücks oder eines Stücks Schlachttier nach dem Oberbegriff des Anspruchs 1.

[0002] Bei der Bearbeitung von einem Fleischstück oder einem Stück Schlachttier werden Haut, Fett, Muskeln, Sehnen und Schwarte entfernt. Sofern das Fleischstück eine einigermaßen gleichmäßige Dicke aufweist, kann das Entschwarten und Enthäuten mithilfe einer Enthäutungs-, Entvlies und/oder Entschwartungsvorrichtung maschinell erfolgen. Dies gilt zum Beispiel für einen ausgelösten Schweinebauch. Die Reste von Fett, die beim automatischen Bearbeiten an einer Fleischplatte verbleiben oder die Reste von Fleisch, die beim automatischen Bearbeiten an einer Flettplatte verbleiben, werden jedoch bislang von Hand enffernt. Hierbei muß der Bearbeiter zwischen Muskelfleisch und Fett unterscheiden. An den Rändern des ausgelösten Schweinebauchs sind häufig Hauffalten vorhanden. Aufgrund der unregelmäßigen Dicke ist an diesen Stellen eine Nachbearbeitung von Hand ebenfalls notwendig. Diese Bearbeitung von Hand ist nicht nur zeit- und kostenintensiv sondern auch mit einer Verletzungsgefahr für den Bearbeiter verbunden.

[0003] Das Abschwarten eines ausgelösten Schweineschinkens erfolgt bislang ebenfalls teilweise von Hand. Der Schinken mit Fuß oder die Schulter mit Rippe wird durch einen Bearbeiter von Hand aufgenommen und an die Klinge einer Abschwartungsmaschine herangeführt. Dabei muss der Schinken so ausgerichtet werden, dass die Klinge die Schwarte beim Anschneiden erfassen kann. Sobald die Klinge in die Schwarte eingedrungen ist, wird der Schinken durch Walzen an die Klinge angedrückt und gedreht. Dies bedeutet eine hohe Verletzungsgefahr für den Bearbeiter insbesondere im Bereich seiner Hände. Darüber hinaus ist Bearbeitung von Hand mit hohen Kosten verbunden.

Die Erfindung und ihre Vorteile

[0004] Demgegenüber hat die erfindungsgemäße Vorrichtung mit den Merkmalen des Anspruchs 1 den Vorteil, dass die abzutrennenden Teile durch ein Sensorsystem erkannt werden. Hierzu sind eine Kamera mit Bildverarbeitungssystem und eventuell zusätzlich ein Abstandsmeßsystem vorgesehen. Die Kamera und das Bildverarbeitungssystem erfassen die Koordinaten des abzutrennenden Teils insbesondere an dessen Oberfläche in zwei oder drei Dimensionen. Der Abstand zwischen der Oberfläche und dem Manipulatorarm des Roboters kann entweder ebenfalls mit der Bildverarbeitung oder mit einem Abstandsmesssystem erfasst werden. Damit lassen sich die Koordinaten der Oberfläche des abzutrennenden Teils vollständig erfassen. Diese erfassten Daten werden von Mikroprozessoren zu Signalen verarbeitet. Die Signale steuern entweder ein Schneidwerkzeug oder einen Greifer an einem Manipulatorarm eines Industrieroboters. Der Manipulatorarm bewegt das Schneidwerkzeug an das ruhende oder mit konstanter Geschwindigkeit bewegte Stück heran. Mithilfe des Schneidwerkzeugs werden die Teile von dem Stück abgetrennt. Der mit einem Greifer ausgestattete Manipulatorarm nimmt das Stück auf und führt es einem fest stehenden Schneidwerkzeug zu. Dabei richtet der Greifer das Stück so aus, dass das Teil durch das Schneidwerkzeug abgetrennt werden kann.

[0005] Eine Nachbearbeitung von Hand ist nicht notwendig. Um absolut sicher zu gehen, dass die Teile vollständig abgetrennt wurden, kann das Stück nach der Bearbeitung mithilfe der Kamera und dem Bildverarbeitungssystem erneut untersucht werden. Sind noch Reste am Stück vorhanden, so wird das Schneidwerkzeug erneut angesteuert. Die Steuerung des Manipulatorarms erfolgt mithilfe eines Rechners.

[0006] Mit der erfindungsgemäßen Vorrichtung können Bereiche von Fleischstücken oder Stücken von Schlachttieren bearbeitet werden, die unregelmäßig geformt oder nur schwer zugänglich sind und daher bislang ausschließlich von Hand bearbeitet werden konnten. Die Unterscheidung zwischen den abzutrennenden Teilen und der Umgebung erfolgt mithilfe der Kamera und der Bildverarbeitung.

[0007] Die mit der erfindungsgemäßen Vorrichtung bearbeiteten Lebensmittelstücke können nach dem Abtrennen der unerwünschten Teile der weiteren Verarbeitung oder der Verpackung zugeführt werden.

[0008] Bei dem Industrieroboter kann es sich entweder um einen Roboter mit einem Manipulatorarm mit mehreren Freiheitsgraden oder um einen Skara Roboter mit einem Manipulatorarm handeln. Die Anzahl der Freiheitsgrade ist bei letzterem geringer jedoch je nach Anwendung ausreichend.

[0009] Nach einer vorteilhaften Ausgestaltung der Erfindung ist als Abstandsmesssystem ein Sender, ein Empfänger und eine Auswerteeinheit vorgesehen. Die Bestimmung des Abstands erfolgt berührungslos. Sender und Empfänger können dabei optische oder akustische Signale verwenden. So kann beispielsweise ein Laser-Entfernungsmesser eingesetzt werden. Ist die Oberfläche des zu bearbeitenden Stücks nahezu eben, so genügt die Bestimmung des Abstands zwischen einem Nullpunkt und einem Messpunkt an der Oberfläche des Stücks im Bereich des abzutrennenden Teils. Dies gilt beispielsweise bei einem ausgelösten Schweinebauch. Der Manipu-

latorarm mit dem Schneidwerkzeug wird anschließend um eine Strecke, die aus dem gemessenen Abstand bestimmt wird, an die Oberfläche des Stücks herangefahren. Schließlich wird das Schneidwerkzeug in einem Bereich über die Oberfläche des Stücks bewegt, der dem mithilfe der Kamera und der Bildverarbeitung ermittelten abzutrennenden Teil entspricht. Dabei wird das Schneidwerkzeugs so angetrieben, dass das Teil von dem Stück abgeschnitten wird. Bei den abzutrennenden Teilen kann es sich um Reste von Fleisch oder Fett handeln, die beim maschinellen Entschwarten an der Oberfläche verblieben sind. Derartige Reste werden bislang von Hand mithilfe eines Trimmers beseitigt. Dabei handelt es sich um ein Messer mit einer zur Rotation angetriebenen ringförmigen Klinge mit Schnitttiefeneinstellung. Ein derartiges Messer kann an dem Manipulatorarm vorgesehen sein, um die Reste zu entfernen. Da sich das rote Muskelfleisch und das weiße Fett in ihrer Farbe hinreichend unterscheiden, können die Bereiche mithilfe der Kamera und der Bildverarbeitung voneinander unterschieden werden. Aus der Größe der abzutrennenden Bereiche kann die Dicke des Bereichs zumindest näherungsweise bestimmt werden. Die Schnitttiefe wird entsprechend der Dicke eingestellt. Der mit einem Trimmer ausgestattete Manipulatorarm fährt an der Oberfläche entlang und trennt die Reste von dem Stück ab.

[0010] Anstelle eines Trimmers mit einer ringförmigen Klinge kann auch eine scheibenförmige rotierende Klinge vorgesehen sein. Darüber hinaus sind andere Messer, die einen ziehenden Schnitt ausführen oder die zu einen Sägebewegung angetrieben werden, möglich.

[0011] Nach einer weiteren vorteilhaften Ausgestaltung der Erfindung sind drei Sender und Empfänger vorgesehen, um den Abstand zwischen drei Messpunkten und einem vorgegebenen Nullpunkt zu bestimmen. Ist die Oberfläche des Stücks nicht eben, wie beispielsweise die nach außen weisende Oberfläche einer Schlachttierhälfte, so genügt es nicht, den Abstand zwischen der Oberfläche und einem Nullpunkt zu bestimmen. Vielmehr ist es notwendig, die Form des Stücks an der zu bearbeitenden Stelle zu ermitteln. Dies geschieht durch die Bestimmung des Abstands zwischen drei Messpunkten und einem vorgegebenen Nullpunkt. Dabei dürfen die drei Messpunkte nicht auf einer Linie liegen. Aus den aus den Abständen gewonnenen Daten kann die Steigung oder das Gefälle in dem untersuchten Bereich bestimmt werden. Daraus ergibt sich nicht nur die Strecke, die das Schneidwerkzeug bis zur Oberfläche des Stücks zurücklegen muss, sondern auch der Winkel, unter dem das Schneidwerkzeug an die Oberfläche angesetzt werden muss. Eine derartige Bearbeitung ist beispielsweise zur Entschwartung entlang der Zerlegelinien einer Hälfte eines geschlachteten Schweins notwendig. Entlang der Zerlegelinien wird das Schlachttier in mehrere größere Stücke zerteilt. Bisher wird der Schweinebauch erst nach dem Auslösen entschwartet. Dies hat jedoch den Nachteil, dass die Ränder des Schweinebauchs Hautfalten aufweisen und sich daher nicht vollständig maschinell entschwarten lassen. An den Rändern verbleiben stets Schwartenreste. Mit der erfindungsgemäßen Vorrichtung kann die Schweinehälfte bereits vor dem weiteren Zerlegen und dem Auslösen des Schweinebauchs entlang der Zerlegelinien entschwartet werden. Die den Schweinebauch begrenzenden Zerlegelinien, an denen Hautfalten auftreten, befinden sich an der Schulter und oberhalb des Hinterlaufs. Um in diesen Bereichen zu entschwarten, wird die aufgehängte Schlachttierhälfte mithilfe von Klammern an einer Platte befestigt. Dabei hat die Platte eine Farbe, welche sich stark von der Farbe des Schweins unterscheidet, beispielsweise blau. Mithilfe der Kamera und dem Bildverarbeitungssystem werden anhand der Umrisse der Schweinhälfte die zu bearbeitenden Bereiche erkannt. Anhand der Daten aus der Abstandsmessung wird das Schneidwerkzeug, eine Entschwartungsvorrichtung, an die Oberfläche herangeführt und unter dem ermittelten Winkel an die Oberfläche angesetzt. Beim Führen der Entschwartungsvorrichtung über die Oberfläche des Schlachttiers ist Winkel gegebenenfalls entsprechend der Form der Oberfläche zu variieren.

[0012] Die Form der Oberfläche kann statt mit einem Abstandsmesssystem auch mit einer Kamera und einer Bildverarbeitung bestimmt werden.

[0013] Bei der Enthäutungs- und Entschwartungsvorrichtung kann es sich um eine mobile Vorrichtung handeln, wie sie zur Entschwartung von Hand eingesetzt wird. Darüber hinaus ist es möglich, eine fest stehende Enthäutungs- und Entschwartungsvorrichtung einzusetzen, an die das Stück mithilfe eines Greifers herangeführt wird. Dies ist bei einer Schlachttierhälfte nicht angebracht, jedoch eignen sich fest stehende Entschwartungsvorrichtungen bei bereits ausgelösten Bauchstücken, Schinken oder Schultern. Die Enthäutungs- und Entschwartungsvorrichtungen basieren auf dem Prinzip, dass über eine Zugwalze ein Behandlungsgut an eine Klinge angedrückt und gegenüber der Klinge bewegt wird. Dabei wird der zwischen Klinge und Zugwalze befindliche Teil vom Behandlungsgut abgeschnitten. Über den Abstand zwischen Zugwalze und Klinge kann die Dicke der abgeschnittenen Schicht vorgegeben werden. Je nach Dicke und Art der abgetrennten Schicht spricht man von Entschwarten, Enthäuten oder Entvliesen.

[0014] Zum Entschwarten eines Schinkens mit Fuß oder eines Schulter mit Rippe wird das Stück auf einer Unterlage in einer vorgegebenen Position ausgerichtet. Anhand der Kamera und des Bildverarbeitungssystems wird die Schwarte und die Position, an

der die Klinge einer Entschwartungsvorrichtung ansetzen kann, ermittelt. Anschließend nimmt ein an dem Manipulatorarm des Industrieroboters angeordneter Greifer das Stück auf und führt es einer fest stehenden Entschwartungsvorrichtung zu. Sobald die Klinge der Entschwartungsvorrichtung in die Schwarte eingedrungen ist, wird das Stück mithilfe der Zugwalze transportiert. Der Greifer kann sich daher von dem Stück lösen und dieses erst dann wieder aufnehmen, wenn die Entschwartung beendet ist.

[0015] Nach einer weiteren vorteilhaften Ausgestaltung der Erfindung ist als Anordnungsvorrichtung ein Transportband vorgesehen. Es dient dazu, das Stück von einer Bearbeitungsstation zur nächsten zu transportieren. Das auf dem Transportband aufliegende Stück kann von dem oberhalb angeordneten Sensorsystem analysiert werden. Hierzu kann das Transport angehalten werden. Der Manipulatorarm des Industrieroboters ergreift oder bearbeitet das Stück. Verbleibt das Stück bei der Bearbeitung auf dem Transportband, so kann es nach Abschluss der Bearbeitung auf dem Transportband weiter transportiert werden.

[0016] Nach einer weiteren vorteilhaften Ausgestaltung der Erfindung ist eine Absaugvorrichtung vorgesehen, welche die abgeschnittenen Teile absaugt. Die Teile können anschließend gesammelt und gegebenenfalls verarbeitet werden.

[0017] Nach einer weiteren vorteilhaften Ausgestaltung der Erfindung ist der Industrieroboter mit einem Reinigungsgerät ausgestattet. Dabei kann es sich zum Beispiel um ein Dampfreinigungsgerät mit Sprühlanze handeln. Damit kann die Vorrichtung von selbst eine Reinigung ihrer mit dem Lebensmittel Stücke in Berührung kommenden Teile und eventuell der Umgebung durchführen.

[0018] Weitere Vorteile und vorteilhaften Ausgestaltung in der Erfindung sind den Ansprüchen zu entnehmen.

[0019] Sämtliche Merkmale der Erfindung können sowohl einzeln als auch in beliebiger Kombination miteinander erfindungswesentlich sein.

Patentansprüche

1. Vorrichtung zum Abschneiden eines oder mehrerer Teile von einem Fleischstück oder einem Stück Schlachttier, **dadurch gekennzeichnet**,
dass eine Anordnungsvorrichtung zum Anordnen des Stücks vorgesehen ist,
dass ein Industrieroboter mit einem Manipulatorarm vorgesehen ist,
dass ein Sensorsystem, welches die Koordinaten der Oberfläche des Stücks bestimmenden abzutrennenden Teil erkennt, vorgesehen ist,
wobei das Sensorsystem eine Kamera und ein Bildverarbeitungssystem umfasst, und
dass ein Schneidwerkzeug vorgesehen ist, welches das Teil von dem Stück abtrennt.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass das Sensorsystem ein Abstandsmesssystem umfasst, welches den Abstand zwischen einem vorgegebenen Nullpunkt und einem Messpunkt an der Oberfläche des Stücks bestimmt.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, dass als Abstandsmesssystem ein Sender, ein Empfänger und eine Auswerteeinheit vorgesehen sind.

4. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, dass das Abstandsmesssystem mit drei Sendern und Empfängern zur berührungsfreien Bestimmung des Abstands zwischen einem Nullpunkt und drei Messpunkten an der Oberfläche des Stücks ausgestattet ist.

5. Vorrichtung nach Anspruch 3 oder 4, dadurch gekennzeichnet, dass optische oder akustische Sender und Empfänger vorgesehen sind.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass als Schneidwerkzeug eine Enthäutungs- und/oder Entschwartungsvorrichtung vorgesehen ist.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass das Schneidwerkzeug an dem Manipulatorarm vorgesehen ist.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, dass als Schneidwerkzeug ein Messer vorgesehen ist.

9. Vorrichtung nach Anspruch 8, dadurch gekennzeichnet, dass das Messer eine ringförmige oder scheibenförmige rotierende Klinge aufweist.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass als Anordnungsvorrichtung ein Transportband vorgesehen ist.

11. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass als Anordnungsvorrichtung eine Platte und mehrere Klammern zum Befestigen des Stücks an der Platte vorgesehen sind.

12. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, dass die Platte eine von der Farbe des Stücks abweichende Farbe aufweist.

13. Vorrichtung nach Anspruch 6 und 10, dadurch gekennzeichnet, dass an dem Industrieroboter ein Greifer vorgesehen ist, der das Stück von dem Transportband aufnimmt und einer fest stehenden Enthäutungs- und/oder Entschwartungsvorrichtung zuführt.

14. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass eine Absaugvorrichtung zum Absaugen der abgetrennten Teile vorgesehen ist.

15. Verfahren zum Entschwarten oder Trimmen eines Fleischstücks oder eines Stücks Schlachttier insbesondere mithilfe einer Vorrichtung nach einem der Ansprüche 1 bis 14, gekennzeichnet durch folgende Verfahrensschritte:
dass das Stück auf einer Unterlage angeordnet wird oder aufgehängt und fixiert wird,
dass das beim Entschwarten oder Trimmen abzutrennende Teil in zwei oder drei Dimensionen mit Hilfe einer Kamera und einem Bildverarbeitungssystem und/oder mit einem Abstandsmesssystem ermittelt wird,
dass ein Schneidwerkzeug mithilfe eines Manipulatorarms eines Industrieroboters entsprechend den ermittelten Daten an die Oberfläche des Stücks herangeführt wird,
dass das Schneidwerkzeug im Bereich des abzutrennenden Teils an der Oberfläche entlangbewegt wird.

16. Verfahren nach Anspruch 15, dadurch gekennzeichnet, dass der Abstand zwischen einem vorgegebenen Nullpunkt und einem Messpunkt an der Oberfläche des Stücks bestimmt wird,

17. Verfahren zum Entschwarten eines Fleischstücks insbesondere mithilfe einer Vorrichtung nach einem der Ansprüche 1 bis 14, gekennzeichnet durch folgende Verfahrensschritte:
dass das Stück auf einer Unterlage angeordnet wird,
dass das abzutrennende Teil in zwei oder drei Dimensionen mit Hilfe einer Kamera und einem Bildverarbeitungssystem und/oder mit einem Abstandsmesssystem ermittelt wird,
dass das Stück mithilfe eines Greifers aufgenommen und entsprechend den ermittelten Daten ausgerichtet wird und
dass es mit dieser Ausrichtung einer Entschwartungsvorrichtung zugeführt wird.

Es folgt kein Blatt Zeichnungen

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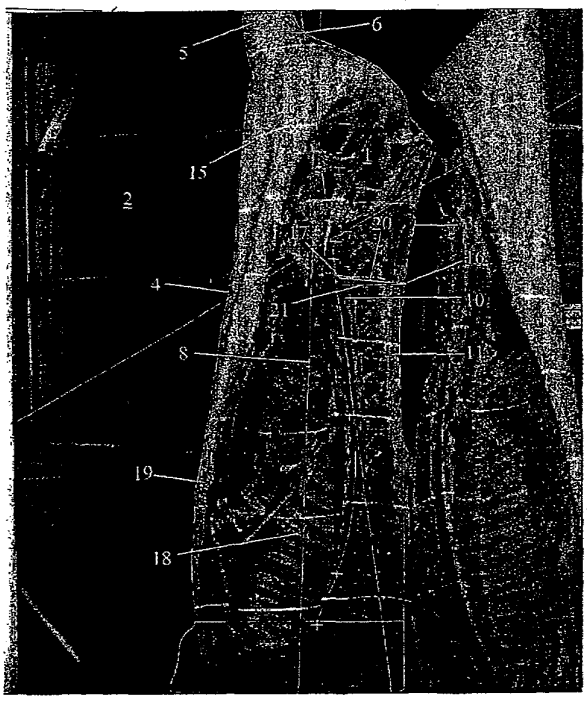
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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

Prüfungsantrag gem. § 44 PatG ist gestellt

(54) Verfahren zur Handelswertbestimmung der Teilstücke von Schweineschlachttierkörpern

(57) Die Erfindung betrifft ein Verfahren zur handelswertbestimmung von Schweineschlachttierkörpern im Hinblick auf eine Bestimmung der Gewichte und Gewichtsanteile von Teilstücken, wie Schinken, Kotelett, ausgelöstes Kotelett, Filet, Schulter, Bug, Bauch und/oder weiterer durch die Fleischproduzenten vorgegebener selbständig handelbarer oder weiterzuverarbeitender Teilstücke nach der Patentanmeldung DE 19952628.1.
Ihr liegt die Aufgabe zugrunde, auf der Grundlage des Verfahrens nach der genannten Patentanmeldung eine noch genauere Bewertung der Teilstücke eines Schlachttierkörpers mittels einer Online-Bewertung unzerteilter Schweinehälften zu ermöglichen.
Dazu werden aus der Bestimmung von Volumenmaßen resultierende Prädikatoren für die Bewertung herangezogen. Diese werden unter Verwendung des Lichtschnittverfahrens mittels dabei entstehender Höhenlinien aus Flächenmaßen abgeleitet, welche anhand des Verlaufs der äußeren Kontur der Schweinehälfte unter Berücksichtigung physiologisch markanter Punkte der Kontur gewonnen werden.



DE 100 50 836 A 1

Beschreibung

[0001] Die Erfindung betrifft ein Verfahren zur Handelswertbestimmung von Schweineschlachttierkörpern im Hinblick auf eine Bestimmung der Gewichte und Gewichtsanteile von Teilstücken, wie Schinken, Kotelett, ausgelöstes Kotelett, Filet, Schulter, Bug, Bauch und/oder weiterer durch die Fleischproduzenten vorgegebener selbständig handelbarer oder weiterzuverarbeitender Teilstücke nach der Patentanmeldung DE 199 52 628.1.

[0002] Aufgrund des scharfen Preiswettbewerbes bei der fleischverarbeitenden Industrie werden die Genauigkeitsanforderungen an die Fleischbewertung, also an die Ermittlung den Preis bestimmender Qualitätskriterien, ständig erhöht. Zum Ausschluss subjektiver Fehler ist es dabei bereits seit einiger Zeit bekannt, die Fleischbewertung automatisiert unter Einsatz hierfür geeigneter Technik vorzugsweise elektronischer Werkzeuge vorzunehmen. Von besonderem Interesse ist es zudem, die Bewertung der Fleischqualität bereits in einer frühen Phase der Fleischverarbeitung vorzunehmen. Für die Industrie ist es von Vorteil, wenn die Bewertung bereits am noch unzerteilten bzw. unzerlegten Schlachttier erfolgt, um bereits frühzeitig Aussagen über den im Ergebnis der Verarbeitung zu erwartenden Anteil selbständig handelbarer oder weiterzuverarbeitender Ware zu erhalten. In diesem Zusammenhang wird von einer Online-Bewertung gesprochen, nämlich von einer Bewertung, welche in den Verfahrensablauf der Fleischverarbeitung innerhalb einer Schlachtlinie einbezogen bzw. integriert ist, ohne diesen zu unterbrechen. Für die Online-Bewertung sind dabei unterschiedliche Methoden denkbar und im Einsatz. Als sehr günstig hat sich eine Bewertung mittels Kameras und angeschlossener Videobildverarbeitung erwiesen.

[0003] Aus der DE 29 46 912 ist ein Verfahren zur Klassifizierung von Schlachttierkörpern bekannt, welches prinzipiell für eine Online-Bewertung einsetzbar ist. Entsprechend diesem Verfahren werden Qualitätsaussagen auf der Grundlage ermittelter Verhältnisse zwischen Fettgewebeanteil und Fleischfülle getroffen. Das in der Schrift dargestellte Verfahren hat es sich zur Aufgabe gemacht, insbesondere eine genauere Bestimmung der Fleischfülle in den fleischtragenden Körperpartien zu ermöglichen. Die dabei erhaltenen Daten werden schließlich in Relation zu Daten über den Fettgewebeanteil gesetzt. Zur Bestimmung des Fettgewebeanteils wird gemäß der Schrift eine Messung der Rückenspeckdichte an definierter Stelle vorgenommen. Auf der Grundlage einer Extrapolation wird aus den hierbei ermittelten Messwerten auf den Fettgewebeanteil geschlossen. Aus der DE 39 16 049 ist eine Vorrichtung zur Klassifizierung von Schweinehälften bekannt, welche mit dem kombinierten Einsatz von Kameras und Ultraschalltechnik arbeitet. Alle mittels der Vorrichtung gewonnenen physischen Parameter für die Fleischgewinnung werden, ähnlich wie bei der zuvor erläuterten Lösung, auch hier innerhalb eines eng begrenzten Bereiches einer Schweinekarkasse bestimmt. Nach dem mittels der Vorrichtung durchführbaren Verfahren wird aus den im Bereich des Schinkens gewonnenen Werten zum Fett- und Fleischanteil auf die Qualität des Schlachttierkörpers insgesamt geschlossen. Beide genannten Vorgehensweisen erlauben bereits eine relativ gute Bewertung. Jedoch werden sie den in jüngster Zeit gestiegenen Anforderungen der Industrie an die Bewertung nicht gerecht.

[0004] Gemäß der durch die Patentanmeldung DE 199 52 628.1 vorgeschlagenen Lösung, auf welche sich die vorliegende Erfindung bezieht, wird daher eine genauere Bestimmung einzelner Parameter des Schlachttierkörpers vorgenommen. Hierzu wird nahezu der gesamte Schlachttierkörper bzw. eine gesamte Schlachttierkörperhälfte einer eingehenden Bewertung unter Bestimmung exakter Konturverläufe genauer Flächenverhältnisse sowie des Fettanteils vorgenommen. Im Hinblick auf eine möglichst genaue Bestimmung des Fettanteils stellt dabei die Gewinnung einer Verfettungsinformation durch eine Auswertung nahezu der gesamten subkutanen Speckschicht des Rückenbereichs ein wesentliches Element der in der Anmeldung beschriebenen Lösung dar.

[0005] Der Erfindung liegt die Aufgabe zugrunde, ausgehend von der DE 199 52 628.1 und ihres erfinderischen Grundgedankens, ein weiter verbessertes Verfahren zur noch genaueren Bewertung von Teilstücken eines Schlachttierkörpers mittels einer Online-Bewertung unzerteilter Schweinehälften anzugeben.

[0006] Die Aufgabe wird gelöst durch ein Verfahren mit den Merkmalen des Hauptanspruchs. Weitere gleichberechtigte, das Verfahren nach der DE 199 52 628.1 (Stammanmeldung) weiter ausgestaltende Verfahrensvarianten, sind durch die Patentansprüche 7 und 8 gegeben.

[0007] In Fortführung der grundsätzlichen Lehre der Stammanmeldung erfolgt im Zuge einer Online-Bewertung videotechnisch von der Knochen- und von der Hautseite erfasster, unzerteilter Schweinehälften die Bestimmung der Gewichte, Gewichts- und Fleischanteile einzelner Teilstücke der Schweinehälfte auf der Grundlage von Prädiktoren, die aus Flächenmaßen, aus Informationen über die Lage und den Verlauf der Wirbelsäule, sowie insbesondere aus einer durch die relative Dicke und den Verlauf der näherungsweise gesamten subkutanen Speckschicht des Rückenbereichs repräsentierten Verfettungsinformation resultieren. Darüber hinaus werden aber weitere aus der Bestimmung von Volumenmaßen resultierende Prädiktoren für die Bewertung herangezogen. Dabei werden die Flächenmaße aus dem Verlauf der äußeren Kontur der Schweinehälfte innerhalb der jeweils betrachteten, durch physiologisch markante Punkte auf der Kontur begrenzten Teilebereiche abgeleitet. Die zumindest für ausgewählte Teilbereiche bestimmten Volumenmaße werden, ausgehend von den für diese Teilbereiche ermittelten Flächenmaßen, anhand des Verlaufs von Höhenlinien, welche mittels des Lichtschnittverfahrens auf die zu bewertende Körperoberfläche projiziert werden, ermittelt. Die aus geometrischen Abmaßen und den Informationen über die Beschaffenheit der Gewebekompartimente resultierenden Prädiktoren werden schließlich unter Berücksichtigung zwischen ihnen bestehender statistischer Zusammenhänge in Relation gesetzt und so die Aussagen über die Gewichte bzw. Gewichts- und Fleischanteile der Teilstücke erhalten. Wie zu erkennen ist, werden zur Gewinnung möglichst vieler und genauer Informationen Videoaufnahmen von zwei Seiten des Schlachttierkörpers verarbeitet. Dies betrifft einmal Aufnahmen von der Knochenseite, bei welchen die bei der Teilung des Schlachttierkörpers entstehenden Schnittflächen der Kamera zugewandt sind, so dass das nach der Teilung zugängliche Körperinnere erfasst wird. Zum anderen wird die 180° gegenüberliegende Seite, die Hautseite, videotechnisch erfasst. Konturpunkte sowie bestimmte Flächenmaße, wie Lage des Vorderbeinpunktes, Schinkenbreite, Schinkenlänge u. dgl., und hieraus sich durch den Einsatz des Lichtschnittverfahrens ergebende Volumeninformationen werden dabei für beide Ansichten des Schlachttierkörpers bestimmt. Weitere, sich mehr auf das Körperinnere beziehende Informationen, wie Aussagen zum Verlauf der Wirbelsäule oder über die Dicke der subkutanen Speckschicht erhält man hingegen nur aus der Verarbeitung der knochenseitig erfassten Videobilder.

[0008] Das Verfahren ist vorteilhaft ausgestaltet, wenn die Online-Bewertung bei vorzugsweise am Hinterbein hängen-

den oder bei liegenden Schweinehälften erfolgt, indem die Schweinehälfte an einem Videokamerasystem oder das Videokamerasystem an der Schweinehälfte vorbeigeführt wird. Die Bewertung erfolgt entsprechend einer möglichen Vorgehensweise nach folgenden Verfahrensschritten.

- Zunächst erfolgt eine Videoerfassung der kompletten Schweinehälfte als Bildobjekt vor einem sich in Hinblick auf seine Helligkeit und/oder Farbe eindeutig vom Bildobjekt (einmal des knochenseitig, einmal des hautseitig erfassten Videobildes) absetzenden Hintergrund.
- Die erfassten Videobilder werden einer hard- und softwarebasierten Bildverarbeitungseinheit zugeführt.
- Es wird der Konturverlauf der Schweinehälfte ermittelt, indem die Bildpunkte der erfassten Videobilder nach ihrer Zugehörigkeit zum Hintergrund oder zum Bildobjekt selektiert werden. Dabei erfolgt die Selektion über eine Bewertung des Gradienten der Helligkeitsänderung von Bildpunkt zu Bildpunkt und/oder mittels einer Schwellwertbewertung eines oder mehrerer Farbanteile eines Bildpunktes.
- Die den Konturverlauf beschreibende mathematische Funktion wird über die Länge des Bildobjektes im Hinblick auf eine Ausdehnungsrichtung zur Ermittlung der Fläche des Bildobjektes integriert.
- Vorzugsweise ebenfalls durch Integration erfolgt die Festlegung des Flächenschwerpunktes zur eindeutigen Bestimmung von bauch- und rückenseitiger Konturlinie.
- Der Schinkenansatzpunkt wird ermittelt, indem die bauch- und die rückenseitige Konturlinie, vorzugsweise am Hinterbein beginnend abgetastet werden und der Schinkenansatzpunkt auf der Rückenkonturlinie durch die Feststellung einer sprunghaften Breitenänderung gefunden wird.
- Der Vorderbeinpunkt wird in analoger Weise als sprunghafte Breitenänderung des Bildobjektes in der Nähe des kopfseitigen Rumpfendes im Zuge der weiteren Abtastung der Konturlinien ermittelt.
- Im Bereich zwischen Schinkenansatzpunkt und Vorderbeinpunkt wird eine Schwerpunktgerade ermittelt.
- Um gegebenenfalls eine seitliche Verdrehung des Schlachttierkörpers festzustellen und diese durch Einführung von Korrekturfaktoren zu berücksichtigen, wird der Winkel der Schwerpunktgeraden in bezug auf die Senkrechte (bzw., beim liegenden Schlachttierkörper, in Bezug auf die Waagerechte) ermittelt.
- Es werden geometrische Parameter abgeleitet, die physische Merkmale einzelner Körperregionen beschreiben. Dabei handelt es sich um Längen-, Flächen-, Volumenmaße und Winkel, wie beispielsweise den Abstand zwischen Vorderbein und Hinterbein auf der Schwerpunktgeraden, die Fläche und das Volumen des Schinkens oder den Schinkenwinkel, wobei der Schinkenwinkel als Winkel zwischen einer an den Schinken angelegten Tangente und der Schwerpunktgeraden Aufschluss über die Ausprägung des Schinkens gibt.

[0009] Während die vorstehenden Verfahrensschritte sich auf Auswertungsvorgänge beziehen, die sowohl an den von der Knochenseite als auch an den von der Hautseite aufgenommenen Videobildern vorgenommen werden, betreffen die nachfolgenden Schritte die weitergehende Verarbeitung von Videobildern der Knochenseite. Im einzelnen schließen sich dabei folgende Verarbeitungsschritte an:

- Die Schwerpunktgerade wird in eine bestimmte Anzahl von Segmenten, beispielsweise in 6 Segmente, unterteilt.
- Die einzelnen Segmente werden im Hinblick auf eine Grobabschätzung von Lage und Verlauf der Wirbelsäule, unter Zugrundelegung statistisch ermittelter relativer bzw. prozentualer Abstandsmaße zu den Konturlinien analysiert.
- Es schließt sich eine exakte Bestimmung der Lage und des Verlaufes der Wirbelsäule innerhalb des durch die vorangegangene Grobabschätzung ermittelten Bereiches durch eine Bewertung der Helligkeitsinformation und/oder der Farbinformation der Bildpunkte an.
- Für Teilbereiche innerhalb der Segmente werden weitere Längen-, Flächen- und Volumenmaße abgeleitet, unter anderem der sehr aussagekräftige Flächeninhalt der Fläche zwischen der Wirbelsäule und der Rückenkonturlinie.
- Es wird ein die subkutane Speckschicht mit Sicherheit enthaltender Bereich (region of interest) zwischen Rückenkonturlinie und Wirbelsäule festgelegt.
- Nachfolgend erfolgt die exakte Ermittlung von Dicke und Verlauf der subkutanen Speckschicht im Bereich ihrer Erstreckung zwischen einem Punkt geringster Speckdicke in der Nähe des Schinkenansatzpunktes sowie dem Schnittpunkt zwischen der Rückenkonturlinie und einer die Rückenkonturlinie mit dem Vorderbeinpunkt verbindenden, die Schwerpunktlinie orthogonal schneidenden Geraden durch Bewertung der Helligkeitsinformation der Bildpunkte innerhalb der region of interest, wobei der Übergang zwischen subkutaner Speckschicht und umgebendem Gewebe durch eine Schwellwertbewertung des Helligkeitswertes gefunden wird.
- Auf der Grundlage der die physischen Merkmale des Körperbaus repräsentierenden, im vorangegangenen Verfahrensablauf ermittelten geometrischen Parameter wird eine Verfettungsinformation als prozentuales Verhältnis der Verfettung einzelner Körperregionen gewonnen.
- Schließlich werden das Gewicht sowie die Gewichts- und Fleischanteile der für den Handel oder zur Weiterverarbeitung vorgesehenen Teilstücke auf der Grundlage empirisch ermittelter statistischer Zusammenhänge zwischen der Verfettungsinformation und den durch die geometrischen Parameter charakterisierten Körperregionen gewonnen.

[0010] Die dargestellte Reihenfolge der Verfahrensschritte ist, soweit sie nicht durch die Abhängigkeit einzelner Teilergebnisse von anderen bedingt ist, nicht zwingend.

[0011] Eine vorteilhafte Weiterbildung des Verfahrens ist dadurch gegeben, dass Verfälschungen der Bewertungsinformationen, welche aufgrund eines gegenüber der Kamera verdrehten Schlachttierkörpers entstehen können, ausgeschlossen werden. Dazu wird der Winkel, welchen eine die Schnittpunkte einer Höhenlinie mit der Rückenkonturlinie und der Wirbelsäule verbindende Gerade mit einer Geraden einschließt, die bezogen auf eine am Hinterbein hängende Schweinehälfte waagerecht oder bezogen auf eine liegende Schweinehälfte senkrecht durch die Wirbelsäule verläuft, ermittelt und zur Ableitung eines Korrekturfaktors verwendet.

[0012] Die Bestimmung der Volumenmaße erfolgt vorteilhafterweise unter Verwendung eines Integrationsverfahrens. Hierbei werden die für den jeweiligen Teilbereich ermittelten Flächen mit dem Ergebnis einer Integration der den Verlauf einer Höhenlinie in dem entsprechenden Teilbereich beschreibenden mathematischen Funktion multipliziert. Die

Integration über den Verlauf der Höhenlinie erfolgt innerhalb der Grenzen zwischen der Rückenkontur- und der Bauchkonturlinie. Die Funktionswerte der die Höhenlinien beschreibenden mathematischen Funktion werden vorzugsweise durch einen Koeffizienten bestimmt, welcher an einem Prüfkörper gewonnen wird. Bei dem Prüfkörper handelt es sich um einen Körper, dessen ansonsten ebene, dem Kamerasystem zugewandte Oberfläche eine Ausbuchtung bekannter räumlicher Tiefe aufweist. Auf den Prüfkörper werden mittels der später auch für die Fleischbewertung verwendeten Lichtquelle erzeugte Linien projiziert, die im bereich der ebenen Körperoberfläche gerade verlaufenden. Im Bereich der Ausbuchtung des Prüfkörpers hingegen erfahren die vom Licht erzeugten Linien eine Auslenkung aus welcher in Relation zu der bekannten räumlichen Tiefe der Ausbuchtung die zuvor erwähnten Koeffizienten bestimmt werden können.

[0013] Bei einer vorteilhaften Weiterbildung des Verfahrens werden die für die beiden Hälften eines Schlachttierkörpers in der zuvor geschilderten Weise gewonnenen Volumenmaße gegeneinander verglichen. Aus den sich dabei ergebenden Differenzen kann auf einen möglichen Spaltfehler bei der Teilung des Schlachttierkörpers geschlussfolgert werden. Diese Information über den gegebenenfalls vorhandenen Spaltfehler kann dann bei der Bewertung der Teilstücke im Hinblick auf eine Aussage zu den Qualitätsmerkmalen des gesamten Schlachttierkörpers berücksichtigt werden. Außerdem ist es möglich, den Spaltfehler betreffende Daten an diejenige Station der Schlachtlinie zu übermitteln, an welcher die Teilung der Schlachttierkörper erfolgt und somit auf eine Verringerung der Spaltfehler hinzuwirken.

[0014] Eine sich unmittelbar auf die Anmeldung 199 25 628.1 oder auf deren durch die zuvor erläuterten Ausgestaltungen gegebene Verbesserungen beziehende Verfahrensvariante schließt für noch genauere Aussagen über die Verfettung in die Bewertung eine zusätzliche im Bereich des Rippenbogens gewonnene Verfettungsinformation in das Verfahren ein. Dabei wird im Bereich des Rippenbogens innerhalb einer region of interest eine Bewertung der Gelb- und Blauanteile der von dem Farbbildkamerasystem erfassten Videobilder vorgenommen. Die region of interest wird anhand der zuvor über den Konturverlauf, über Körpermaße, die Lage und den Verlauf der Wirbelsäule, über die Lage signifikanter Konturpunkte sowie über die subkutane Speckschicht erhaltenen Informationen festgelegt. Von vergleichbaren Überlegungen geht eine Ausgestaltung des Verfahrens aus, bei welcher ein weiterer Informationsparameter zur Verbesserung der Aussagen über die Verfettung im Bereich des Bauches gewonnen wird. Auch hier erfolgt eine Bewertung der Gelb- und Blauanteile innerhalb einer region of interest. Diese wird wiederum auf der Grundlage der zuvor, bei der Erläuterung der Vorgehensweise im Bereich des Rippenbogens, genannten Kriterien festgelegt.

[0015] Die Erfindung soll nachfolgend anhand eines Ausführungsbeispieles näher erläutert werden. In den zugehörigen Zeichnungen zeigen:

[0016] **Fig.** 1: Die Videoaufnahme einer Schweinehälfte (knochenseitig),

[0017] **Fig.** 2: Teilbereiche beider Hälften eines Schlachttierkörpers.

[0018] Die **Fig.** 1 zeigt eine Schweinehälfte in einer knochenseitig erfassten Aufnahme, bei welcher der Rücken **3** auf der linken und der Bauch **4** auf der rechten Seite des Bildes erkennbar sind. Anhand der **Fig.** 1 wird nochmals die grundsätzliche Vorgehensweise der Bewertung entsprechend der Stammanmeldung verdeutlicht. Diese erfolgt in verkürzter Darstellung wie folgt:

Zunächst werden die Bildpunkte des Videobildes hinsichtlich ihrer Zugehörigkeit zum Hintergrund **2** oder zum Bildobjekt **1**, also der Schlachttierhälfte, selektiert. Vorteilhaft ist dies dadurch möglich, dass die Aufnahme vor einem Hintergrund **2** erfolgt, der sich im Hinblick auf seine Helligkeit und/oder seine Farbe deutlich vom Schlachttierkörper abhebt. In der Bildverarbeitungseinheit erfolgt die Unterscheidung zwischen Hintergrund **2** und Bildobjekt **1** durch eine Schwellwertbewertung der Helligkeit der Bildpunkte. Durch eine vollständige Bewertung der Bildpunktmatrix mittels dieses Kriteriums lässt sich sonach der Konturverlauf des Schlachttierkörpers bestimmen. Vermittels einer Integration der diesen Konturverlauf beschreibenden mathematischen Funktionen über die gesamte Ausdehnung des Körpers in seiner Längserstreckung kann anschließend der Flächeninhalt berechnet werden. Nachfolgend wird für diese Fläche der Flächenschwerpunkt, vorzugsweise ebenfalls durch Integration, ermittelt. Durch die Lage des Flächenschwerpunktes kann eindeutig bestimmt werden, auf welcher Seite des Bildes sich die Rückenkonturlinie **3** und die Bauchkonturlinie **4** befinden. Nun erfolgt, vorzugsweise beginnend vom Hinterbein **5**, eine Abtastung der Konturlinien **3**, **4**, wobei die sich jeweils zwischen ihnen ergebende Breite des Bildobjektes **1** ermittelt wird. Eine sprunghafte Änderung der Breite gibt die Lage des Schinkenansatzpunktes **6** auf der Rückenkonturlinie an. In analoger Weise zum Schinkenansatzpunkt wird anschließend der Vorderbeinpunkt **7** als sprunghafte Breitenänderung des Bildobjektes in der Nähe des kopfseitigen Rumpfes gefunden. Im nächsten Schritt wird im Bereich zwischen dem Schinkenansatzpunkt **6** und dem Vorderbeinpunkt **7** eine Schwerpunktgerade **8** festgelegt. Von dieser Schwerpunktgeraden **8** wird der Winkel gegenüber der Senkrechten bestimmt, um hieraus Rückschlüsse über eine mögliche seitliche Verdrehung zu gewinnen und sich daraus scheinbar ergebende Verkürzungen von Längenmaßen zu korrigieren.

[0019] Auf der Basis des ermittelten Konturverlaufs der Flächeninformation und der Bestimmung der Lage von Schinkenansatzpunkt **6** und Vorderbeinpunkt **7** können nun weitere geometrische Parameter ermittelt werden, welche die physische Beschaffenheit einzelner Körperregionen charakterisieren, so beispielsweise der Abstand zwischen Schinkenansatzpunkt und Vorderbeinpunkt oder der Winkel einer den Schinken tangierenden Geraden des sogenannten "Schinkenwinkels" mit der Schwerpunktgeraden **8**. Die vorstehend geschilderten Verarbeitungsvorgänge erfolgen in gleicher Weise an den die Hautseite erfassenden Videoaufnahmen.

[0020] Hiernach werden dann die Videoaufnahmen der Knochenseite einer weitergehenden Verarbeitung unterzogen. Nach einer Unterteilung der Schwerpunktgeraden **8** in einzelne Segmente **9** kann dann durch eine Analyse innerhalb der Segmente **9** unter Zugrundelegung statistisch ermittelter relativer Abstandsmaße zu den Konturlinien zunächst grobe Bestimmung der Lage der Wirbelsäule **10** erfolgen und anschließend deren Lage und Verlauf durch eine Schwellwertbewertung von Farb- oder Helligkeitsinformationen genau bestimmt werden. In jedem Fall befindet sich die im Hinblick auf die Handelswertbestimmung nach der grundsätzlichen Überlegung der Erfindung möglichst genau zu bestimmende subkutane Speckschicht **11** zwischen der Wirbelsäule **10** und der Außenkontur des Rückens **3**. Der genaue Verlauf der subkutanen Speckschicht **11** wird in einer zur Ermittlung des Wirbelsäulenverlaufes vergleichbaren Weise ermittelt. Dabei erfolgt die Feinanalyse im Bereich einer minimalen Speckdicke **12** in der Nähe des Hinterschinkens und einem Punkt **13**, welcher sich aus dem Schnittpunkt einer vom Vorderbeinpunkt **7** zur Rückenkonturlinie **3** verlaufenden und orthogonal auf der Schwer-

punktlinie **8** stehenden Geraden **14** mit der Rückenkonturlinie ergibt. Somit ist die Speckschicht **11** in nahezu ihrem gesamten Verlauf erfasst und nur wenige vor dem Schnittpunkt **13** liegende oder unterhalb der definierten Minimaldicke **12** liegende Teile der Speckschicht **11** bleiben unberücksichtigt. Diese können jedoch auch bei hohen Genauigkeitsanforderungen vernachlässigt werden.

[0021] Die über die jeweilige Dicke und den Verlauf der Speckschicht **11** gewonnenen Informationen werden schließlich in Relation zu den aus Längen- und Flächenmaßen sowie Winkeln unter Berücksichtigung der genauen Lage und des Verlaufs der Wirbelsäule **10** resultierenden Prädiktoren gesetzt. Bei den Prädiktoren handelt es sich um die genannten, den Körperbau beschreibenden physischen Größen selbst oder daraus, gegebenenfalls auch unter Berücksichtigung statistischer Zusammenhänge, gewonnene Größen. Aus der Relation zwischen der Speckschicht **11** und den anderen Prädiktoren erhält man eine Verfettungsinformation über die jeweilige Schweinehälfte. Zwischen dieser Verfettungsinformation und den den Körperbau beschreibenden Prädiktoren bestehen auf empirischem Wege ermittelte statistische Zusammenhänge mittels denen das Gewicht und die Gewichtsanteile der einzelnen interessierenden Teilstücke des Schlachttierkörpers sowie die Anteile der Gewebekompartimente jeweils bestimmt werden können. Durch eine kurzzeitige 90°-Drehung der Schlachttierhälfte können außerdem noch, sofern gewünscht, zusätzliche Aufnahmen der Silhouette angefertigt und gegebenenfalls ausgewertet werden. Auf die Silhouette kann aber auch durch eine die knochenseitig und die hautseitig erhaltenen Aufnahmen in Relation zueinander setzende Umrechnung der Videobilder geschlossen werden. Dabei ist es schließlich auch möglich den rechnerisch ermittelten Silhouettenverlauf als Simulation graphisch mittels eines hierfür geeigneten Ausgabegerätes (Bildschirm, Drucker oder dgl.) darzustellen.

[0022] In der **Fig.** 2, welche beide Körperhälften eines Schlachttierkörpers ausschnittsweise darstellt, wird erkennbar, mittels welcher Maßnahmen die Volumenmaße gewonnen werden, durch deren Einbeziehung in ein grundsätzlich nach der Stammanmeldung ablaufendes eine noch exaktere Bestimmung wichtiger Qualitätskriterien möglich wird. Die Gewinnung volumetrischer Informationen erfolgt dabei wiederum sowohl ausgehend von knochenseitig erfassten Videoaufnahmen als auch anhand von Videoaufnahmen der Hautseite, wird aber hier nur für die Knochenseite eingehender erläutert. Auf den Schlachttierkörper, also das Bildobjekt **1**, werden mittels einer Lichtquelle Linien **15** projiziert, welche beim Auftreffen auf eine ebene Fläche normalerweise einen geraden Verlauf besitzen. Aufgrund der volumetrischen Ausbildung des Schlachttierkörpers erfolgt in den einzelnen Teilbereichen eine unterschiedlich starke Auslenkung bzw. Krümmung dieser Linien **15**. Mittels eines Koeffizienten, der zuvor an einem dafür geeigneten Prüfkörper gewonnen wurde, können dann für den Verlauf dieser Höhenlinien **15** Funktionswerte bestimmt und daraus eine den Kurvenverlauf beschreibende mathematische Funktion abgeleitet werden. Durch Integration der den Kurvenverlauf beschreibenden Funktion innerhalb der Grenzen zwischen der Bauch- **4** und der Rückenkonturlinie **3** werden auf der Grundlage der zuvor für den jeweiligen Bereich nach der bereits eingehend erläuterten Vorgehensweise gewonnenen Flächenmaße Volumenmaße erhalten. Auf der Grundlage einer Vielzahl von Längen-, Flächen- und Volumenmaße und möglichst präziser Informationen über die Verfettung ist im Ergebnis des erfindungsgemäßen Verfahrens eine sehr exakte Bewertung einzelner Körperteile im Hinblick auf deren Gewicht bzw. ihren Gewichts- und Fleischanteil möglich. Die Bewertung stützt sich dabei auf empirisch gewonnene statistische Zusammenhänge zwischen den genannten Größen.

[0023] Die aus den knochenseitig erfassten Videoaufnahmen gewonnene Verfettungsinformation kann gemäß einer weitergehenden Verfeinerung des Verfahrens noch über die bereits aus der Beschaffenheit der subkutanen Speckschicht **11** erhaltenen Aussagen hinaus präzisiert werden, indem der Fettgehalt der Körperregion um den Rippenbogen **18** herum einer genaueren Betrachtung unterzogen wird. Dazu wird eine region of interest im Bereich des Rippenbogens **18** festgelegt und innerhalb dieser Region eine genaue Bestimmung der Gelb- und Blauanteile des Videobildes vorgenommen. Das vorgestellte Verfahren macht sich dabei zunutzte, dass die fetthaltigeren Teilbereiche, wie eben beispielsweise die Region um den Rippenbogen **18**, im Videobild einen gegenüber den übrigen Bereichen verringerten Rotanteil aufweisen. Rückschlüsse auf die genaue Beschaffenheit des Gewebes in den Bereichen mit erhöhtem Körperfettanteil werden dann noch durch eine Auswertung der Relationen zwischen dem Gelb- und dem Blauanteil möglich. Auch hierbei erfolgt zur Ableitung einer weiterverarbeitbaren Verfettungsinformation ein Abgleich der aus der Auswertung des Videobildes gewonnenen Informationen mit empirisch gewonnenen Größen. Durch die Berücksichtigung der Fettanteile bzw. Fettzusammensetzung in der subkutanen Speckschicht **11** des Rückenbereichs und der Region des Rippenbogens **18** erhält man im Hinblick auf die angestrebten Aussagen zu Qualitätskriterien bereits sehr exakte Vorhersagewerte. Allerdings, und dies ist letztendlich eine Frage des jeweils gewünschten oder vertretbaren Aufwandes, lässt sich die Genauigkeit durch die Einbeziehung einer Verfettungsinformation im Bereich der Bauchschicht (Bauchfett **19**) noch weiter erhöhen. Die Vorgehensweise orientiert sich dabei an der zuvor erläuterten. Die region of interest sowohl für die spektrale Bewertung des Rippenbogens **18** als auch des Bauchfetts **19** wird jeweils auf der Grundlage zuvor ermittelter Längen- und Flächenmaße und unter Berücksichtigung der Lage und des Verlaufs der Wirbelsäule festgelegt. Eine gegebenenfalls bestehende Verdrehung des Schlachttierkörpers gegenüber der Kamera kann dabei zur Eliminierung von Fehlern durch einen Korrekturfaktor berücksichtigt werden, der sich aus dem Winkel, welchen die die Schnittpunkte **16**, **17** einer Höhenlinie **15** mit der Rückenkonturlinie **3** und der Wirbelsäule **10** verbindende Gerade **20** mit der waagerecht durch die Wirbelsäule verlaufenden Geraden **21** einschließt, ergibt.

Liste der verwendeten Bezugszeichen

1 Bildobjekt
2 Hintergrund
3 Rücken, Rückenkonturlinie
4 Bauch, Bauchkonturlinie
5 Hinterbein
6 Schinkenansatzpunkt
7 Vorderbeinpunkt
8 Schwerpunktgerade
9 Segmente
10 Wirbelsäule
11 (subkutane) Speckschicht
12 Bereich minimaler Speckdicke
13 Schnittpunkt
14 Gerade
15 Höhenlinie
16 Schnittpunkt
17 Schnittpunkt
18 Rippenbogen

19 Bauchfett
20 Gerade
21 Gerade

Patentansprüche

1. Verfahren zur Handelswertbestimmung der Teilstücke von Schweineschlachttierkörpern im Hinblick auf eine Bestimmung der Gewichte, Gewichts- und Fleischanteile von Teilstücken wie Schinken, Kotelett, ausgelöstes Kotelett, Filet, Schulter, Bug, Bauch und/oder weiterer durch die Fleischproduzenten vorgegebener selbständig handelbarer oder weiterzuverarbeitender Teilstücke, nach Patentanmeldung 199 52 628.1, bei dem im Zuge einer Online-Bewertung videotechnisch von der Knochen- und von der Hautseite erfasster, unzerteilter Schweinehälften die Bestimmung der Gewichte, Gewichts- und Fleischanteile der einzelnen Teilstücke einer Schweinehälfte auf der Grundlage von Prädiktoren erfolgt, die aus Flächen- und Volumenmaßen, welche die Ausprägung einzelner Teilbereiche des Schlachttierkörpers charakterisieren, aus Informationen über die Lage und den Verlauf der Wirbelsäule sowie insbesondere aus einer für die Schweinehälfte gewonnenen, durch die relative Dicke und den Verlauf der näherungsweise gesamten subkutanen Speckschicht des Rückenbereiches repräsentierten Verfettungsinformation resultieren und zueinander unter Berücksichtigung zwischen ihnen bestehender statistischer Zusammenhänge in Relation gesetzt werden, wobei die Flächenmaße aus dem Verlauf der äußeren Kontur der Schweinehälfte innerhalb der jeweils betrachteten, durch physiologisch markante Punkte auf der Kontur begrenzten Teilbereiche abgeleitet werden, während Volumenmaße zumindest für ausgewählte Teilbereiche ausgehend von den für diese Teilbereiche ermittelten Flächenmaßen anhand des Verlaufs von mittels des Lichtschnittverfahrens auf die zu bewertende Körperoberfläche projizierten Höhenlinien ermittelt werden.

2. Verfahren nach Anspruch 1, wobei die Online-Bewertung bei vorzugsweise am Hinterbein hängenden oder bei liegenden Schweinehälften erfolgt, indem die jeweilige Schweinehälfte an einem Videokamerasystem oder ein Videokamerasystem an der Schweinehälfte vorbeigeführt wird, umfassend die Verfahrensschritte

a) Videoerfassung der kompletten Schweinehälfte als Bildobjekt (**1**) vor einem sich im Hinblick auf seine Helligkeit und/oder Farbe eindeutig vom Bildobjekt (**1**) absetzenden Hintergrund (**2**), wobei die Schweinehälfte knochen- und hautseitig erfasst wird,

b) Zuführung des oder der erfassten Videobilder zu einer hard- und softwarebasierten Bildverarbeitung,

c) Ermittlung des Konturverlaufs der Schweinehälfte durch Selektion der Bildpunkte nach ihrer Zugehörigkeit zum Hintergrund (**2**) oder zum Bildobjekt (**1**) über eine Bewertung des Gradienten der Helligkeitsänderung von Bildpunkt zu Bildpunkt und/oder mittels einer Schwellwertbewertung eines oder mehrerer Farbanteile eines Bildpunktes,

d) Ermittlung der Fläche des Bildobjektes (**1**) durch Integration der den Konturverlauf beschreibenden mathematischen Funktion oder Funktionen über die Länge des Bildobjektes (**1**) im Hinblick auf eine Ausdehnungsrichtung,

e) Ermittlung des Flächenschwerpunktes zur Feststellung der Lage des Schlachttierkörpers im Hinblick auf die bauchseitige und die rückenseitige Konturlinie (**4**, **3**),

f) Ermittlung des Schinkenansatzpunktes (**6**) auf der rückenseitigen Konturlinie (**3**) als sprunghafte Breitenänderung des Bildobjektes (**1**) hinsichtlich seiner Breite zwischen bauch- und rückenseitiger Konturlinie (**4**, **3**) im Zuge einer vorzugsweise am Hinterbein (**5**) beginnenden Abtastung der Konturlinien (**3**, **4**),

g) Ermittlung des Vorderbeinpunktes (**7**) auf der bauchseitigen Konturlinie (**4**) als sprunghafte Breitenänderung des Bildobjektes (**1**) in der Nähe des kopfseitigen Rumpfendes im Zuge der weiteren Abtastung der Konturlinien (**3**, **4**),

h) Ermittlung einer sich zwischen den Konturlinien (**3**, **4**) und den nach f) und g) ermittelten Punkten erstreckenden Schwerpunktgeraden (**8**),

i) Ermittlung des Winkels zwischen der Schwerpunktgeraden (**8**) und der Senkrechten (bzw., bei einer liegenden Schlachttierhälfte, Waagerechten) zur Ableitung von Korrekturfaktoren im Falle einer seitlichen Verdrehung des Schlachttierkörpers

j) Ableitung geometrischer Parameter, wie Lägenmaße, Flächenmaße, Volumenmaße oder Winkel, welche physische Merkmale einzelner Körperregionen beschreiben,

k) Unterteilung der Schwerpunktgeraden (**8**) des knochenseitig erfassten Videobildes in Segmente (**9**),

l) Analyse der Segmente (**9**) für eine erste grobe Bestimmung der Lage der Wirbelsäule (**10**) als auf der Grundlage statistischer Größen gewonnene Bereichsangabe,

m) exakte Bestimmung von Lage und Verlauf der Wirbelsäule (**10**) innerhalb des nach l) ermittelten Bereiches durch eine Analyse der Farb- und/oder Helligkeitswerte der Bildpunkte innerhalb dieses Bereiches,

n) Ableitung weiterer Längen-, Flächen- und Volumenmaße für Teilbereiche innerhalb der Segmente (**9**) auf der Basis der festgestellten Lage der Wirbelsäule (**10**),

o) Festlegung eines die subkutane Speckschicht (**11**) mit Sicherheit enthaltenden Bereiches (region of interest) zwischen Rückenkonturlinie (**3**) und Wirbelsäule (**10**) anhand statistischer Daten,

p) exakte Ermittlung von Dicke und Verlauf der subkutanen Speckschicht (**11**) im Bereich ihrer Erstreckung zwischen einem Punkt geringster Speckdicke **12** in der Nähe des Schinkenansatzpunktes (**6**) sowie dem Schnittpunkt **13** zwischen der Rückenkonturlinie (**3**) und einer Geraden (**14**), welche die Rückenkonturlinie (**3**) mit dem Vorderbeinpunkt (**7**) verbindet und die Schwerpunktgerade (**8**) dabei orthogonal schneidet, wobei der Übergang zwischen der subkutanen Speckschicht und dem angrenzenden Gewebe innerhalb der region of interest durch die Auswertung des Gradienten der Helligkeitsänderung beim Übergang von einem Bildpunkt zum nächsten jeweils als maximaler Gradient der Helligkeitsänderung gefunden wird,

q) Berechnung eines prozentualen Verhältnisses der Verfettung einzelner Körperregionen, welche durch die gemäß j) und n) ermittelten geometri-

schen Parameter bestimmt sind,

r) Berechnung des Gewichtes sowie der Gewichts- und Fleischanteile der Teilstücke des Schlachttierkörpers aufgrund empirisch ermittelter statischer Zusammenhänge zwischen den nach j) und n) abgeleiteten geometrischen Parametern für einzelne Körperregionen und der aus q) erhaltenen Verfettungsinformation.

3. Verfahren nach einem der Anspruch 2, dadurch gekennzeichnet, dass der Winkel, welchen eine die Schnittpunkte (**16, 17**) einer Höhenlinie mit der Rükkenkonturlinie (**3**) und der Wirbelsäule (**10**) verbindende Gerade (**20**) mit einer bezogen auf eine am Hinterbein hängende Schweinehälfte waagerecht oder bezogen auf eine liegende Schweinhälfte senkrecht durch die Wirbelsäule (**10**) verlaufenden Geraden (**21**) in dem knochenseitig erfassten Videobild einschließt zur Ableitung eines Korrekturfaktors im Hinblick auf eine gegebenenfalls bestehende Verdrehung der Schweinehälfte gegenüber dem zur Online-Bewertung eingesetzten Kamerasystem dient.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, dass die Ermittlung der Volumenmaße durch Multiplikation der für den jeweiligen Teilbereich ermittelten Fläche mit dem Ergebnis einer Integration der den Verlauf einer Höhenlinie in dem Teilbereich beschreibenden mathematischen Funktion innerhalb der Grenzen zwischen Rückenkonturlinie (**3**) und Bauchkonturlinie (**4**)erfolgt.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, dass die Funktionswerte der die Höhenlinien (**15**) beschreibenden mathematischen Funktionen mittels eines Koeffizienten bestimmt werden, welcher an einem Prüfkörper gewonnen wird, dessen ansonsten ebene dem Kamerasystem zugewandte Oberfläche eine Ausbuchtung bekannter räumlicher Tiefe aufweist, indem diese bekannte räumliche Tiefe in Relation gesetzt wird zu der Ablenkung, welche auf den Prüfkörper auftreffende gerade verlaufende, mittels einer Lichtquelle erzeugte Linien im Bereich der Ausbuchtung erfahren.

6. Verfahren nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, dass aus den sich zwischen den Volumenmaßen gleicher Teilbereiche der beiden Hälften eines Schlachttierkörpers ergebenden Differenzen auf einen möglichen Spaltfehler bei der Teilung des Schlachttierkörpers geschlussfolgert und dieser gegebenenfalls vorhandene Spaltfehler bei der Bewertung der Teilstücke im Hinblick auf eine Aussage über die Qualitätsmerkmale des gesamten Schlachttierkörpers berücksichtigt und/oder an die die Teilung des Schlachttierkörpers vornehmende Station der Schlachtlinie als Informationsparameter übermittelt wird.

7. Verfahren nach Patentanmeldung 199 52 628.1 oder nach Anspruch 1 unter Verwendung eines Farbkamerasystems, dadurch gekennzeichnet, dass in die Bewertung eine zusätzliche im Bereich des Rippenbogens (**18**) von einem knochenseitig aufgenommenen Videobild gewonnene Verfettungsinformation einbezogen wird, welche aus einer Ermittlung des Gelb- und Blauanteils innerhalb einer region of interest im Bereich des Rippenbogens (**18**) resultiert, wobei die region of interest anhand der zuvor zum Konturverlauf, zur Lage und zum Verlauf der Wirbelsäule (**10**), zur Lage signifikanter Konturpunkte (**6, 7**) sowie über die subkutane Speckschicht (**11**) erhaltenen Informationen festgelegt wird.

8. Verfahren nach Patentanmeldung 199 52 628.1 oder nach Anspruch 1 oder 7 unter Verwendung eines Farbkamerasystems, dadurch gekennzeichnet, dass in die Bewertung eine zusätzliche, zum Anteil des Bauchfetts (**19**) gewonnene Verfettungsinformation einbezogen wird, welche aus einer Ermittlung des Gelb- und Blauanteils innerhalb einer region of interest im Bauchbereich resultiert, wobei die region of interest anhand der zuvor zum Konturverlauf, zur Lage und zum Verlauf der Wirbelsäule, zur Lage signifikanter Konturpunkte (**6, 7**) sowie über die subkutane Speckschicht (**11**) erhaltenen Informationen festgelegt wird.

Hierzu 2 Seite(n) Zeichnungen

- Leerseite -

Nummer: DE 100 50 836 A1
Int. Cl.[7]: A 22 B 5/00
Offenlegungstag: 27. Juni 2002

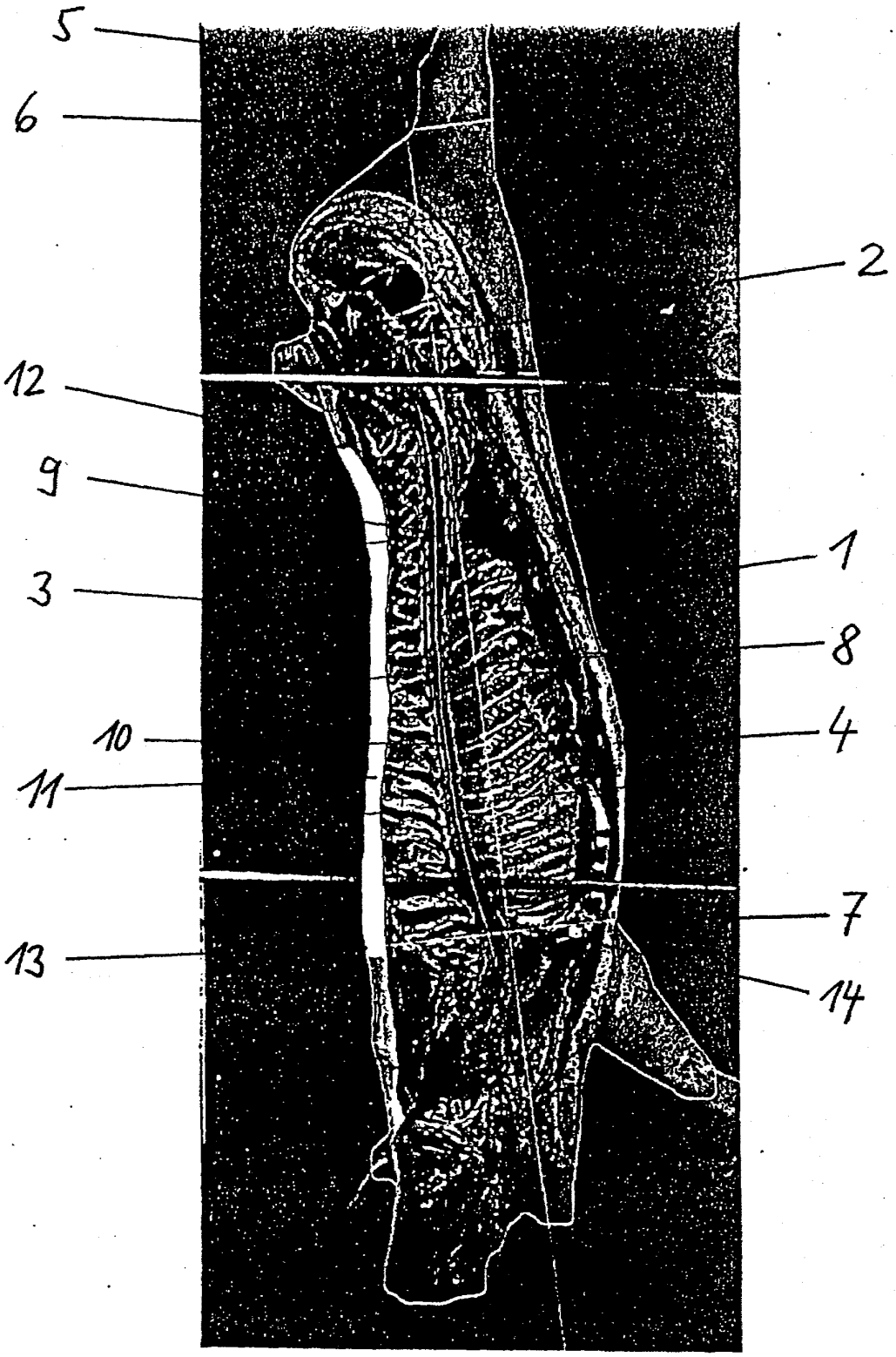


Fig. 1

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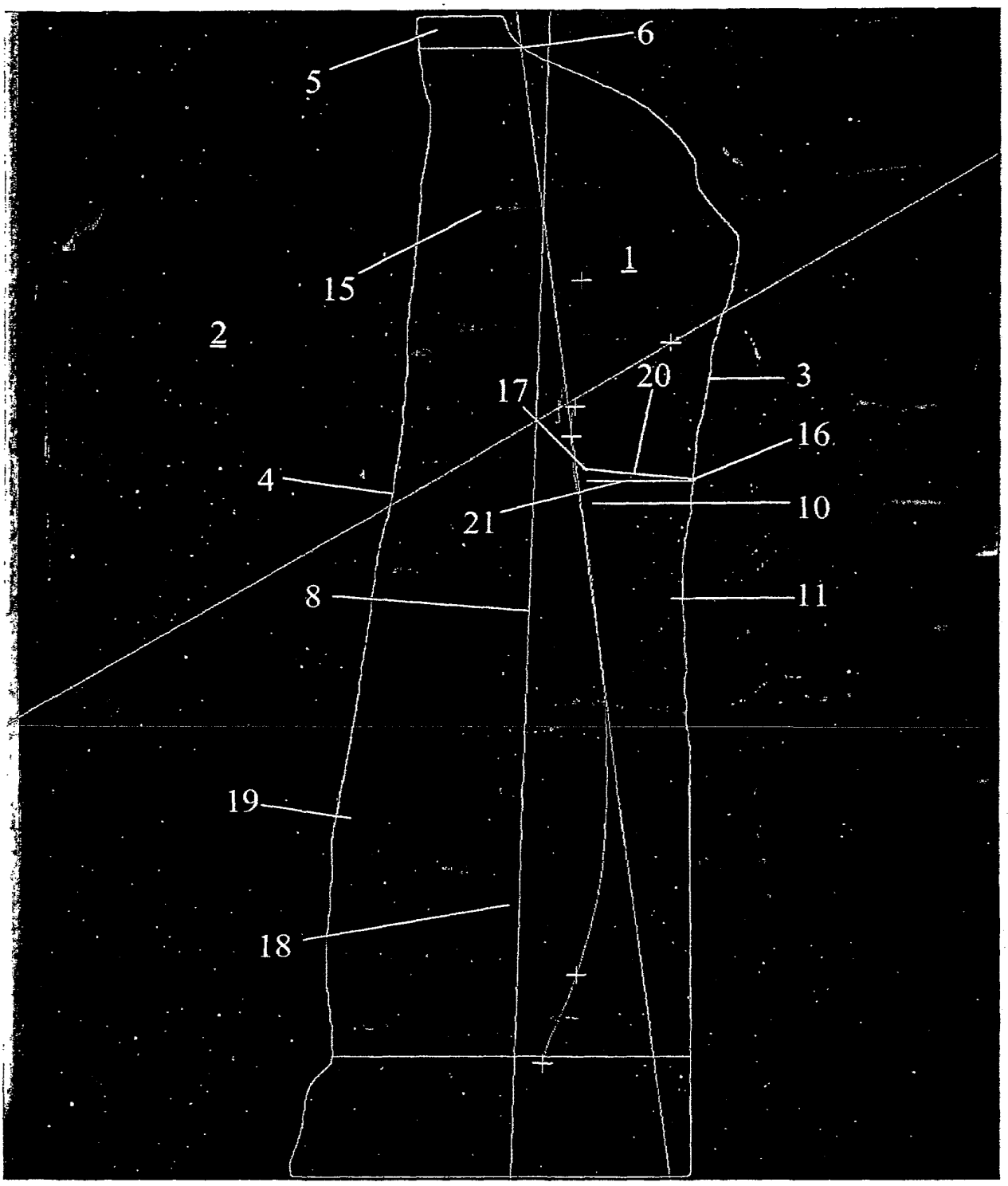


Fig. 2

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(54) Method for trimming pork bellies

(57) A method for portioning hog carcass sides is disclosed. In one use of the invention, the hog carcass is portioned according to a computer generated scribe line. The scribe line is generated by mapping the end-points of lean lines of meat. The method contemplates generating a scribe line without thickness mapping of the actual scribe line. The invention may be used in hog butchering processes where industry standards mandate portioning of the fatback be made with relation to the scribe line. Trimming of the belly can be carried out using the computer generated scribe line as well.

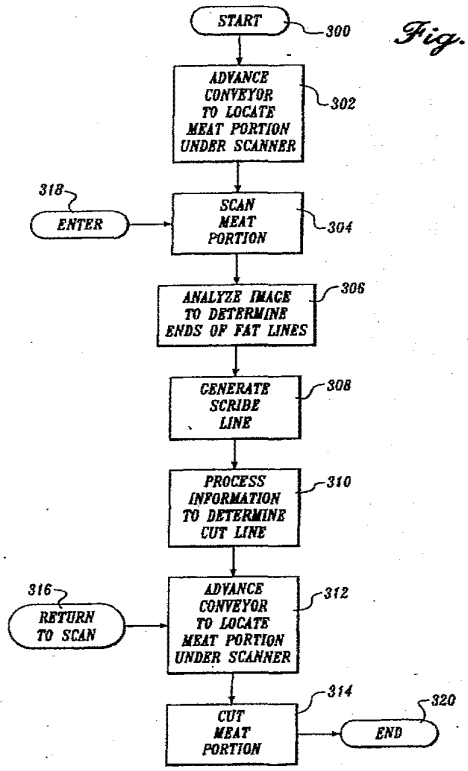


Fig. 6

EP 1 174 034 A1

Description

Field of the Invention

[0001] This invention relates to the meat processing industry, and more particularly to methods for use in trimming pork bellies.

Background of the Invention

[0002] Slaughterhouses portion hog carcasses into two similar halves by cutting down the middle of the backbone. The hog halves are then further portioned into primal cuts including the foot (front and back), fatback, loin, belly, shoulder, ham and jowl. Ham and shoulder cuts are generally removed before sectioning the midsection of the hog. The midsection contains the fatback, loin, ribs and belly. A pork belly is the cut of meat taken from a hog half midsection after removal of the loin, fatback, and ribs. Pork bellies are required to be trimmed of fat and defects. The ham includes the leg and hind quarters of the animal. The shoulder is the anterior portion of the animal including the butt and picnic. Usually, a next step is to portion the hog midsection into its respective primal cuts.

[0003] There are numerous patents which describe methods and apparatus for removing the various cuts from the midsection portion of the hog. For example, in U.S. Patent No. 5,902,177 to Tessier et al., a method and apparatus are described which determines the thickness of the ribs and then derives a cut profile according to a predetermined meat thickness which is desirable to leave under the ribs. U.S Patent No. 4,662,029 to Helsene et al., also describes a method of separating the loin and removing the ribs from the pork half. In this method, after the loin and ribs are removed, the fatback is removed with a fatback knife that makes a cut three inches from the longitudinal edge closest to the backbone side. The position of the fatback knife is controlled by the computer in response to information conveyed by a vision system camera. The bellies are further trimmed in response to the information read and transmitted by the vision system camera.

[0004] Using either of the aforementioned methods to remove the ribs, the hog half is left with a region of meat where the ribs have been removed and thicker portions where there were no ribs. Underlying the ribs is a network of lean lines of meat interspersed with fat (the "fingers of lean"). Since ribs do not cover all of the surface area of the pork belly, there is a curved line remaining after separation of the ribs from the belly where the ribs were attached to the loin. The demarcation line between the two areas is often referred to as the scribe line. The ends of the lean fingers correlate substantially to the location of the scribe line. This is common in all hogs. Thus, a scribe line is generally suited to serve as a reference for trimming pork bellies to a proportional standard for all hog species.

[0005] Beef associations, such as the National Association of Meat Purveyors (NAMP), set voluntary standards for the various cuts of meat. Those producers which choose to follow the standards set forth by these associations made up of industry participants earn the right to advertise their compliance with the associations' standards. Some standards may exceed those set by the United States Department of Agriculture. Thus, those meat processors which follow the standards set forth by a self-regulating segment of the industry will be able to command higher prices for their meat products. NAMP has set forth a certain standard for pork bellies which uses the scribe line as the reference for trimming the pork bellies. For example, NAMP mandates that the fatback be removed from the belly by a straight cut not more than 1½ inches from the outermost dorsal curvature of the scribe line. Further trimming of the pork belly likewise references the scribe line to comply with another standard for removal of scores and snowballs that measure in excess of 3 inches square. This standard specifies that the scores and snowballs be removed from the ventral side of the scribe line. The scribe line will not be considered a score so long as it is less that ¼ of an inch at any point. Thus, it becomes important to have an accurate measure of the scribe line to meet the standards.

[0006] Automated means of trimming pork bellies are now in existence which use video cameras or other optical devices to guide the cutting apparatus. The video cameras reference the trimming that is to be performed on the pork belly from the scribe line as mandated by the standards. There are devices which are able to discern areas of thick and thin meat regions and which can produce a thickness map of the meat portion. See for example U.S. Patent No. 5,324,228 to Vogeley, Jr. and more specifically, the application it references, Serial No. 07/772,309. However, the scribe line may often be difficult to discern because industry standards also mandate the depth of the scribe line, and on a flat surface, the scribe line can distort causing both thin and thick areas to appear equal in proportion. If cut too deep, the scribe line is seen as an undesirable score on the meat, which will lead to rejection of the product. Also, if a cut is too shallow, the methods for detecting areas of thin and thick regions do not accurately reflect the true scribe line. This, coupled with the fact that most trimming is done on a flat surface, makes scanning and determining the scribe line difficult. Over time, errors in trimming due to faulty prediction of the scribe line may cost the industry vast sums of money and time. In addition, middle distributors, and eventually the consumers, are not guaranteed a consistent quality product.

[0007] Prior methods of trimming use video or optical cameras that are able to detect differences in the surface contours to generate thickness maps of the meat products. However, the narrow tolerances between having an acceptable scribe line and overscoring the meat prevents most of these methods from being used effi-

ciently to determine exactly where the scribe line lies.

[0008] Therefore, there is a longstanding need for a more reliable method of ascertaining a suitable reference, such as a scribe line, to be used in the meat industry. The method preferably works with existing devices, such as video and other optical cameras to properly guide cutting devices in trimming pork bellies and other meat products.

Summary of the Invention

[0009] The present invention is directed to a method of trimming pork bellies using a method of calculating the location of the scribe line by measuring the ends of lean lines ("fingers") with the use of the present video imaging technology as opposed to previous methods of direct contouring or thickness mapping. The method of the invention includes the steps of scanning the meat portion in a manner that is able to discern the lean tissue from fat tissue. Then analyzing the image to determine the ends of the lean "fingers". Connecting the coordinates of the ends of the lean "fingers" to build a continuous reference line gives a reference related to the location of the scribe line. Finally, the meat portion is trimmed using the computer generated line as opposed to a scribe line obtained from thickness mapping.

[0010] In a preferred embodiment, the method is used in a process for portioning a side of a hog carcass. The side includes primal cuts of meat such as the ham, shoulder, fatback, loin and belly. A step in the method includes removing the ham and shoulder primals and leaving the fatback, loin and belly as one midsection unit. A next step is removing the ribs leaving behind a midsection which includes thin and thick regions of meat. Underlying the ribs is a network of lean meat interspersed with fat. The ends of the lean lines accurately references the scribe line. A computer having a scanning device can generate a scribe line from the ends of the lean tissue accurately representing the actual scribe line. The computer generated scribe line is used to portion the fatback from the midsection. The computer generated scribe line is also used as a reference in trimming the belly of defects.

[0011] Use of the existing technology which is capable of discerning between areas of lean and fat tissue may be advantageously used in this method to generate an accurate scribe line to use in referencing any trimming operations for any of the various cuts of meats.

Brief Description of the Drawings

[0012] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a schematic representation of a hog carcass showing the primal cuts of meat

FIGURE 2 is a plan side view of a hog midsection showing the fatback, loin, belly and ribs

FIGURE 3 is a plan side view of the hog midsection of FIGURE 3 without the ribs

FIGURE 4 is a cross-sectional view of the hog midsection of FIGURE 4 showing the thin and thick meat portions after removal of the ribs

FIGURE 5 is a schematic representation of the apparatus used to carry out the method of the present invention

FIGURE 6 is a schematic representation of a method in accordance with the present invention.

Detailed Description of the Preferred Embodiment

[0013] The present invention is directed to a method of trimming primal cuts of meat using scanners which can detect a discontinuity in tissue, such as occurs between fat, bone, or cartilage with lean tissue. The method uses video or optical scanning devices to determine a plurality of termini of one of the tissue types, such as the lean tissue, bone, fat or cartilage and then uses those termini to build a suitable reference line with the aid of a computer. The computer then directs further processing or trimming of the meat with reference to that line. The-method of the present invention can be used in any instance whenever termini of any tissue type signifies the appropriate reference line to be used in trimming. Thus, the present invention may be used in any of a number of meat processing steps which rely on first locating a suitable reference line and then guiding a cutting device in accordance with that reference line. The preferred embodiment will be described with reference to hog butchering, however, the method of the present invention is adaptable to any meat portioning operation, provided there are tissues with termini correlating to a reference.

[0014] In a typical method of butchering hogs, the hog is first sectioned into two halves by cutting the hog down the middle of the backbone. The carcass now represents two distinct but similar sides. Each side portion of the hog is further subdivided into primals as shown in FIGURE 1. The hog side includes the hind foot 100 and forefoot 102, the ham 104, fatback 106, loin 108, belly 110, butt 112 and picnic 114. Collectively, the butt 112 and picnic 114 are referred to as the shoulder. Processing of the hog sides into primals continues identically for the two sides. Helsene et al. (U.S. Patent No. 4,662,029) and Vogt et al. (U.S. Patent No. 3,159,869) provide a general explanation of the sequence of hog butchering steps.

[0015] In a typical hog slaughterhouse, the ham 104 including the hind foot 100, as well as the shoulder 116, including the forefoot 102 and jowl 118, are removed prior to sectioning the midsection primals. The shoulder 116 may further be sectioned into the butt 112, picnic

114 and jowl 118. The midsection, generally denoted as 120, includes the fatback 106, lying in the dorsalmost part of the hog carcass. Ventrally to the fatback 106 lies the loin 108. The loin contains the longissimus dorsi muscle which forms the major paraspinal muscle. The loin may further be divided into rib chops, centerloin chops and tenderloin chops, from front to back, respectively. Lying ventrally of the loin is the belly 110. The midsection also includes ribs 122 and a portion of the backbone 124.

[0016] In a typical hog processing plant, the ribs 122 are removed prior to sectioning the midsection 120 into the three primals discussed above. A suitable method for removing the ribs 122 is described in Helsene et al., which uses a knife to section the ribs from the midsection with guidance from a vision system cameral. While Helsene et al. describes an adequate method of removing ribs, the method still relies in large part on manual interaction and is thus not fully automated as in another method described in U.S. Patent No. 5,902,177 to Tessier et al., which is herein incorporated by reference. In Tessier et al., an optical imaging device including a laser and camera is able to determine the thickness of the ribs using optical triangulation techniques. The computer then performs calculations to determine the appropriate depth to trim the ribs. The meat underlying the ribs is filled with lean lines interspersed with fat. The ventral terminal ends of the lines follow a path related to the location of the scribe line.

[0017] Once the ribs 122 have been removed, the hog midsection is ready to be portioned into primal cuts including the fatback 106, loin 108 and belly 110. The Helsene et al. '029 patent and the Vogt '869 patent, both of which are herein incorporated by reference, describe ways of trimming the loin from the midsection. Vogt et al. uses a semi-automatic method consisting of a movably mounted table and U-shaped cutting knife. The loin removal step can be accompanied with removal of the backbone. Helsene similarly uses a U-shaped knife to remove the loin from the midsection.

[0018] Once the ribs and loin have been removed, the belly and fatback primals remain attached to one another. The fatback 106 can be trimmed from the loin 108 as described in Helsene et al. In Helesene, a fatback knife cuts a 3-inch strip from the belly along a longitudinal edge which is the closest to the backbone. The position of the fatback knife is controlled by a computer in response to the information conveyed by the vision system camera. Vogt et al. also describes a method of removing the fatback in Application Serial No. 203,931.

[0019] It should be readily apparent that the ordering of steps is no consequence to the present invention, therefore in some embodiments, the loin removal step may precede the rib removal step, or the fatback removal step may precede both the rib and loin removal steps or any combination thereof. These embodiments are meant to be included within the scope of the present invention and the invention can be advantageously used in these steps as well. Equally suitable is the use of the present invention in other meat processing industries such as fowl, fish or cattle.

[0020] The present invention is meant to be used in any meat portioning operation, including those described above, or those not mentioned but well known to others in fowl, fish or beef portioning industries.

[0021] The preferred embodiment of the present invention contemplates using the termini of lean lines of meat underlying the ribs to construct a reference line which may be used in trimming the meat portion according to that line. Furthermore, the present invention can be used with scanners and automated cutting devices already in existence which reduces the cost of converting old processes into the present invention. And furthermore, other tissue types such as bone or cartilage may be used, so long as the termini of the tissue signifies a desirable reference line. Because the present invention relies on the inherent properties of the meat, there is no scoring or thickness mapping that is required to take place in order to build the reference line. This is a significant difference between the present invention and previous methods of portioning meat, especially in trimming pork bellies.

[0022] As shown schematically in FIGURE 6, the first step 302 is to advance the conveyor carrying a meat portion to the scanning station where the meat portion is scanned in step 302.

[0023] As shown in FIGURE 5, in the preferred embodiment of the present invention, the hog carcass 200 is carried on a endless conveyor mechanism 202 which moves the hog carcass 200 through a series of stations. The movement of the conveyor system 202 may be continuous or may be in discrete steps, i.e., stopping at each station. A combination of movable overhead devices and a continuously moving conveyor system may provide the advantage of increasing productivity. In accordance with the present invention, the hog carcass 200 passes through a scanning system, generally denoted by 204. The scanning system 204 is able to detect regions of fat and lean muscle tissue and, more particularly, the scanning system is able to discern the ends of lean lines or "fingers". The lean lines underlie the ribs and are visible once the ribs have been removed in a previous processing operation. Suitable scanning systems are described in U.S. Patent Nos. 5,324,228 to Vogeley, Jr. and 5,937,080 to Vogeley, Jr. et al., which are herein incorporated by reference. The scanning system 204 may use one or a plurality of cameras 206, 208. Furthermore, the scanning devices 206, 208 need not use electromagnetic radiation in the visible light region, other scanning devices which use higher or lower frequency radiation may be used as well, for example X-rays or infrared radiation or any other suitable energy wave in the electromagnetic radiation spectrum. The scanning devices 206, 208 work on the principle that different kinds of tissue effect electromagnetic waves in different ways. For example, fat and lean tissue are

made of different components, or even if they have similar components, one tissue may have a higher or lower amount of the same component. Scanners rely on the inherent differences between tissues to measure the effects the tissues have on the radiation, such as the amount that is reflected. Sensors mounted in strategic positions can record the reflectance or transmittance of the radiation, and provide data which is further analyzed to determine the boundaries between tissue types.

[0024] Following the scanning step 304 of FIGURE 6, steps for analyzing the data, generating a scribe line, and processing the information to determine the cutting path can proceed, respectively in steps 306, 308 and 310, according to FIGURE 6.

[0025] As shown in FIGURE 5, the preferred embodiment to carry out the above steps will include a computer 210 having a memory 212, a central processing unit 214 (CPU), and a user interface 216. Collectively, these devices will store, analyze and process the data collected from the scanners 206, 208. Not only will the computer store and analyze the data, but the computer may also network or interface with other computers running different parts of the butchering system, such as earlier primal removing steps, or the computer may drive peripherals such as the conveyor, the scanners or the cutting devices. Between computers, they may send signals or flags to trigger one event, provided completion of a preliminary step has occurred. In this manner, computers can provide checks for one another to enable a completely automated system. The memory 212 can store instructions in the form of a computer program which executes upon the happening of a given event, such as input from a user or from a different computer or any peripheral devices. The data entering via the scanning devices may likewise be stored in the computer memory. For instance, an event may alert the scanner that a food portion has entered within the scope of the scanners and data needs to be collected. The data sent to the computer can be collected and stored to await further processing. When all the data for the given foodstuff has been collected, an event will be triggered to end data collection and signal that the next scan will be for a different food portion. The data is now processed and analyzed.

[0026] In the method according to the present invention, the data will be useful in determining the regions of fat and lean tissue. FIGURE 2 shows a side of a hog carcass including the ribs, backbone, fatback, loin and belly. FIGURE 3 shows the same side of the hog carcass with the ribs and backbone removed and FIGURE 4 shows the cross section of FIGURE 3. In a hog carcass, the tissue of interest for purposes of the present invention is in the form of alternating lean and fat lines which underlie the ribs. The ends of these lines substantially correspond to the scribe line 124 of FIGURE 3 which marks the division between the thinner regions of meat where the ribs were attached and the thicker regions of meat. The CPU 214 is able to analyze the data and determine therefrom the termini or endpoints of the lean tissue which substantially correlates to the scribe line 124 according to a pre-programmed algorithm. The CPU 214 can assign coordinates to the endpoints of the lean lines. Once the endpoints have been assigned coordinates, the CPU 214 may generate a scribe line which is substantially an accurate representation of the actual scribe line. In fact, the computer generated scribe line may be closer to the ideal scribe line because it uses the anatomical features rather than a cut line that is prone to have errors. Thus, the method of the present invention can use well-know scanning devices in a way to advantageously derive a computer-generated scribe line which is not dependent on the thickness measurement the way previous methods used to. The method of the present invention is preferable to methods which rely on contour or thickness mapping the surface of the hog carcass. This is a significant difference between the present invention and previous methods.

[0027] A step in the preferred method of the present invention uses the computer generated scribe line as a reference in trimming the midsection of the hog carcass, shown as step 314 in FIGURE 6. One trimming operation where the scribe line is a useful reference is the fatback removal step. The fatback is the part of the hog carcass that lies dorsally to all other parts. The fatback is a relatively continuous section of fat tissue. The computer generated scribe line is the reference used to remove the fatback rather than the actual scribe line which may be displaced a considerable distance from the ideal scribe line due to previous errors in the de-ribbing operation. Since the present invention relies on the ideal scribe line, better results are obtained since the error in previous steps is not carried over into this step. One standard adopted throughout the industry and by NAMP is that the fatback shall be removed by a straight cut not more than 1½ inches from the outermost dorsal curvature of the scribe line. Thus, the computer generated scribe line can be used to measure this exact amount of tissue to trim off. Furthermore, other standards regulate the amount and size of defects which lie ventrally of the scribe line. Similarly, the present invention provides a computer generated scribe line which can be used to comply with this standard as well.

[0028] Step 314, the trimming of the fatback, can take place in a downstream station generally denoted as 218 in FIGURE 5. At the same time the conveyor is continually advancing to a predetermined location to allow the cutting device to perform the cutting step 314, the conveyor places another hog carcass underneath the scanner and begins the method again from step 312 for another hog carcass and returns to step 304 as shown in FIGURE 6. In step 314, the computer generates the appropriate cutting path by a pre-programmed algorithm to meet specific standards, such as described above, and then directs a cutting device to follow the path. In addition, the computer memory can be pre-programmed with many standards. The operator at the cutting work-

station can enter one of several pre-programmed algorithms via the user interface 216 to perform the task at hand.

[0029] The cutting device 220 is configured to receive signals from the computer and can cut the hog carcass accordingly as shown in FIGURE 5. The cutting device 220 may have one or a plurality of cutting implements, such as circular or band saws. Preferably, the cutting device is a high pressure water jet as described in Patent No. 5,931,178 to Pfarr, which is herein incorporated by reference. A plurality of cutting jets may ride on an articulating arm which moves bi-directionally, meaning that the arm can carry the cutting jets horizontally in both a longitudinal and traverse direction to the hog carcass. In addition, the cutting jets may articulate in a vertical direction as well to provide a cutting path along a third axis.

[0030] Other alternatives for a cutting station are to provide a series of multiple water jet heads to perform two cutting paths simultaneously. For example, one standard calls for removal of the fatback, while another standard calls for removal of defects below the scribe line. Both tasks can be completed simultaneously with multiple cutting jets. The tasks may also be sequenced if only one cutting jet is available.

[0031] Other alternates of the preferred embodiment can include portioning other primals of the carcass. The sequence of steps described in FIGURE 6, may suitably be adapted for any portioning step, provided there are suitable termini of a tissue from which to build a reference. In addition, the method of the preferred embodiment, may be "stacked" on top of one another, meaning that the method is sequentially performed. For example, a primal such as the ham is first portioned using the method of the present invention, followed by portioning the shoulder, again by the method of the present invention, followed by the ribs, loin and fatback, sequentially portioned, and using the method of the present invention. It is also to be understood that the method can be used in combination with other portioning methods which do not rely on a reference line. The benefit of the present invention is that it may be incorporated into existing facilities, since much of the equipment may be located on site already.

[0032] While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

Claims

1. A method for trimming a foodstuff having tissue with termini, comprising:

   scanning the foodstuff,
   detecting the termini of the tissue
   generating a line with the aid of a computer by using the termini as points on the line, and
   trimming the foodstuff with reference to the line.

2. The method of Claim 1, wherein the foodstuff is a pork belly.

3. The method of Claim 2, wherein the tissue comprises fat and lean tissue.

4. The method of Claim 3, wherein the line is a scribe line.

5. A method for trimming a foodstuff having fat and lean tissue, comprising:

   scanning the foodstuff;
   discerning the fat from the lean tissue;
   building a reference from the ends of the lean tissue to guide a trimming device; and
   trimming the foodstuff according to the reference.

6. The method of Claim 5, wherein the foodstuff is a pork belly.

7. The method of Claim 5, wherein the reference is a scribe line.

8. The method of Claim 5, wherein the device is a high-pressure water jet.

9. The method of Claim 5, wherein the scanning step is carried out with an optical camera.

10. A method for trimming a foodstuff having fat and lean tissue, comprising:

    scanning the foodstuff,
    detecting terminus points on the lean tissue,
    generating a line with the points, and
    trimming the foodstuff with reference to the generated line.

11. The method of Claim 10, wherein the foodstuff is a pork belly.

12. The method of Claim 10, wherein the line is a scribe line.

13. The method of Claim 10, wherein the step of trimming is carried out with a high-pressure water jet.

14. The method of Claim 10, wherein the step of scanning is carried out with an optical camera.

15. The method of Claim 10, wherein the steps of detecting and generating is carried out with a computer.

16. A method for trimming a pork belly having ribs, comprising:

removing the ribs from the pork belly to expose fat lines and lean tissue, and
trimming the pork belly with reference to the ends of the alternating lean and fat lines.

17. A method for portioning a side of a hog carcass having ribs, fatback, loin and belly primals, comprising:

removing the ribs from the carcass to expose fat and lean tissue,
portioning the fatback with reference to a computer generated scribe line, and
trimming the belly with reference to the computer generated scribe line.

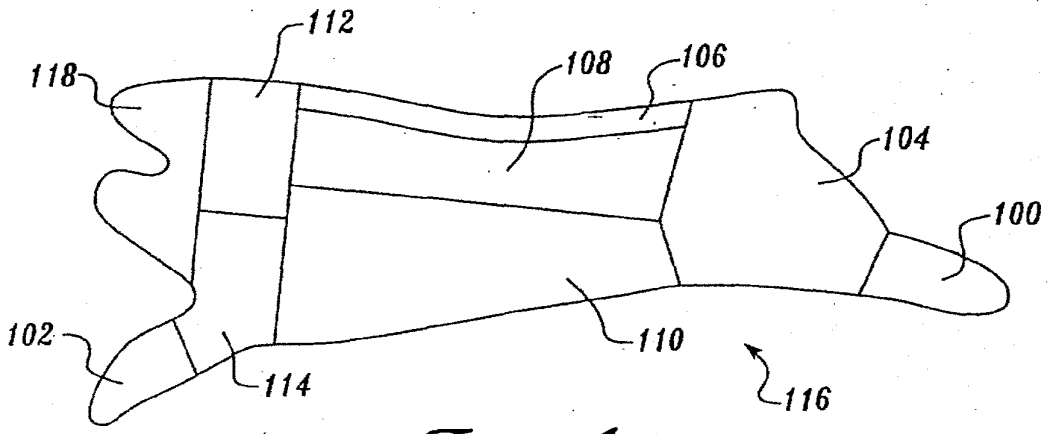


Fig. 1

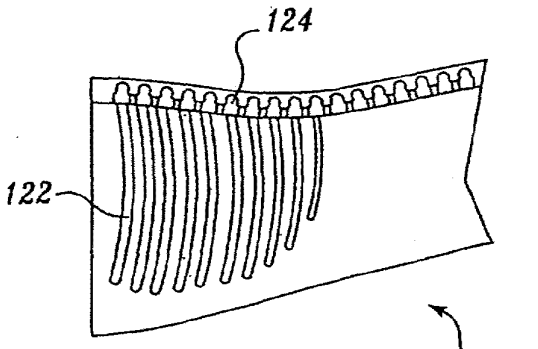


Fig. 2

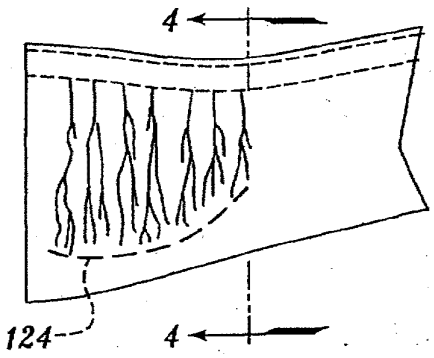


Fig. 3



Fig. 4

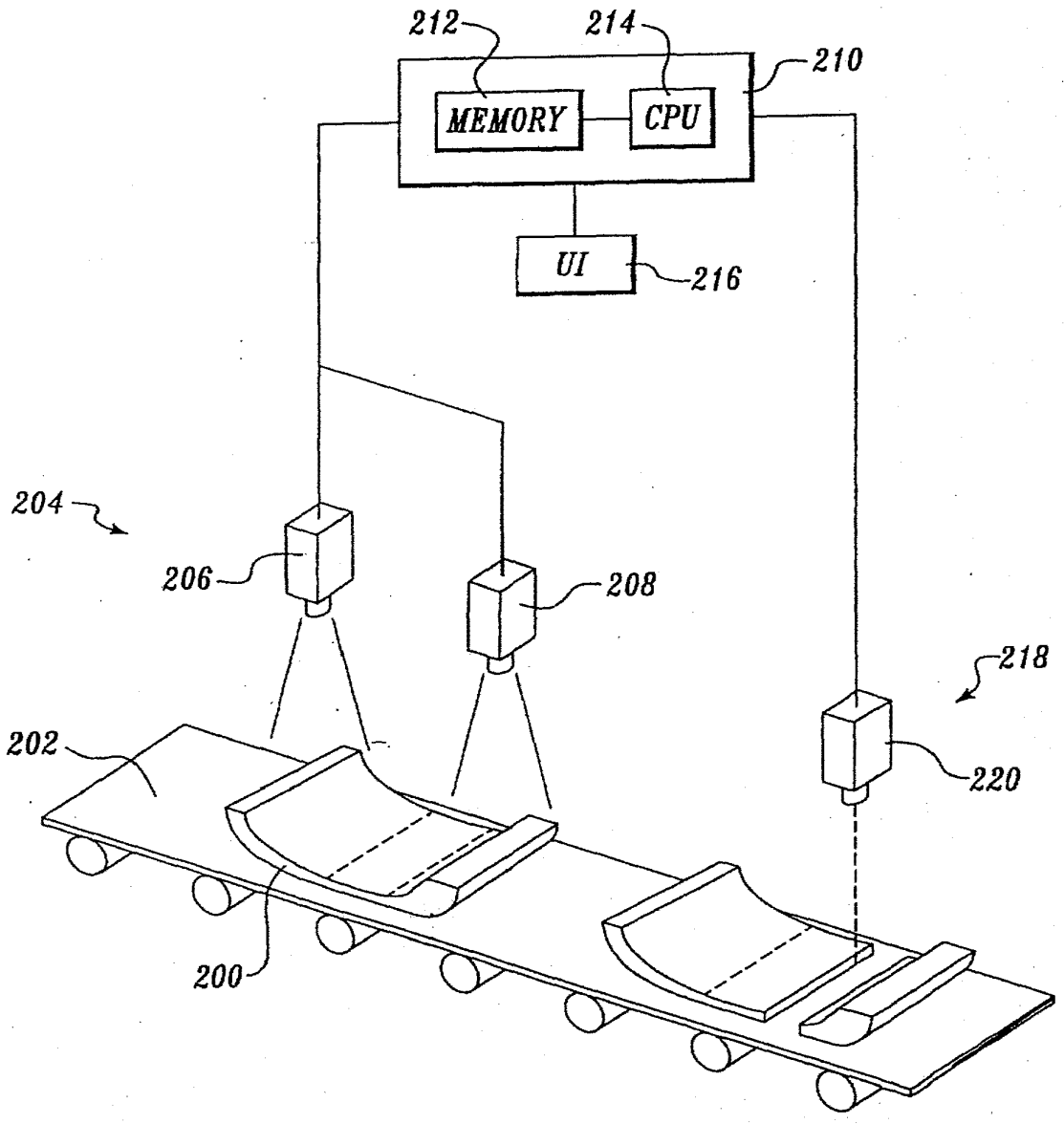


Fig. 5

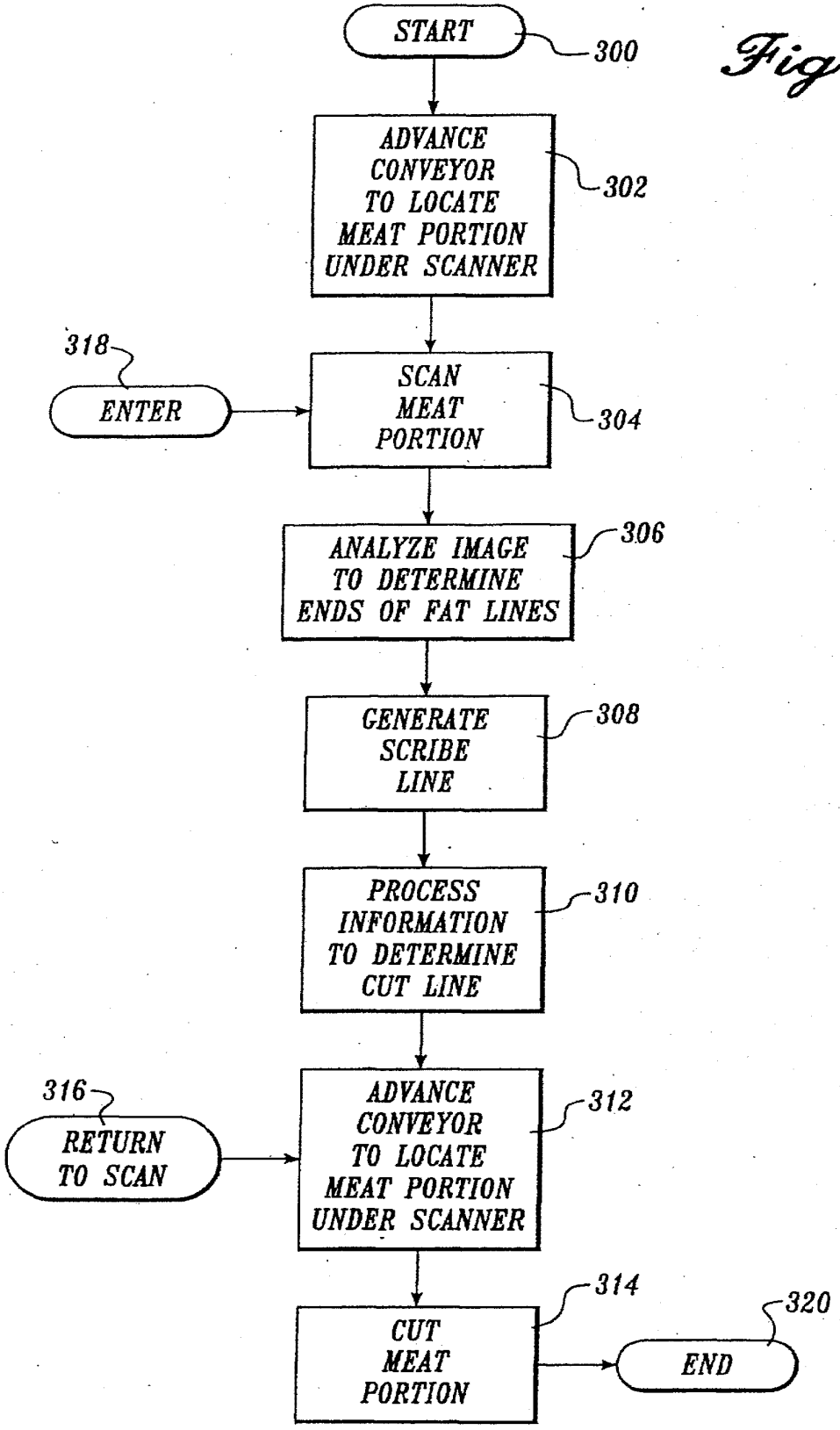

START
300
ADVANCE CONVEYOR TO LOCATE MEAT PORTION UNDER SCANNER
302
318
ENTER
SCAN MEAT PORTION
304
ANALYZE IMAGE TO DETERMINE ENDS OF FAT LINES
306
GENERATE SCRIBE LINE
308
PROCESS INFORMATION TO DETERMINE CUT LINE
310
316
RETURN TO SCAN
ADVANCE CONVEYOR TO LOCATE MEAT PORTION UNDER SCANNER
312
CUT MEAT PORTION
314
END
320

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 7089

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A22B
A22C
B26D
G01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 September 2001	Acerbis, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 11 7089

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21-09-2001

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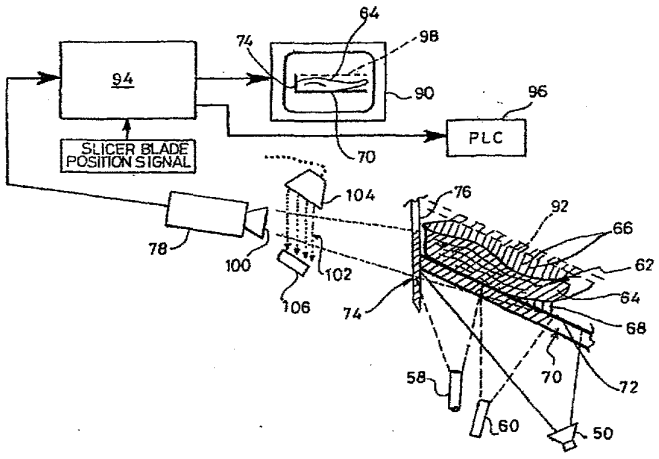
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— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: TWO COLOUR VISION SYSTEM



(57) Abstract: A vision system is described for viewing the end face of product mounted in a machine which in use produces measurements relating to the area of the end face and of at least one constituent part of the product which is visible in the end face. The system comprises means for illuminating the end face and a video camera for producing a video signal from an image of the illuminated end face. The end face is illuminated by light of two predominantly different wavelengths. One wavelength illuminates an area which contains both the end face and surrounding parts of the machine, while light of the other wavelength from a laser source produces a pattern of parallel spaced apart lines of light of the said other wavelength. A memory stores information on the components of the machine which in use extend into the field of view of the scanning means, and signals obtained from the stored information are employed to gate the video signal to exclude video signal corresponding to regions of the field view which are known not to contain any part of the product end face. The parallel lines cross the end face at a specific given angle, and parallel lines in the field of view at other angles indicate regions in the field of view which are not part of the end face of the product. Gating excludes video signal of parallel lines in the image which are not at the specific angle and of parallel lines crossing flat regions of the machine parallel to the end face of the product, to leave a residual video signal corresponding to the end face, from which an electronic mask is generated which represents the extent of the product end face. A full colour video signal of the field of view is gated by the mask. The vision system forms part of a product slicing machine and measurements and/or dimensional values obtained from the video signal control the thickness of the next slice to be cut and are also sent to slice and pack grade-level decision logic, to control down-line gates.

WO 2006/136818 A1

Title: Two colour vision system.

Field of the invention

This invention concerns vision systems, especially vision systems as employed in food cutting and portioning apparatus.

Background to the invention

It is known to illuminate and view the end face of a length of foodstuff such as meat, using a video camera to obtain a video signal representation of visibly different regions in the end face, such a lean and fat regions, and to process the signal and compute for example the lean to fat ratio as well as the overall area of the end face.

The latter can be employed together with a density value for the foodstuff to compute the distance through which the foodstuff should be moved to enable a slice of a given weight to be cut from the length.

The lean to fat ratio can be compared with stored ratio values, to determine the quality of the portion, and this information can be used to direct the cut portion to one location or another, according to the lean/fat ratio which is usually a measure of the quality of the meat.

Difficulties have been experienced in accurately determining what in the camera field of view is product and what is supporting structure, so that the computation of the area is not always as accurate as it should be. Indeed a key difficulty in using vision systems to analyse product at the slicer cutting point is the acquisition of an accurate image and

therefore video signal of the cut face of the product, clearly differentiated from the background to allow accurate image processing of the video signal and quantitative assessment of eg. fat to lean areas. This background may include parts of the machine itself, areas of product contamination and debris, and surface the product which is not part of the cut face.

This has been approached previously by offsetting light sources to the side or below the product, to place non-product cut face material in shadow, in an attempt to allow video signals relating to it to be excluded from video signals relating to the cut face, by thresholding the signal from the camera.

Other techniques have illuminated the sides of the product, casting the cut face in shadow, but this does not allow analysis of the cut face (eg to quantify lean to fat proportions of the cut face) which is now in shadow.

This allows the overall area of the cut face to be computed.

Object of the invention

It is an object of the present invention to provide an improved vision system which can be used to produce more accurate measurements of the end face of a length of foodstuff, especially meat, and in particular a more accurate measurement of the area of the end face and of the ratio of one constituent part of the foodstuff from at least one other constituent part thereof, when both are present in the end face.

It is also an object of the invention to provide a video signal from which the shape of the end face can be determined by reference to pre-stored shape data.

It is also an object of the invention to provide apparatus and methods by which data obtained by the improved vision system can be used to control the slicing and packaging of the sliced product.

Summary of the invention

According to one aspect of the invention there is provided a vision system for viewing the end face of product mounted in a machine which in use produces measurements relating to the area of the end face and of at least one constituent part of the product which is visible in the said end face and which comprises means for illuminating a region containing the end face and surrounding parts of the machine and scanning means for producing a video signal from an image of the illuminated region, wherein the region and end face of the product is illuminated by light of two predominantly different wavelengths characterised in that light of one wavelength is employed to generally uniformly illuminate the region, while light of the other wavelength is employed to produce a pattern of light at least on the product end face..

Preferably the light is obtained from two separate light sources.

Typically the light pattern extends over the whole area.

Typically the pattern is one of parallel spaced apart lines of light of the said other wavelength.

Typically the generally uniform illumination is performed using green or blue light, and the pattern is formed using red light.

Conveniently the green or blue source comprises an array of green or blue LEDs, or a filament or halogen lamp or array of white LED's with a green or blue filter placed between the lamp or the array and the region to be illuminated.

Preferably a laser light source is employed to create the pattern.

The laser source may form a part of a structured light generating head which in use produces a series of parallel straight lines of monochromatic light, typically red, typically equally spaced apart, on the product.

Preferably the scanning means comprises a video camera which produces the video signal.

In a preferred embodiment different components of the video signal corresponding to the two different wavelengths of illuminating light are separated by software into a first image signal comprising only signal corresponding to the pattern and into a second image signal comprising signal corresponding to the image produced by the illumination using the said one wavelength light.

Conveniently information on the extent of the end face is determined by processing an image signal derived from the first image signal.

Preferably memory means is provided for storing information on the components of the machine which in use extend into the field of view of the scanning means, and signals obtained from the stored information are employed to gate the video signal to exclude video signal corresponding to regions of the field view which are known not to contain any part of the product end face.

Preferably the angle the parallel lines make relative to the end face, is adjustable, so that the lines cross the end face at a specific given angle, and in general only those parts of the field of view of the scanning means which are crossed by lines of the appropriate wavelength, and which are at that given angle, will correspond to the end face of the product, while parallel lines in the field of view at other angles, indicate a region in the field of view which is not part of the end face of the product.

Conveniently the gating operates to exclude video signal of parallel lines crossing flat regions of the machine parallel to the end face of the product to leave a residual video signal composed of parallel lines only where they cross the end face of the product.

Signals defining an electronic mask to be used inter alia for video signal gating may be generated from the residual video signal, using image processing techniques. The mask also defines the size and shape of the product end face.

Alternatively points in the video signal at which the parallel lines change direction or disappear are determined using image processing techniques, and using a point joining algorithm these points can be joined by software to generate an electronic mask as aforesaid which can be employed for gating and equates to the size and shape of the product end face.

In a further preferred embodiment a source of white light is also provided whereby in use the whole of the region in the field view of the scanning means can be illuminated by white light and the scanning means is enabled to produce a full colour video signal of the region, and the mask is used to gate the full colour video signal to remove parts thereof which do not correspond to the product end face, to leave a full colour video signal of the end face alone.

The gated full colour video signal of the product end face is subjected to image processing software to identify signals of at least one particular colour.

Typically differently coloured regions of the product end face are distinguished by the software by reference to colour, and measurements using further software are performed on the signals corresponding to the differently coloured regions.

A vision system as aforesaid which produces an original full colour video signal may be used to scan the end face of a piece of meat containing lean and fat regions, and wherein signals relating to the latter are distinguished and separated from those relating to the former by colour and measurements made thereon to determine the size of lean and fat regions.

Where grey-level thresholding tools (software or hardware) are to be used to determine the different regions in the product end face, such as regions of lean (which will tend to be dark grey) and regions of fat (which will tend to be light grey or white) in a piece of meat, or cavities or discoloured regions in the end face of a piece of cheese, the colour video signal may be converted to a monochrome grey-level image signal to allow thresholding to be performed, and measurements are then performed on the thresholded signal and if appropriate also the original signal, ` using appropriate further software or hardware.

Software or hardware calliper tools may be employed to measure the height and /or width of the product end face, and/or of different visually distinguishable regions in the end face, and area values of the measured regions can be computed.

Typically the following dimensions of the end face of a meat product are obtained from the video signal, namely

Overall area of end face,
Area of lean meat in end face,
Height of end face,
Area of fat within the end face, and
Width of end face.

A ratio of lean to fat areas may be computed from the two area values.

A vision system as aforesaid may form part of a product slicing machine and the measurements and/or dimensional values are sent to a slicer controller, to control the thickness of the next slice to be cut.

In such a vision system the dimensional values may also be sent to slice and pack grade-level decision logic, to control down-line gates.

Where a monochrome grey scale video signal is produced, the latter may be sent to a feature classifier which in use is adapted to return an electronic flag to indicate whether or not a particular feature can be found in the video signal of the end face.

In such a vision system a state vector machine (SVM) based feature classifier may be employed and if a feature is found to be present, its dimensions are determined.

The invention is of particular use in assessing the end face of a side of bacon, and, in this event the classifier operates to determine if certain bacon muscle is present or not in the end face, and if so its dimensions are measured.

As previously mentioned, when the vision system forms part of a slicing machine for slicing a side of bacon the dimensional values may be sent to a slicer controller to control the thickness of the next slice of bacon to be cut.

According to another aspect of the invention, there is provided a method of assessing an end face of product which is to be sliced and routing the slice according to the assessment and which is viewed by a colour video camera set in front, but to one side of, the product end face, comprising the steps of:-

1) using substantially monochromatic light centred on a first wavelength, illuminating the camera field of view to form a first picture signal.

2) using substantially monochromatic light centred on a second wavelength forming a plurality of spaced apart parallel lines which as seen by the camera will appear to cross the camera field of view at an acute azimuth angle to the scanning direction of the camera.

3) selecting the different wavelengths so that video signal content produced by light of one wavelength is readily separable from video signal content produced by light of the other

wavelength on the basis of colour or after conversion to a grey scale monochromatic signal, by reference to grey level.

4) selecting the position of the second wavelength source relative to the product end face so that the parallel lines of light in the camera field of view extend at one angle across the product end face, but at a different angle where they intersect a side or top surface of the product.

5) in a first signal processing step, processing the video signal so as to separate signal content produced by the first wavelength light from that produced by the second wavelength light so as to leave only signal content relating to the line image of the second wavelength light.

6) in a second processing step, identifying any part of the line image video signal content which relates to lines in the field of view which extend at the said one angle, and separating each such part from parts of the signal which relates to lines which extend at other angles, to leave as a residual line image signal only signal content which corresponds to lines in the field of view, which extend thereacross at the said one angle, and therefore identify the end face of the product.

7) generating an electronic mask from the residual line image signal which corresponds to the shape and size of the end face.

8) creating from the electronic mask a gating signal, and gating the video signal produced using the first wavelength light, so as to exclude therefrom all video signal content not coincident with the mask signal, to form a residual picture signal, corresponding only to the end face.

9) separating those parts of the residual picture signal which relate to lighter coloured (or lighter grey) regions of the end face, from those parts which relate to darker (or

darker grey) regions of the end face, to leave a partial video signal relating only to one or the other type of region.

10) computing the total area of the end face from the residual picture signal or the mask, and the total area of the regions of the end face corresponding to the partial video signal, and

11) computing a grade value for the product from the area value of the end face and the area value from the partial video signal, and comparing the grade value with at least one preset numerical value, and directing a subsequently cut slice of the product to one or another of two or more collection points depending on the grade value computed for the end face of the product from which the slice has been cut.

If the separation step (9) is to be performed by grey level thresholding the colour video signal is converted to a monochrome grey level signal.

Where the video signal is a colour video signal the separation of step (9) can be performed on the basis of colour.

The invention also lies in the combination of a slicing machine a vision system as aforesaid when adapted to operate in accordance with the foregoing method.

The invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a slicing machine embodying the invention;

Figure 2 is a perspective view to an enlarged scale of the cutting region of the machine of Figure 1 with the safety covers removed showing the blade, delivery conveyor and a product collecting jump conveyor;

Figure 3 is another perspective view of the cutting region from a different angle showing the laser housing, the camera housing and the illumination light source;

Figure 4 is a further perspective view of the cutting region, from above, showing the extent to which the light from the illuminating light source will illuminate the blade and the cut end face of the product and the immediate environs of the blade;

Figure 5 is a view from above, with the cover removed, of the laser source;

Figure 6 is a view from above, with the cover removed, of the camera housing;

Figure 7 is a diagrammatic illustration of how the laser source, illuminating light source and camera interact to provide signals for processing, and for display on a monitor screen;

Figure 8 illustrates one of the screen displays which can be obtained on the monitor;

Figure 9 is a side elevation of the machine shown in Figure 1 and shows the general position of the lasers.

Figure 10 is a block schematic diagram of the vision system, video signal processing stage and controls for the machine of Figures 1 et seq;

Figure 11 is a timing diagram which should be read in conjunction with Figure 10;

Figure 12 is a screen display produced by image signal from a camera viewing a cut end face of a side of bacon at the end of a delivery conveyor with lines of red light crossing the cut end face at approximately 45° relative to the plane of the delivery conveyor, in which the camera image signal has been electronically gated to remove signal content of objects in the field of view of the camera but not in the immediate vicinity of the end face;

Figure 13 is a screen display of the coarse mask which remains after thresholding the signal corresponding to the area crossed by the 45° lines, from the signal corresponding to the remainder of the end face image;

Figure 14 is the image signal obtained by eroding and then dilating the signal producing the outline of Figure 13, to remove small dark islands separated from the main region which is crossed by the 45° lines, to produce a final mask signal corresponding to the shape of the end face of the product;

Figure 15 is a screen display showing the end face of a side of bacon on the delivery conveyor illuminated by green light;

Figure 16 is a screen display of the signal remaining after the signal which produces the Figure 15 image is gated by the red mask signal of Figure 14, to allow the areas of the darker and lighter regions of the end face to be computed.

The slicing machine in Figure 1 is shown with all the safety covers in place, and comprises a housing 10 within which an inclined product delivery conveyor (not shown) is located, a product exit 12 through which a collection conveyor (not shown) extends, onto which cut product is delivered, and a control panel 14. The covers are denoted by 16, 18, 20 and 22.

With covers 16 and 18 removed as in Figure 2, the lower end of the inclined delivery conveyor 24 can be seen through an opening 26 in a plate 28 on which is mounted a slicing blade 30 which is rotated in use by a motor (not shown) mounted to the rear of the plate 28. The drive shaft is visible at 32 and the blade is located on the shaft in a conventional manner by being sandwiched between discs such as 34, and secured in place by a nut 36.

In front of, and to the left of the blade, is a camera housing 38 with removable cover 40, and in front and to the right is a laser housing 42 with a removable cover 44.

Also to the right of the blade and located nearer to the blade is a lamp assembly 46 for illuminating the lower end of the delivery conveyor 24.

The housings 38 and 42 are supported by frame members 39 and 43 and the lamp assembly 46 is carried by the cover 18.

The two housings 38 and 42 are joined by a rigid arm 48 and the lamp can be seen at 50 in both of Figures 2 and 3.

In front of the lamp is a window assembly 52 which includes one or more filters such as 54 (see Figure 4) so as to remove any red light wavelengths from the light passing through the window 52.

The lamp 50 may be a filament lamp but is more preferably a halogen bulb having an integral reflector which produces a diverging beam of generally white light. A filter can be employed to remove all wavelengths except green or blue light, so that the end face of the product will be illuminated by light whose wavelength is very different from that of the red end of the visible spectrum. The illumination can be seen emanating from the window, as a diverging beam 56.

Within the housing 42 are two red lasers 58, 60 best seen in Figure 5. Each produces a slightly diverging beam of red light which is split into a plurality of parallel spaced apart thin lines of red light using an integral grating or mask.

Two lasers are used so as to produce a sufficient number of parallel lines across the field of view, to encompass the whole of the end face of the product, which as shown comprises a side of bacon. Other product could be lamb or pork which is to be sliced into steaks or chops, beef which is to be sliced into steaks or cheese which is to be sliced. The use of two lasers can result in supernumerary lines and these are masked by one or more plates in the housing 42, so that one pattern of lines from one laser can be positioned next to that

from another laser without he supernumerary lines from one laser corrupting the pattern of lines from the adjacent laser.

Typically the two lasers produce 15° divergent beams and together produce a total of 66 lines, at a spacing of 5mm on the product end face, in which the lines lie at 45° to the front end of the delivery conveyor (which corresponds to the plane of that conveyor at that point along its length, and which will normally extend generally horizontally).

However the number of lines, the spacing, the 45° angle and the number of lasers is a matter of design choice, and the invention is not limited to the illustrated arrangement of 2 lasers.

By projecting the spaced apart parallel lines of light from the side of the product delivery conveyor at an angle towards the end face of the product which is generally perpendicular to the plane of the delivery conveyor, the lines will appear orientated at 45° on the end face. However, as shown in Figure 12, as the lines of laser light leave the end face and begin to traverse the visible upper surface of the product, which is generally parallel to the plane of the delivery conveyor, and therefore at approximately 90° to the end face, they will change direction and trace a corresponding number of generally parallel lines at a rather different angle from that which the lines traverse the end face of the product. In Figure 7 the end face of the product (typically a side of bacon) is denoted by 62 and the laser lines traversing the end face are denoted by 64, those traversing the upper surface of the product are denoted by 66 and those traversing the generally flat upper surface of the delivery conveyor by 68.

The exit end of the conveyor is protected by a plate 70 defining a straight edge 72 which also constitutes the shear plate for the blade 30. The left hand end of the conveyor (as viewed from the lasers) is defined by a plate 74 which defines a second straight edge 76 perpendicular to the edge 70, against which the left hand end of the product is abutted.

A camera 78 is shown in Figure 6, located within 38, which views the illuminated region.

The straight edges 72 and 76 define the bottom and left hand edges of the field of view of interest (as seen by the camera 78), and its field of view is further delineated by an aperture 80 in a wall 82 located in front of the front wall 84 of the camera housing 38. The wall 84 also includes an aperture 86. The camera is adjustable in height, inclination and angle by being mounted about a 3-axis assembly generally designated 88.

The camera 78 is also shown in Figure 7 and the view seen by the camera is shown in the screen display on the monitor 90 which forms part of the control panel 14, shown in Figure 1. The displayed image shows the upright and transverse plates 74, 70 and the end face 64 of the product.

Typically a device such as an upper conveyor or thrust bar (shown in dotted outline at 92 in Figure 7) overlies the upper surface of the product but terminates a short way back from the end face so as to be well clear of the path of the blade 30. Any such device will also present a face on which the laser light can form lines, and at least some of the end of the device can be generally parallel to the product end face 68, so that the red laser lines will traverse 92 at a generally similar angle of inclination as they traverse the end face 68.
There is also a region to the right hand end of the product end face which may contain other parts of the machine which can produce spurious reflections of red laser light, some of which can be at a similar angle to that of those traversing the end face 68.

However it is possible to electronically gate out the signals in the video signal from the camera 78 in a vision computer and signal processing stage 94. The signals sent to monitor 90 are limited to those arising within a generally rectangular area defined by an electronically generated, generally rectangular window, shown dotted at 98 in Figure 7. The left hand and bottom edges of the window are set to correspond to the straight edges 74 and 70. The upper and right hand edges are set manually, or automatically by window defining software or firmware in 94, relative to the left hand and bottom edges 76, 70.

Digital output signals from 94 are sent to a PLC 96 (in Fig. 7) and comprises a thickness signal with grade variable's such as height, width, lean fraction-muscle length. 94 and 96 will be described in more detail in relation to Fig. 10.

It will be appreciated that since plates 74 and 70 are fixed relative to the machine and therefore the camera 78, their x,y co-ordinates in the camera field of view will be constant, and the left hand and bottom edges of the window 98 can therefore be defined with reference to x and y co-ordinates within the photosensitive device (not shown) in the camera 78.

If the latter is read out on a pixel by pixel basis the x,y co-ordinates are definable by reference to the pixel matrix of the photosensitive device in the camera.

If the video signal is produced by line scanning at a constant scan rate, to allow different points on the photosensitive device to be defined by time lapse from the beginning of a scan, the x,y co-ordinates of the left hand and bottom edges 74, 70 (and therefore left hand and bottom edges of the window 98) can be defined in a similar time-related manner.

In a similar manner, the x,y co-ordinates of the top and right hand edges of the window 98 can be defined with reference to the pixel matrix, or by reference to lapsed time from the beginning of a scan.

The camera includes a lens 100.

In order to prevent spatter and debris produced as the product is cut by the blade 30, from obscuring the camera 78 or any window in front of the lens, a curtain of moving air 102 from a source 104 is created in front of the camera, and in particular in front of a polycarbonate protective window (not shown) located in front of the lens 100.

A heater 106 is also provided to warm the air in the region of the camera, to reduce condensation and prevent the lens or window 100 from misting up when the machine is

operated in a low temperature environment, as may be required if the product is a foodstuff that needs to be kept below a particular temperature such as 4°C or lower.

Where the product is not of uniform height from left to right (as in the case of bacon, lamb, pork or beefsteak) the product compressing device 92 may be adapted to follow the general trend of the product cross section, and in that event may extend across the camera field of view non-parallel to the straight edge defined by 70. In that event the upper edge of the window 98 may be adjusted either manually, or automatically within 94, so as to follow the inclination of 92. Alternatively a further smaller window may be electronically generated, typically within 94, in which the upper edge is inclined relative to the lower edge, so as to correspond to the inclination of 92, and the signals released by the first window are gated by the further smaller window.

The effect of the further smaller window can be seen in Figure 8, in which the generally rectangular primary window is designated by 108 and the further window by the slanting upper edge of the outline 110, in the screen shot of a display on the monitor 90.

Figure 9 shows diagrammatically the inclination of the delivery conveyor housing 10, the position of the lasers 58, 60 and the blade 30, and of adjustable feet 112, 114 by which the machine can be levelled, and/or raised or lowered. This allows it to be aligned with an exit conveyor (not shown) which accepts cut product from a jump conveyor 116 (see Figures 2, 3 and 4) onto which slices of product fall after being severed from the leading end of the product on the delivery conveyor. A jump conveyor is described in US Patent 5125303.

The described system allows full illumination of the end face without the need for complex lighting arrangements. The illumination can be from a white light source, a monochrome source or from two or more sources of differing colour to obtain good contrast between different features of different types of product.

In particular, by using a laser wavelength which is very different from the wavelength light used to generally illuminate the end face, it can be differentiated from the remainder of the

field of view, and video signals relating to the end face are separated readily from video signals relating to the rest of the field of view, to provide signals on which image processing can be performed to assist in identification and quantification of features within the cut face.

The face of the product is protected from sources of light other than those described above in order to produce the clearest possible images. This is conveniently achieved by the covers such as 16,18 and slicer guards (not designated) which enclose the containing the product delivery conveyor and the camera and light sources.

In the slicer control system of Figure 10, images of the product are captured, ideally by the system which will be determining the slice thickness and thereafter doing the grading. A camera may be located in a position which is close to where the slicing is to occur to obtain images which are close enough to the slicing station to start a classification process.

The camera 78 provides images to a signal pre-processor 118 for supply to a vision computer 120 (all of which make up 94 in Fig. 7). This includes a frame grabber 122 and performs separation by colour to produce Red and Green image data in 124 and 126. Signals are grabbed in response to trigger signals from the sensor 128 which in turn is triggered by the rotation of the blade 30.

A gating device 121 is controlled by signals from a control unit 123 which in turn is controlled by data from a memory device 125, which is triggered to release data stored therein by signals from the blade sensor 128 using the camera readout scan as a timebase synchronising signal. The operator control terminal 14 may used to enter the data in the memory device corresponding to the size and position of fixed objects such as machine and delivery conveyor parts in the camera field of view. Alternatively the data may be obtained from an image signal from the camera 78 when set to view only the end of the delivery conveyor when no product is present. In either case the data is such that when read out in synchronism with the blade rotation and the camera readout, it can be employed via 123 to

inhibit image signals relating to the fixed objects from reaching the Red image signal processor 124.

Appropriately positioning 128 ensures that the camera only images the end face 68 when the blade 30 is clear of the face 68, as shown in Figure 2.

The green image signals in 126 are gated by an electronic mask/gating signal obtained from 124 to leave only image signals of the product cut face. These are then analysed further in 130 to measure the area of fat and the area of lean. Mean density values for fat and lean meat together with the fat and lean area measurements may be used to calculate in 130 the thickness to which a slice must be cut to give a particular weight. Module 134 forms part of the PLC 96 of Fig.7, and provides signals to servo amplifiers 136 to control servo motors 132 which control each slice thickness.

The height, width and lean fraction of the end face are determined from the parameters of the end face area image signals in a feature classifier 138. Signals from 138 pass to 134 and also to other logic in 140. This determines whether a desired feature is present in the image of the end face and if so what its key dimensions are using vision processing calliper tools. The values of these key dimensions allow a grading of the next slice, and the grade decision is passed to an array of gates 142 to control the delivery of the next slice to be cut, to an appropriate packing station 144.

The logic 140 compares the grade information from 138 with a series of pre-set thresholds for each parameter. Depending on the pre-set threshold settings, the slice (or a pack which is to contain two or more slices) is tagged as a reject, or a Grade A, B or C etc, and is diverted into the appropriate packing station(s) which process that grade of product.

Reject statistics are compiled in 141.

Data classification has been one of the important elements in the growing field of Artificial Intelligence (AI) and machine learning. In the general case the machine is presented with a

set of inputs that represent some data point, and is asked to suggest an output (classification) based on a set of pre-stored conclusions (information usually referred to as a knowledge base).

Perhaps the most important feature of any classification algorithm in the realm of machine-learning is its ability to build a "knowledge-base," based on a set of training data, or in other words, to learn. A training data set may for example encompass thousands of images (the inputs) which are pre-classified (by a human operator) in an off-line procedure, into different score-groups (the outputs). Using a method known as supervised learning, the algorithm parses all of these input/output pairs and attempts to determine (ie to "learn") the function that appropriately maps the inputs onto their corresponding outputs. Using a formal learning method, it builds some knowledge that is based on the training set which can later be used to classify other data into sets. Usually characteristics (known as vectors) of the inputs are identified as determining the particular score for any input, and these vectors are looked for in the future inputs.

In the realm of supervised learning algorithms, there are many options. Neural Network and State Vector Machine (SVM) systems have been successfully implemented and enjoy widespread use. SVM's appear to have very good generalisation behaviour, which is a learning machines ability to draw conclusions from learning samples and apply them to other pattern instances, which it has never seen before.

An SVM based system is employed in the off-line classifier incorporated into the present system of figure 10. The preferred SVM based system is the MANTO system (particularly MANTO 2) as developed and supplied by Stemmer Imaging of Germany.

At the heart of the MANTO system there are two components: One is a non-linear multi-resolution filter (MRF) for image-preprocessing, which detects relevant features at different scales and transforms image information into a feature vector. The other ingredient is a learning and pattern classification algorithm, based on the technology of

support vector machines (SVMs), as has been developed at various universities and research laboratories.

The MANTO system recognises an image pattern by first applying an MRF to the image and then feeding the resulting feature vector into SVM, which then decides on class membership and quality. The knowledge which enables MANTO to do this is contained in a data-structure called the MANTO-classifier (MCF), which contains the MRF parameters and the knowledge obtained by training from lists of learning samples. MANTO 2 allows the classifier to determine and express how nearly an image represents an instance of particular classification (regression). A probability can be given to this, producing a sliding scale for the feature property of interest. e.g. if a bacon muscle is between 75mm and 100mm long, but nearer 100mm, the MANTO 2 system might assess its length as 92mm.

To this end threshold values for the comparators and logic in 140 are obtained using state vector machine (SVM) techniques. In particular 138 comprises a state vector machine (SVM) based feature classifier. This allows images to be classified according to the presence or absence of feature(s) (vectors) of interest, and further classified according to the properties and dimensions of feature(s) of interest, eg the shape of the end face and/or of the length of a particular individual, region common to the end faces, such as a region of muscle in bacon.

The grade attributable to a slice to be cut, obtained from 138, may be used to direct the slice thickness calculation in 134 such that one grade of product is sliced at a different thickness from other grades. This would generate, as an example, differing fixed weight slices or packs, for different grades of product.

Items 150, 152, 154 and 156 comprise a suite of off-line classifier building and testing tools which assists with the classification, in that a person can perform a classification visually, and identify whether a desired feature is present or not. If the feature is present, a line can be drawn on the screen image showing a dimension of the feature, using a

mouse or tracker ball device. The length of the line is measured and recorded in 150 and 154. The image signals can be scaled to real world dimensions so that the length extracted from the drawn line can be displayed and saved in conventional units of length with an image of the product end face on which the measurement has been made.

Collection of data from specimen product end faces is undertaken prior to operation of the machine, and can be done on initial installation and left, or performed when the machine is to be used to slice a new batch of product, or completely different product.

A check on the decision-making accuracy of 138 can be performed off-line by running a software program to present data of previously classified images in 150 to classifier logic in 154 in order to analyse its performance. Batches of images can be processed to produce statistics on the classifier accuracy.

The system shown in Figure 10 also includes a grading supervisor module 146. This is supplied with data from 144 and a check weigher 148 so as thereby to monitor the numbers of product slices or packs being classified into each grade. The grade acceptance thresholds in 140 are controlled by 146 which in turn can be altered by signals from the control terminal 14 so as to override neural classifier produced criteria, so that a constant throughput can be maintained if desired, whereby a given grade will always be the same percentage of the overall output. In this way minor variations in input product characteristics will not result in increased percentages of slices or packs graded as rejected or a lower grade. Using such a technique, the acceptance thresholds can be adjusted so that for example a similar percentage of product will be placed into each grade category irrespective of the actual input quality, and the properties of each grade will change according to the properties of the input material.

Product end-face image data from the frame grabber 122 is not only supplied to 124 and 126, but is also available for storing as a plurality of classified images in a product analysis tool 150 which collects and classifies product images from 122. Image files of differently classified product end faces are stored in 150, with the related feature classification

information. A classifier structure control tool 154 determines parameters by which image signals relating to end face parameters can be classified by 138 and supplies these to 138. Product grade is determined in 138 and the grade information is sent to the grade threshold and comparator logic 140. The output from 140 comprises product grade command information for controlling sorter gates for cut product, as previously described.

The classifier structure control tool, 154 also provides data for off-line software testing by 156. Pre-classified images, can be used in 156 to optimise the classifier rules in 154 to in turn alter grade determination by 138. The threshold data in 140 can therefore be updated fully automatically without operator intervention or manually by allowing operator input commands from 14 to override data stored in 140 in response to statistics displayed by 14 (typically but not exclusively by the monitor 90) to the operator. These could show that an inappropriate set of thresholds is being employed in 140 following a change of circumstances, or input product, or customer requirements.

Figure 11 shows the occurrence of camera operation and signal processing events in relation to blade position. Where the machine operates to deliver the product to the cutting station at a constant rate, the slice thickness is controllable by altering the time delay between cuts. This may be easily achieved by driving the blade 30 through a variable speed drive, and slowing down or speeding up the blade after a cut has been made, so that more or less of the product has been advanced into the path of the blade before the latter next enters the product.

Where the blade speed is not controllable the thickness adjustment is made by speeding up or slowing down the delivery conveyor, so that more or less product has been advanced through the cutting plane before the next cut is made.

The present invention is applicable to either technique, but the latter is the preferred one.

From Figure 11 it will be seen that the high speed data capture and processing is possible using a CCD camera and a high speed computer. This can enable a decision on slice

thickness to be made in the time interval after the blade 30 leaves the product and before it has rotated to the position at which it will next enter the product.

Figures 12 to 16 illustrate what will be seen by the operator on the monitor display 90 depending on which stage of processing the video signal is derived from for display, and

- Figure 12 shows the red image before processing by 124 to exclude non-45° red lines,

- Figure 13 shows an intermediate stage in 124 after thresholding the video signal of Figure 12,

- Figure 14 shows the output from 124 after eroding the signal of Figure 13 to remove small unconnected detail and dilating the resulting signal to merge the components into a single monochrome shape, corresponding to the shape of the end face of the product, so as to exclude any extraneous features from the image,

- Figure 15 shows the original colour picture image without any processing.

- Figure 16 shows the result of gating the signal of Figure 15 with a window or mask generated from the signal of Figure 14 and thresholding so as to convert to white those parts of the video signal which relate to light coloured regions of the signal of Figure 15, and to convert to black, those parts of the video signal which relate to grey regions in Figure 15. This thereby yields a two phase representation of the end face, in which lean regions of the product are black and fat regions are white. The lean regions can be quantified by appropriate processing of the "black" signal content of the signal producing the Figure 16 display.

If the area of fat is required the signal producing Figure 16 can be inverted so that lean regions are white and fat appears as black, and the black area quantified by appropriate processing of the black signal content of the inverted signal.

The area of the whole of the end face can be obtained by adding the computed area value of lean to the computed area value of value fat.

The proportion of lean to overall area can be calculated by comparing the lean area value with the total computed area value.

The value of lean to fat is calculable by comparing the area value of lean to the area value of fat.

The height and width of the end face in Figure 16 can be measured by conventional image calliper processing in 138. The results can be sent to 140 for grade threshold comparison, as described above.

CLAIMS

1. A vision system for viewing the end face of product mounted in a machine which in use produces measurements relating to the area of the end face and of at least one constituent part of the product which is visible in the said end face, and which comprises means for illuminating a region containing the end face and surrounding parts of the machine and scanning means for producing a video signal from an image of the illuminated region, wherein the region and end face of the product is illuminated by light of two predominantly different wavelengths, characterised in that light of one wavelength is employed to generally uniformly illuminate the region, while light of the other wavelength is employed to produce a pattern of light at least on the product end face.

2. A vision system as claimed in claim 1 wherein the light is obtained from two separate light sources.

3. A vision system as claimed in claim 1 or 2 wherein the light pattern extends over the whole area.

4. A vision system as claimed in claim 1, 2 or 3 wherein the pattern is one of parallel spaced apart lines of light of the said other wavelength.

5. A vision system as claimed in claim 3 or 4 wherein the generally uniform illumination is performed using green or blue light, and the pattern is formed using red light.

6. A vision system as claimed in claim 5 wherein the green or blue source comprises an array of green or blue LEDs, or a filament or halogen lamp with a green or blue filter placed between it and the area to be illuminated

7. A vision system as claimed in any of claims 1 to 6 wherein a laser light source is employed to create the pattern

8. A vision system as claimed in claim 7 wherein the laser source forms a part of a structured light generating head which in use produces a series of parallel straight lines of red light, typically equally spaced apart, on the product.

9. A vision system as claimed in any of claims 1 to 8 wherein the scanning means comprises a video camera which produces the video signal.

10. A vision system as claimed in any of claims 1 to 9 wherein different components of the video signal corresponding to the two different wavelengths of illuminating light are separated by software into a first image signal comprising only signal corresponding to the pattern and into a second image signal comprising signal corresponding to the image produced by the illumination using the said one wavelength light.

11. A vision system as claimed in claim 10 wherein information on the extent of the end face is determined by processing an image signal derived from the first image signal.

12. A vision system as claimed in any of claims 1 to 11 which includes memory means for storing information on the components of the machine which in use extend into the field of view of the scanning means, whereby signals obtained from the stored information can be employed to gate the video signal to exclude video signal corresponding to regions of the field of view which are known not to contain any part of the product end face.

13. A vision system as claimed in any of claims 4 to 12 wherein the angle the parallel lines make relative to the end face, is adjustable, so that the lines cross the end face at a specific given angle, and in general only those parts of the field of view of the scanning means which are crossed by lines of the appropriate wavelength, and which are at that given angle, will correspond to the end face of the product, while parallel lines in the field of view at other angles, indicate a region in the field of view which is not part of the end face of the product.

14. A vision system as claimed in claim 13 wherein the gating excludes video signal of parallel lines crossing flat machine regions parallel to the product end face to leave a residual video signal composed of parallel lines only where they cross the end face.

15. A vision system as claimed in claim 14 wherein signals defining an electronic mask to be used for video gating are generated from the residual video signal, and the mask also defines the size and shape of the product end face.

16. A vision system as claimed in any of claim 13 wherein points in the video signal at which the parallel lines change direction or disappear are determined using image processing techniques, and using a point joining algorithm these points are joined by software to generate an electronic mask to be employed for gating purposes and which equates to the product end face.

17. A vision system as claimed in either claim 15 or 16 further comprising a source of white light whereby in use the whole of the region in the field view is illuminated by white light and the scanning means is enabled to produce a full colour video signal of the region, and the mask is used to gate the full colour video signal to remove parts thereof which do not correspond to the end face, to leave a full colour video signal of the end face alone.

18. A vision system as claimed in claim 17 wherein the gated full colour video signal of the product end face is subjected to image processing software to identify signals corresponding to at least one particular colour.

19. A vision system as claimed in claim 18 wherein differently coloured regions of the product end face are distinguished by the software by reference to colour, and measurements using further software are performed on the signals corresponding to the differently coloured regions.

20. A vision system as claimed in any of claims 17 to 19 when used to scan the end face of a piece of meat containing lean and fat regions or a piece of cheese containing cavities or

discolourations, wherein signals relating to lean or fat or cavity or discolouration are distinguished and separated on the basis of colour.

21. A vision system as claimed in claim 17 wherein the colour signal is converted to a monochrome grey-level image signal, and software or hardware grey level thresholding tools are employed to separate signals according to grey level.

22. A vision system as claimed in claim 21 when used to scan the end face of a piece of meat containing lean regions (which appear dark grey) and fat (which will appear light grey or white) or a piece of cheese in which cavities or discoloured regions will appear a different shade of grey from the rest of the face of the cheese, whereby the grey-level thresholding is employed to determine and separate signals relating to different regions or cavities from signals relating to the remainder of the product end face.

23. A vision system as claimed in any of claims 17 to 22 wherein in use software or hardware calliper tools are employed to measure the height and/or width of the product end face and/or of different visually distinguishable regions in the end face, and area values of the measured regions are computed.

24. A vision system as claimed in any of claims 19 to 24 wherein the following dimensions of the end face of a meat product are obtained from the video signal, namely

Overall area of end face,
Area of lean meat in end face,
Height of end face,
Area of fat within the end face, and
Width of end face.

25. A vision system as claimed in any of claims 21 to 24 wherein a ratio of lean to fat areas is computed from the area values.

26. A vision system as claimed in any of claims 19 to 25 which forms part of a product slicing machine and the measurements and/or dimensional values are sent to a slicer controller, to control the thickness of the next slice to be cut.

27. A vision system as claimed in claim 26 wherein the dimensional values are also sent to slice and pack grade-level decision logic, to control down-line gates.

28. A vision system as claimed in claim 22 or 23 wherein the monochrome grey scale video signal is sent to a feature classifier which in use is adapted to return an electronic flag to indicate whether or not a particular feature can be found in the video signal of the end face.

29. A vision system as claimed in claim 28 wherein a state vector machine (SVM) based feature classifier is employed and if a feature is found to be present, its dimensions are determined.

30. A vision system as claimed in claim 29 wherein the product is a side of bacon and the classifier operates to determine if certain bacon muscle is present or not in the end face, and if so its dimensions are measured.

31. A vision system as claimed in claim 30 which form part of a slicing machine and the dimensional values are sent to a slicer controller to control the thickness of the next slice to be cut.

32. A method of assessing an end face of product which is to be sliced, and routing the slice according to the assessment, and which is viewed by a colour video camera set in front, but to one side, of the product end face, comprising the steps of:-

1) using substantially monochromatic light centred on a first wavelength, illuminating the camera field of view to form a first picture signal.

2) using substantially monochromatic light centred on a second wavelength forming a plurality of spaced apart parallel lines which as seen by the camera will appear to cross the camera field of view at an acute azimuth angle to the scanning direction of the camera.

3) selecting the different wavelengths so that video signal content produced by light of one wavelength is readily separable from video signal content produced by light of the other wavelength on the basis of colour or after conversion to a grey scale monochromatic signal, by reference to grey level.

4) selecting the position of the second wavelength source relative to the product end face so that the parallel lines of light in the camera field of view extend at one angle across the product end face, but at a different angle where they intersect a side or top surface of the product.

5) in a first signal processing step, processing the video signal so as to separate signal content produced by the first wavelength light from that produced by the second wavelength light so as to leave only signal content relating to the line image of the second wavelength light.

6) in a second processing step, identifying any part of the line image video signal content which relates to lines in the field of view which extend at the said one angle, and separating each such part from parts of the signal, which relates lines which extend at other angles, to leave as a residual line image signal, only signal content which corresponds to lines in the field of view, which extend thereacross at the said one angle, and therefore identify the end face of the product.

7) generating an electronic mask from the residual line image signal which corresponds to the shape and size of the end face.

8) creating from the electronic mask a gating signal, and gating the video signal produced using the first wavelength light, so as to exclude therefrom all video signal content not

coincident with the mask signal, to form a residual picture signal, corresponding only to the end face.

9) separating those parts of the residual picture signal which relate to lighter coloured (or lighter grey) regions of the end face, from those parts which relate to darker (or darker grey) regions of the end face, to leave a partial video signal relating only to one or the other type of region.

10) computing the total area of the end face from the residual picture signal or the mask, and the total area of the regions of the end face corresponding to the partial video signal, and

11) computing a grade value for the product from the area value of the end face and the area value from the partial video signal, and comparing the grade value with at least one preset numerical value, and directing a subsequently cut slice of the product to one or another of two or more collection points depending on the grade value computed for the end face of the product from which the slice has been cut.

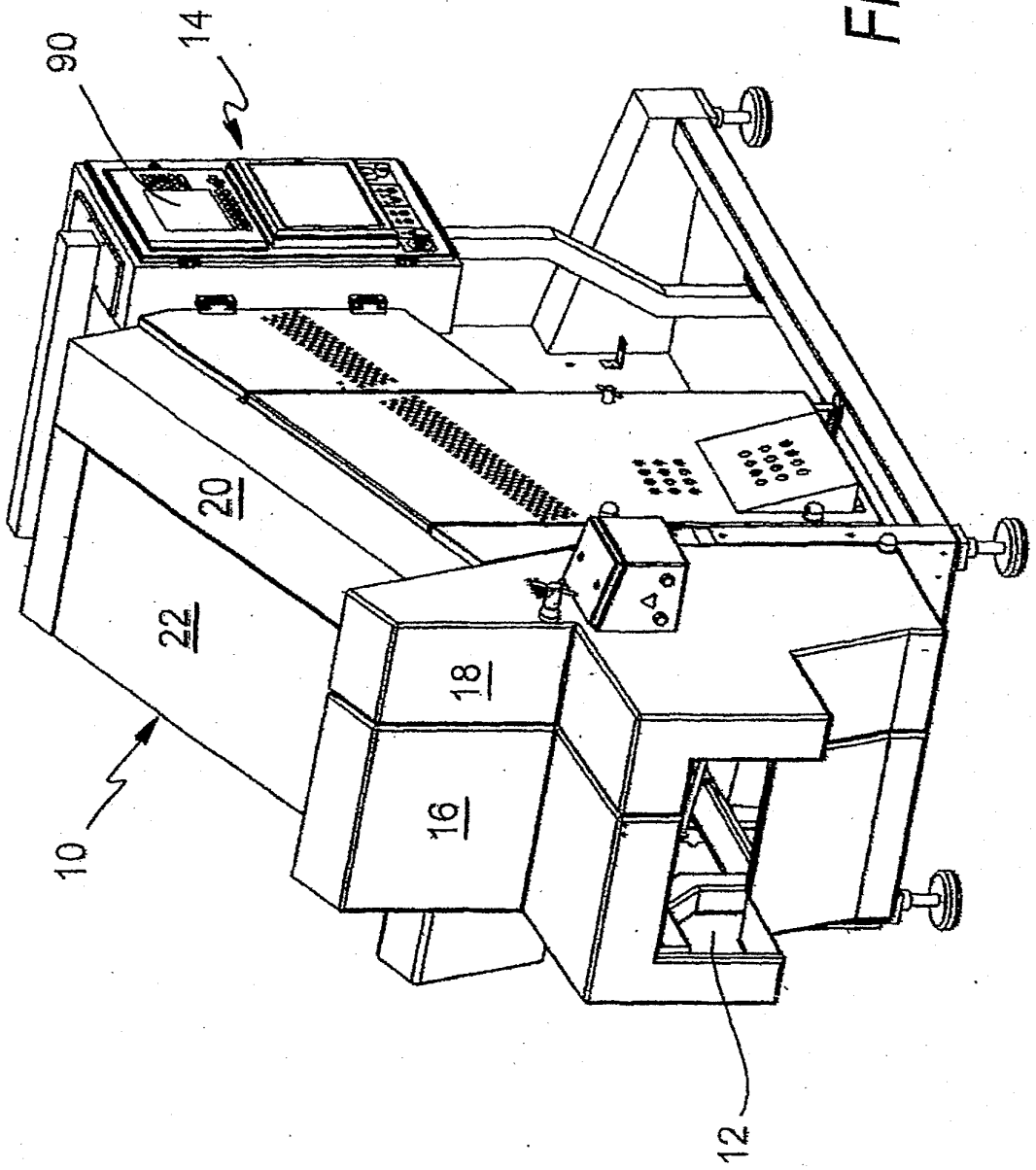
33. A method as claimed in claim 32 wherein the video signal comprises or is converted to a monochrome grey level signal, and step (9) is performed by grey level thresholding.

34. A method as claimed in claim 33 wherein the separation of step (9) is performed on the basis of colour.

35. A slicing machine in combination with a vision system as claimed in claim 1 when adapted to operate in accordance with claim 32, 33 or 34.

36. A vision system and slicing machine constructed, arranged and adapted to operate substantially as described herein and with reference to the accompanying drawings.

Fig. 1



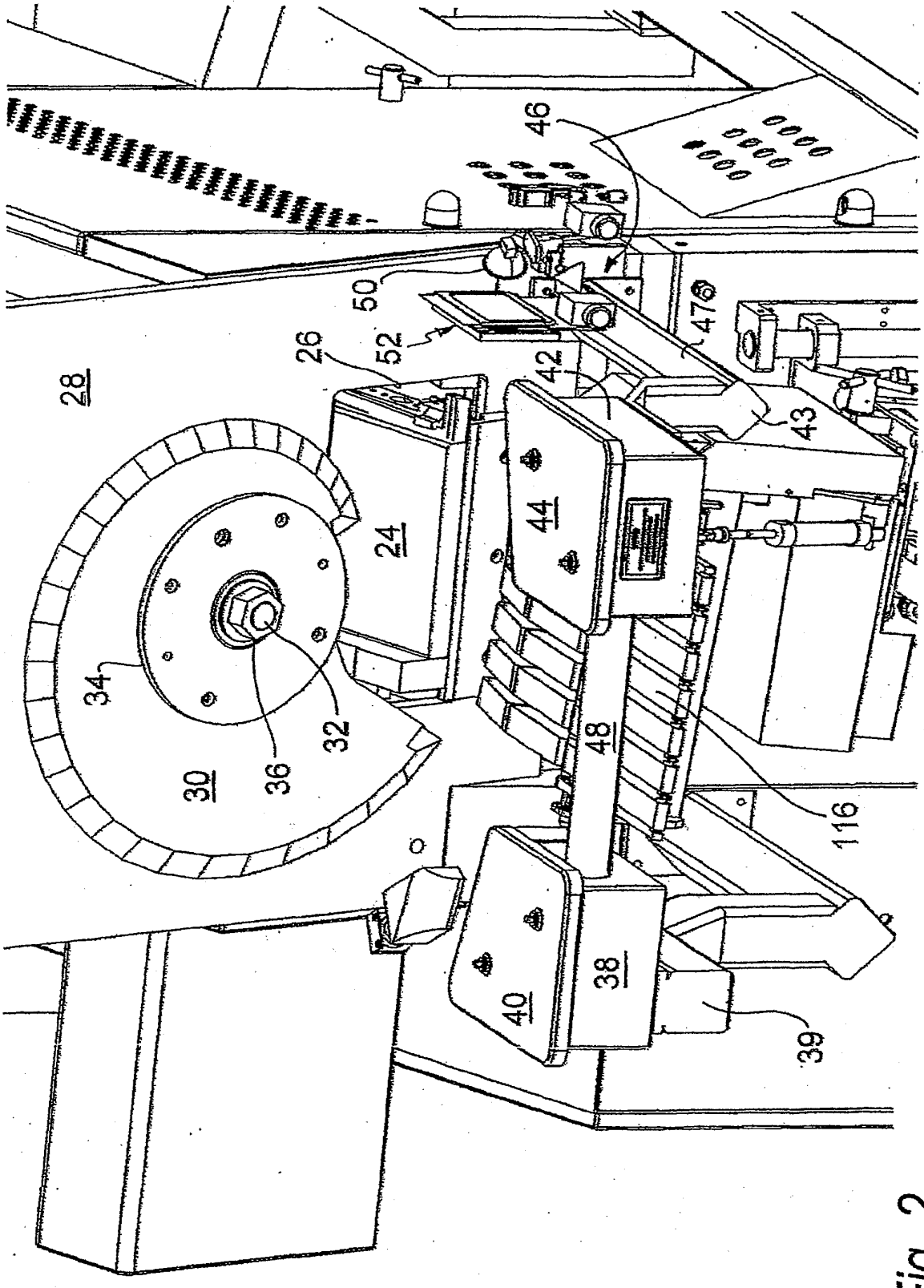


Fig. 2

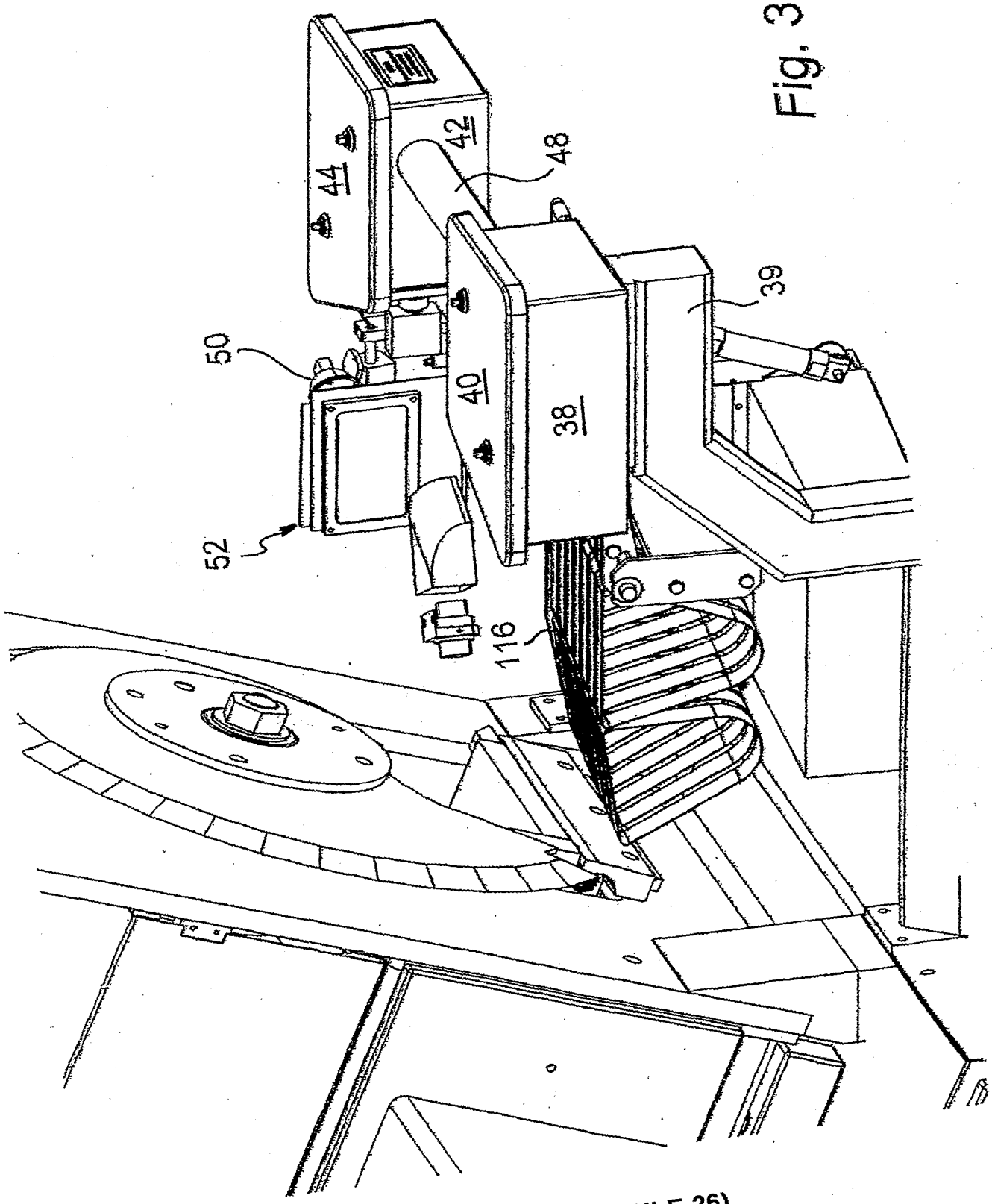
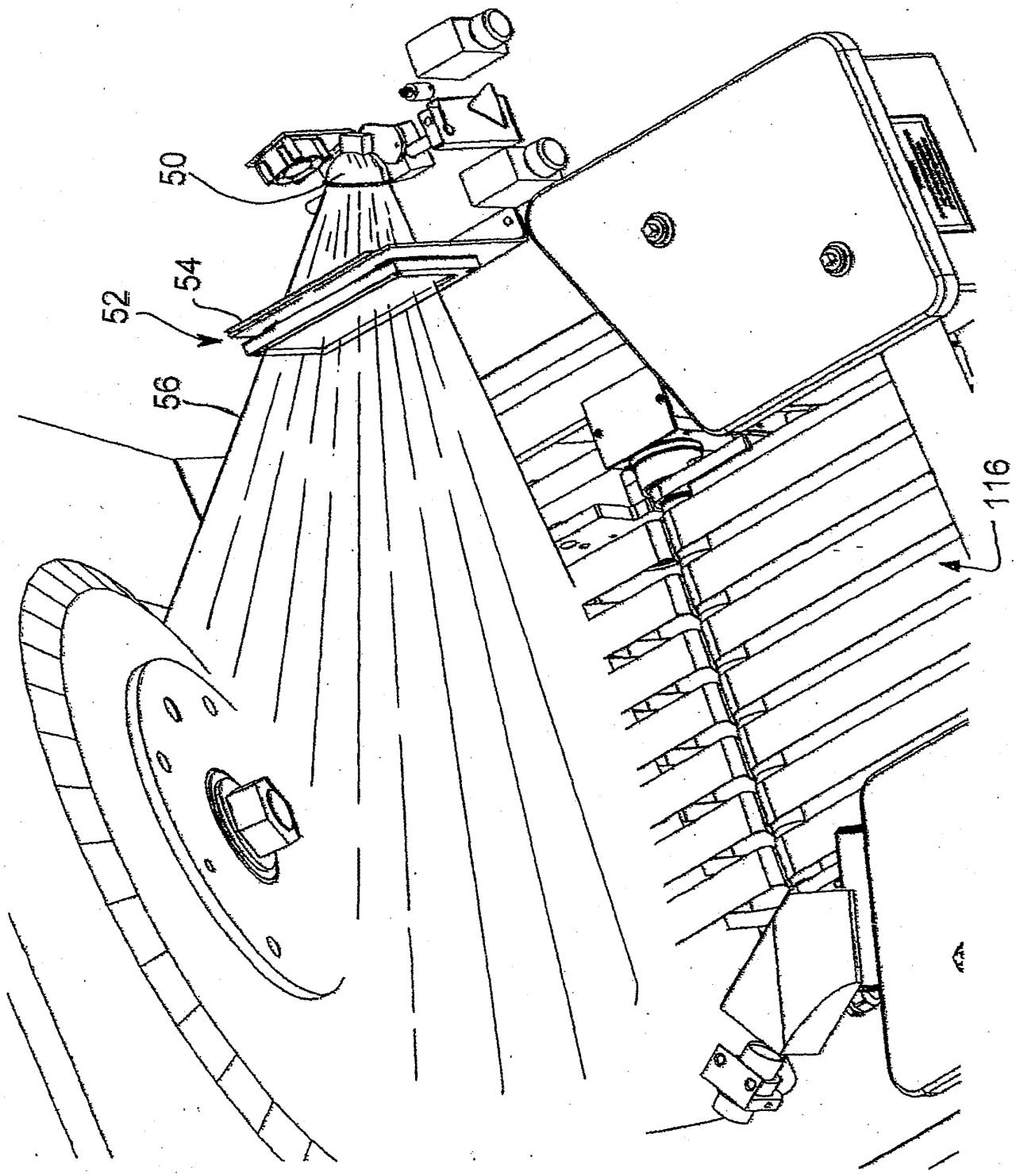


Fig. 3

Fig. 4



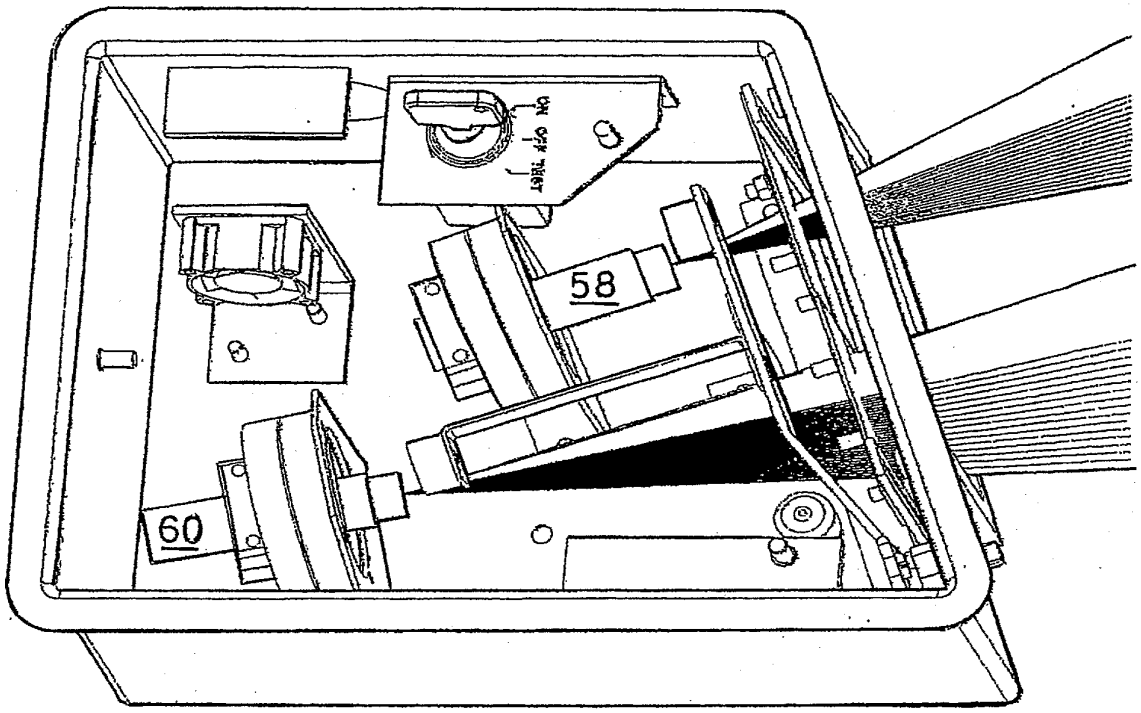


Fig. 5

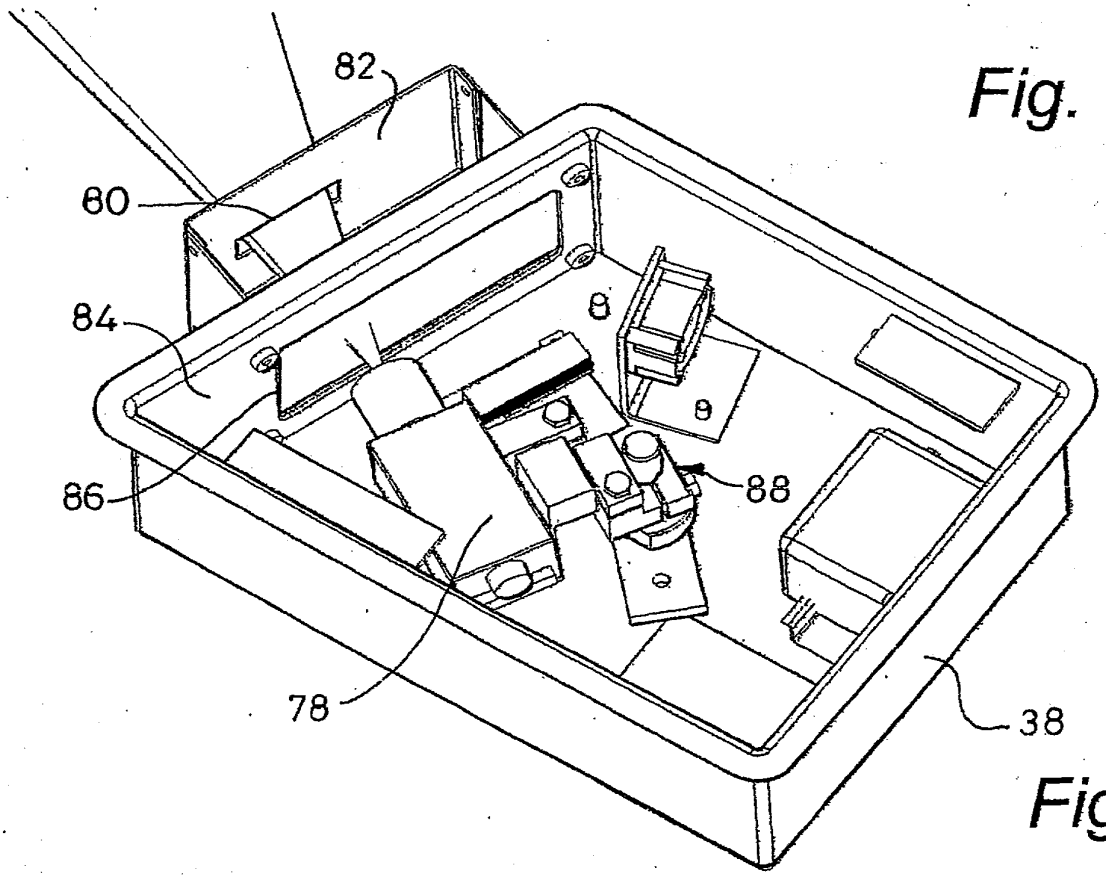


Fig. 6

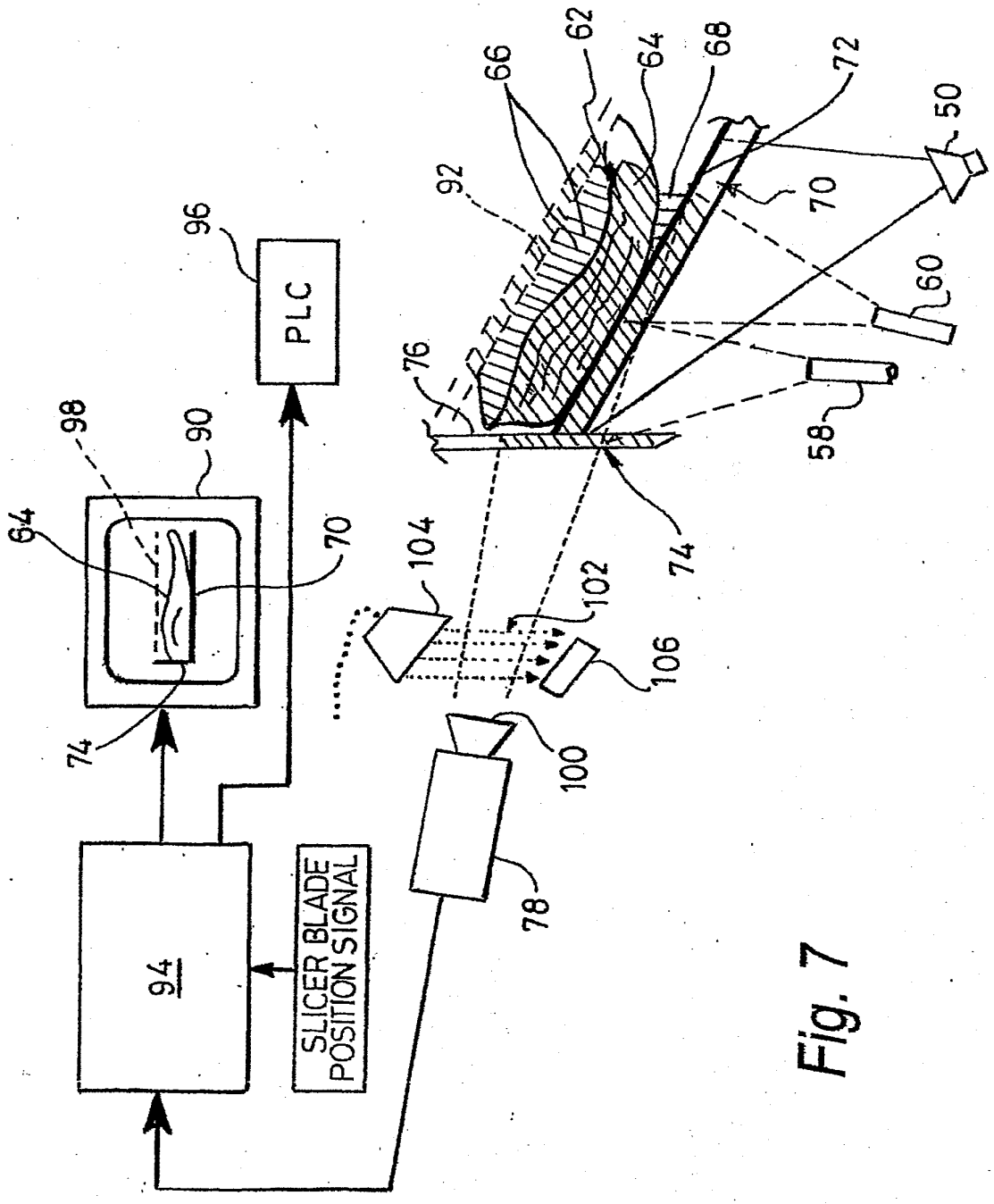

PLC
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SLICER BLADE POSITION SIGNAL
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Fig. 7

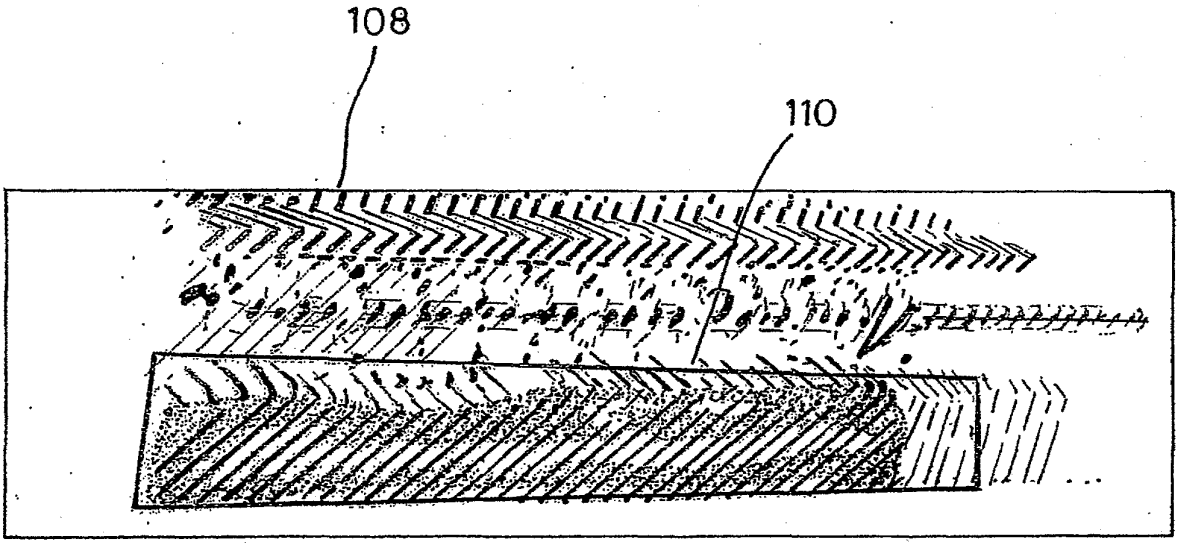
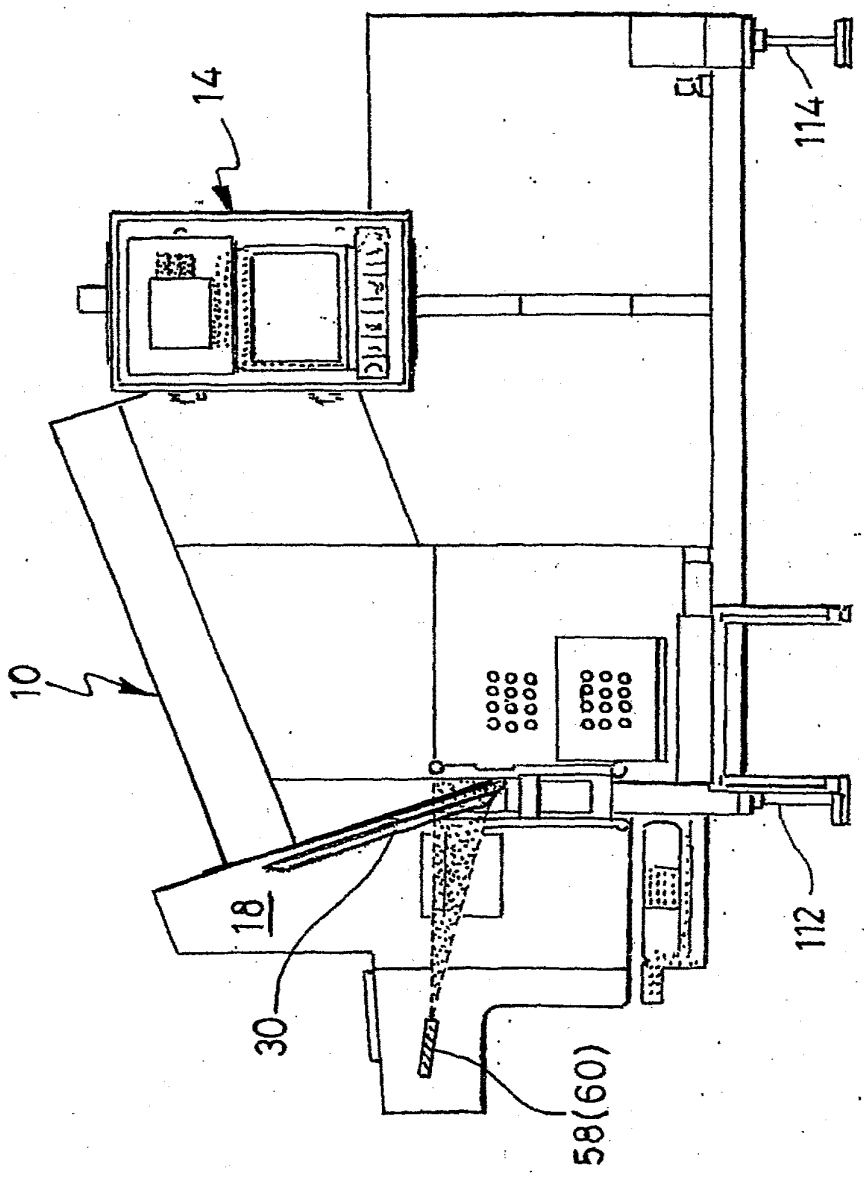


Fig. 8

Fig. 9



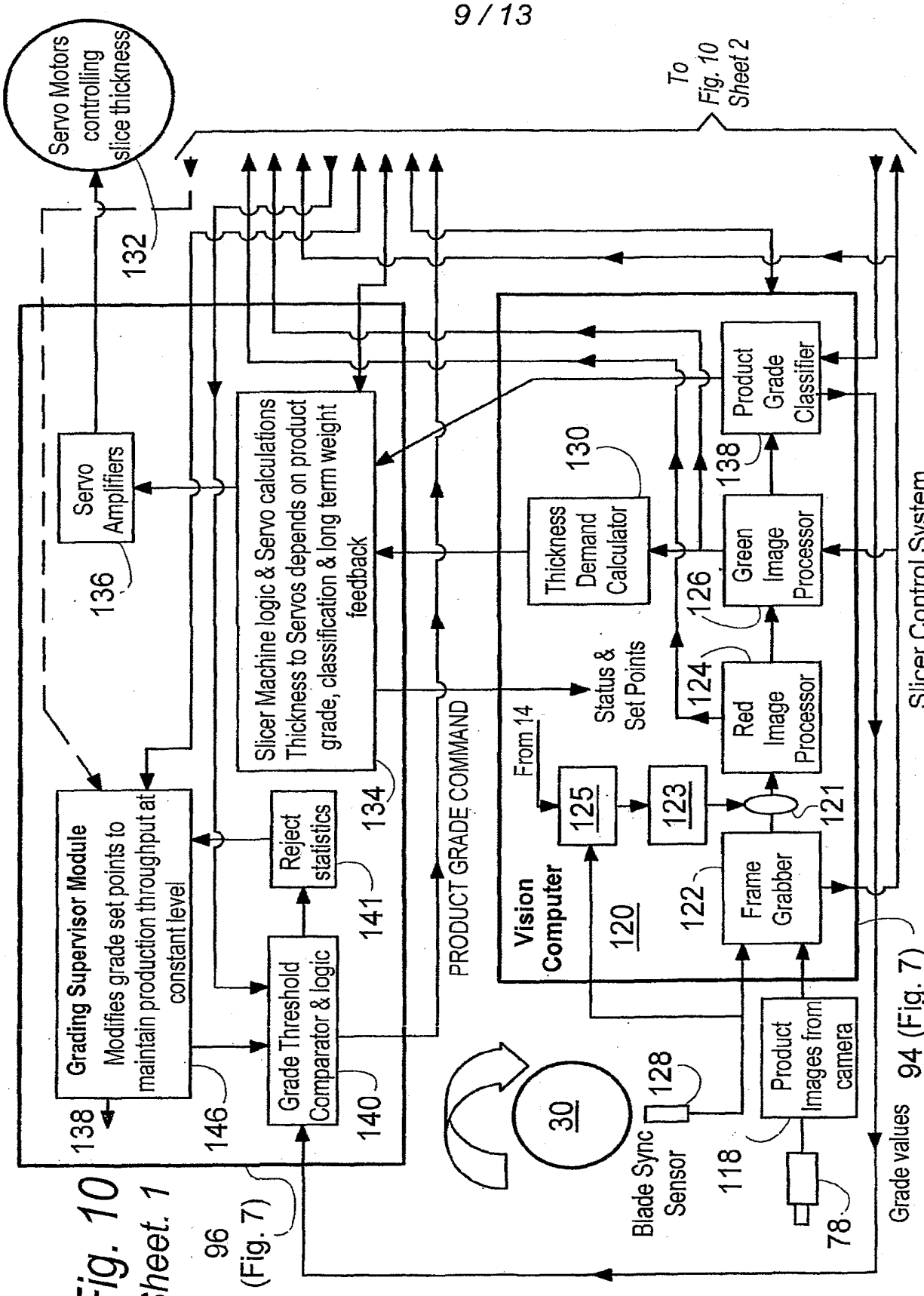


Fig. 10
Sheet. 1

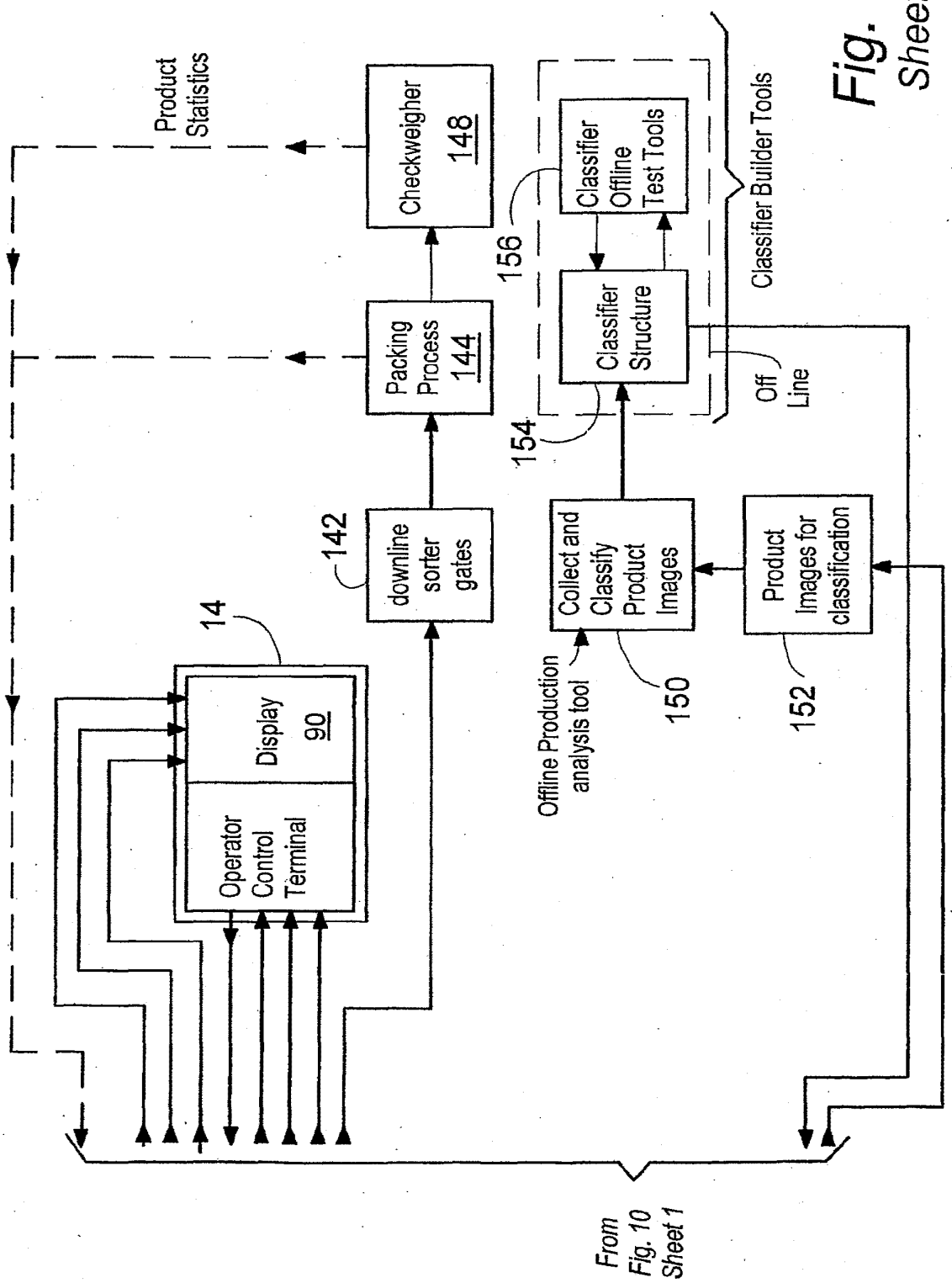
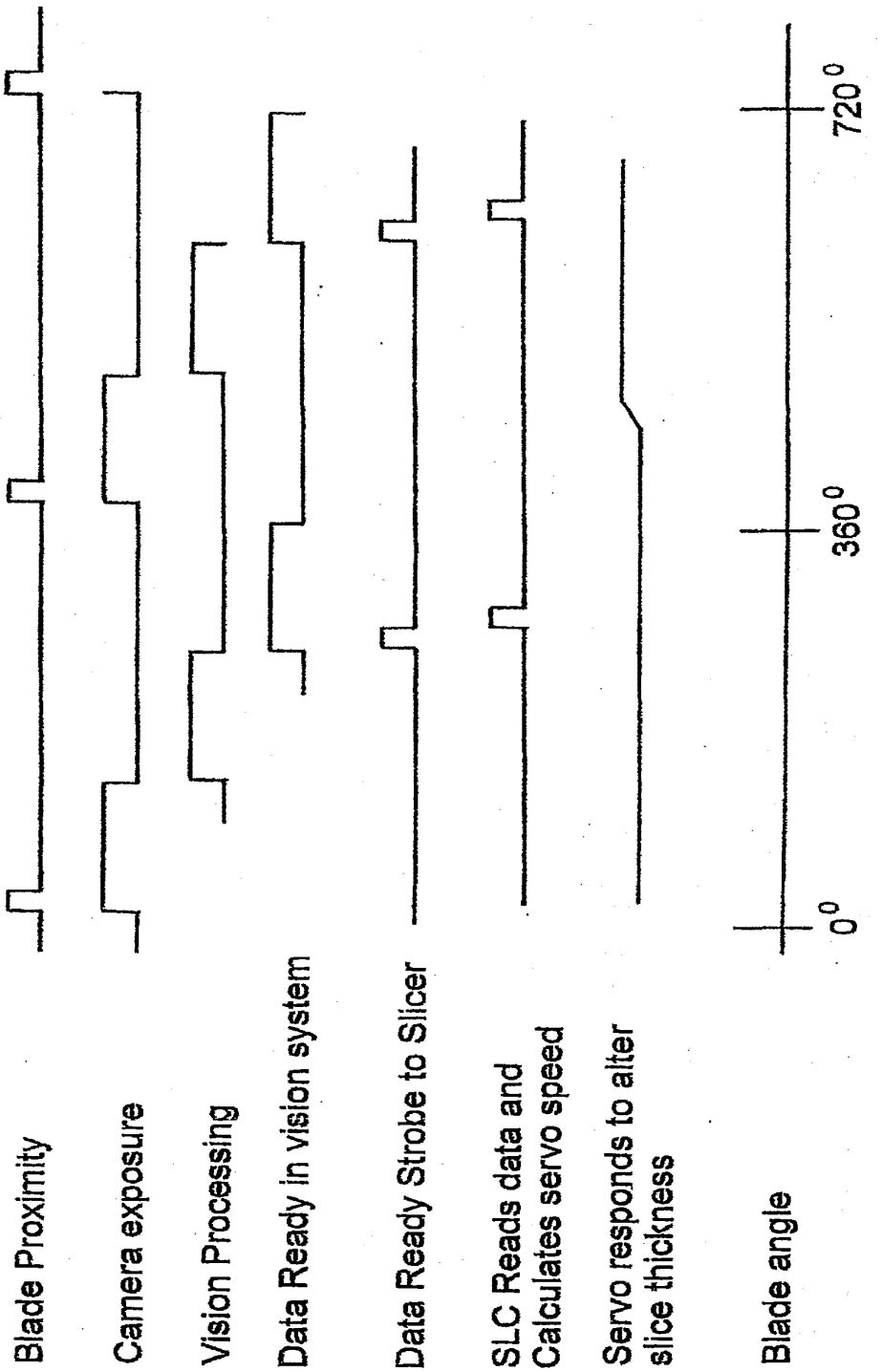


Fig. 10
Sheet 2



Timing Diagram

Fig. 11

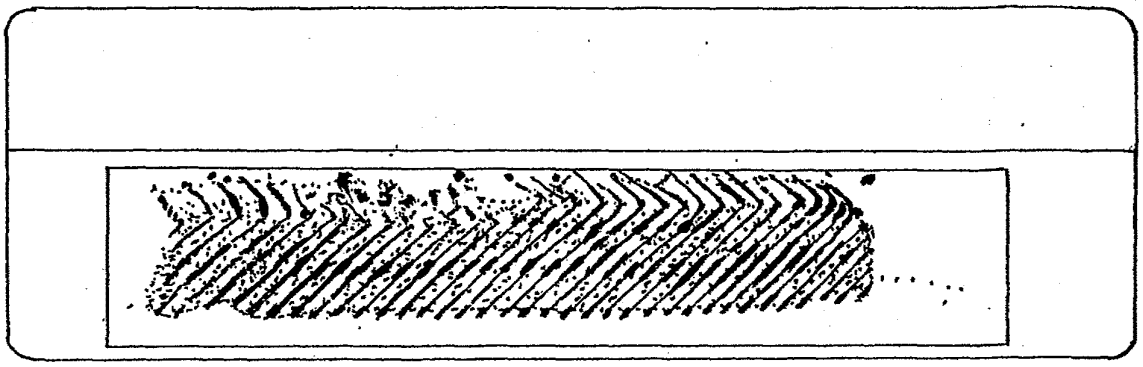


Fig. 12

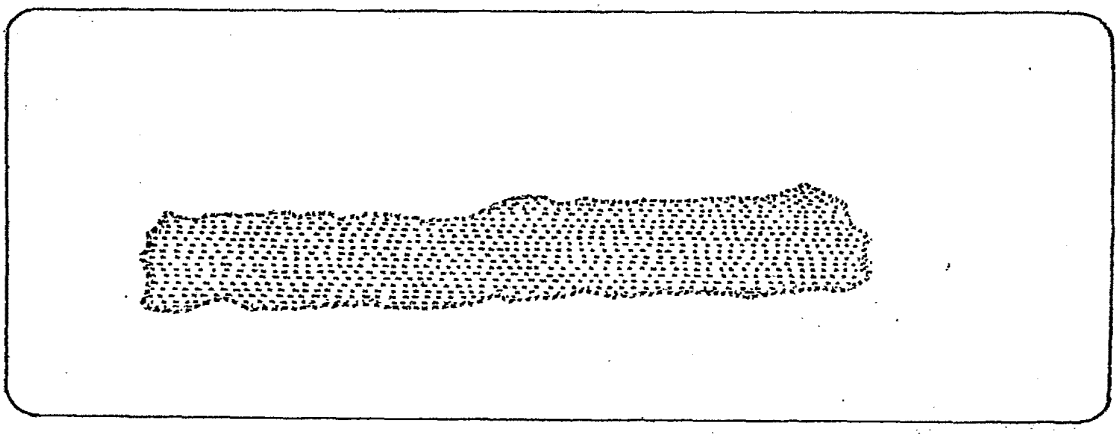


Fig. 13

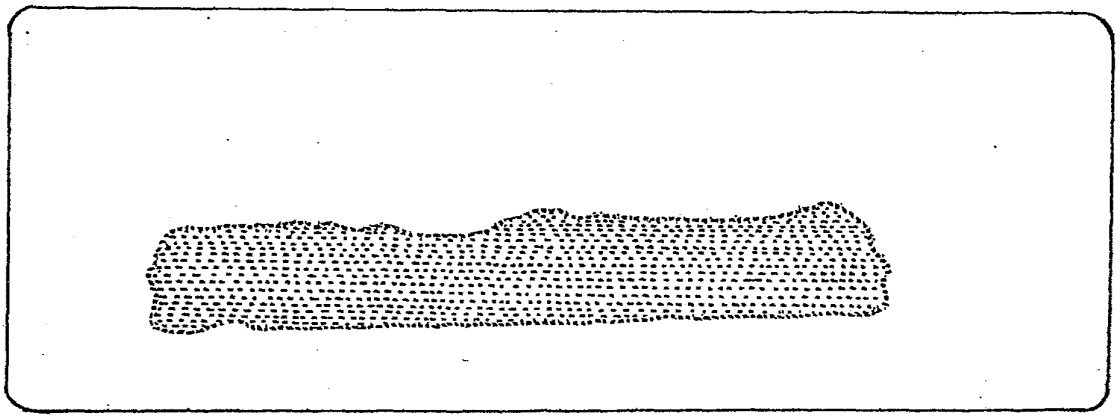


Fig. 14

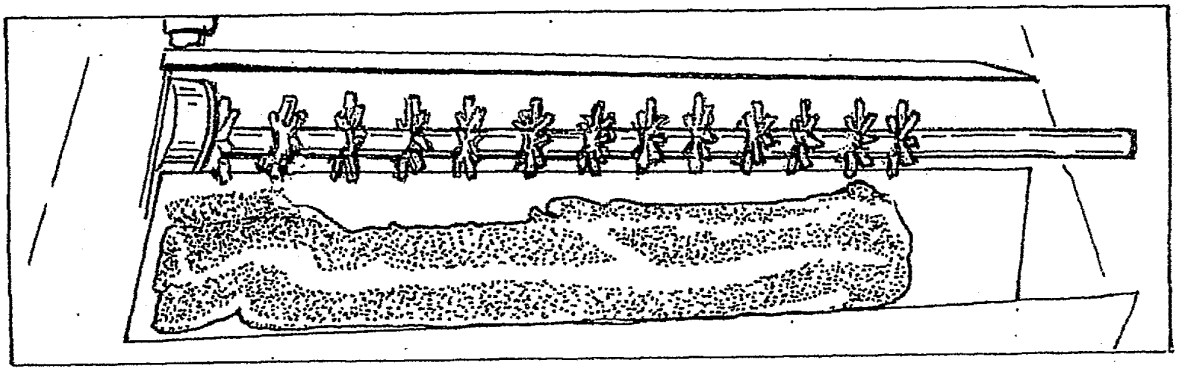


Fig. 15

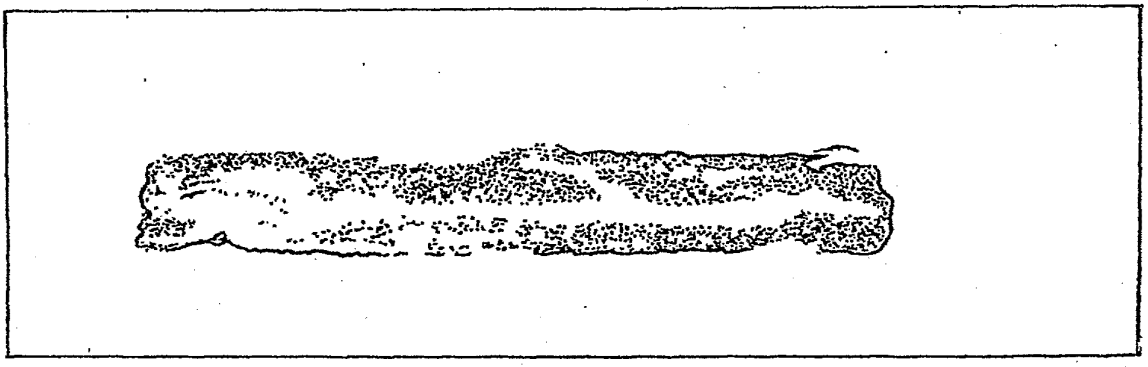


Fig. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002270

A. CLASSIFICATION OF SUBJECT MATTER
INV. B26D5/00
ADD. B26D7/30

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)
B26D A22B G01N

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/120844 A1 (WEBER GUNTHER) 9 June 2005 (2005-06-09) paragraphs [0009], [0012], [0016], [0038]; claims 39,42; figure 1	1-36
Y	DE 101 36 809 A1 (DIPL.-ING. SCHINDLER & WAGNER GMBH & CO. KG) 13 February 2003 (2003-02-13) paragraphs [0051] - [0053], [0060] - [0063], [0067]; claims 1,5,11; figures 1,2,7	1-36
A	US 5 324 228 A (VOGELEY, JR. ET AL) 28 June 1994 (1994-06-28) the whole document	1-36

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"E" earlier document 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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2006	25/09/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Wimmer, Martin

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002270

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 371 738 A (* AEW ENGINEERING COMPANY LIMITED) 7 August 2002 (2002-08-07) page 3 - page 4	1-36
A	US 5 054 345 A (WEBER ET AL) 8 October 1991 (1991-10-08) the whole document	1-36

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2006/002270

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		DE 10131701 A1	16-01-2003
		DK 1401619 T3	19-06-2006
		WO 03004228 A1	16-01-2003
		EP 1401619 A1	31-03-2004
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		EP 0332895 A2	20-09-1989
		FI 891228 A	17-09-1989
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		NO 891128 A	18-09-1989

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(74) Agent: **PATENTGRUPPEN APS**; Arosgaarden, Aaboulevarden 31, DK-8000 Aarhus C (DK).

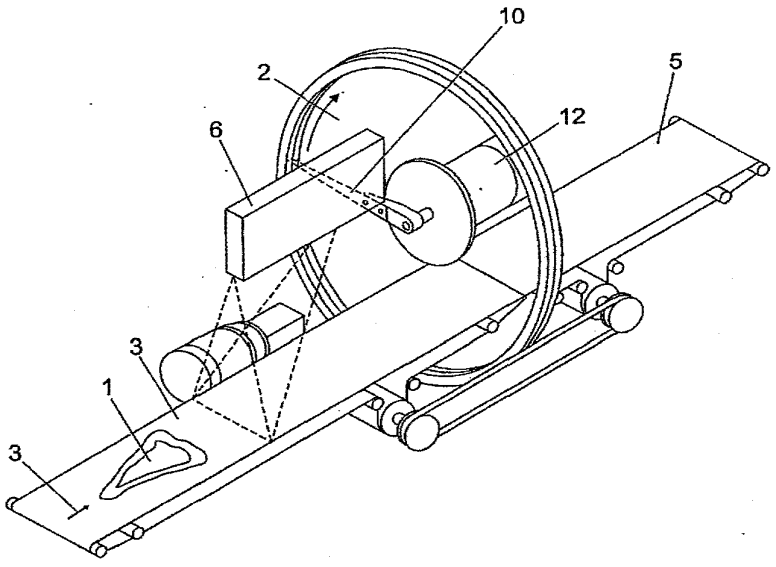
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Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS AND METHOD FOR PORTION CUTTING OF FOOD ARTICLES



(57) Abstract: The present invention relates to an apparatus and a method for portion cutting of items, in particular food articles, comprising scanning means (6) comprising an ultrasonic and/or X-ray sensor for registration of selected item parameters such as contour and inner composition; control means for the determination of a cutting pattern based on said selected item parameters and predetermined portion cutting parameters; at least a trimming unit for trimming the items in a direction substantially along the conveying direction and/or a portion cutting unit for sectioning of the items; and conveyor means for conveying the items to the scanning means and the portion cutting means; wherein said conveyor means and said trimming and/or portion cutting units are controllable by the control means according to said cutting pattern.

WO 2004/106020 A1

APPARATUS AND METHOD FOR PORTION CUTTING OF FOOD ARTICLES

The present invention relates to an apparatus and a method for portion cutting of food articles.

From Danish utility model no. DK 96 00164 U3 such an apparatus for portion cutting of food product items is known. Herein, a machine for portion cutting of food product items is described, which comprises a rotatable cutting unit for sectioning the items, which are guided through the cutting unit by a first and second conveyor respectively. A vision system for detecting the surface geometry of the items is arranged at the first conveyor. The form of the items is registered in a control system controlling the machine for cutting the items into portions of a predetermined length or size.

The items are guided on a conveyor and scanned in a vision system. Based on this registered item form and/or average density, and the conveyor velocity, the cutting rate of the cutting unit is controlled in order to make the portions or slices uniform or in a predetermined individual size, as long as no relative movement between the products and the conveyor occurs between the vision system and the cutting unit. This relative movement may be avoided by applying holding means during use of the cutting unit.

Conventionally, the average density is known by the control system from either (a) manual input or (b) weighings performed in connection with the process and so the above-mentioned term "size" may include the weight of the items.

In connection with certain product types, the items have non-uniform consistence. This may e.g. be caused by meat pieces containing larger or smaller amounts of fat, bone, skin or the like, and also varying inner distribution of fat in the meat part, i.e. varying degree of marbling, over the section of the items. Because of this non-uniform consistence the density varies and so the approximation being made, that the

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items are uniform in density, causes in these cases that the cut pieces are weighing different from their predicted weight.

Furthermore, the cutting process may be subject to a risk of disturbance or even interruption, if the knife of the cutting unit is not able to cut through a section of the item containing bone. In other cases it can happen that the items are pushed during the cutting, in which cases a non-precise cutting may result from this.

In US patent 6,129,625 is described an apparatus and a method of trimming a meat article by using a trimming blade to cut away e.g. a brim of fat based on ultrasonic measurement and predetermined trim parameters. The brim of fat is positioned facing downwards as the trimming blade is positioned opposing a holding device comprising a number of idler wheels aside from the conventional driving rolls, which entails a complex construction in order to keep down the piece of meat during trimming of the fat layer.

In European patent EP 0 324 522 is described a device for trimming a bacon and/or fat layer from meat, in which the device comprises knife sections for adjustable trimming of a varying thickness of fat layer based on ultrasonic measurement of the fat layer and a gripping roll over which the downwards facing fat layer is guided during trimming.

In US patent application 2002/0067797 X-ray analysis is performed on a meat article in order to cut a meat piece containing a lower or higher density element and having a selected special shape to ease the off-loading from a conveyor.

None of the above prior art considers portion cutting into relatively uniformly sized meat pieces of similar appearance.

On this background, it is the object of the present invention to provide an apparatus and a method of portion cutting having increased reliability and dependability.

This object is achieved by an apparatus for portion cutting of items, in particular food articles, comprising

- scanning means comprising an ultrasonic and/or X-ray sensor for registration of selected item parameters such as contour and inner composition;
- control means for the determination of a cutting pattern based on said selected item parameters and predetermined portion cutting parameters;
- at least a portion cutting unit for sectioning of the items and/or a trimming unit for trimming the items in a direction substantially along the conveying direction, said portion cutting and trimming units being controllable by the control means according to said cutting pattern; and
- conveyor means for conveying the items to the scanning means and the portion cutting means, said conveyor means being controllable by the control means according to said cutting pattern.

By using X-ray and/or ultrasonic scanning the apparatus according to the invention will be able to determine the composition of the items and not just the outer form of the items. Hereby, the consistence and the inner texture may be determined with fine accuracy, such that areas of fat and/or bone may be identified and the cutting and/or trimming may be performed based on this determination. The cutting is thus regulated or controlled in accordance to said determination, based on the portion cutting characteristics or parameters, provided by user selection of the final portion cut sizes and product type and said item parameters, provided by the scanning means such as item composition, i.e. marbling, bone and/or fat and/or skin content, and item form, including surface contour. The control means is adjusting the rate of the cutting unit and the conveying speed of the items to the cutting unit in accordance with predetermined portion cutting criteria established as portion cutting parameters, such as e.g. the weight of the portion cut pieces being similar, or being different in a controlled way, or the portion cut pieces being without bone or without a fat brim etc. Hereby, the items can be divided into pieces in such a way as to each of the portion cut pieces being sold to a better price as compared to the quality of meat

product type, the portion cut pieces have been cut from. Further, the waste percentage provided by an apparatus according to the invention may be substantially reduced, as the resulting portion cut pieces has been divided into uniform or predetermined portions with a high degree of accuracy.

By the invention it has been realized, that a scanning performed with an X-ray and/or ultrasonic scanning device may be utilised for the determination of the surface geometry and marbling of the items in question.

A meat article may thus be trimmed based on the available determined cutting pattern; avoiding a need for further scanning means or control means for the trimming action. The cutting pattern may thus be calculated to provide for both portion cutting and trimming action. Thus, product types such as ham, bacon, i.e. comprising a brim of fat or layer of bone may also be trimmed in order to provide portion cut meat pieces, which may be sold to a better price as compared to the quality of meat product type, the portion cut pieces have been cut from. Further, a high degree of accuracy is obtained for the cutting profile for the trimming of the meat product in order to completely remove the fat layer or alternatively to leave a controlled amount of fat from the fat layer in order to improve the taste of the portion cut meat piece, when being prepared by the consumer by roasting or frying. A further advantage of a trimming unit being provided is the possibility of utilising said trimming unit for cutting an item into a lower and an upper trim part, both being further processed, e.g. by packing, or alternatively one or both trim parts being destined for removal. The items may also be cut into portions for subsequent manual or automatic trimming and/or quality sorting. In that case the portion cutting may be arranged so that the items after trimming have the predetermined size, e.g. the same size.

In the preferred embodiment, the trimming unit of the apparatus comprises a cutting device comprising at least one section, each section being individually adjustable in height, i.e. distance to a surface of the conveyor, in accordance with said cutting

pattern. The cutting pattern available for the portion cutting and trimming is thus further utilised for a trimming being adjustable in resulting thickness of the trimmed fat layer, and consequently allows for a very accurate trimming of a fat layer of varying thickness in a direction perpendicular to the conveyor direction. Thus, the resulting waste percentage may be kept even lower, and the resulting portion cut meat pieces may be of a much higher quality, that the initial product type initially gave rise to. In one embodiment said at least one section includes a cutting member, such as a wire, saw, or knife. In one embodiment the cutting member includes a cutting edge, which may be provided with means for providing a reciprocating movement. Thus, the trimming unit may adjustably be utilised for a very precise trimming action.

In one embodiment a holding device is provided at the conveyor for retaining the items during trimming and/or cutting. In the preferred embodiment, the holding device is a vacuum box. Said vacuum box is advantageous for retaining the item during trimming, since the vacuum ensures that the item is stationary relative to the conveyor surface and does not move during trimming, does not deform during retaining and does not form a hinder for an adjustable trimming of a fat layer with varying thickness transversal to the conveyor direction. Accordingly, this embodiment eases the trimming operation and a further more accurate removal of fat or low quality meat. The layer to be trimmed may be oriented in any convenient direction

As an alternative to the vacuum box, a pick-up freeze drum may be used. According to this embodiment, the food item is brought into contact with the freezing drum surface rotating with a speed substantially the same as the conveyor velocity. The item sticks to the drum surface due to the freezing surface temperature. The item is then lifted up from the conveyor as it is rotated by the conveyor and is then trimmed at a subsequent trimming unit located at the periphery of the drum. The trimmed item is then returned to a conveyor for portion cutting. The drum may also be provided

with ultrasonic measurement equipment for scanning the food item when it is held in contact with the drum surface, and the trimming may be adjusted accordingly.

In one embodiment, weighing means are arranged upstream the scanning means for weighing the items before scanning. Preferably, these weighing means may be a flow weighing device inserted in those conveyors guiding the items into the scanning process. Thus, a further weight parameter may be added to the portion cutting parameters obtained from user input and the scanning of the item parameters in order to obtain a high level of accuracy in trimming and cutting according to the determined cutting pattern.

By the scanning sections of the items are determined as they are guided through the scanning plane. In the control unit the three-dimensional structure of an item is established, and based upon this, the cutting process of each individual item is planned. The scanning means may have a number of X-ray sources and sensors arranged to look at the items from various angles.

Further, the invention provides for a method for portion cutting of items, in particular food articles, with an apparatus according to the invention, said method comprising

- providing portion cutting parameters such as article type or size to a control means;
- conveying the items through scanning means, and the trimming unit for trimming the item, and/or the portion cutting unit for sectioning the item;
- scanning the items with an ultrasonic and/or X-ray sensor for registration in the control means of selected item parameters;
- determining a cutting pattern based on said registered item parameters and portion cutting parameters; and
- controlling the conveyor and the trimming unit and/or the portion cutting unit for a sectioning of the items according to said cutting pattern.

According to the invention, said method avails the possibility to further improve the portion cutting of the items and thus a more economical portion cutting of the items is achieved, as the items are cut into different meat qualities and waste is reduced.

In one preferred embodiment, the method comprises that after the scanning the items are trimmed during conveying according to said cutting pattern. Thus, an improved and more accurate trimming of the items and thus resulting portion cutting may be achieved.

In the following, the invention is described in more detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic perspective view of an apparatus according to the invention;

Fig. 2 is a schematic perspective view of an apparatus according to a second preferred embodiment of the invention;

Fig. 3 is a schematic view of the control means by an apparatus according to the invention;

Fig. 4 is a side view of a detail of the apparatus of Fig.3;

Fig. 5 is a front view of a first embodiment of the detail of the apparatus of Fig. 3;

Fig. 6 is a front view of a second embodiment of the detail of the apparatus of Fig. 3 in an inactive position; and

Fig. 7 is a front view of the same second embodiment of the detail of the apparatus of Fig. 3 in an active position.

As seen from Fig. 1, the apparatus for portion cutting according to a preferred embodiment of the invention comprises three conveyors 3, 4, 5, arranged in line in a frame (not shown). Between the two conveyors 3, 4 is arranged a scanning unit 6, capable of scanning the items 1 and detect the form of the items in the entire scanning plane, i.e. 360° around the axis of the conveyor direction. Between the second and third conveyor 4, 5 is arranged a portion cutting unit 2, comprising a rotatable knife 10, driven by a motor 12 in the plane substantially perpendicular to

the conveying direction, and in the embodiment shown in Fig. 3 also a trimming unit 8, as described below.

At the end of the second conveyor 4, immediately at the trimming unit 8 and/or at the portion cutting unit 2, a holding device 7 such as a belt conveyor or an arm may be provided in order to hold down the items 1 during trimming and/or cutting to prevent these from moving during cutting and/or trimming. Further, at this position, upstream the cutting unit 2 as shown in fig. 3 or alternatively downstream (not shown) the cutting unit 2, the trimming unit 8 may be provided, preferably in connection with a holding device 9 such as a vacuum box. Said trimming unit 8 advantageously trims the items 1 in a direction parallel to the conveying direction, and will be described further below.

Alternatively a 180° scanning device may be used as shown in Fig. 2. Thus, the items may be guided through the scanning and to the cutting and optional trimming on the same conveyor.

The conveyors may be a combination of any conventional conveyor type, including a V-belt type conveyor as described in the patent application WO 04/034794 assigned to applicant.

During scanning the form and composition of the items 1 is recorded by performing a scan using ultrasound (not shown) and/or X-rays (see fig. 1), optionally combined with a surface geometry scan (see fig. 2), e.g. performed by a vision system or a colour scanning system. This scanning of the items combined with a registration of the conveyor movement forms the basis for a form and structural analysis of the items, said analysis being performed in a control system 21. By the control system, the conveyor movement, cutting of the cutting unit, and trimming of the optional trimming unit is being controlled in order for the portion cutting to be performed according to a predetermined design or resulting determined cutting pattern. This design is modified based on the scanning, as the control system is adapted to

establish the optimal cutting pattern of a given item based on the form and structure determination thereof.

As shown in Fig. 3 a weighing device 20 is optionally arranged upstream the first conveyor 3, whereby the weight of the individual items 1 is determined before scanning. The control system 21 is provided with the scanned or otherwise measured item characteristics or parameters, such as density and total weight, but may also be provided with portion cutting characteristics or parameters, such as type of article, portion size, etc, e.g. by user input on an interface 23 or preselected item parameters provided to the control unit in a conventional way. Based upon this information the cutting pattern is calculated by the control system based upon user input from a user interface 23 of the control system.

Preferably, the portion cutting unit 2 comprises a rotatable knife, as shown in Fig. 1, but it has by the invention been realised, that different kinds of partition means by cutting or sawing (belt saw, circular saw, etc.) may be utilised, including a falling knife, ultrasound cutting, water or laser cutting, just as knifes of different types may be utilised depending on the particular cutting job, i.e. the type of article to be portion cut and the intended portion cut. Alternatively, the item does not have to be cut all the way through, but may be marked by a part cut, a surface cutting marker or the like.

Preferably, the trimming unit 8 comprises a lateral trimming device with a cutting member comprising one section as seen in Fig. 5 or a lateral section strip cutting device comprising multiple sections as seen in Fig. 6 and 7.

As seen in Fig. 5, the lateral trimming device may comprise a knife or saw or wire 81 provided in such a way as to cut in a direction substantially parallel to the conveying direction as shown in Fig 5. In Fig. 5 the cutting member 81 is shown with a substantially horizontal orientation. However, by the invention it is realized that the cutting member 81 of the trimming device may also be oriented with a substantially

vertical orientation (not shown). In the embodiment of Fig. 5 the trimming device comprises a cutting member 81 comprising a substantially flat knife blade, optionally provided with saw teeth for trimming an upper part 41, e.g. a fat layer, from a remaining lower part 42, here a meat part. The trimming device may comprise means for providing the cutting edge of the cutting member a reciprocating movement, i.e. it may vibrate in order to improve the trimming action, possibly by very small movements approaching ultrasound. Also, the trimming device may comprise a mounting 82 for the cutting member, said mounting being rotatable in such a way that the cutting member may assume different shapes for cutting as indicated by the arrows A and B. As indicated by arrow R, the trimming device may be moved between active and non-active positions.

A holding device 9 may be provided during the trimming action, preferably a vacuum box implemented to function as a retaining device for the item on the conveyor surface during trimming, where the conveyor surface is of a type to accommodate such a vacuum box. Alternatively, the holding device 9 may comprise a holding belt or arm or the like.

A cutting device 2 may be utilised when cutting article types having a marbled meat and fat structure, e.g. beef cuts with marbling, and the trimming device may be idle, as shown in Fig. 6.

The trimming device 8 comprises at least one section, each section being individually adjustable in height, i.e. distance to a surface of the conveyor, in accordance with said cutting pattern. In Fig. 7 is shown a trimming device comprising three sections for trimming a fat layer or the like, resulting in an upper trim part 41 comprising three strips and a lower trim part 42 in one piece. In Fig. 7, is indicated the fat layer facing upwards in the drawing, but of course a fat layer or trimmed part may face downwards as well, depending on type of meat product and user selected portion cutting parameters.

The trimming device 8 may be active as seen in Fig. 7 e.g. when cutting article types having bone or fat in a definite layer provided along the conveying direction, e.g. ham or bacon type meat articles or combination meat types comprising both meat, fat and bone.

It has been realised with the invention, that the lateral trimming of the item may result in an upper 41 and a lower trim part 42, where either the lower part or the upper part is a trimmed layer for possible removal, or alternatively, none of the trim parts are trimmed layers, but rather two parts for possible further processing, e.g. for selective packaging of the resulting parts after portion cutting.

Further weighing devices and/or further control devices may be provided down-stream the apparatus according to the present invention, said devices comprising signal feedback for automatic adjustment and/or calibration of the machine.

The invention has now been described in relation to a preferred embodiment, but by the invention it has been realised, that other variants and equivalent solutions may be provided without departing from the scope of the invention as described in the accompanying claims.

Patent claims

1. An apparatus for portion cutting of items, in particular food articles, comprising
- scanning means comprising an ultrasonic and/or X-ray sensor for registration of selected item parameters such as contour and inner composition;
- control means for the determination of a cutting pattern based on said selected item parameters and predetermined cutting parameters;
- at least a trimming unit for trimming the items in a direction substantially along the conveying direction and/or a cutting unit for sectioning of the items; and
- conveyor means for conveying the items to the scanning means and the cutting means;
wherein said conveyor means and said trimming and/or cutting units are controllable by the control means according to said cutting pattern.

2. An apparatus according to claim 1, in which the trimming unit comprises a cutting device adjustable in height, i.e. distance to a surface of the conveyor, in accordance with said cutting pattern.

3. An apparatus according to claim 2, in which the cutting device comprises a multiple of sections, each section being individually adjustable.

4. An apparatus according to claim 3, wherein each section includes a cutting member, such as a wire, saw, or knife.

5. An apparatus according to claim 4, wherein the cutting member includes a cutting edge, which may be provided with means for providing a reciprocating movement.

6. An apparatus according to any of the preceding claims, wherein a holding device is provided at the conveyor for retaining the items during trimming and/or cutting.

7. An apparatus according to claim 6, wherein the holding device is a vacuum box.

8. An apparatus according to any of the preceding claims, wherein weighing means are arranged upstream the scanning means for weighing the items before scanning.

9. An apparatus according to any of the preceding claims, wherein the scanning means further comprises a vision system for detecting the surface geometry of the items.

10. A method for portion cutting of items, in particular food articles, with an apparatus according to any of the preceding claims, said method comprising

- providing cutting parameters such as article type or size to a control means;
- conveying the items through scanning means, and the trimming unit for trimming the item, and/or the cutting unit for sectioning the item;
- scanning the items with an ultrasonic and/or X-ray sensor for registration in the control means of selected item parameters;
- determining a cutting pattern based on said registered item parameters and cutting parameters; and
- controlling the conveyor and the trimming unit and/or the cutting unit for a sectioning of the items according to said cutting pattern.

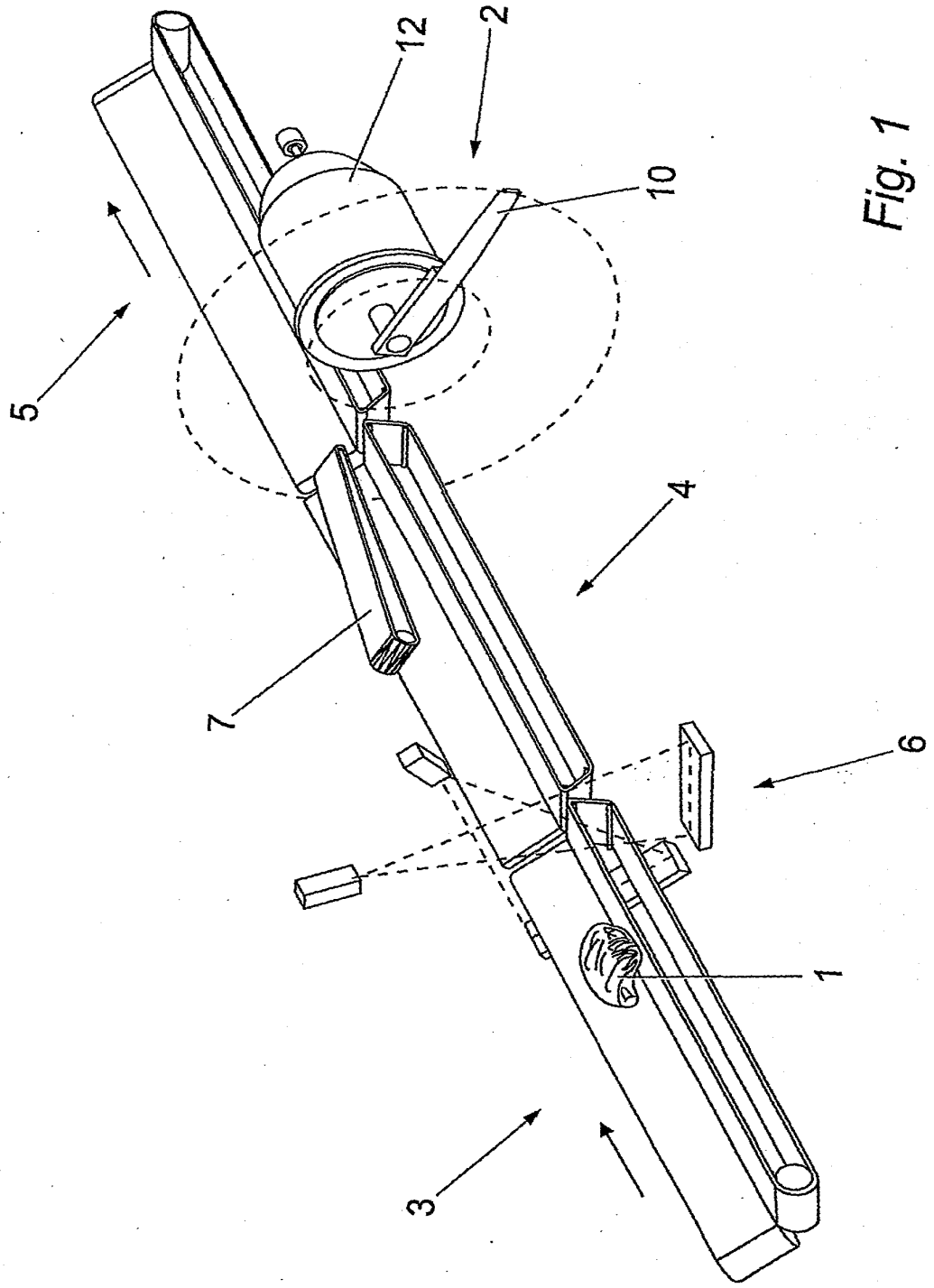


Fig. 1

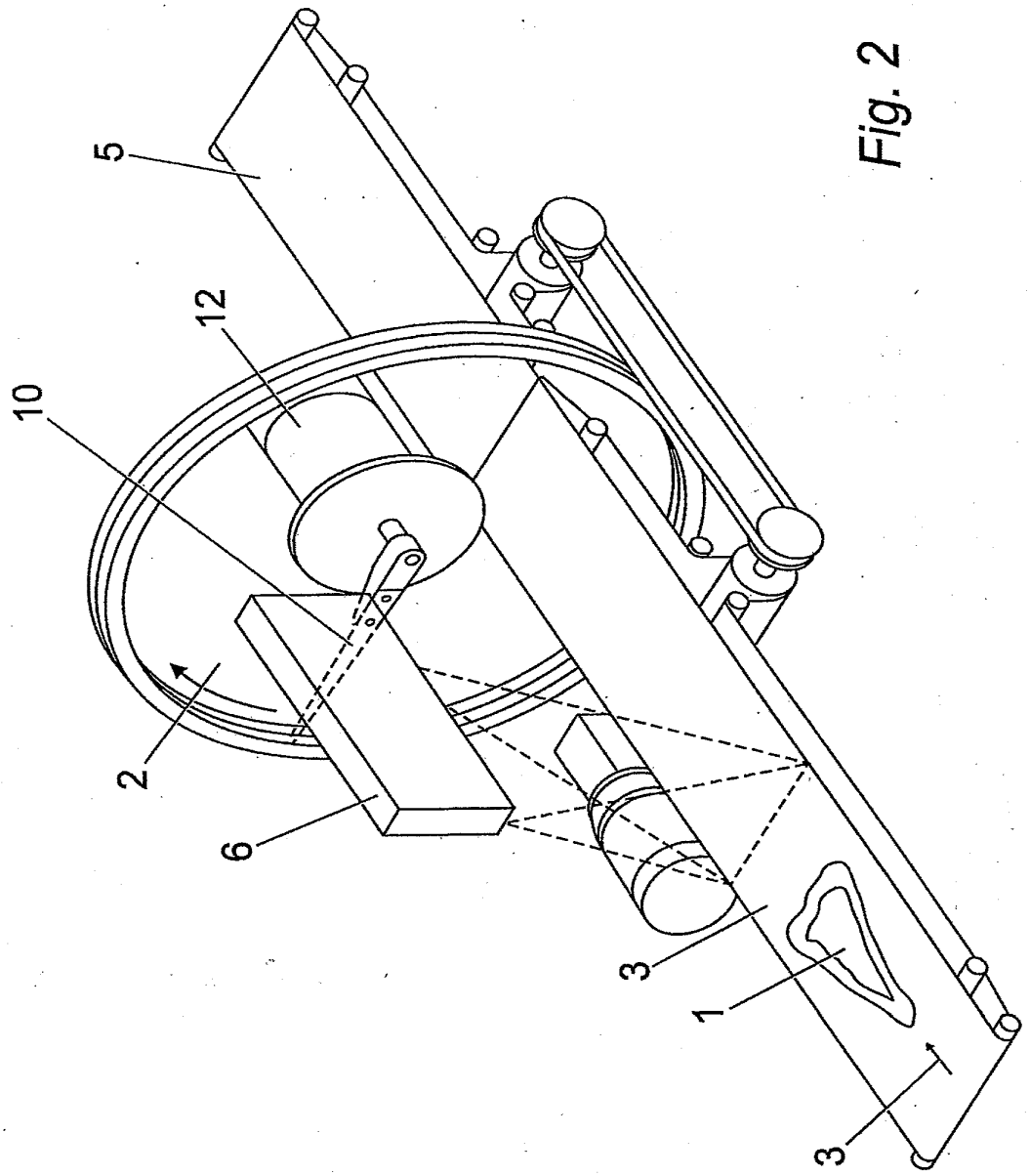


Fig. 2

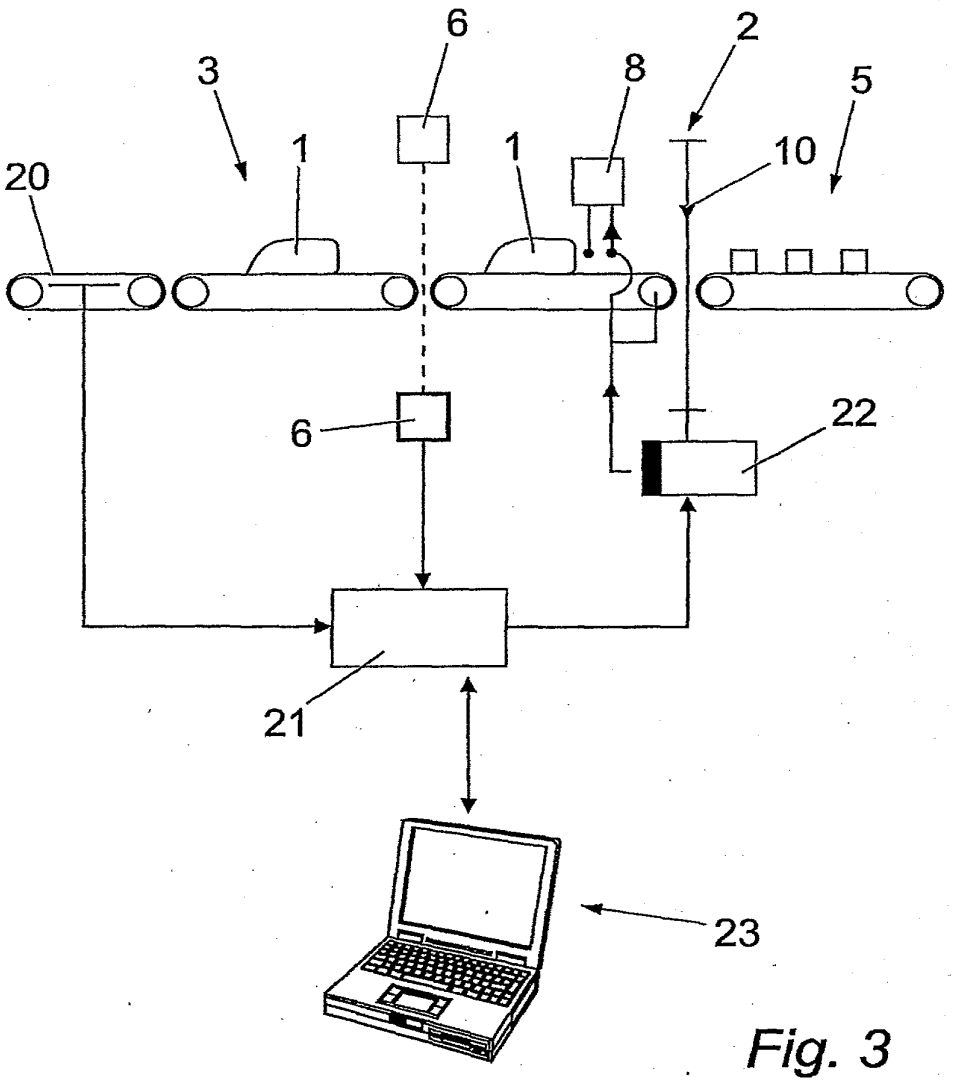


Fig. 3

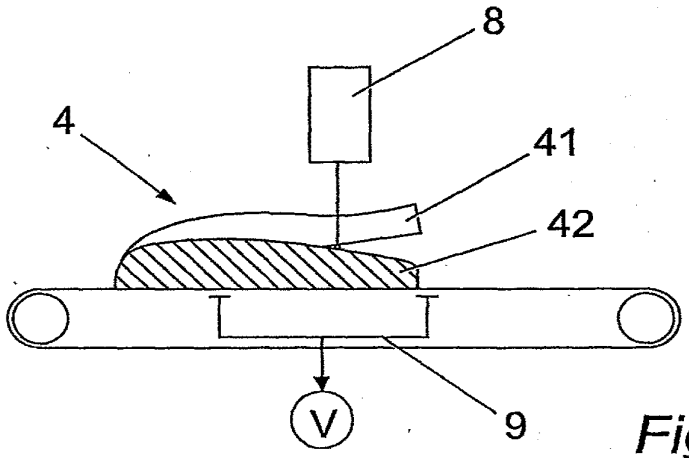


Fig. 4

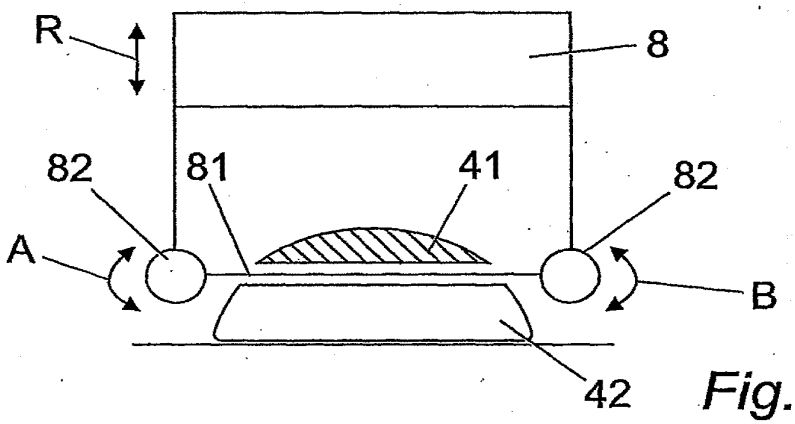


Fig. 5

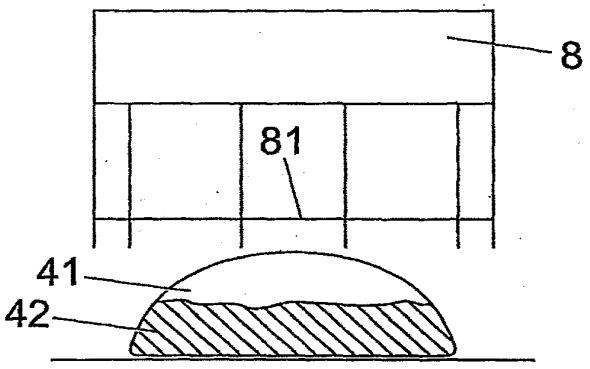


Fig. 6

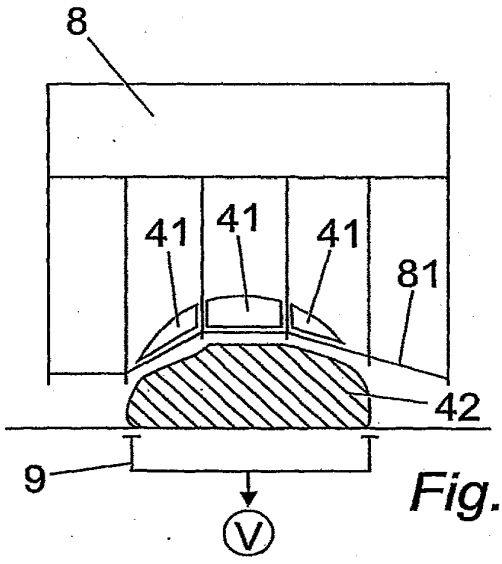


Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK2004/000382

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B26D7/30 B26D5/20

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 7 B26D A22C

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 285 126 A (NEWMAN PAUL BERNARD DAVID) 28 June 1995 (1995-06-28) page 1, line 1 - page 5, line 2; figures 1a,1b	1,10
X	GB 2 364 894 A (KIM KWANG S ET AL) 13 February 2002 (2002-02-13)	1,2,6,7, 9,10
A	the whole document	4,5
A	US 6 277 019 B1 (HOLMS DON D ET AL) 21 August 2001 (2001-08-21) abstract; figures 3c,3d	2
T	US 5 937 080 A (VOGELEY JR ARTHUR W ET AL) 10 August 1999 (1999-08-10) column 5, line 20 - line 29	8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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 document 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
6 August 2004	16/08/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Rabolini, M

INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK2004/000382

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4 246 837 A (CHENERY BRIAN R) 27 January 1981 (1981-01-27) Fat trimmer (early model).	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/DK2004/000382

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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(43) Date of A Publication 13.02.2002

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(51) INT CL[7]
B26D 5/32 7/06 7/26

(52) UK CL (Edition T)
A4C CDA CPA CR CUG C110 C112 C117 C119 C131
C132 C133 C134 C139

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GB 2218615 A
US 5324228 A
US 4662029 A

(58) Field of Search
UK CL (Edition S) A4C CR
INT CL[7] B26D
Online: EPODOC; WPI; PAJ

(54) Abstract Title
Computer controlled, adjustable cutters for food

(57) The image scanned 206 by optical or x-ray techniques is fed into a computer 210 that controls cutters. The cutting path is determined by comparing the scanned three dimensional map with stored data. Preferably the product is rescanned after each cut. The food is turned or cut when it is transferred between continuous belt conveyors. In one embodiment the food moves between conveyors under vacuum. Preferably at least one conveyor has perforations. The apparatus includes three angled or adjustable, preferably fluid jet, rotating, oscillating, laser, band or ultrasonic cutters (220 figure 4). The apparatus is used for cutting fish or meat. Both the apparatus and method are claimed.

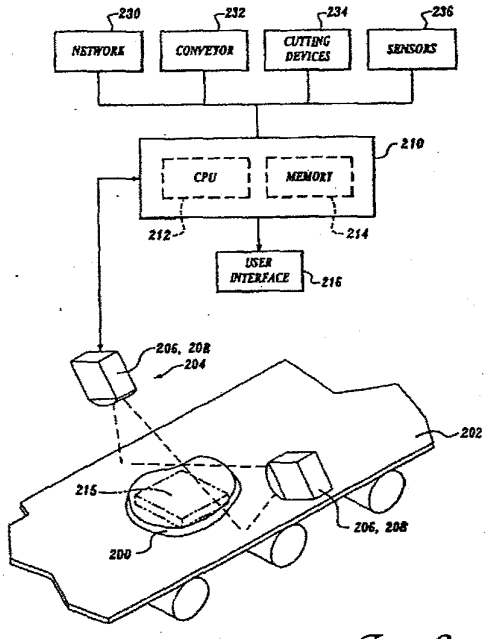


Fig. 2

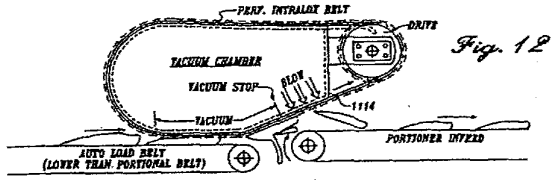


Fig. 12

GB 2 364 894 A

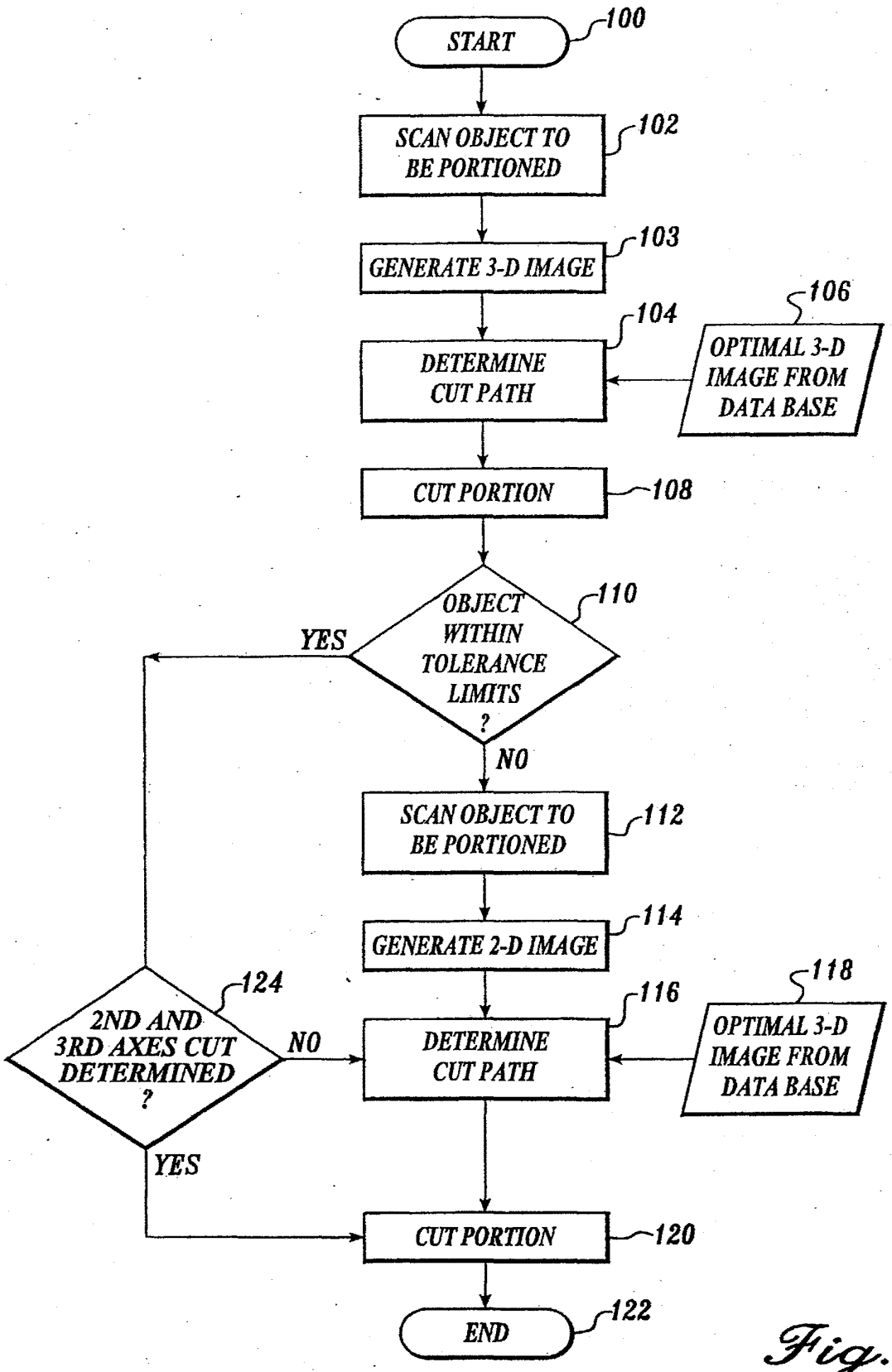

START
100
SCAN OBJECT TO BE PORTIONED
102
GENERATE 3-D IMAGE
103
DETERMINE CUT PATH
104
OPTIMAL 3-D IMAGE FROM DATA BASE
106
CUT PORTION
108
OBJECT WITHIN TOLERANCE LIMITS ?
110
YES
NO
SCAN OBJECT TO BE PORTIONED
112
GENERATE 2-D IMAGE
114
2ND AND 3RD AXES CUT DETERMINED ?
124
NO
DETERMINE CUT PATH
116
OPTIMAL 3-D IMAGE FROM DATA BASE
118
YES
CUT PORTION
120
END
122

Fig. 1

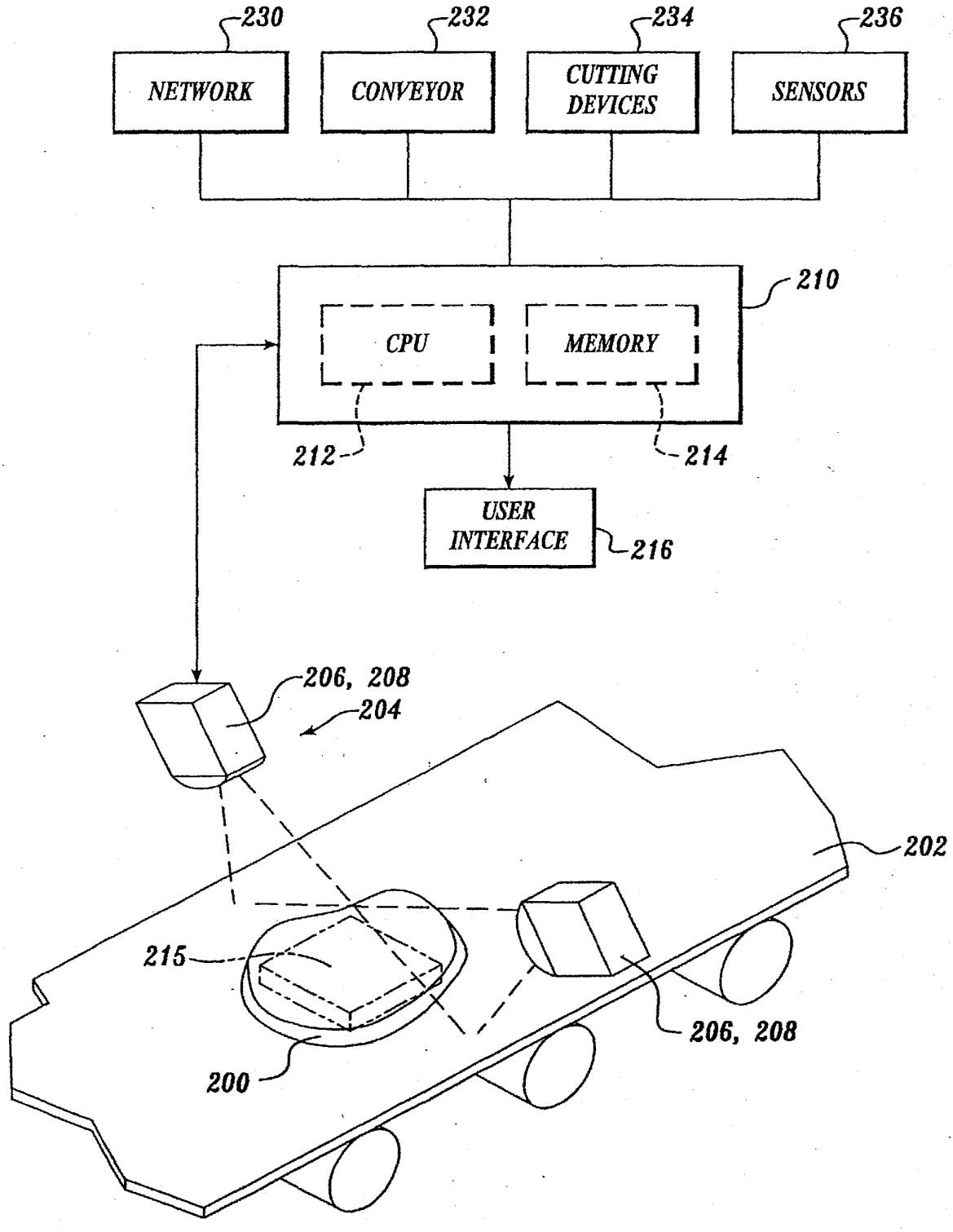

230
NETWORK
232
CONVEYOR
234
CUTTING DEVICES
236
SENSORS
210
CPU
MEMORY
212
214
USER INTERFACE
216
206, 208
204
202
215
206, 208
200

Fig. 2

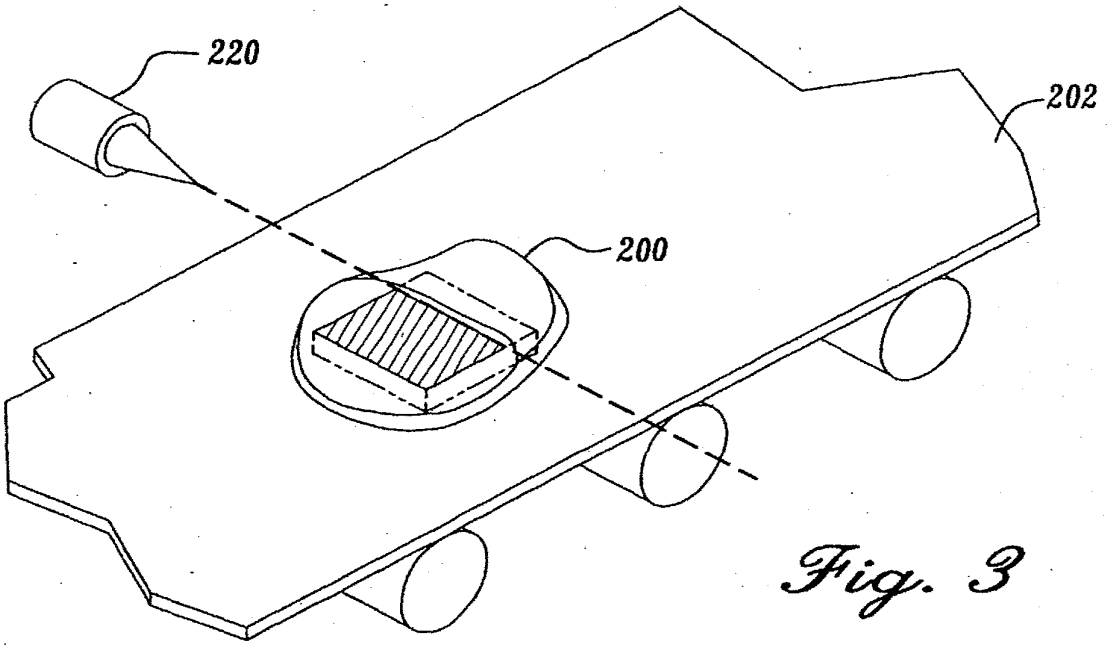


Fig. 3

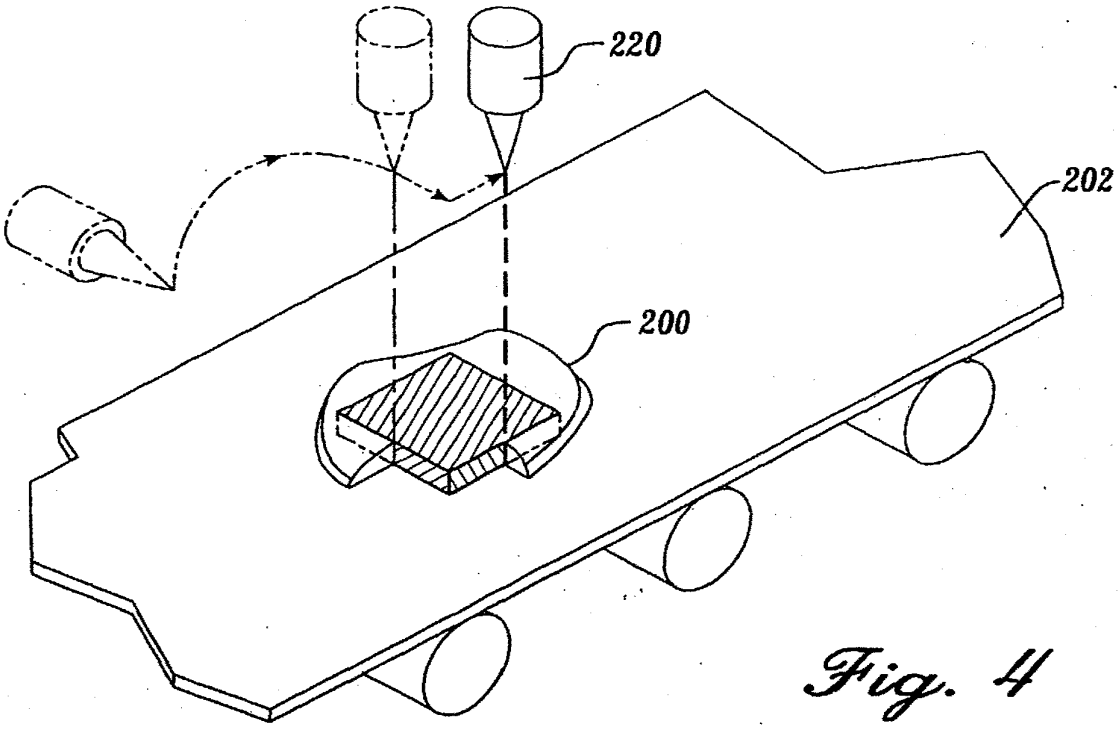


Fig. 4

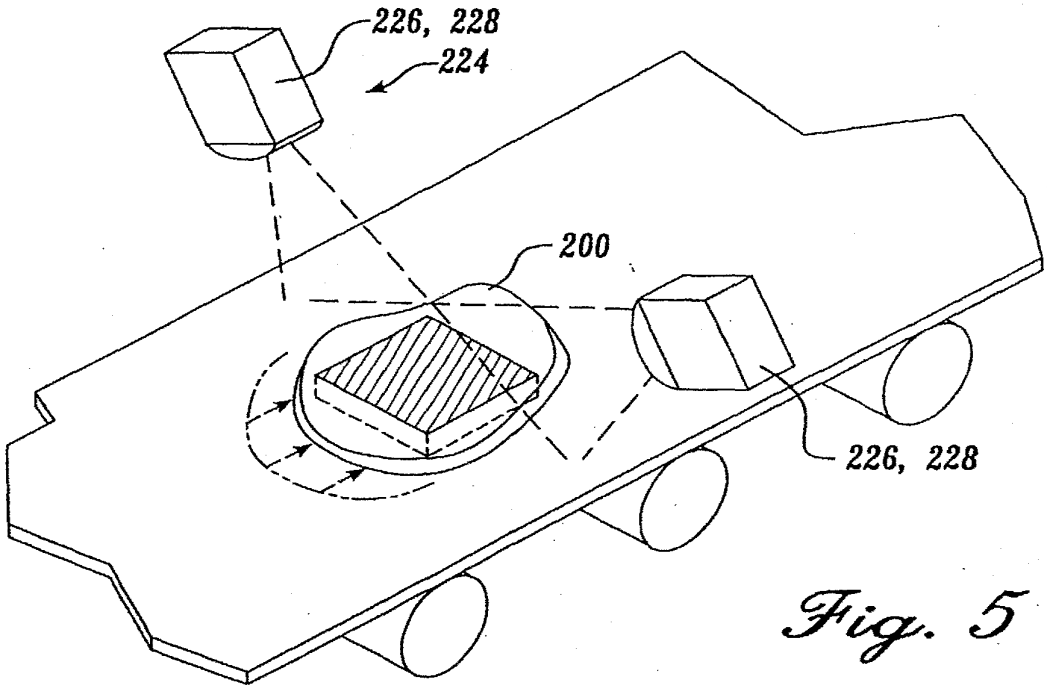


Fig. 5

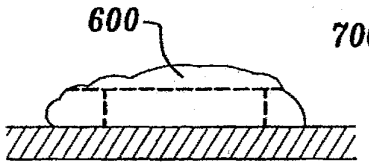


Fig. 6

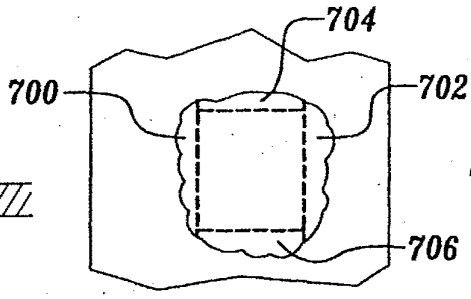


Fig. 7

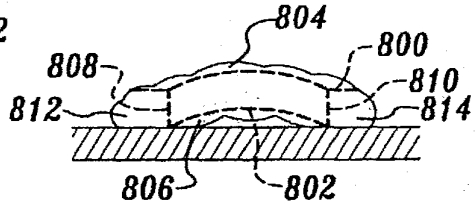


Fig. 8

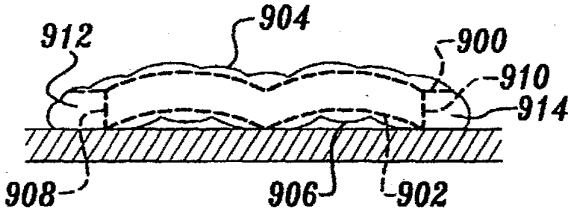


Fig. 9

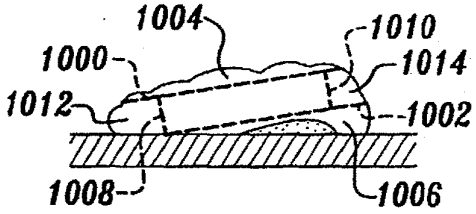


Fig. 10

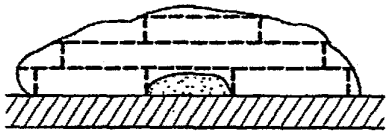
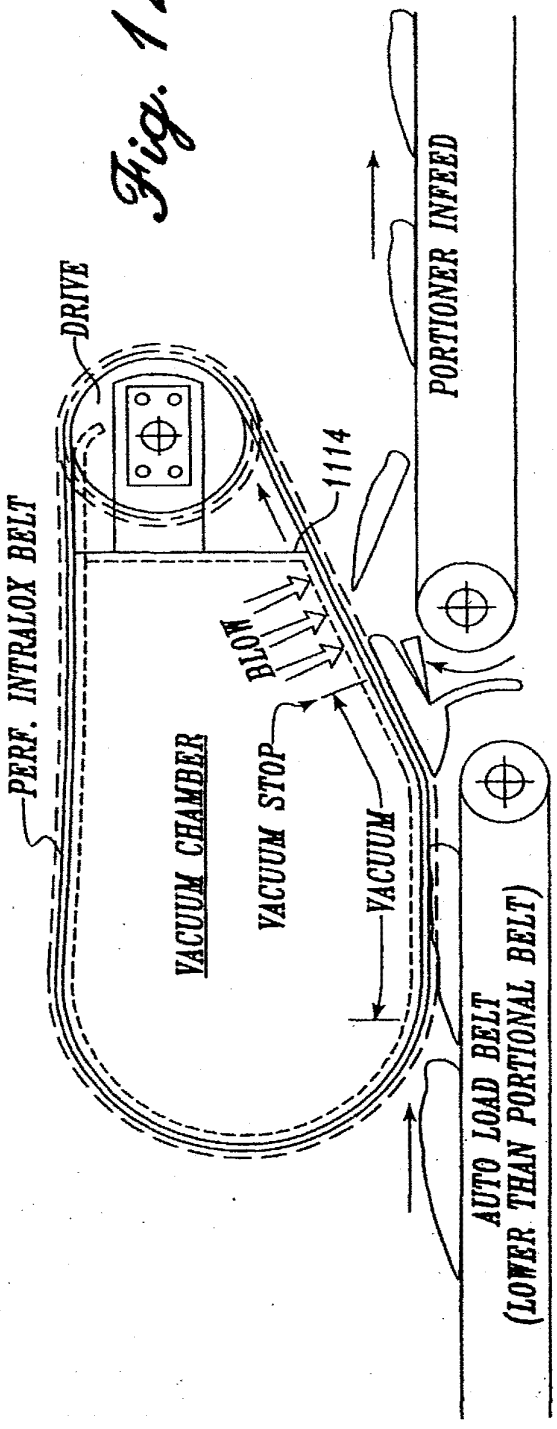


Fig. 11

Fig. 12


PERF. INTRALOX BELT
DRIVE
1114
PORTIONER INFEED
BLOW
VACUUM CHAMBER
VACUUM STOP
VACUUM
AUTO LOAD BELT
(LOWER THAN PORTIONAL BELT)

2364894

THREE AXIS PORTIONING METHOD

Field of the Invention

This invention pertains to methods for portioning foodstuff, and more particularly, for portioning a foodstuff in accordance with a predetermined shape by building a three-dimensional map of the foodstuff and then cutting the foodstuff in three dimensions.

Background of the Invention

The slaughterhouse industries have traditionally been labor intensive; however, as in other labor intensive segments of industry, attempts are being made to reduce manual labor, increase speed, and improve productivity. A particularly labor intensive task is the portioning of foodstuffs such as meats from beef, poultry or fish. An important goal in food portioning is consistency. For instance, restaurants want to serve portions that will not differ markedly from day to day in size, quality, fat content and/or other criteria. In order to meet minimum weight specifications, a food portion often has to exceed the acceptable minimum weight. This is because restaurants must take into account some of the variation that can exist between portions. In order to assure that all portions meet minimum specifications, it is usually necessary to use a target weight that is somewhat above the minimum. This may be a bonus to consumers but a problem for restaurateurs and others who may end up giving away a significant portion of their profit margin. By having consistent portions, restaurateurs can reduce the amount of excess that is built into the portions they serve, and consumers are more likely to receive the same quantity and quality of meat product.

Up until now, skilled workers usually bore the responsibility of cutting foodstuffs into constant weight or constant sized portions. These methods can and often do result in waste. Workers, in theory, can manually portion meat to about the same size of portions. However, workers, unlike machines, fatigue and the constant repetitive motion involved with butchering may lead to disabling injuries.

Therefore, the industry is aware of the need to increase the productivity of its work, without unduly burdening its workers. Several inventors have sought to devise ways to equally portion meats utilizing automated machinery to reduce manual labor. Therefore, methods and machines have been designed in an attempt to automatically cut food so that portions are of approximately equal weight.

One approach to introduce automation into the food portioning industry is to measure the cross sectional area of the foodstuff and assume that such area remains constant throughout the length of foodstuff. As the conveyer moves forward, a transverse cutting device is activated at equally spaced predetermined time intervals. This method achieves portions of equal thickness, but not necessarily equal weight, as the cross-sectional profile of each succeeding cut can be smaller or larger than the previous one. In order to achieve substantial equal weight portions, this method requires that a human operator trim the foodstuff so that it essentially conforms to a uniform cross-section along the longitudinal axis. Once this step is performed, the machine may proceed cutting at predetermined lengths. This method could lead to a large amount of waste, and inconsistent weight portions.

An improvement over the above method can take into account the cross-sectional area after each cut is made. From this measurement and the assumed density of the foodstuff, the thickness to achieve a desired weight can be calculated by integrating the cross sectional area over the length until the desired weight is reached. As the conveyor advances, its forward progress is monitored and the foodstuff is trimmed in a transverse manner at the point when the thickness corresponds to the calculated thickness. This process is repeated until the whole foodstuff, for example, a primal cut of beef, or a fish is portioned into individualized, nearly equal weight portions. However, this method does not account for indentations, significant contours, or tissue discontinuities appearing throughout the foodstuff, which can often affect the density. Further, these methods do not contemplate cutting in three dimensions, meaning that usually one dimension is always fixed, as happens with chicken breasts or a primal cut of beef. Chicken

breasts may be portioned along the length and width, and a primal cut of beef, such as a loin, is cut lengthwise.

Other automated methods are aimed at producing food portions which trim fat to produce portions with acceptable quantities of lean meat in relation to fat. Again, with these methods, portioning is done in two dimensions. As with previous methods, the initial portioning is done by human operators to carve the initial starting block and only then, can the machine proceed. These methods can rely on a scanning apparatus to determine where the demarcations between fat, bone, or cartilage and meat lie. Scanning apparatus require light or X-ray radiation to detect the fat regions. After this determination is made, a machine can trim the fat from the lean tissue. Once the fat is removed, the resultant food portion is weighed and sorted. These methods are "after the fact," since the weight or size of the individual food portions is not considered in determining the appropriate amount of portioning. The portions are simply sorted according to weight after the trimming operation is complete.

In a variant of a previous method, other methods of portioning involve scanning the foodstuff to determine the thickness of the foodstuff passing directly underneath the scanner. From the scan, a computer will be able to mark the cutting line at which to cut to achieve the predetermined weight or size. The cutting apparatus can move while the foodstuff also moves on the conveyor, or the conveyor may stop at a cutting station and allow the cutting apparatus to cut the portion. These methods are limited in that the only cut that can be made is in the transverse direction. Using this method, one is also limited to a foodstuff portion having the initial thickness.

Other methods are directed at ways of classifying meats to determine which cut will maximize profit, i.e., which cut of meat is selling at the highest price per pound at the current time. A computer may be used to calculate and determine a portioning strategy to maximize the amount of those portions which are selling at the highest price. These methods lack the capability to generate a three-dimensional map and are concerned only with making primal cuts of meat.

Other methods are directed at increasing the speed of the cutting devices, or perhaps cutting the foodstuff in two directions. However, these methods, as with the methods previously mentioned, assume that the foodstuff is fixed in one dimension, most commonly the thickness dimension. This may be unacceptable for a variety of reasons. Heretofore, attempts have not been made to portion foodstuffs automatically along a third dimension to arrive at the desired shape or weight.

Portions of meat, particularly chicken breasts, have now increased in size so greatly that two-directional cuts simply are no longer suitable to trim the breasts down to desired portions.

Therefore, to date no method or apparatus has been devised that will build an accurate three-dimensional map of the foodstuff, including the indentations and contours, that is to be portioned, then compare the map to a predetermined form, and then through the use of a computer controlled system automatically cut the foodstuff in three dimensions so as to achieve the predetermined shape or weight. The method of the present invention seeks to accomplish this task. The present invention will further increase productivity in the methods for portioning foodstuffs, particularly those meats, such as beef, poultry or fish which have uneven surfaces, including indentations and contours, to achieve consistent portions.

Summary of the Invention

The present invention discloses a method for portioning foodstuffs in three dimensions. A step in portioning according to the present invention includes scanning the foodstuff to be portioned. Followed by a step of generating a three dimensional map of the foodstuff. Then, comparing the generated three dimensional map of the foodstuff with the desired shape which is stored in the memory of a computer. The computer will then be able to determine the particular cutting path in three dimensions in order to arrive at the predetermined shape or weight. After comparison of the generated map against the map stored in the computer memory, there follows a step of cutting in one direction to fix at least one dimension of the foodstuff. This is followed by a step of determining whether the foodstuff is within the tolerance limits to proceed with another cutting step or whether the foodstuff portion has moved during the first cutting step. If the foodstuff portion has moved, the foodstuff will be scanned in a second scanning step and a second map of the foodstuff will be generated. Optionally, the scan may only include a map in two dimensions since one dimension has been fixed. Thereafter follows a step of determining the cutting path to cut the foodstuff along two dimensions to arrive at a portion that has been trimmed along three dimensions.

A preferred embodiment of a method according to the present invention will include a step to scan the foodstuff to be portioned. Several apparatus are in existence which are suitable for this purpose. The preferred apparatus can use light or X-ray radiation. The radiation is attenuated or otherwise modified as it strikes the foodstuff or passes through the foodstuff in a predictable manner so that a

relationship is formed between the attenuation and a physical parameter of the foodstuff. The scanner also includes a receiver portion, capable of receiving the radiation after being attenuated or modified by the foodstuff and capable of converting it into electrical signals which vary as a function of the physical parameter of the foodstuff. The signals are processed to represent a three dimensional map which accurately depicts the foodstuff in all details including the indentations, contours and discontinuities. Preferably, this step is carried out by a computer, having a CPU and a memory, capable of analyzing the signals sent by the receiver portion of the scanner. Once having created a three dimensional map, a step of comparing the three dimensional map with a map of a desired shape of the foodstuff follows. Preferably, this step is also carried out by a computer wherein the desired shape is stored in the memory of the computer. The CPU then executes a predetermined algorithm to fit the desired shape within the generated map. Having established a fit, the cutting path is marked in three dimensions. Thereafter, the foodstuff can be cut in at least one dimension to fix that one dimension, for example the thickness. The cutting device is directed by the computer according to the cutting path. Preferably, the cutting device is a high pressure water jet. After the first cutting step, a determination is made whether the foodstuff is within tolerance limits to proceed to a second cutting step. During the first cutting step, the foodstuff may have moved, thereby rendering the three dimensional map created in a previous step no longer accurate. The computer is required to know the position of the foodstuff to accurately cut the foodstuff to the desired shape. Therefore, there are limits placed on the amount of movement that can be tolerated during the first cutting step. If the tolerance limits have not been exceeded, the computer will direct the path of the next cutting step. Otherwise, a step follows wherein the foodstuff is scanned and preferably a two dimensional map is generated, preferably, by devices similar to the devices used in generating a three dimensional map. The newly generated map is again compared with the desired shape of the foodstuff. Preferably, this step is carried out by a computer wherein the desired shape is stored in a computer memory. The CPU may then execute a predetermined algorithm using any of a number of variables, such as the length, width or thickness, for determining a cutting path. Thereafter follows a step of cutting the foodstuff in at least one dimension to fix that dimension, or two dimensions, for example, the foodstuff may be cut a predetermined length and width, the thickness having already being fixed by a previous step. Therefore, the present invention achieves a desired shape from a

foodstuff portioned along three dimension. This is desirable when, for example, the original foodstuff portion is too big for an intended product.

Another embodiment of the present invention further includes a step of fitting several desired shapes into the generated map of the foodstuff, thereby maximizing the amount of foodstuff that is cut into desired shapes and minimizing the wasting of trailing portions.

A further embodiment of the present invention includes a product cut from a foodstuff using a method in accordance with the present invention. The foodstuff is cut and portioned along three dimensions including the thickness, width and length in two cutting steps.

A further embodiment of the present invention includes a product cut from a foodstuff using a method in accordance with the present invention. The desired final product has a substantially constant thickness, but the foodstuff has an arcuate shape. The foodstuff is cut and portioned along three dimensions including the thickness, width and length in two cutting steps. The product is cut from a foodstuff portion having an indentation. The cutting path used to cut the product is arcuate shaped to cut around the indentation in the foodstuff portion.

A further embodiment of the present invention includes a product cut from a foodstuff portion using a method in accordance with the present invention. The final product has a substantially constant thickness. The foodstuff is cut and portioned along three dimensions including the thickness, width and length in two cutting steps. The product is cut from a foodstuff having a undesirable constituent such as bone, cartilage or fat. The cutting path used to cut the product is skewed or at an angle.

A further embodiment of the present invention includes a plurality of final products cut from a foodstuff using a method in accordance with the present invention. The foodstuff is cut and portioned along three dimensions including the thickness, width and length in two cutting steps. The cutting paths can include multiple pass cuts through the foodstuff or partially control the depth of cutting. A plurality of products may be formed from a single foodstuff portion.

An advantage of a portioning method in accordance with the present invention is the elimination of manual labor to perform an initial slicing operation to fix one dimension of a portion of a foodstuff portion. Elimination of manual labor increases the productivity of the butchering industry.

A further advantage of a portioning method in accordance with the present invention is the savings incurred from optimizing a desired cut of meat product.

A further advantage of a portioning method in accordance with the present invention is the capability of cutting irregular shaped foodstuff portions having indentations or undesirable constituents.

Brief Description of the Drawings

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 shows a flow diagram of the steps in a embodiment of a method in accordance with the present invention;

FIGURE 2 shows physical embodiments to perform the steps of the method of FIGURE 1.

FIGURE 3 shows physical embodiments to perform the steps of the method of FIGURE 1

FIGURE 4 shows physical embodiments to perform the steps of the method of FIGURE 1

FIGURE 5 shows a front elevation view of a product to be portioned using the method of FIGURE 1;

FIGURE 6 shows a top plan view of a product to be portioned using the method of FIGURE 1;

FIGURE 7 shows a front elevation view of another product to be portioned using the method of FIGURE 1;

FIGURE 8 shows a plan view of FIGURE 7;

FIGURE 9 shows a front elevation view of a further product to be portioned using the method of FIGURE 1;

FIGURE 10 shows a front elevation view of an additional product to be portioned using the method of FIGURE 1;

FIGURE 11 shows a front elevation view of a plurality of portions to be cut from a foodstuff using the method of FIGURE 1; and

FIGURE 12 shows a schematic view of an alternative embodiment of the present invention.

Detailed Description of the Preferred Embodiment

A preferred embodiment of a method for portioning foodstuffs in accordance with the present invention is shown in FIGURE 1. The method includes the step 102 of scanning the foodstuff to be portioned. Followed by the step 103 of generating a

three dimensional map of the foodstuff. Input 106 depicting a form of a predetermined shape is compared with the map, and a cutting path is determined in step 104 comparing the generated three dimensional map of the foodstuff with one or more desired shapes which are stored in the memory of a computer. Following is a step 108 of cutting the foodstuff in one direction to fix at least one dimension of the foodstuff. Followed by a decision-making step 110 of determining whether the foodstuff is within the tolerance limits or whether the foodstuff portion has moved during the first cutting step 108. If the foodstuff portion has moved during the cutting step 108, the foodstuff will be rescanned in step 112 and in step 114, a two dimensional image of the foodstuff will be generated. If the foodstuff portion has not moved, a second decision will ask whether the second cut path in two axes has also been determined. If the second cut path has been determined in an earlier step, such as step 104, the foodstuff will be portioned along a second and third axis. Otherwise, input 118 is received and a second cutting path is determined in step 116 coming from either step 116 or step 124. Thereafter follows a step 120 of cutting the foodstuff.

Referring to FIGURE 2, in a preferred embodiment of a method according to the present invention, the foodstuff portion 200 will travel on an endless conveyor system 202. An initial step in a method of portioning foodstuff in accordance with the present invention is scanning the foodstuff to be portioned as shown in FIGURE 1. Any number of foodstuffs desired to be portioned may be loaded onto the moving endless conveyor system 202. The conveyor is suited to carry the foodstuff along a processing line where it may be processed by the various apparatus used to carry out the steps of the present invention.

The conveyor belt 202 carries the foodstuff 200 underneath a first scanner system, generally denoted by 204. The scanner system 204 suitable for use in this method will have the ability to generate a three dimensional map of the foodstuffs. The principle behind the scanner system is the use of radiation, which forms a relationship with a physical parameter of the foodstuff which is being scanned. Any one of several devices are suitable for this method. Several devices in use today employ X-rays or visible light to generate an image of the foodstuff. A scanner according to the present invention will include both a generator 206 to irradiate the foodstuff to be scanned with radiation and a receiver 208 to receive the attenuated radiation. The receiver portion 208 can be integral with the generator 206. Radiation

may be electromagnetic radiation throughout the spectrum from high frequency radiation, such as X-rays, to relatively low frequency natural spectrum light.

A scanner can also include a receiver 208 to receive and detect the amount of radiation attenuated by an object. Attenuation can occur by passing through the object or by reflection from the object. When radiation passes through a foodstuff, a certain amount of radiation is absorbed by the foodstuff through which it passes, therefore there will be a relationship in the amount between the radiation sent to the foodstuff and the radiation received after it has passed through the foodstuff. The cause of absorption is believed to reside in the chemical bonds within the molecules of the foodstuff. Radiation once attenuated can be collected, and converted into a useable form. Photodiodes, for example, may be used to convert an amount of radiation in the visible range into a voltage or current signal. For X-rays, a scintillating material may be used to generate visible light capable of detection by a photodiode. This method is described in U.S. Patent No. 5,585,603 to Vogeley, Jr., which is herein incorporated by reference. Other methods teach the use of a video camera to determine the size and/or shape of a foodstuff. These methods and apparatus are described in Reissue Patent Nos. 33,851 and 33,904 to Rudy et al., which are herein incorporated by reference.

The signals generated by photodiodes can then be further processed by a computer to determine a physical quantity which is related to the amount of radiation which is detected. One such quantity may be the mass of the foodstuff. Since the scanner will presumably know the amount of radiation that was sent to the foodstuff and the amount of radiation that was received, the amount absorbed forms a difference which is a direct relationship of the mass of the foodstuff. Once knowing the mass, volume of the incremental scanned area is calculated by assuming a density. The thickness can be derived once knowing the linear dimensions of the volume.

Any one of the above-described devices currently in use today will be suitable for use in a method in accordance with the present invention. Still, other methods of three dimensional imaging may use reflective means rather than absorptive means. For example, a receiver may measure the amount of light reflected from a foodstuff rather than the amount of radiation passing through the foodstuff. The areas of foodstuff tissue are distinguishable from areas, such as the conveyor, which surround the foodstuff and have a different reflective index. These differences can be used to determine the shape of a foodstuff. A person of ordinary

skill in the art will have knowledge of suitable devices of carrying out this step in accordance with the present invention.

Using a selected method, the scanner may repeat the process in quick succeeding intervals corresponding to one incremental dimensional unit such as by advancing the conveyor, or the scanner may execute a strobe-like effect, or the scanning process may be essentially continuous, with the map being formed as the foodstuff is continually advanced underneath the scanner. The imaging process can be integrated over an entire length of foodstuff to arrive at a three dimensional map of the foodstuff. The three dimensional map generated by the computer will have coordinates to fixed points or locations to enable other apparatus to reference these points and trim or portion the foodstuff with reference to these fixed points accurately. Other devices for identifying fat or bony cartilaginous matter and skin may also be incorporated and adapted to the present invention. These methods are also within the scope of this invention.

Step 103 of FIGURE 1 includes generating a three dimensional map of the foodstuff from signals sent via the scanner system as described above, preferably by the use of a computer 210, as shown in FIGURE 2. The computer will be capable of performing executable steps wherein the signals received by the scanner are processed by the computer to produce a three dimensional map, perhaps the map being discrete volume elements which as a whole create the three dimensional map. The step of generating the three dimensional map will be followed by comparing the generated map with one or more stored maps of a desired foodstuff shape in step 104 of FIGURE 1.

Preferably, a computer 210 having a central processing unit 212 (hereinafter CPU) and a memory 214 will be used in the method according to the present invention. Input 106 of FIGURE 1 of a desired shape is stored on computer memory 214. The memory can store additional maps that can readily be selected by a user via a user interface 216 when changing product lines. For instance, the user may be processing chicken breasts for a particular customer who may have a particular desired shape, when the order of the customer is filled, the user may switch the mode of the computer to a different product to meet the specifications of a different customer. This switch may be automated, and triggered by a counter that keeps track of the number of foodstuff portions that have been processed or it may be carried out manually to allow the user time to retool any apparatus or recalibrate. In

other alternate embodiments of a method according to the present invention, a library of maps for a whole production plan can be stored in the memory of a computer.

In still other alternate embodiments, the computer 210 can be in communication with a network system 230 which allows the computer 210 to talk and share information with other computers. Computer 210 can also drive other periphery hardware besides the scanner system 204. For instance, computer 210 can direct the operation of a conveyor 232, or cutting devices, generally denoted as 234. Finally, computer 210 can receive information from various sensors to guide or direct a multitude of systems.

In the preferred embodiment of the method of the present invention, the CPU 212 will retrieve the stored map(s), compare the stored map(s) with the generated map, and determine the path of the first cutting step 108 of FIGURE 1. The CPU will be capable of executing an algorithm wherein the algorithm has a step to select a dimensional unit for comparison. The unit may be along any linear dimension or it may be a combination of linear dimensions. For example, in the preferred embodiment, thickness may be selected as the first unit of dimension to compare. If the generated map of the foodstuff is within the thickness specification of the desired shape, the computer may proceed to a further step wherein a further comparison of a different dimension is made, these comparisons may continue until it is determined that the desired shape will fit within the generated map of the foodstuff. FIGURE 2 shows a foodstuff portion 200 having a desired shaped 215 fit within the dimension of the foodstuff. Thus, the computer will be able to generate one or more cutting paths to arrive at the desired shape 215 by trimming the foodstuff portion 200.

In an alternate embodiment, a first comparison and determination of a first unit dimension is made, if the foodstuff is within specifications of one unit dimension of the desired shape, the computer may direct the cutting devices to proceed to cut the food stuff along the predetermined cutting path to arrive at fixing one dimension. In this embodiment, having fixed one dimension, the computer can now proceed to make comparisons in the remaining dimensions and cut to those dimensions accordingly in later cutting steps.

In another alternate embodiment, all comparisons are completed before cutting begins, and following a step for comparing a dimensional unit, the computer may proceed to compare the foodstuff along a second dimensional unit. For example, in a preferred embodiment, the first dimensional unit for comparison is the

thickness, followed by width and then the length. However, it should be realized that dimensional comparison may proceed in any order and in any combination. Embodiments of a method in accordance with the present invention contemplates these combinations and are within the scope of this invention. The width of the desired shape being then compared to the width of the generated map. If the width of the desired shape can fit within the width of the generated shape, the computer may proceed to compare the foodstuff along a third dimensional unit. For example, if the generated map has so far met the specification for thickness and width, the computer may analyze or compare for length. In this step, the computer will compare the length of the generated map to the desired shape, once the two other parameters have been established. The computer can manipulate the three dimensions individually or in combination trying to find the best fit for the desired shape into the generated map. The computer may even skew or rotate the desired shape within the generated map to avoid defects or abnormalities in the foodstuff or may adjust one dimension only. The computer may also base the best fit algorithm on other considerations. For example, mass rather than size may be the determining factor. To adjust for mass, the computer will have to set two dimensions and vary the third to arrive at the desired mass or any combination of dimensions. It should also be pointed out that comparisons of dimensional units may proceed on an incremental basis, such that the sum of all increments may produce a rounded or otherwise non-linear cutting path.

In determining the optimal cutting path, the computer may avoid indentations or undesired constituents such as bone or fat in the generated map to avoid having these constituents in the finished product. The devices for determining bone or fat tissue can be incorporated into to the present invention for this purpose. Other embodiments may have the computer cut out or around the indentations or undesired constituents.

In still other embodiments, the desired shaped may be optimized, for instance, if longer portions are more valuable than shorter portions, yet both are acceptable to the customer, the computer may adjust the length in order to maximize the length. Other units and dimensions may be selected by the computer or the user in order to maximize the value of the foodstuff portion. Dimensional units which may be used by a computer in comparison, determination and optimization step(s) include units such as length, thickness, width, or weight.

In a preferred embodiment of the method of the present invention, a cutting step 108 will follow the comparison step 104 in FIGURE 1. As the foodstuff

portion 200 travels on a conveyor system 202, the conveyor 202 will have brought the foodstuff portion to a cutting station 218 as shown in FIGURE 3. The cutting device 220 will be controlled by the computer 210 with the appropriate cutting path determined in an earlier step. Preferably, the cutting device in a method according to the present invention will use a band knife or an oscillating knife if the cut to be made is a long cut, but a high pressure water jet may also be used as well, to cut the foodstuff in accordance with the directions from the computer. Such cutting devices are described in U.S. Patent No. 5,931,178 to Pfarr, which is herein incorporated by reference. Bandsaws and blades are described in U.S. Patent No. 5,937,080 to Vogeley, Jr. et al., which is herein also incorporated by reference. However, other cutting devices, such as high pressure gas or lasers, that are well known in the art may also be used.

A suitable cutting device in accordance with the present invention will be capable of cutting along one axis, preferably horizontally as shown in FIGURE 3, to establish one dimensional unit as described above. The water jet nozzle or other cutting device can be mounted on an articulating arm, such that the cutting jet may be directed at an angle or moved bi-directionally in single or multiple planes. Also, multiple cutting jets may be used together. As mentioned earlier, the computer may move the desired shape in a skewed manner to make the desired shape fit within the generated map or the computer may direct a cut be made in an arcuate or rounded configuration. The computer can also determine a cutting path to cut around bone, fat, cartilage or skin. If the desired shape is to be cut at an angle or in a arcuate fashion, a water jet may be one of the most effective ways of accomplishing this task. However, rotating or oscillating mechanical cutters using metal blades may also be used.

Alternatively, the water jet or other cutting device may make one or more passes to cut the desired thickness, or the water jet may cut from both directions. The cutting device may be mounted on a fixed platform or structure and the conveyer speed may determine the rate of portioning. Alternatively, the cutting device may be carried on a movable track system such as is disclosed in U.S. Patent No. 5,868,056 to Pfarr et al., which is herein incorporated by reference. In a movable track system, the cutting tool may move at a speed faster than the conveyor, thereby enabling more complicated and multiple pass cuts. Cutting devices may also be controlled to achieve a predetermined depth, for example when portioning a foodstuff into several products, the cutting device will need to control the depth of a cut to be able to make

several portions from a single larger portion. Any leftover portions may be retained and used for other applications or processed further or discarded.

In a preferred embodiment of the method of the present invention, determining whether the foodstuff portion has shifted from the fixed reference points is performed following the first cutting step in step 110 at FIGURE 1. This step will determine whether the foodstuff portion occupies the same spatial relationship after the first cutting step. Of course, after having gone through a first cutting step, the foodstuff may have been reduced in volume. Therefore, what is being determined is whether the desired portion as defined by the computer has shifted or otherwise moved from its initial position. This is preferable to assuming the foodstuff portion has not moved and further processing the foodstuff portion under this assumption, resulting in an ultimate rejection or rework because the foodstuff portion had in fact moved.

FIGURE 5 shows a system 224 for determining whether the foodstuff portion has shifted. The system may include such apparatus as an optical scanner, video camera, limit switches or other like apparatus for detection of out of bounds movement or motion. A person of ordinary skill in the art may readily appreciate any of a number of apparatus suitable for performing this step. In step 110, if the foodstuff is found not to have moved outside of the tolerance limits, the method according to the present invention will go to another decision step 124 which will determine the need to calculate the second cutting path. It may be that the second cutting path has been determined earlier in step 104, or in the alternate embodiment where only one dimension is determined and cut in the first cutting step, it will become necessary to jump forward to a second step 116 where the computer determines the second cutting path. Otherwise, from step 110 the method will jump directly to the cut portion step 120 of FIGURE 1. In step 120, the computer directs a cutting device for cutting the foodstuff in a second or third dimensional unit, such as is described above. The second cutting step 120 is represented in FIGURE 4. FIGURE 4 shows the same cutting device utilized in an earlier step, to portion the foodstuff 200 in one or more axes. FIGURE 4 shows how the cutting device 220 can trim the foodstuff 200 to arrive at a second dimension, such as length, and a third dimension, such as width, to arrive at a foodstuff which has been portioned in three dimensions by one or more cutting devices. Alternatively, multiple cutting devices may be used to cut along one or more dimensions where the first cutting device is a different station than the second cutting station. For example, the first cut can be

performed by a band saw or an oscillating blade and the second cut can be made by a high pressure water jet.

If the device used to detect shifting of the foodstuff signals that the foodstuff has moved from its initial position, the foodstuff portion may be rescanned in a second rescan step 112 as shown in FIGURE 1 (if step 110 utilizes a scanner, step 112 can utilize the same scanner to scan the foodstuff a second time).

In a preferred embodiment of a method in accordance with the present invention, rescanning the foodstuff may take place with similar equipment that was described for the earlier scanning step 102. FIGURE 5 shows second scanner 224 will likewise include a generator portion 226 and a receiver portion 228, which may be integral or separate devices, to be able to generate a three dimensional map of the foodstuff 200 to compare to the map stored in the computer. Step 114 uses a computer to generate another map of the foodstuff. The generated map of the foodstuff can also be described in only two dimensions, for instance, length and width, since preferably, the thickness has been established by the first cutting step. The comparison and determination of the second cutting path will be recomputed for the newly generated map of the foodstuff in step 116.

A second cutting step 120 proceeds from the second rescan step 112, map generation 114 and comparison step 116 of FIGURE 1, or this step 120 may have been jumped to from a previous step, such as the determination of whether the foodstuff was within tolerance limits in step 110. If the foodstuff has been determined to be within tolerance limits in step 110, a second decision step 124 may follow to decide whether the process jumps to step 116 or step 120. Step 124, may for instance, decide whether the cutting path has been fully described in the previous step 104, in which case, the process may proceed directly to a second cutting step 120. Alternatively, if step 104 only described the first cutting path, then the process would jump to step 116, to calculate the cut path along the second and third axis. In the second cutting step 120, the foodstuff is completed to resemble the desired shape residing within the computer memory.

Referring again to FIGURE 2, an embodiment of a foodstuff 200 to be portioned in three dimensions using a method in accordance with the present invention is shown. A conveyor 202 is suited to carry the foodstuff portion 200, such as a chicken breast, through the various steps of the method. Shown is a representative foodstuff portion 200 with the desired shape 204. A step in the method of the present invention will have generated a three dimensional map of the

chicken breast and the computer will have compared the map with the desired shape. The computer will have determined the most correct fit of the desired shape within the generated map. Shown in phantom are the cutting paths for achieving a foodstuff portion in the desired shape. The chicken breast 200 has a first, a second, and a third dimension representing thickness, width and length, respectively. In a step according to a method of the present invention, the foodstuff portion will be cut along a first path to establish one dimension, such as the thickness, as shown in FIGURE 3. It should be noted that the cutting path need not follow a linear path. The first cutting path may be an arcuate or rounded path. It should also be noted that the first cutting path may make two passes. For example, a first pass may cut along the top of the portion and a second pass will cut along the bottom of the portion. This would be desirable if the chicken breast was not lying exactly prone on the conveyor or if the chicken breast had a portion of bone or other undesirable constituent still attached to it.

A further step in a method according to the present invention will cut along a second path to establish a further dimension such as width or length or both as shown in FIGURE 4. It should be noted that the second cutting device may also move in a bi-directional manner in the same plane or in two dimensions to establish the second and third dimension. For example, the cutting device may be mounted on a moveable platform, where the cutting device may make two passes along the second dimension to shape the width, and two passes along the third dimension to shape the length. The cutting device in this step can also be the cutting device of a previous step, provided that the cutting device is able to articulate as shown in FIGURE 4, moving from the horizontal to the vertical plane. It should also be noted that these paths may not be linear but rather follow a curved or arcuate path as well. The advantage of generating a three dimensional map is that foodstuff portions may now be cut in three dimensions, whereas previously one dimension was always fixed at the start and the other two were adjusted. This is the big difference between the present invention and the prior art.

FIGURE 5 shows steps 112 and 114 of the method of the present invention. Shown is a foodstuff portion 200 which was moved from its original position, defined in phantom, to a new position. It should be noted that the chicken breast now has at least one dimension that is fixed by the first cutting step, therefore, it is only minimally required to generate a cutting path in two dimensions, such as length and width. As before, once a map is generated the map is compared to the desired shape

and the best fit is determined. This is done with the aid of a computer having a CPU and a memory. The computer can then send instructions to the appropriate peripheral devices, including cutting devices.

An embodiment of a foodstuff to be portioned in three dimensions using a method in accordance with the present invention is shown in FIGURE 6. FIGURE 6 shows the cutting path along two dimensions, thickness and width.

FIGURE 7 shows the same food portion as FIGURE 6 showing the length dimension. Using three axis portioning as in the method of the present invention allows for trimming the three dimensions of length, width and thickness. The first cutting step removes region 600 in FIGURE 6, while the second cutting step removes regions 700, and 702, followed by regions 704 and 706, or any combination thereof, thus achieving portioning along three axes.

Another embodiment of a foodstuff to be portioned in three dimensions using a method in accordance with the present invention is shown in FIGURE 8. FIGURE 8 shows the cutting path along two dimensions, thickness and width. However, it is to be understood that a third dimension exists and is subject to be portionable as well. First cutting step 108 may cut along line designated by 800 and 802 to remove regions 804 and 806, thus fixing one dimension. The second cutting step may cut along path 808 and 810 to remove regions 812 and 814, thus fixing two dimensions. Also shown is a cutting path following a curved or arcuate path when the foodstuff portion has indentations which would have prevented a constant thickness using conventional methods, the conventional methods only having capability to portion along two axes or two dimensions automatically. Also shown is a cutting path which can be cut by a first and second pass of the foodstuff or a cutting device having dual water jets to portion the top and the bottom simultaneously to arrive at a constant thickness for a desired shape. Alternatively, a rotating and oscillating cutting device may be used to cut the top and the bottom surfaces of the portion.

Another embodiment of a foodstuff to be portioned in three dimensions using a method in accordance with the present invention is shown in FIGURE 9. FIGURE 9 shows the cutting path along two dimensions, thickness and width, for a first and second half of a foodstuff portion. First cutting step 108 can cut along cutting paths 900 and 902 to remove regions 904 and 906, while second cutting step 120 can cut along paths 908 and 910 to remove regions 912 and 914. It should also be understood that there exists a third dimension, length, which can also be

trimmed in the second cutting step 120. Also shown is a curved cutting path which may be cut by a first and second pass of a cutting device to cut the top and bottom surfaces of the portions to arrive at a thickness for a desired shape. Alternatively, a rotating and oscillating cutting means may be used to cut the top and the bottom trailing portions.

An embodiment of a foodstuff to be portioned in three dimensions using a method in accordance with the present invention is shown in FIGURE 10. FIGURE 10 shows the cutting path along two dimensions, thickness and width. First cutting step 108 can cut along cutting paths 1000 and 1002 to remove regions 1004 and 1006, while second cutting step 120 can cut along paths 1008 and 1010 to remove regions 1012 and 1014. It should also be understood that there exist a third dimension, length, which can be trimmed in the second cutting step 120. In the embodiment, a bone fragment or other undesired constituent may be avoided by skewing or rotating the desired shape within the generated shape to fit the desired shape in the generated shape, thereby avoiding the bone. The resulting cutting path is skewed or angled to avoid the undesired constituent. The cutting path to shape the thickness of the portion can be cut by a first and a second pass of the cutting device to portion the top and the bottom surfaces.

Another embodiment of a foodstuff to be portioned in three dimensions using a method in accordance with the present invention is shown in FIGURE 11. FIGURE 11 shows the cutting path along two dimensions, thickness and width. In the embodiment, a foodstuff portion may be cut into a plurality of desired shapes. The shapes may be arranged into one generated map of the foodstuff via the use of a computer, such that the maximum amount of the foodstuff is utilized. Shown are several desired shapes to be cut from one foodstuff portion. Also shown are multiple cutting paths where several cuts are made by multiple passes of the cutting device or multiple heads. A bone fragment can also be avoided by fitting desired shapes around the bone fragment.

FIGURE 12 schematically illustrates how a foodstuff portion 1100 may be cut to a desired thickness in accordance with the present invention. The apparatus 1101 illustrated in FIGURE 12 includes a first conveyor system 1102 for delivering foodstuff portions 1100 to the underside of a vacuum chamber 1104. The vacuum chamber is shown as including a housing 1106 in generally oblong shape having a rounded leading end portion 1107 overlying the conveyor 1102 which transitions to a substantially flat bottom section 1108 spaced above the upper rung of

the belt 1110 of the conveyor. At approximately the end of the conveyor 1102 the vacuum chamber housing extends diagonally upwardly along section 1112 to a vertical end wall 1114 of the chamber. The top surface of the chamber housing 1116 is substantially flat. A belt 1118 is trained around the top 1116, left end 1107, flat bottom 1108 and diagonal 1112 sections of the vacuum chamber housing, as well as around a drive pulley 1113 positioned outwardly adjacent the end wall 1114 of the chamber housing. The drive pulley is mounted to the wall 1114 by a bracket 1122. The drive pulley can be driven by numerous methods, for instance by an electric motor, hydraulic motor or otherwise.

A vacuum can be applied to the interior of the chamber housing 1106 by any one of numerous methods. The vacuum chamber preferably is perforated or slotted along its bottom section 1108 and the adjacent portion of the diagonal section 1112. Also the belt 1118 is preferably perforated so that suction is applied to the adjacent surface of the foodstuff 1100. Thus, foodstuff 1100 carried by conveyor 1102 becomes attached to the belt 1118 and is carried by the belt after the foodstuff portions leave the conveyor 1102, which occurs as the foodstuff portions move along the diagonal portion 1112 of the vacuum chamber. The upper surface of the foodstuff in essence adheres to the belt 1118.

The foodstuff portions 1100, being carried by the belt 1118, is trimmed to thickness by a band knife 1130, spaced beneath the diagonal section 1112 of the vacuum chamber. Rather than a band knife, another type of knife, such as an ultrasonic knife, may be utilized. The distance between the knife 1130 and the adjacent surface of the housing 1106 can be varied to adjust the thickness of the foodstuff portion 1100 as desired.

The perforations in the housing 1106, in communication with a vacuum source, do not exist past the location of the band knife 1130. Instead, pressurized air is directed through perforations in the diagonal section 1112 of a vacuum chamber housing adjacent end wall 1114, thereby to break the suction between the foodstuff portion 1100 and the belt 1118, thereby to drop the trimmed foodstuff portion onto a conveyor 1132, which then can transport the foodstuff portions to another location to be further trimmed and portioned in accordance with the present invention. As shown in FIGURE 12, a gap 1134 exists between the adjacent ends of conveyors 1102 and 1132 to allow the trim 1136 from the foodstuff to drop down away from the knife 1130.

One type of foodstuff with respect to which the present invention may be particularly useful are chicken breasts that have skin on one surface of the breasts. Preferably, such chicken breasts are placed on the conveyor 1102 with the skin side up, which is believed to provide a better suction contact with the belt 1110 than if the chicken breasts were positioned skinless side up. However, it is to be understood that other types of foodstuff can be trimmed to thickness using the present invention.

While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

CLAIMS

1. A method for cutting a three-dimensional portion from a foodstuff in accordance with a predetermined shape, comprising:

scanning the foodstuff;

building a three-dimensional map of the foodstuff from the scan, the three dimensions being thickness, width and length of the foodstuff;

comparing the three-dimensional map with one or more desired predetermined shapes for one or more portions to be cut from the foodstuff;

computing one or more cutting path that would portion the foodstuff in the one or more predetermined shapes; and

cutting the foodstuff according to the computed one or more cutting paths.

2. A method according to Claim 1, further comprising the step rescanning the foodstuff after partially cutting the foodstuff to build a renewed multi-dimensional map of the foodstuff from the rescan to determine if the foodstuff has moved during the partial cutting.

3. A method according to Claim 2, further comprising the step of computing a second path of portioning along at least a second dimension to substantially conform to the predetermined shape and cutting the foodstuff according to the computed second path.

4. A method according to Claim 3, wherein the computed second path of portioning includes a third dimension and cutting the foodstuff according to the computed second path.

5. The method of Claim 4, wherein the first dimension is length, the second dimension is width, and the third dimension is length.

6. The method of Claim 1, wherein the scanning step utilizes a technique selected from the group consisting of optical scanning, video scanning and x-ray scanning.

7. The method of Claim 1, wherein the food product foodstuff moves on an endless belt conveyor.

8. The method of Claim 1, wherein the cutting step uses a high speed water jet.

9. The method of Claim 1, wherein the cutting step uses a rotating and oscillating cutting means.

10. The method of Claim 1, wherein a CPU is used for the computing step.

11. The method of Claim 10, wherein the CPU performs executable steps comprising a step of comparing at least one dimensional variable of a desired map with the generated three-dimensional map.

12. The method of Claim 1, wherein the one dimensional variable is thickness.

13. The method of Claim 11, wherein the one dimensional variable is +width.

14. The method of Claim 11, wherein the one dimensional variable is length.

15. An apparatus for processing foodstuff portions along a first axis, comprising:

a first conveyor run adapted to carry foodstuff portions on a first side;

a second conveyor run, spaced from the first conveyor run, and extending along the first conveyor run, the second conveyor run capable of carrying the foodstuff portions from the first conveyor run on a second foodstuff portion side; and

an adjustable cutting device positioned along the second conveyor run at a selected distance from the second conveyor run to cut the foodstuff portions being carried by the second conveyor run to a desired thickness.

16. The apparatus of Claim 15, wherein the second conveyor run defines a first surface located above the first conveyor run and a second surface on a diagonal defining an acute angle with the first conveyor run.

17. The apparatus of Claim 16, wherein the cutting device is positioned along the diagonal portion of the second conveyor run.

18. The apparatus of Claim 17, wherein the second conveyor run includes perforations.

19. The apparatus of Claim 18, further comprising a vacuum source at the first surface to bias the foodstuff portions against the second conveyor run.

20. The apparatus of Claim 19, further comprising a vacuum source at the second surface to bias the foodstuff portions against the second conveyor run.

21. The apparatus of Claim 20 further comprising a pressure source at the second surface downstream from the vacuum source to repel the portions therefrom.

22. The apparatus of Claim 15, further comprising a third conveyor run located a spaced distance from the first conveyor run to form a gap therebetween, said third conveyor run being suitably located to carry the trimmed foodstuff portions from the second conveyor run.

23. The apparatus of Claim 15, wherein the cutting device is a band knife.

24. The apparatus of Claim 15, wherein the cutting device is an ultrasonic knife.

25. The apparatus of Claim 15, further comprising a second cutting device to portion the foodstuff portions along a second axis.

26. The apparatus of Claim 25, wherein the second cutting device is selected from the group consisting of band saws, band knives, oscillating saws, oscillating knives, water jets, high pressure fluid jets, and lasers.

27. The apparatus of Claim 26, further comprising a third cutting device to portion the foodstuff portions along a third axis.

28. The apparatus of Claim 27, wherein the third cutting device is selected from the group consisting of band saws, band knives, oscillating saws, oscillating knives, water jets, high pressure fluid jets, and lasers.

29. A system for portioning foodstuff portions along three axis, comprising:

means for conveying foodstuff portions to a first cutting means;

first cutting means for portioning the foodstuff portions along a first axis;

means for conveying the foodstuff portions to a second cutting means;

second cutting means for portioning the foodstuff portions along a second axis; and

third cutting means for portioning the foodstuff portions along a third axis, wherein the first, second, and third cutting means are substantially operating simultaneously to produce a continuous flow of foodstuff portions portioned along three axes.

30. A method for processing foodstuff portions, comprising steps for:

transferring foodstuff portions from a first conveyor run to a second conveyor run, wherein the foodstuff portion is carried on a first side on the first conveyor run, and carried from a second side on the second conveyor run; and

portioning the foodstuff portions at the first side while the foodstuffs are carried by the second conveyor run.

31. The product produced by the method according to Claim 30.

32. An apparatus for processing foodstuff portions along a first axis, comprising:

a first conveyor having a first carrying belt to carry foodstuff portions on a first side thereof;

a second conveyor having a second carrying belt trained on a vacuum chamber housing, wherein the second belt includes perforations, and wherein the second conveyor is located above the first conveyor and extends along the first conveyor;

a vacuum source located at the vacuum chamber housing to cause the foodstuff portions to be biased through the second conveyor belt perforations onto the second belt, thusly taking up the foodstuff portions on a second side; and

a cutting device positioned below the second conveyor to portion the first side of the foodstuff portions.

33. A method for cutting a three-dimensional portion from a foodstuff substantially as described herein with reference to and as illustrated in Figures 1 to 11 of the accompanying drawings.

34. A method for cutting a three-dimensional portion from a foodstuff substantially as described herein with reference to and as illustrated in Figure 12 of the accompanying drawings.

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Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2285126 A	(NEWMAN) especially the figures and abstract	1, 6 and 10 at least
X	GB 2218615 A	(LAITRAM) especially the figures and abstract	1, 6, 8 and 10 at least
X	WO 89/08983 A1	(DESIGN) especially the figures and abstract	1, 6-8 and 10 at least
X, Y	US 5324228 A	(VOGELEY) especially the figures and abstact	X = 1, 6, 7 and 10 at least Y = 2 and 3
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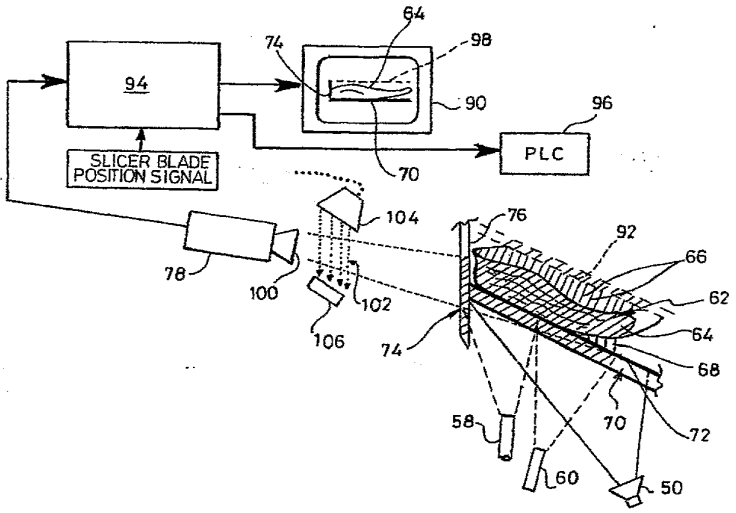
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(54) Title: VISION SYSTEM WITH PICTURE CORRECTION STORAGE



(57) Abstract: A vision system is described for viewing the end face of product mounted in a machine which in use produces measurements relating to the area of the end face and of at least one constituent part of the product which is visible in the end face. The system comprises means for illuminating the end face and a video camera for producing a video signal from an image of the illuminated end face. The end face is illuminated by light of two predominantly different wavelengths. One wavelength illuminates an area which contains both the end face and surrounding parts of the machine, while light of the other wavelength from a laser source produces a pattern of parallel spaced apart lines of light of the said other wavelength. A memory stores information on the components of the machine which in use extend into the field of view of the scanning means, and signals obtained from the stored information are employed to gate the video signal to exclude video signal corresponding to regions of the field view which are known not to contain any part of the product end face. The parallel lines cross the end face at a specific given angle, and parallel lines in the field of view at other angles indicate regions in the field of view which are not part of the end face of the product. Gating excludes video signal of parallel lines in the image which are not at the specific angle and of parallel lines crossing flat regions of the machine parallel to the end face of the product, to leave a residual video signal corresponding to the end face, from which an electronic mask is generated which represents the extent of the product end face. A full colour video signal of the field of view is gated by the mask. The vision system forms part of a product slicing machine and measurements and/or dimensional values obtained from the video signal control the thickness of the next slice to be cut and are also sent to slice and pack grade-level decision logic, to control down-line gates.

WO 2006/136814 A1

Title: Vision system with picture correction storage

Field of the invention

This invention concerns vision systems, especially vision systems as employed in food cutting and portioning apparatus.

Background to the invention

It is known to illuminate and view the end face of a length of foodstuff such as meat, using a video camera to obtain a video signal representation of visibly different regions in the end face, such a lean and fat regions, and to process the signal and compute for example the lean to fat ratio as well as the overall area of the end face.

The latter can be employed together with a density value for the foodstuff to compute the distance through which the foodstuff should be moved to enable a slice of a given weight to be cut from the length.

The lean to fat ratio can be compared with stored ratio values, to determine the quality of the portion, and this information can be used to direct the cut portion to one location or another, according to the lean/fat ratio which is usually a measure of the quality of the meat.

Difficulties have been experienced in accurately determining what in the camera field of view is product and what is supporting structure, so that the computation of the area is not always as accurate as it should be. Indeed a key difficulty in using vision systems to analyse product at the slicer cutting point is the acquisition of an accurate image and therefore video signal of the cut face of the product, clearly differentiated from the

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background to allow accurate image processing of the video signal and quantitative assessment of eg. fat to lean areas. This background may include parts of the machine itself, areas of product contamination and debris, and surface the product which is not part of the cut face.

This has been approached previously by offsetting light sources to the side or below the product, to place non-product cut face material in shadow, in an attempt to allow video signals relating to it to be excluded from video signals relating to the cut face, by thresholding the signal from the camera.

Other techniques have illuminated the sides of the product, casting the cut face in shadow, but this does not allow analysis of the cut face (eg to quantify lean to fat proportions of the cut face) which is now in shadow.

This allows the overall area of the cut face to be computed.

Object of the invention

It is an object of the present invention to provide an improved vision system which can be used to produce more accurate measurements of the end face of a length of foodstuff, especially meat, and in particular a more accurate measurement of the area of the end face and of the ratio of one constituent part of the foodstuff from at least one other constituent part thereof, when both are present in the end face.

It is also an object of the invention to provide a video signal from which the shape of the end face can be determined by reference to pre-stored shape data.

It is also an object of the invention to provide apparatus and methods by which data obtained by the improved vision system can be used to control the slicing and packaging of the sliced product.

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Summary of the invention

According to one aspect of the invention there is provided a vision system for viewing the end face of product mounted in a machine which in use produces measurements relating to the area of the end face and of at least one constituent part of the product which is visible in the said end face, and which comprises means for illuminating a region containing the end face and surrounding parts of the machine and scanning means for producing a video signal from an image of the illuminated region, wherein the region and end face of the product is illuminated by light of two predominantly different wavelengths, characterised by signal processing means adapted to separate out components of the video signal attributable to one wavelength and to generate an electronic mask therefrom on which measurements can be made and which can serve to gate the video signal to isolate components thereof corresponding to the said end face, memory means adapted to store information on the size and shape and position of components of the machine which in use extend into the field of view of the scanning means, whereby in use signals are obtained from the stored information and employed to gate the video signal to exclude components thereof corresponding to regions of the field of view which are known not to contain any part of the product end face.

The light may be obtained from two separate light sources.

One of the illuminations is performed using green or blue light.

The green or blue source may comprise an array of green or blue LEDs, or a filament or halogen lamp with a green or blue filter placed between it and the area to be illuminated

The other light source may be a laser light source.

The scanning means may comprise a video camera which produces the video signal.

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Information on the extent of the end face is determined by processing an image signal derived from the electronic mask.

One of the light sources may comprise a source of white light whereby in use the whole of the region in the field view of the scanning means is illuminated by white light and the scanning means is adapted to produce a full colour video signal of the region, and the mask is used to gate the full colour video signal to remove parts thereof which do not correspond to the product end face.

The gated full colour video signal of the product end face may be subjected to image processing software to identify signals corresponding to at least one particular colour.

Differently coloured regions of the product end face may be distinguished by the software by reference to colour, and measurements using further software are performed on the signals corresponding to the differently coloured regions.

When used to scan the end face of a piece of meat containing lean and fat regions, signals relating to the latter can be distinguished from those relating to the former on the basis of colour.

The colour signal may be converted to a monochrome grey-level image signal, and measurements using further software are performed thereon depending on grey-level.

When such a vision system is used to scan the end face of a piece of meat containing lean and fat regions, grey-level threseholding tools (software or hardware) may be used to determine the regions which are lean (which will tend to be dark grey) and regions of fat (which will tend to be light grey or white).

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Software or hardware calliper tools may be employed to measure the height and /or width of the product end face, and /or of different regions in the end face, and area values of the measured regions are computed.

Typically the following dimensions of the end face of a meat product are obtained from the video signal, namely

Overall area of end face,
Area of lean meat in end face,
Height of end face,
Area of fat within the end face, and
Width of end face.

The ratio of lean to fat areas is computed from area values obtained from the measurements using the further software.

A vision system as aforesaid may form part of a product slicing machine in which the measurements and/or dimensional values are sent to a slicer controller, to control the thickness of the next slice to be cut.

In such a combination the dimensional values may also be sent to slice and pack grade-level decision logic, to control down-line gates.

Where a monochrome grey scale video signal is obtained, this may be sent to a feature classifier which in use is adapted to return an electronic flag to indicate whether or not a desired feature can be found in the video signal of the end face.

Typically a state vector machine (SVM) based feature classifier is employed and if a feature is found to be present, its dimensions are determined.

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The invention may be used to inspect a side of bacon in which event the classifier may operate to determine if certain bacon muscle is present or not in the end face, and if so its dimensions are measured.

A vision system as aforesaid which form part of a slicing machine and the dimensional values are sent to a slicer controller to control the thickness of the next slice to be cut.

According to another aspect of the invention there is provided a method of assessing an end face of product which is to be sliced and routed according to the assessment which is viewed by a colour video camera set in front, but to one side of, the product end face, comprising the steps of: -

1) using substantially monochromatic light centred on each of two predominantly different wavelengths, illuminating the camera field of view to form a first picture signal containing components attributable to the two different wavelengths,

2) selecting the different wavelengths so that video signal content produced by light of one wavelength (the first wavelength) is readily separable from video signal content produced by light of the other wavelength (the second wavelength) on the basis of colour or after conversion to a grey scale monochromatic signal, by reference to grey level.

3) using information on the components of the machine which in use extend into the field of view of the scanning means stored in a memory means to generate a gating signal and gating at least the first picture signal so as to exclude video signal corresponding to regions of the field of view which are known not to contain any part of the product end face.

4) in a first signal processing step, processing the video signal so as to separate signal content produced by the first wavelength light from that produced by the second wavelength light so as to leave only a residual image signal relating to content attributable to the second wavelength light.

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5) generating an electronic mask from the residual image signal which corresponds to the shape and size of the end face.

6) creating from the electronic mask a gating signal, and gating the video signal produced using the first wavelength light, so as to exclude therefrom all video signal content not coincident with the mask signal, to form a residual picture signal, corresponding only to the end face.

7) separating those parts of the residual picture signal which relate to lighter coloured (or lighter grey) regions of the end face, from those parts which relate to darker (or darker grey) regions of the end face, to leave a partial video signal relating only to one or the other type of region.

8) computing the total area of the end face from the residual picture signal or the mask, and the total area of the regions of the end face corresponding to the partial video signal, and

9) computing a grade value for the product from the area value of the end face and the area value from the partial video signal, and comparing the grade value with at least one preset numerical value, and directing a subsequently cut slice of the product to one or another of two or more collection points depending on the grade value computed for the end face of the product from which the slice has been cut.

The video signal may comprise or be converted to a monochrome grey level signal, and step (7) is performed by thresholding.

Where the video signal is a colour signal the separation of step (7) can be performed on the basis of colour.

The invention also lies in a slicing machine in combination with a vision system as aforesaid.

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The invention also lies in the combination of a slicing machine a vision system as aforesaid when adapted to operate in accordance with the foregoing method.

The invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a slicing machine embodying the invention;

Figure 2 is a perspective view to an enlarged scale of the cutting region of the machine of Figure 1 with the safety covers removed showing the blade, delivery conveyor and a product collecting jump conveyor;

Figure 3 is another perspective view of the cutting region from a different angle showing the laser housing, the camera housing and the illumination light source;

Figure 4 is a further perspective view of the cutting region, from above, showing the extent to which the light from the illuminating light source will illuminate the blade and the cut end face of the product and the immediate environs of the blade;

Figure 5 is a view from above, with the cover removed, of the laser source;

Figure 6 is a view from above, with the cover removed, of the camera housing;

Figure 7 is a diagrammatic illustration of how the laser source, illuminating light source and camera interact to provide signals for processing, and for display on a monitor screen;

Figure 8 illustrates one of the screen displays which can be obtained on the monitor;

Figure 9 is a side elevation of the machine shown in Figure 1 and shows the general position of the lasers;

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Figure 10 is a block schematic diagram of the vision system, video signal processing stage and controls for the machine of Figures 1 et seq;

Figure 11 is a timing diagram which should be read in conjunction with Figure 10;

Figure 12 is a screen display produced by image signal from a camera viewing a cut end face of a side of bacon at the end of a delivery conveyor with lines of red light crossing the cut end face at approximately 45° relative to the plane of the delivery conveyor, in which the camera image signal has been electronically gated to remove signal content of objects in the field of view of the camera but not in the immediate vicinity of the end face;

Figure 13 is a screen display of the coarse mask which remains after thresholding the signal corresponding to the area crossed by the 45° lines, from the signal corresponding to the remainder of the end face image;

Figure 14 is the image signal obtained by eroding and then dilating the signal producing the outline of Figure 13, to remove small dark islands separated from the main region which is crossed by the 45° lines, to produce a final mask signal corresponding to the shape of the end face of the product;

Figure 15 is a screen display showing the end face of a side of bacon on the delivery conveyor illuminated by green light;

Figure 16 is a screen display of the signal remaining after the signal which produces the Figure 15 image is gated by the red mask signal of Figure 14, to allow the areas of the darker and lighter regions of the end face to be computed.

The slicing machine in Figure 1 is shown with all the safety covers in place, and comprises a housing 10 within which an inclined product delivery conveyor (not shown) is located, a product exit 12 through which a collection conveyor (not shown) extends, onto which cut

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product is delivered, and a control panel 14. The covers are denoted by 16, 18, 20 and 22.

With covers 16 and 18 removed as in Figure 2, the lower end of the inclined delivery conveyor 24 can be seen through an opening 26 in a plate 28 on which is mounted a slicing blade 30 which is rotated in use by a motor (not shown) mounted to the rear of the plate 28. The drive shaft is visible at 32 and the blade is located on the shaft in a conventional manner by being sandwiched between discs such as 34, and secured in place by a nut 36.

In front of, and to the left of the blade, is a camera housing 38 with removable cover 40, and in front and to the right is a laser housing 42 with a removable cover 44.

Also to the right of the blade and located nearer to the blade is a lamp assembly 46 for illuminating the lower end of the delivery conveyor 24.

The housings 38 and 42 are supported by frame members 39 and 43 and the lamp assembly 46 is carried by the cover 18

The two housings 38 and 42 are joined by a rigid arm 48 and the lamp can be seen at 50 in both of Figures 2 and 3.

In front of the lamp is a window assembly 52 which includes one or more filters such as 54 (see Figure 4) so as to remove any red light wavelengths from the light passing through the window 52.

The lamp 50 may be a filament lamp but is more preferably a halogen bulb having an integral reflector which produces a diverging beam of generally white light. A filter can be employed to remove all wavelengths except green or blue light, so that the end face of the product will be illuminated by light whose wavelength is very different from that of the red end of the visible spectrum. The illumination can be seen emanating from the window, as a diverging beam 56.

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Within the housing 42 are two red lasers 58, 60 best seen in Figure 5. Each produces a slightly diverging beam of red light which is split into a plurality of parallel spaced apart thin lines of red light using an integral grating or mask.

Two lasers are used so as to produce a sufficient number of parallel lines across the field of view, to encompass the whole of the end face of the product, which as shown comprises a side of bacon. Other product could be lamb or pork which is to be sliced into steaks or chops, beef which is to be sliced into steaks or cheese which is to be sliced. The use of two lasers can result in supernumerary lines and these are masked by one or more plates in the housing 42, so that one pattern of lines from one laser can be positioned next to that from another laser without he supernumerary lines from one laser corrupting the pattern of lines from the adjacent laser.

Typically the two lasers produce 15° divergent beams and together produce a total of 66 lines, at a spacing of 5mm on the product end face, in which the lines lie at 45° to the front end of the delivery conveyor (which corresponds to the plane of that conveyor at that point along its length, and which will normally extend generally horizontally).

However the number of lines, the spacing, the 45° angle and the number of lasers is a matter of design choice, and the invention is not limited to the illustrated arrangement of 2 lasers.

By projecting the spaced apart parallel lines of light from the side of the product delivery conveyor at an angle towards the end face of the product which is generally perpendicular to the plane of the delivery conveyor, the lines will appear orientated at 45° on the end face. However, as shown in Figure 12, as the lines of laser light leave the end face and begin to traverse the visible upper surface of the product, which is generally parallel to the plane of the delivery conveyor, and therefore at approximately 90° to the end face, they will change direction and trace a corresponding number of generally parallel lines at a rather different angle from that which the lines traverse the end face of the product. In

NSDOCID: <WO 2006136814A1 I >

Figure 7 the end face of the product (typically a side of bacon) is denoted by 62 and the laser lines traversing the end face are denoted by 64, those traversing the upper surface of the product are denoted by 66 and those traversing the generally flat upper surface of the delivery conveyor by 68.

The exit end of the conveyor is protected by a plate 70 defining a straight edge 72 which also constitutes the shear plate for the blade 30. The left hand end of the conveyor (as viewed from the lasers) is defined by a plate 74 which defines a second straight edge 76 perpendicular to the edge 70, against which the left hand end of the product is abutted.

A camera 78 is shown in Figure 6, located within 38, which views the illuminated region.

The straight edges 72 and 76 define the bottom and left hand edges of the field of view of interest (as seen by the camera 78), and its field of view is further delineated by an aperture 80 in a wall 82 located in front of the front wall 84 of the camera housing 38. The wall 84 also includes an aperture 86. The camera is adjustable in height, inclination and angle by being mounted about a 3-axis assembly generally designated 88.

The camera 78 is also shown in Figure 7 and the view seen by the camera is shown in the screen display on the monitor 90 which forms part of the control panel 14, shown in Figure 1. The displayed image shows the upright and transverse plates 74, 70 and the end face 64 of the product.

Typically a device such as an upper conveyor or thrust bar (shown in dotted outline at 92 in Figure 7) overlies the upper surface of the product but terminates a short way back from the end face so as to be well clear of the path of the blade 30. Any such device will also present a face on which the laser light can form lines, and at least some of the end of the device can be generally parallel to the product end face 68, so that the red laser lines will traverse 92 at a generally similar angle of inclination as they traverse the end face 68.

BNSDOCID: <WO 2006136814A1 I >

There is also a region to the right hand end of the product end face which may contain other parts of the machine which can produce spurious reflections of red laser light, some of which can be at a similar angle to that of those traversing the end face 68.

However it is possible to electronically gate out the signals in the video signal from the camera 78 in a vision computer and signal processing stage 94. The signals sent to the monitor 90 are limited to those arising within a generally rectangular area defined by an electronically generated, generally rectangular, window shown dotted at 98 in Figure 7. The left hand and bottom edges of the window are set to correspond to the straight edges 74 and 70. The upper and right hand edges are set manually, or automatically by window defining software or firmware in 94, relative to the left hand and bottom edges 76, 70. Digital output signals from 94 are sent to a PLC 96 (in Fig 7) and comprise a thickness signal with grade variables such as height, width, lean fraction - muscle length. Items 94 and 96 will be described in more detail in relation to Fig 10.

It will be appreciated that since plates 74 and 70 are fixed relative to the machine and therefore the camera 78, their x,y coordinates in the camera field of view will be constant, and the left hand and bottom edges of the window 98 can therefore be defined with reference to x and y coordinates within the photosensitive device (not shown) in the camera 78.

If the latter is read out on a pixel by pixel basis the x,y coordinates are definable by reference to the pixel matrix of the photosensitive device in the camera.

If the video signal is produced by line scanning at a constant scan rate, to allow different points on the photosensitive device to be defined by time lapse from the beginning of a scan, the x,y coordinates of the left hand and bottom edges 74, 70 (and therefore left hand and bottom edges of the window 98) can be defined in a similar time-related manner.

NSDOCID: <WO 2006136814A1 I >

In a similar manner, the x,y coordinates of the top and right hand edges of the window 98 can be defined with reference to the pixel matrix, or by reference to lapsed time from the beginning of a scan.

The camera includes a lens 100.

In order to prevent spatter and debris produced as the product is cut by the blade 30, from obscuring the camera 78 or any window in front of the lens, a curtain of moving air 102 from a source 104 is created in front of the camera, and in particular in front of a polycarbonate protective window (not shown) located in front of the lens 100.

A heater 106 is also provided to warm the air in the region of the camera, to reduce condensation and prevent the lens or window 100 from misting up when the machine is operated in a low temperature environment, as may be required if the product is a foodstuff that needs to be kept below a particular temperature such as 4°C or lower.

Where the product is not of uniform height from left to right (as in the case of bacon, lamb, pork or beefsteak) the product compressing device 92 may be adapted to follow the general trend of the product cross section, and in that event may extend across the camera field of view non-parallel to the straight edge defined by 70. In that event the upper edge of the window 98 may be adjusted either manually, or automatically within 94, so as to follow the inclination of 92. Alternatively a further smaller window may be electronically generated, typically within 94, in which the upper edge is inclined relative to the lower edge, so as to correspond to the inclination of 92, and the signals released by the first window are gated by the further smaller window.

The effect of the further smaller window can be seen in Figure 8, in which the generally rectangular primary window is designated by 108 and the further window by the slanting upper edge of the outline 110, in the screen shot of a display on the monitor 90.

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Figure 9 shows diagrammatically the inclination of the delivery conveyor housing 10, the position of the lasers 58, 60 and the blade 30, and of adjustable feet 112, 114 by which the machine can be levelled, and/or raised or lowered. This allows it to be aligned with an exit conveyor (not shown) which accepts cut product from a jump conveyor 116 (see Figures 2, 3 and 4) onto which slices of product fall after being severed from the leading end of the product on the delivery conveyor. A jump conveyor is described in US Patent 5125303.

The described system allows full illumination of the end face without the need for complex lighting arrangements. The illumination can be from a white light source, a monochrome source or from two or more sources of differing colour to obtain good contrast between different features of different types of product.

In particular, by using a laser wavelength which is very different from the wavelength light used to generally illuminate the end face it can be differentiated from the remainder of the field of view, and video signals relating to the end face are separated readily from video signals relating to the rest of the field of view, to provide signals on which image processing can be performed to assist in identification and quantification of features within the cut face.

The face of the product is protected from sources of light other than those described above in order to produce the clearest possible images. This is conveniently achieved by the covers such as 16,18 and slicer guards (not designated) which enclose the containing the product delivery conveyor and the camera and light sources.

In the slicer control system of Figure 10, images of the product are captured, ideally by the system which will be determining the slice thickness and thereafter doing the grading. A camera may be located in a position which is close to where the slicing is to occur to obtain images which are close enough to the slicing station to start a classification process.

The camera 78 provides images to a signal pre-processor 118 for supply to a vision computer 120 (94 in Fig 7). This includes a frame grabber 122 and performs separation

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by colour to produce Red and Green image data in 124 and 126. Signals are grabbed in response to trigger signals from the sensor 128 which in turn is triggered by the rotation of the blade 30.

A gating device 121 is controlled by signals from a control unit 123 which in turn is controlled by data from a memory device 125, which is triggered to release data stored therein by signals from the blade sensor 128 using the camera readout scan as a timebase synchronising signal. The operator control terminal 14 may used to enter the data in the memory device corresponding to the size and position of fixed objects such as machine and delivery conveyor parts in the camera field of view. Alternatively the data may be obtained from an image signal from the camera 78 when set to view only the end of the delivery conveyor when no product is present. In either case the data is such that when read out in synchronism with the blade rotation and the camera readout, it can be employed via 123 to inhibit image signals relating to the fixed objects from reaching the Red image signal processor 124.

Appropriately positioning 128 ensures that the camera only images the end face 68 when the blade 30 is clear of the face 68, as shown in Figure 2.

The green image signals in 126 are gated by an electronic mask/gating signal obtained from 124 to leave only image signals of the product cut face. These are then analysed further in 130 to measure the area of fat and the area of lean. Mean density values for fat and lean meat together with the fat and lean area measurements may be used to calculate in 130 the thickness to which a slice must be cut to give a particular weight. Module 134 forms part of the PLC 96 of Fig. 7, and provides signals to servo amplifiers 136 to control servo motors 132 which control each slice thickness.

The height, width and lean fraction of the end face are determined from the parameters of the end face area image signals in a feature classifier 138. Signals from 138 pass to 134 and also to other logic in 140. This determines whether a desired feature is present in the image of the end face and if so what its key dimensions are using vision processing calliper

BNSDOCID: <WO 2006136814A1 >

tools. The values of these key dimensions allow a grading of the next slice, and the grade decision is passed to an array of gates 142 to control the delivery of the next slice to be cut, to an appropriate packing station 144.

The logic 140 compares the grade information from 138 with a series of pre-set thresholds for each parameter. Depending on the pre-set threshold settings, the slice (or a pack which is to contain two or more slices) is tagged as a reject, or a Grade A, B or C etc, and is diverted into the appropriate packing station(s) which process that grade of product.

Reject statistics are compiled in 141.

Data classification has been one of the important elements in the growing field of Artificial Intelligence (AI) and machine learning. In the general case the machine is presented with a set of inputs that represent some data point, and is asked to suggest an output (classification) based on a set of pre-stored conclusions (information usually referred to as a knowledge base).

Perhaps the most important feature of any classification algorithm in the realm of machine-learning is its ability to build a "knowledge-base," based on a set of training data, or in other words, to learn. A training data set may for example encompass thousands of images (the inputs) which are pre-classified (by a human operator) in an off-line procedure, into different score-groups (the outputs). Using a method known as supervised learning, the algorithm parses all of these input/output pairs and attempts to determine (ie to "learn") the function that appropriately maps the inputs onto their corresponding outputs. Using a formal learning method, it builds some knowledge that is based on the training set which can later be used to classify other data into sets. Usually characteristics (known as vectors) of the inputs are identified as determining the particular score for any input, and these vectors are looked for in the future inputs.

In the realm of supervised learning algorithms, there are many options. Neural Network and State Vector Machine (SVM) systems have been successfully implemented and enjoy

ISDOCID: <WO 2006136814A1 | >

widespread use. SVM's appear to have very good generalisation behaviour, which is a learning machines ability to draw conclusions from learning samples and apply them to other pattern instances, which it has never seen before.

An SVM based system is employed in the off-line classifier incorporated into the present system of figure 10. The preferred SVM based system is the MANTO system (particularly MANTO 2) as developed and supplied by Stemmer Imaging of Germany.

At the heart of the MANTO system there are two components: One is a non-linear multi-resolution filter (MRF) for image-preprocessing, which detects relevant features at different scales and transforms image information into a feature vector. The other ingredient is a learning and pattern classification algorithm, based on the technology of support vector machines (SVMs), as has been developed at various universities and research laboratories.

The MANTO system recognises an image pattern by first applying an MRF to the image and then feeding the resulting feature vector into SVM, which then decides on class membership and quality. The knowledge which enables MANTO to do this is contained in a data-structure called the MANTO-classifier (MCF), which contains the MRF parameters and the knowledge obtained by training from lists of learning samples. MANTO 2 allows the classifier to determine and express how nearly an image represents an instance of particular classification (regression). A probability can be given to this, producing a sliding scale for the feature property of interest. e.g. if a bacon muscle is between 75mm and 100mm long, but nearer 100mm, the MANTO 2 system might assess its length as 92mm.

To this end threshold values for the comparators and logic in 140 are obtained using state vector machine (SVM) techniques. In particular 138 comprises a state vector machine (SVM) based feature classifier. This allows images to be classified according to the presence or absence of feature(s) (vectors) of interest, and further classified according to the properties and dimensions of feature(s) of interest, eg the shape of the end face and/or

PNSDOCID: <WO 2006136814A1 I >

of the length of a particular individual, region common to the end faces, such as a region of muscle in bacon.

The grade attributable to a slice to be cut, obtained from 138, may be used to direct the slice thickness calculation in 134 such that one grade of product is sliced at a different thickness from other grades. This would generate, as an example, differing fixed weight slices or packs, for different grades of product.

Items 150, 152, 154 and 156 comprise a suite of off-line classifier building and testing tools which assists with the classification, in that a person can perform a classification visually, and identify whether a desired feature is present or not. If the feature is present, a line can be drawn on the screen image showing a dimension of the feature, using a mouse or tracker ball device. The length of the line is measured and recorded in 150 and 154. The image signals can be scaled to real world dimensions so that the length extracted from the drawn line can be displayed and saved in conventional units of length with an image of the product end face on which the measurement has been made.

Collection of data from specimen product end faces is undertaken prior to operation of the machine, and can be done on initial installation and left, or performed when the machine is to be used to slice a new batch of product, or completely different product.

A check on the decision-making accuracy of 138 can be performed off-line by running a software program to present data of previously classified images in 150 to classifier logic in 154 in order to analyse its performance. Batches of images can be processed to produce statistics on the classifier accuracy.

The system shown in Figure 10 also includes a grading supervisor module 146. This is supplied with data from 144 and a check weigher 148 so as thereby to monitor the numbers of product slices or packs being classified into each grade. The grade acceptance thresholds in 140 are controlled by 146 which in turn can be altered by signals from the control terminal 14 so as to override neural classifier produced criteria, so that a constant

NSDOCID: <WO 2006136814A1 I >

throughput can be maintained if desired, whereby a given grade will always be the same percentage of the overall output. In this way minor variations in input product characteristics will not result in increased percentages of slices or packs graded as rejected or a lower grade. Using such a technique, the acceptance thresholds can be adjusted so that for example a similar percentage of product will be placed into each grade category irrespective of the actual input quality, and the properties of each grade will change according to the properties of the input material.

Product end-face image data from the frame grabber 122 is not only supplied to 124 and 126, but is also available for storing as a plurality of classified images in a product analysis tool 150 which collects and classifies product images from 122. Image files of differently classified product end faces are stored in 150, with the related feature classification information. A classifier structure control tool 154 determines parameters by which image signals relating to end face parameters can be classified by 138 and supplies these to 138. Product grade is determined in 138 and the grade information is sent to the grade threshold and comparator logic 140. The output from 140 comprises product grade command information for controlling sorter gates for cut product, as previously described.

The classifier structure control tool, 154 also provides data for off-line software testing by 156. Pre-classified images, can be used in 156 to optimise the classifier rules in 154 to in turn alter grade determination by 138. The threshold data in 140 can therefore be updated fully automatically without operator intervention or manually by allowing operator input commands from 14 to override data stored in 140 in response to statistics displayed by 14 (typically but not exclusively by the monitor 90) to the operator. These could show that an inappropriate set of thresholds is being employed in 140 following a change of circumstances, or input product, or customer requirements.

Figure 11 shows the occurrence of camera operation and signal processing events in relation to blade position. Where the machine operates to deliver the product to the cutting station at a constant rate, the slice thickness is controllable by altering the time delay between cuts. This may be easily achieved by driving the blade 30 through a variable

BNSDOCID: <WO 2006136814A1 I >

speed drive, and slowing down or speeding up the blade after a cut has been made, so that more or less of the product has been advanced into the path of the blade before the latter next enters the product.

Where the blade speed is not controllable the thickness adjustment is made by speeding up or slowing down the delivery conveyor, so that more or less product has been advanced through the cutting plane before the next cut is made.

The present invention is applicable to either technique, but the latter is the preferred one.

From Figure 11 it will be seen that the high speed data capture and processing is possible using a CCD camera and a high speed computer. This can enable a decision on slice thickness to be made in the time interval after the blade 30 leaves the product and before it has rotated to the position at which it will next enter the product.

Figures 12 to 16 illustrate what will be seen by the operator on the monitor display 90 depending on which stage of processing the video signal is derived from for display, and

- Figure 12 shows the red image before processing by 124 to exclude non-45° red lines,

- Figure 13 shows an intermediate stage in 124 after thresholding the video signal of Figure 12,

- Figure 14 shows the output from 124 after eroding the signal of Figure 13 to remove small unconnected detail and dilating the resulting signal to merge the components into a single monochrome shape, corresponding to the shape of the end face of the product, so as to exclude any extraneous features from the image,

- Figure 15 shows the original colour picture image without any processing.

WPDOCID: <WO 2006136814A1 >

- Figure 16 shows the result of gating the signal of Figure 15 with a window or mask generated from the signal of Figure 14 and thresholding so as to convert to white those parts of the video signal which relate to light coloured regions of the signal of Figure 15, and to convert to black, those parts of the video signal which relate to grey regions in Figure 15. This thereby yields a two phase representation of the end face, in which lean regions of the product are black and fat regions are white. The lean regions can be quantified by appropriate processing of the "black" signal content of the signal producing the Figure 16 display.

If the area of fat is required the signal producing Figure 16 can be inverted so that lean regions are white and fat appears as black, and the black area quantified by appropriate processing of the black signal content of the inverted signal.

The area of the whole of the end face can be obtained by adding the computed area value of lean to the computed area value of value fat.

The proportion of lean to overall area can be calculated by comparing the lean area value with the total computed area value.

The value of lean to fat is calculable by comparing the area value of lean to the area value of fat.

The height and width of the end face in Figure 16 can be measured by conventional image calliper processing in 138. The results can be sent to 140 for grade threshold comparison, as described above.

BNSDOCID: <WO 2006136814A1 >

CLAIMS

1. A vision system for viewing the end face of product mounted in a machine which in use produces measurements relating to the area of the end face and of at least one constituent part of the product which is visible in the said end face, and which comprises means for illuminating a region containing the end face and surrounding parts of the machine and scanning means for producing a video signal from an image of the illuminated region, wherein the region and end face of the product is illuminated by light of two predominantly different wavelengths, characterised by signal processing means adapted to separate out components of the video signal attributable to one wavelength and to generate an electronic mask therefrom on which measurements can be made and which can serve to gate the video signal to isolate components thereof corresponding to the said end face, memory means adapted to store information on the size and shape and position of components of the machine which in use extend into the field of view of the scanning means, whereby in use signals are obtained from the stored information and employed to gate the video signal to exclude components thereof corresponding to regions of the field of view which are known not to contain any part of the product end face.

2. A vision system as claimed in claim 1 wherein the light is obtained from two separate light sources.

3. A vision system as claimed in claim 1 of 2 wherein light of one wavelength is employed to illuminate an area which contains both the end face and surrounding parts of the machine.

4. A vision system as claimed in claim 3 wherein the area illumination is performed using green or blue light.

5. A vision system as claimed in claim 4 wherein the green or blue source comprises an

NSDOCID: <WO_____2006136814A1 I >

array of green or blue LEDs, or a filament or halogen lamp with a green or blue filter placed between it and the area to be illuminated

6. A vision system as claimed in any of claims 3 to 5 wherein the other light source is a laser light source.

7. A vision system as claimed in any of claims 3 to 6 wherein the scanning means comprises a video camera which produces the video signal.

8. A vision system as claimed in claim 7 wherein information on the extent of the end face is determined by processing an image signal derived from the electronic mark.

9. A vision system as claimed in any of claims 1 to 8 further comprising a source of white light whereby in use the whole of the region in the field view of the scanning means is illuminated by white light and the scanning means is adapted to produce a full colour video signal of the region, and the mask is used to gate the full colour video signal to remove parts thereof which do not correspond to the product end face.

10. A vision system as claimed in claim 9 wherein the gated full colour video signal of the product end face is subjected to image processing software to identify signals corresponding to at least one particular colour.

11. A vision system as claimed in claim 10 wherein differently coloured regions of the product end face are distinguished by the software by reference to colour, and measurements using further software are performed on the signals corresponding to the differently coloured regions.

12. A vision system as claimed in any of claims 9 to 11 when used to scan the end face of a piece of meat containing lean and fat regions, wherein signals relating to the latter are distinguished from those relating to the former on the basis of colour.

BNSDOCID: <WO 2006136814A1 I >

13. A vision system as claimed in claim 9 wherein the colour signal is converted to a monochrome grey-level image signal, and measurements using further software are performed thereon depending on grey-level.

14. A vision system as claimed in claim 13 when used to scan the end face of a piece of meat containing lean and fat regions, wherein grey-level threseholding tools (software or hardware) are used to determine the regions which are lean (which will tend to be dark grey) and regions of fat (which will tend to be light grey or white).

15. A vision system as claimed in any of claims 9 to 14 wherein in use software or hardware calliper tools are employed to measure the height and /or width of the product end face, and /or of different regions in the end face, and area values of the measured regions are computed.

16. A vision system as claimed in any of claims 1 to 15 wherein the following dimensions of the end face of a meat product are obtained from the video signal, namely

Overall area of end face,
Area of lean meat in end face,
Height of end face,
Area of fat within the end face, and
Width of end face.

17. A vision system as claimed in any of claims 13 to 16 wherein a ratio of lean to fat areas is computed from area values, obtained from the measurements using the further software.

18. A vision system as claimed in any of claims 11 to 17 which forms part of a product slicing machine and the measurements and/or dimensional values are sent to a slicer controller, to control the thickness of the next slice to be cut.

ISDOCID: <WO_____2006136814A1_I_>

19. A vision system as claimed in claim 18 wherein the dimensional values are also sent to slice and pack grade-level decision logic, to control down-line gates.

20. A vision system as claimed in claim 14 or 15 wherein the monochrome grey scale video signal is sent to a feature classifier which in use is adapted to return an electronic flag to indicate whether or not a desired feature can be found in the video signal of the end face.

21. A vision system as claimed in claim 20 wherein a state vector machine (SVM) based feature classifier is employed and if a feature is found to be present, its dimensions are determined.

22. A vision system as claimed in claim 21 wherein the product is a side of bacon and the classifier operates to determine if certain bacon muscle is present or not in the end face, and if so its dimensions are measured.

23. A vision system as claimed in claim 22 which form part of a slicing machine and the dimensional values are sent to a slicer controller to control the thickness of the next slice to be cut.

24. A method of assessing an end face of product which is to be sliced and routed according to the assessment which is viewed by a colour video camera set in front, but to one side of, the product end face, comprising the steps of: -

1) using substantially monochromatic light centred on each of two predominantly different wavelengths, illuminating the camera field of view to form a first picture signal containing components attributable to the two different wavelengths,

2) selecting the different wavelengths so that video signal content produced by light of one wavelength (the first wavelength) is readily separable from video signal content produced

PNSDOCID: <WO 2006136814A1 >

by light of the other wavelength (the second wavelength) on the basis of colour or after conversion to a grey scale monochromatic signal, by reference to grey level.

3) using information on the components of the machine which in use extend into the field of view of the scanning means stored in a memory means to generate a gating signal and gating at least the first picture signal so as to exclude video signal corresponding to regions of the field of view which are known not to contain any part of the product end face.

4) in a first signal processing step, processing the video signal so as to separate signal content produced by the first wavelength light from that produced by the second wavelength light so as to leave only a residual image signal relating to content attributable to the second wavelength light.

5) generating an electronic mask from the residual image signal which corresponds to the shape and size of the end face.

6) creating from the electronic mask a gating signal, and gating the video signal produced using the first wavelength light, so as to exclude therefrom all video signal content not coincident with the mask signal, to form a residual picture signal, corresponding only to the end face.

7) separating those parts of the residual picture signal which relate to lighter coloured (or lighter grey) regions of the end face, from those parts which relate to darker (or darker grey) regions of the end face, to leave a partial video signal relating only to one or the other type of region.

8) computing the total area of the end face from the residual picture signal or the mask, and the total area of the regions of the end face corresponding to the partial video signal, and

9) computing a grade value for the product from the area value of the end face and the

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area value from the partial video signal, and comparing the grade value with at least one preset numerical value, and directing a subsequently cut slice of the product to one or another of two or more collection points depending on the grade value computed for the end face of the product from which the slice has been cut.

25. A method as claimed in claim 24 wherein the video signal comprises or is converted to a monochrome grey level signal, and step (7) is performed by thresholding.

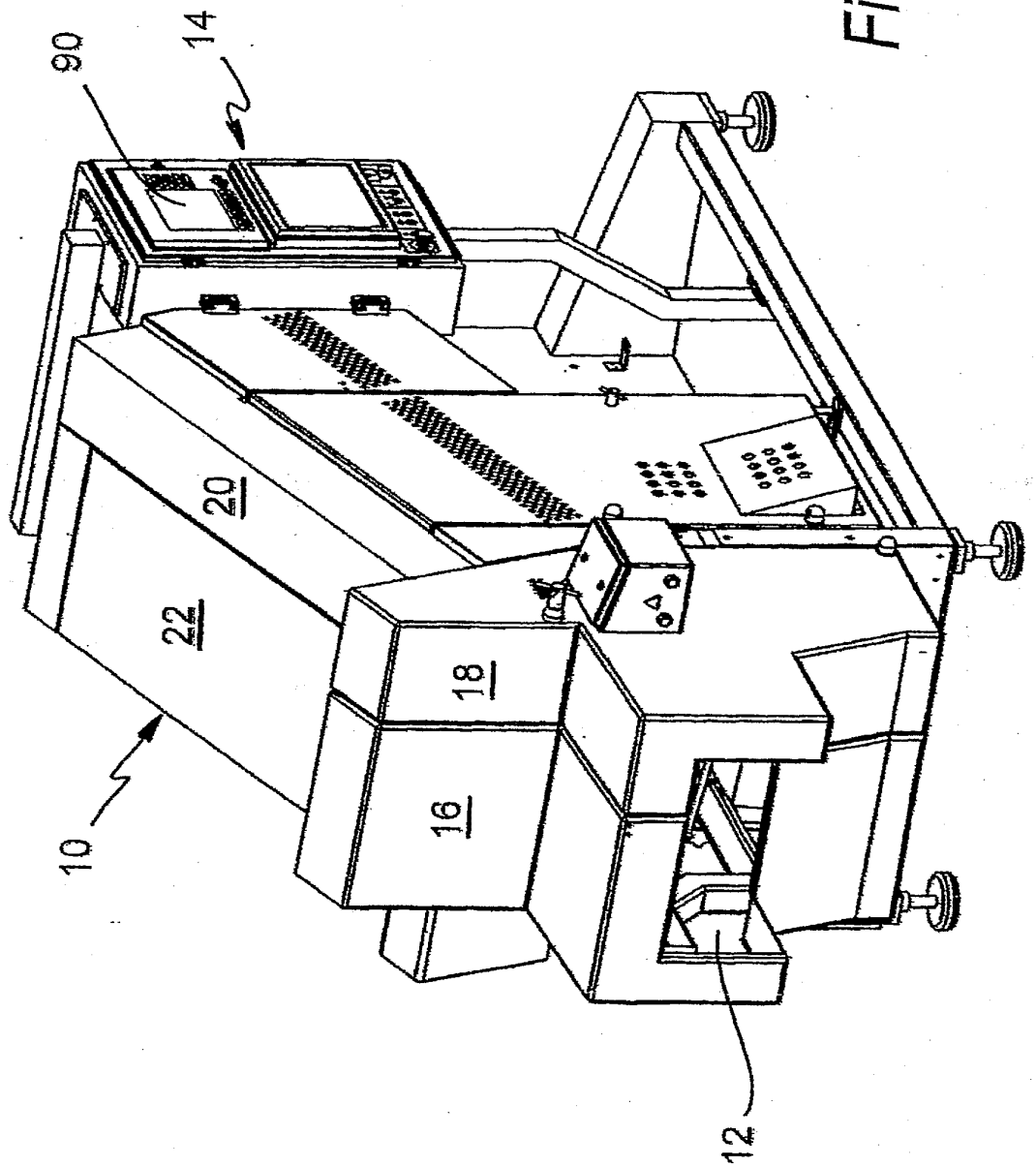
26. A method as claimed in claim 24 wherein the separation of step (7) is performed on the basis of colour.

27. A slicing machine in combination with a vision system as claimed in any of claims 1 to 23.

28. A vision system and slicing machine constructed, arranged and adapted to operate substantially as herein described and with reference to the accompanying drawings.

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Fig. 1



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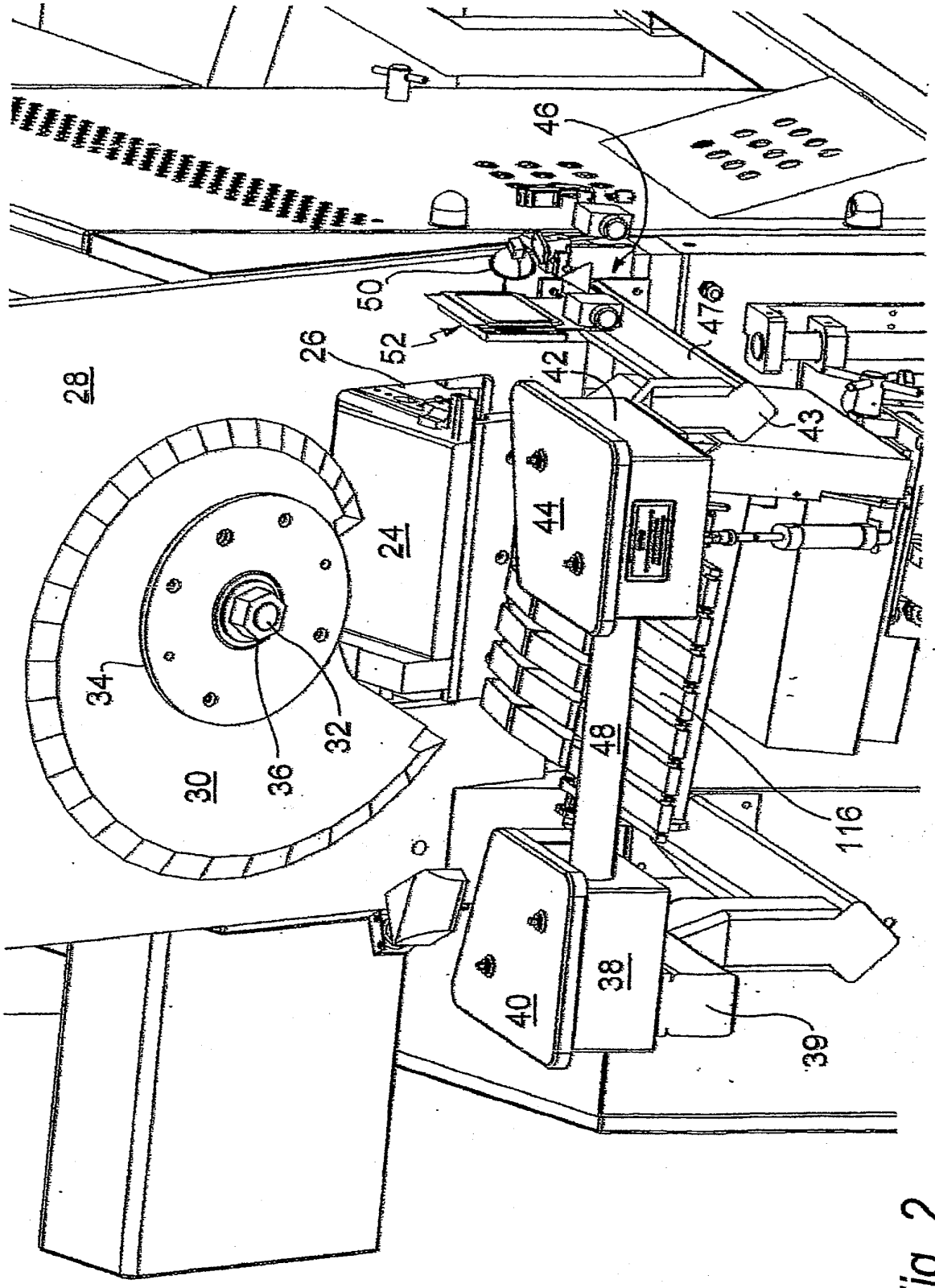


Fig. 2

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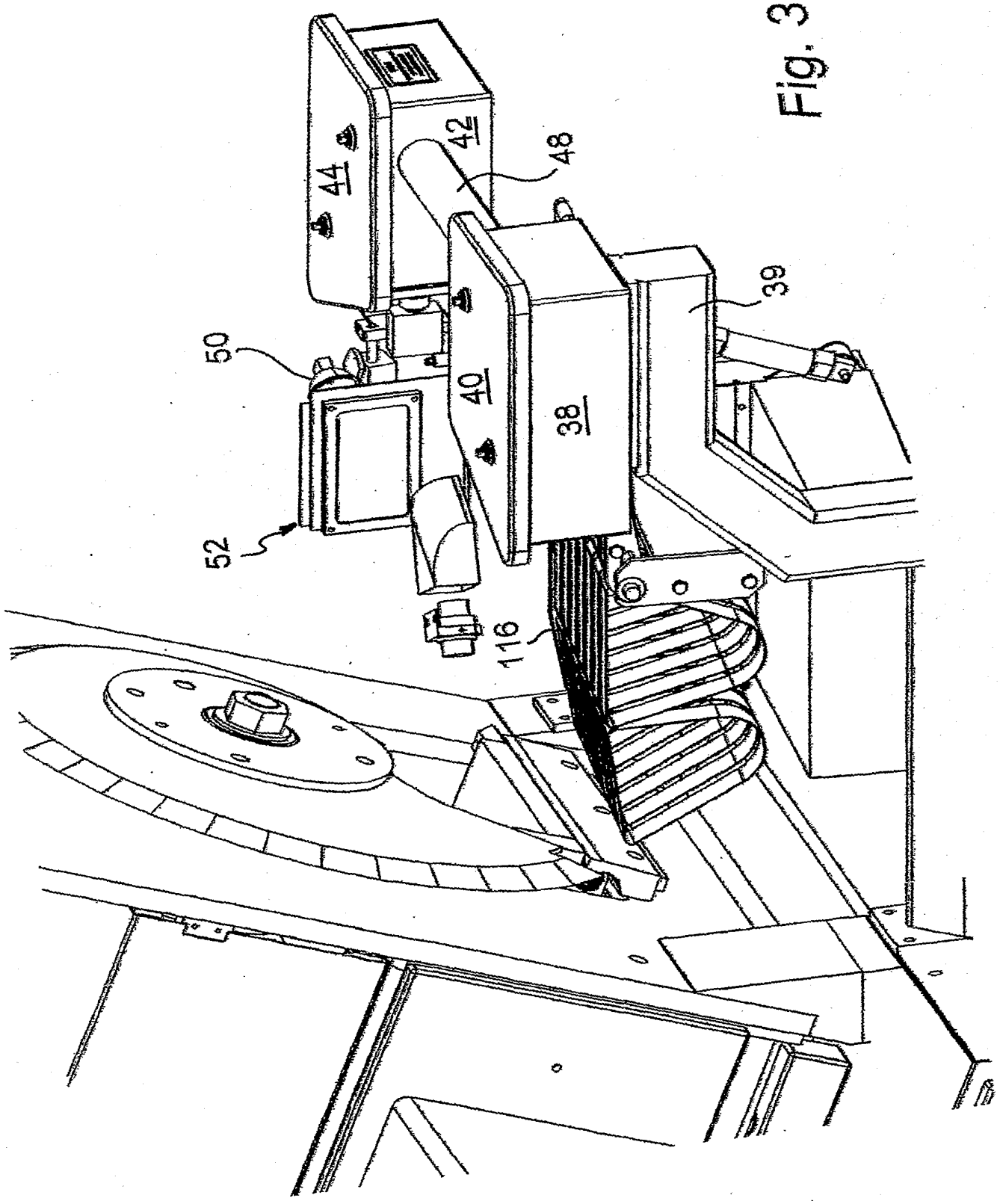
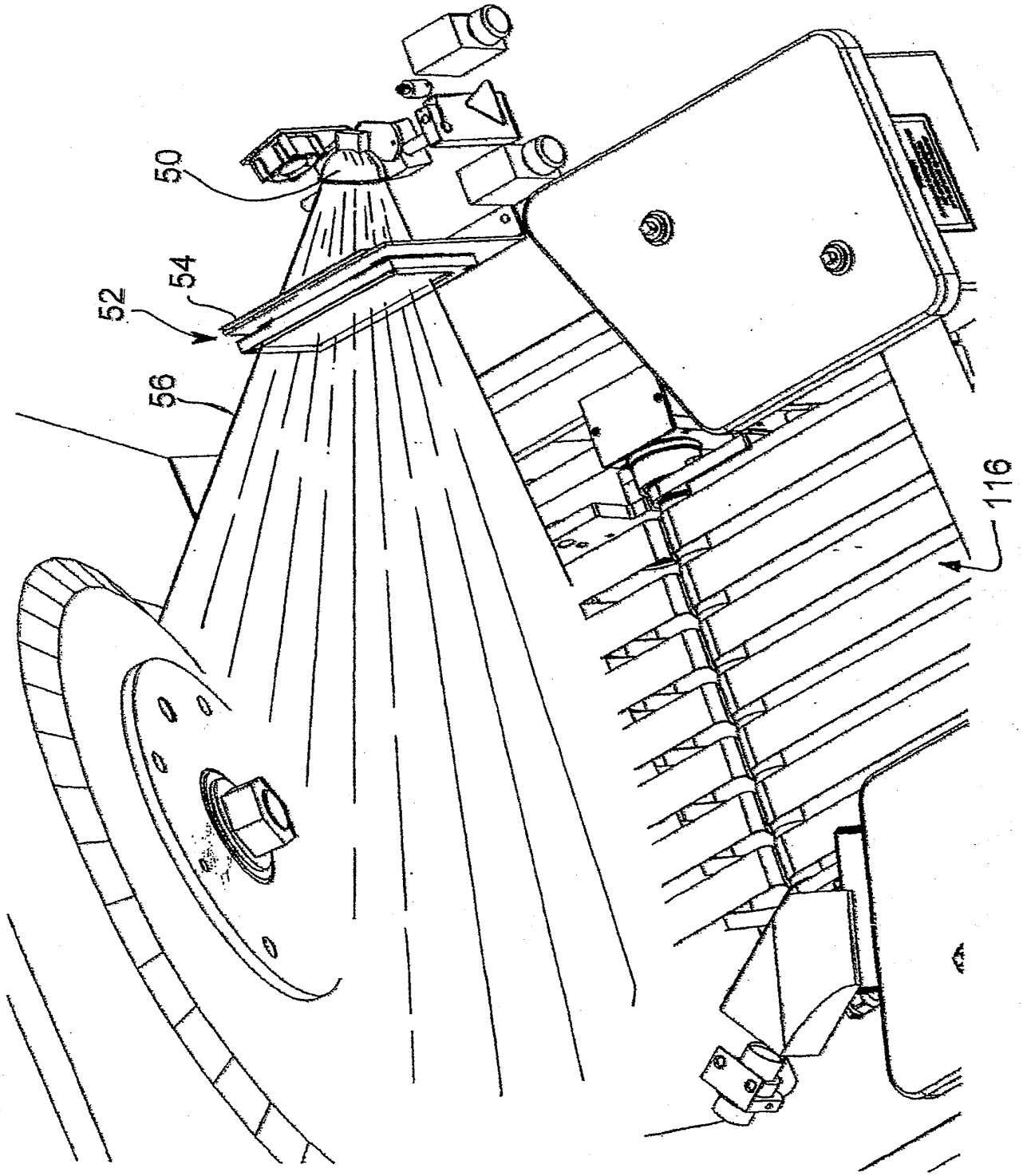


Fig. 3

Fig. 4



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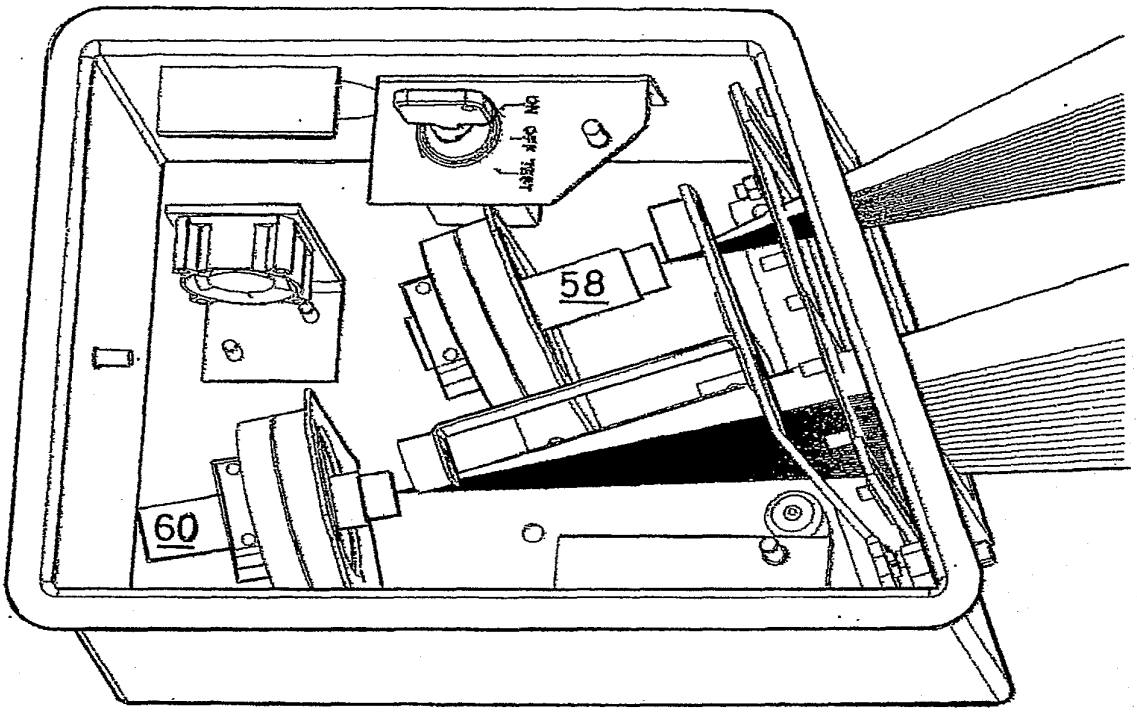


Fig. 5

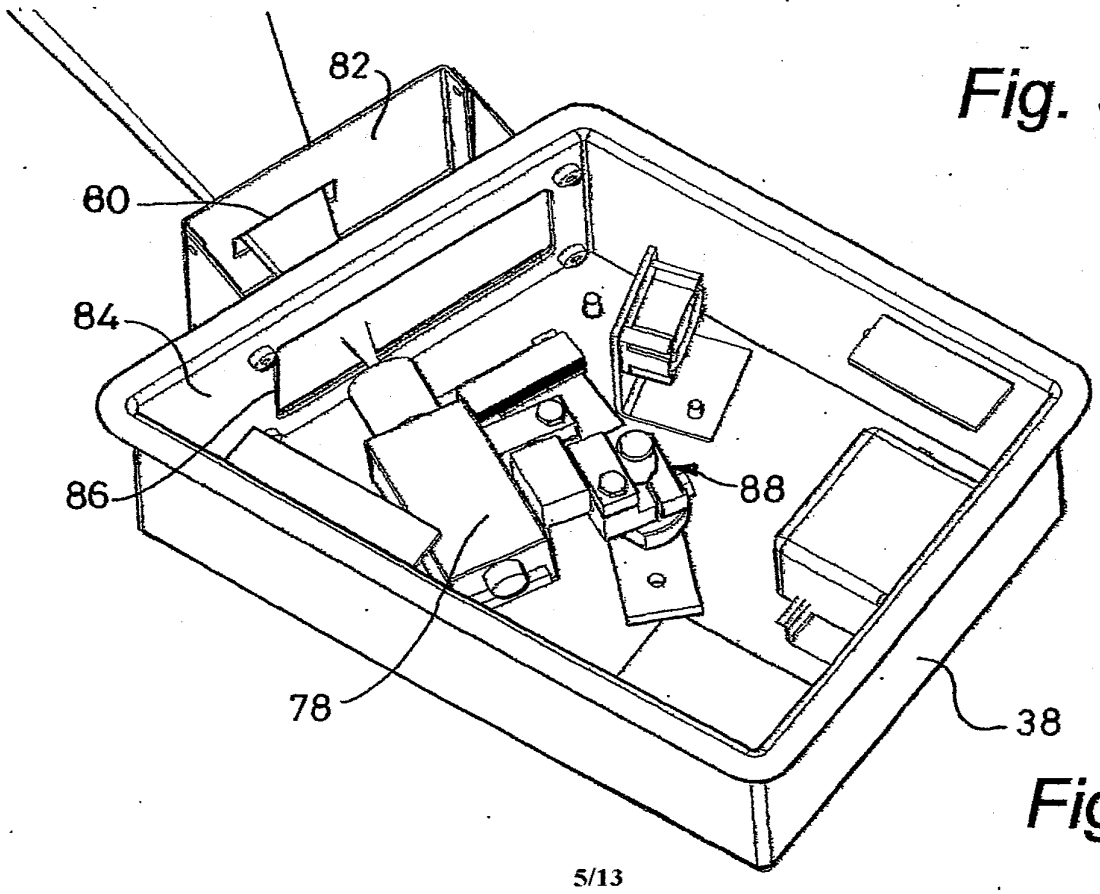


Fig. 6

ISDOCID: <WO 2006136814A1 I >

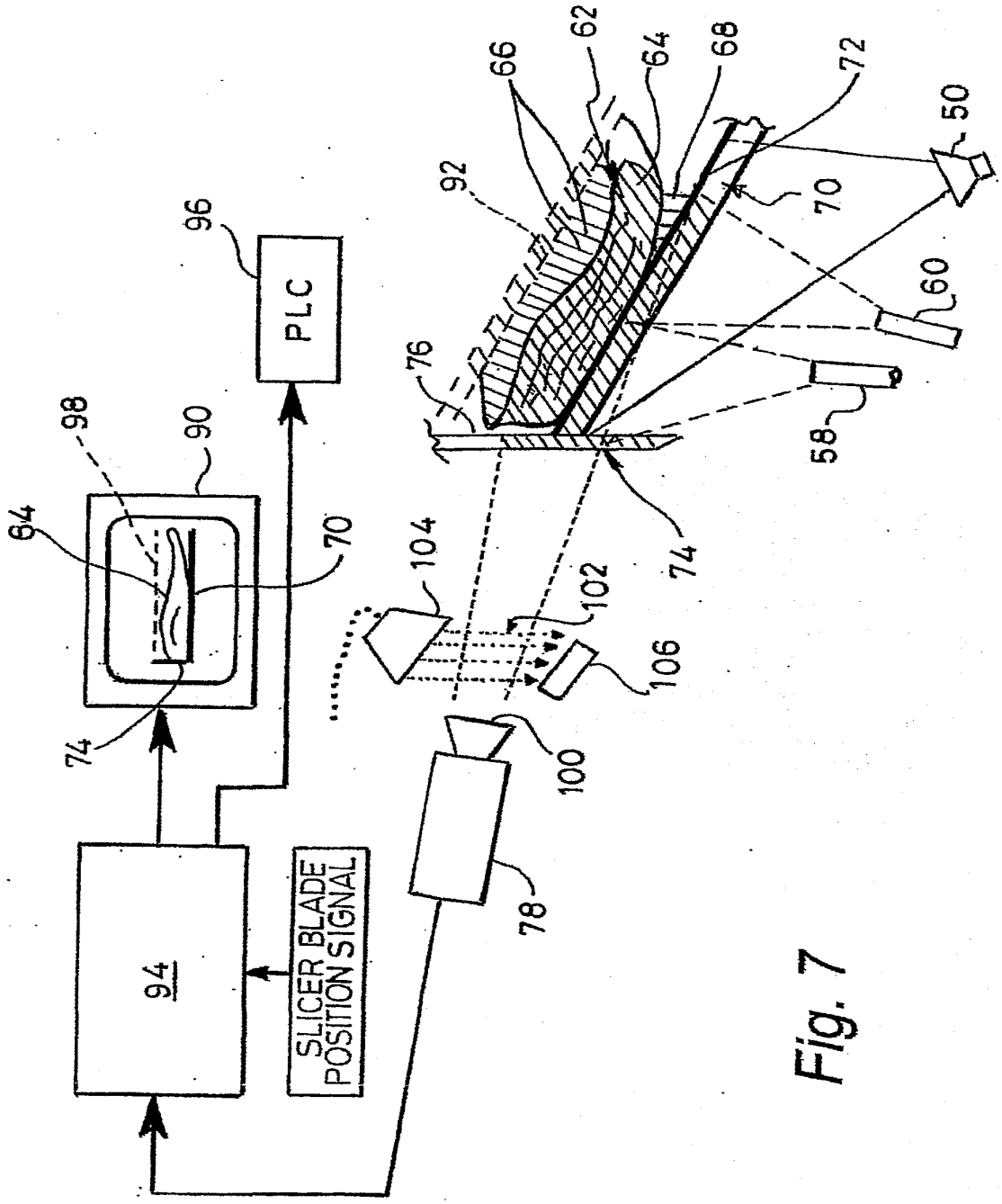


Fig. 7

SUBSTITUTE SHEET (RULE 26)

BNSDOCID: <WO 2006136814A1 I >

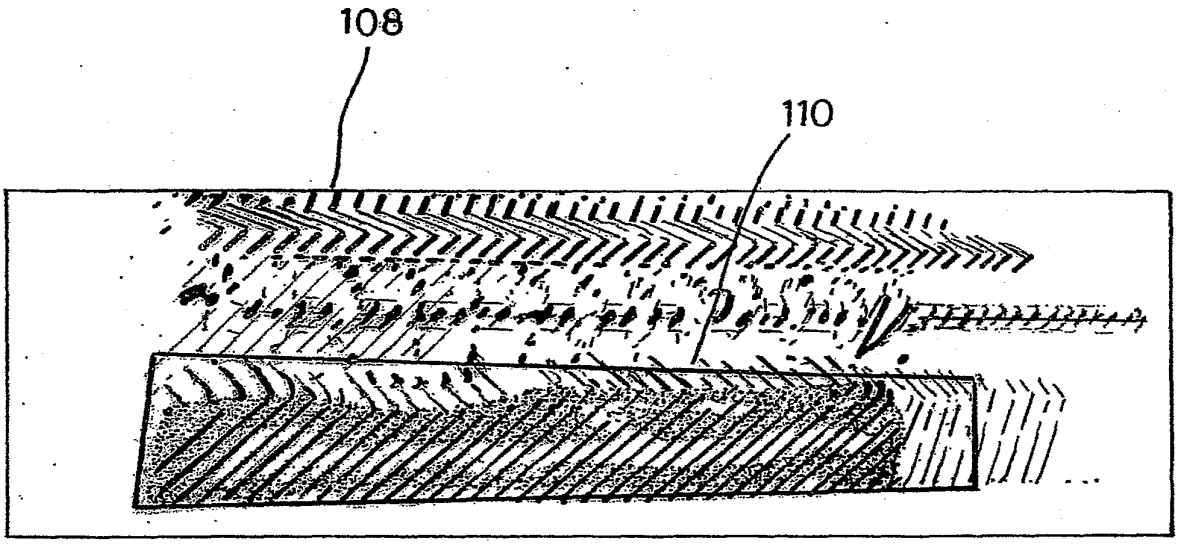
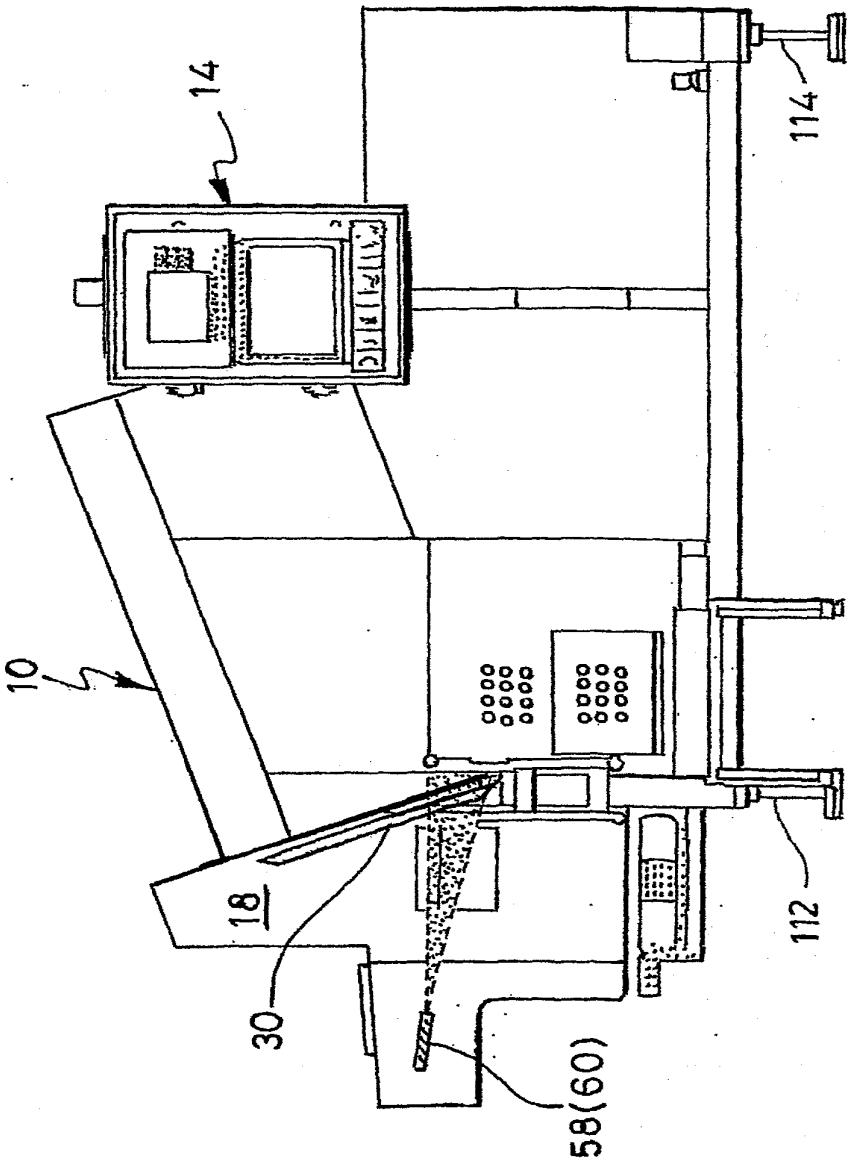


Fig. 8

NSDOCID: <WO_____2006136814A1_I_>

Fig. 9



ISDOCID: <WO_____2006136814A1 | >

SUBSTITUTE SHEET (RULE 26)

Fig. 10
Sheet. 1

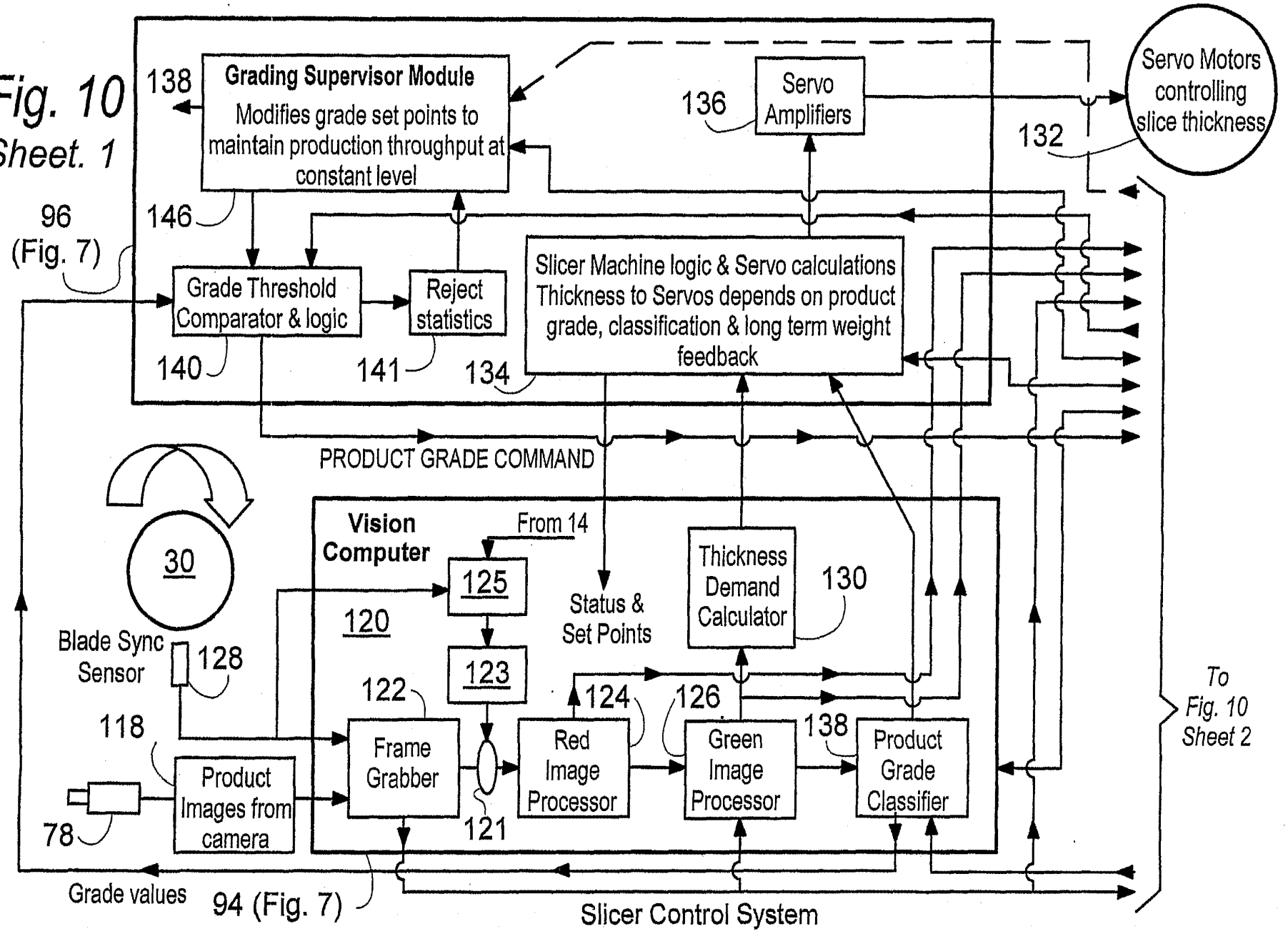
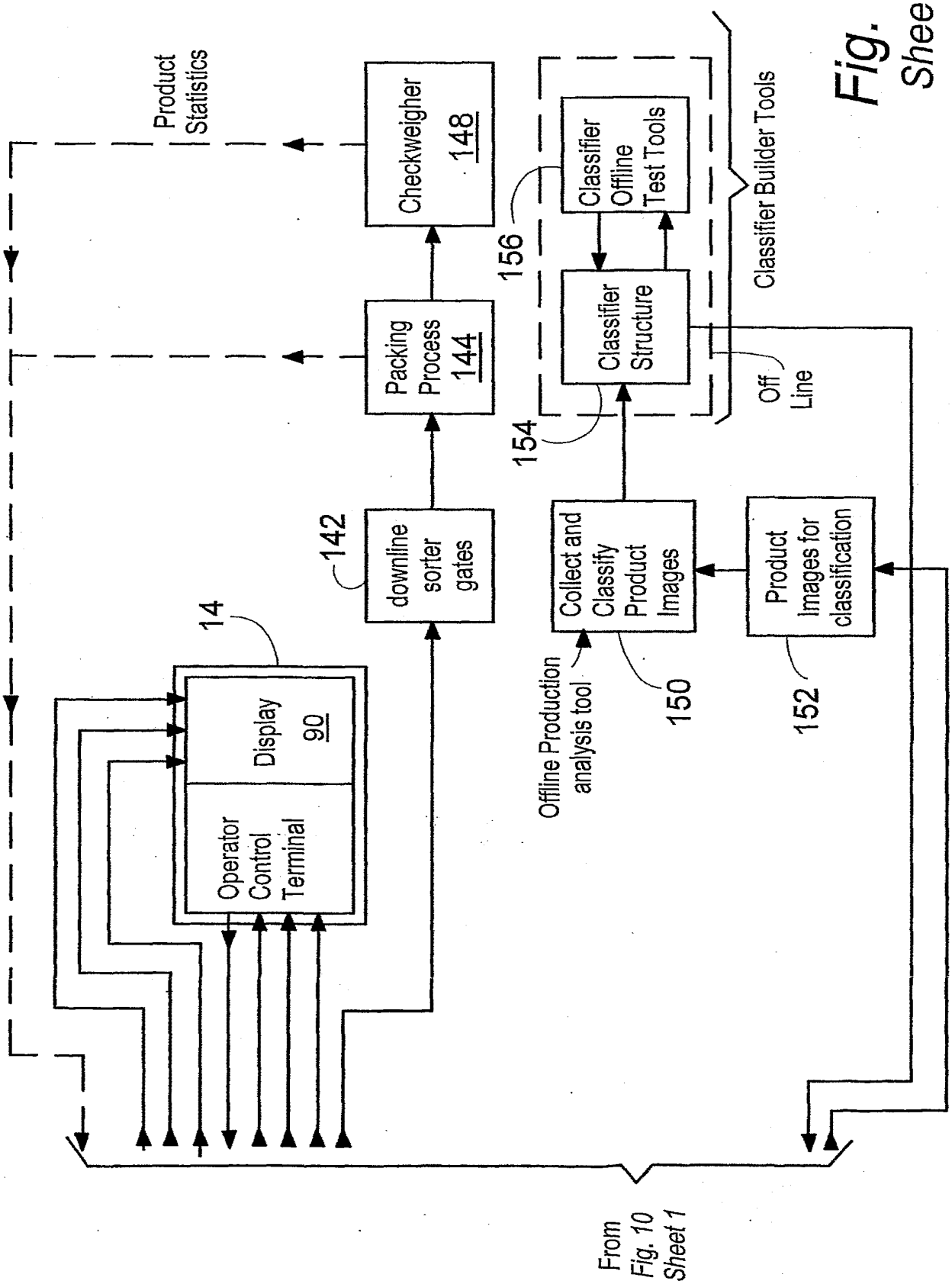
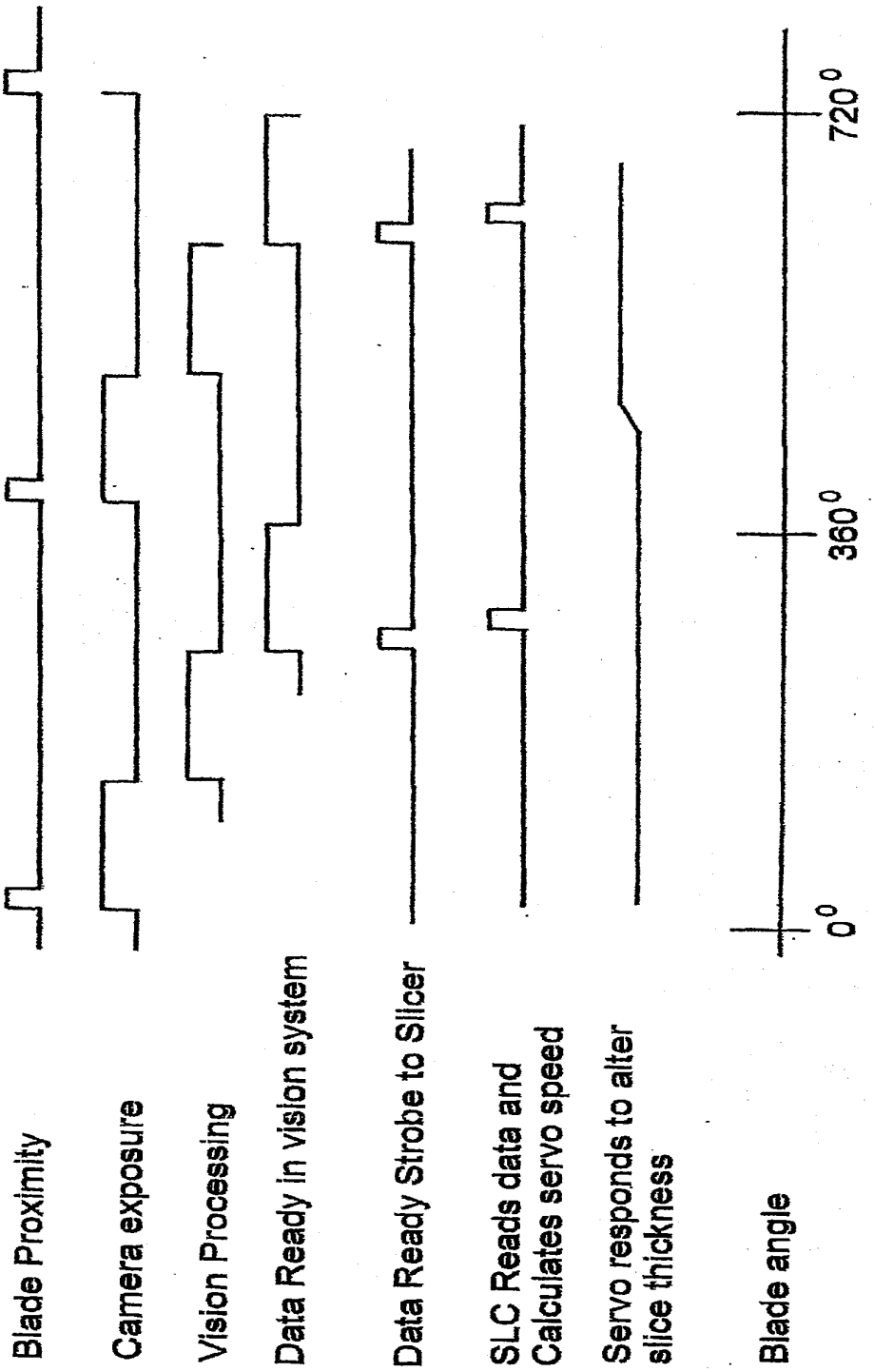


Fig. 10
Sheet 2



BNSDOCID: <WO_____2006136814A1_I_>



Timing Diagram

Fig. 11

NSDOCID: <WO_____2006136814A1_I_>

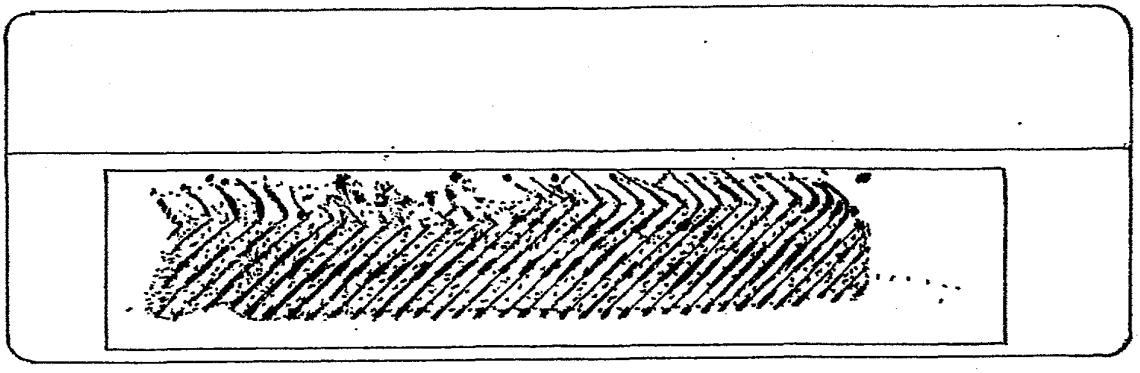


Fig. 12

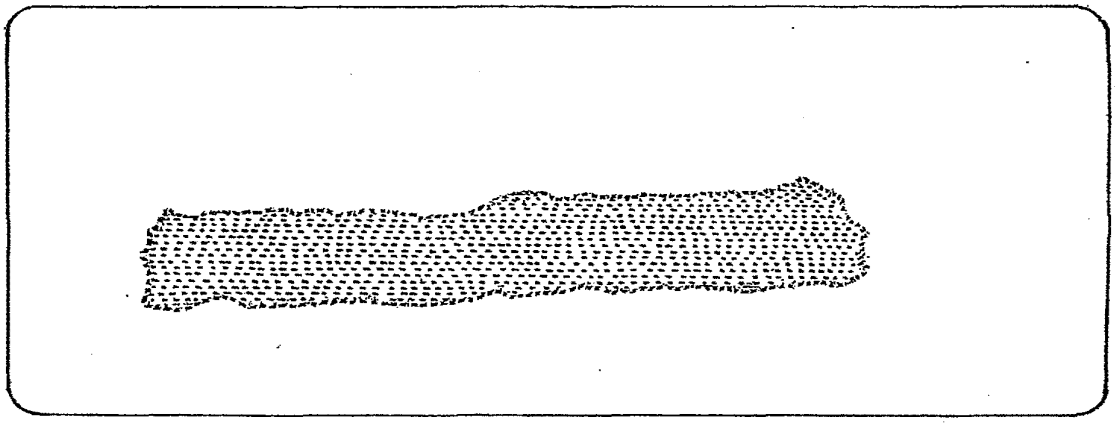


Fig. 13

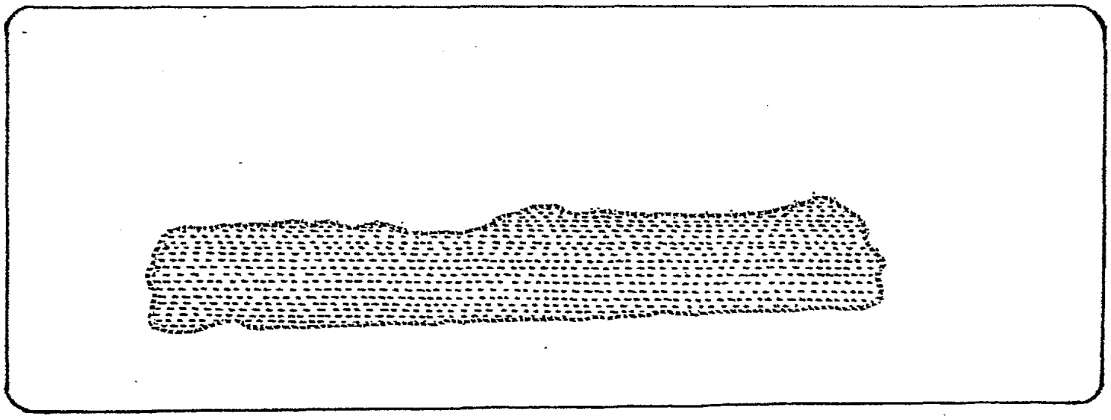


Fig. 14

BNSDOCID: <WO_____2006136814A1_I_>

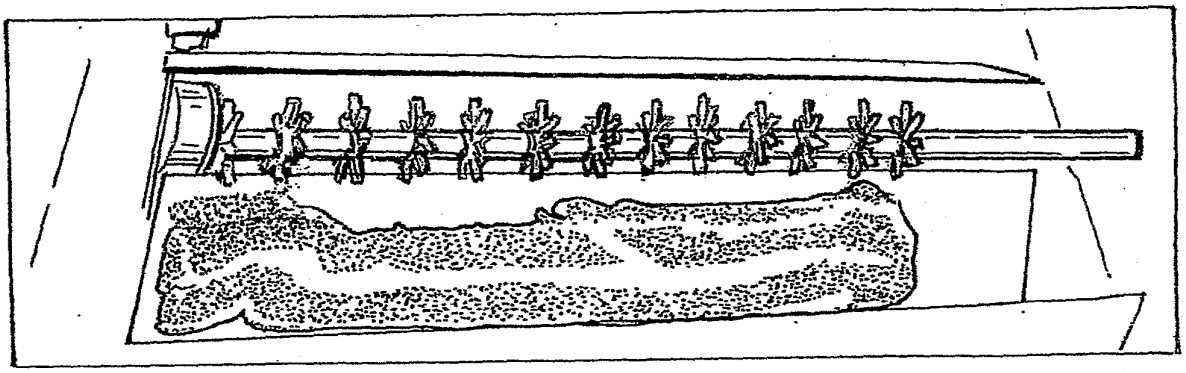


Fig. 15

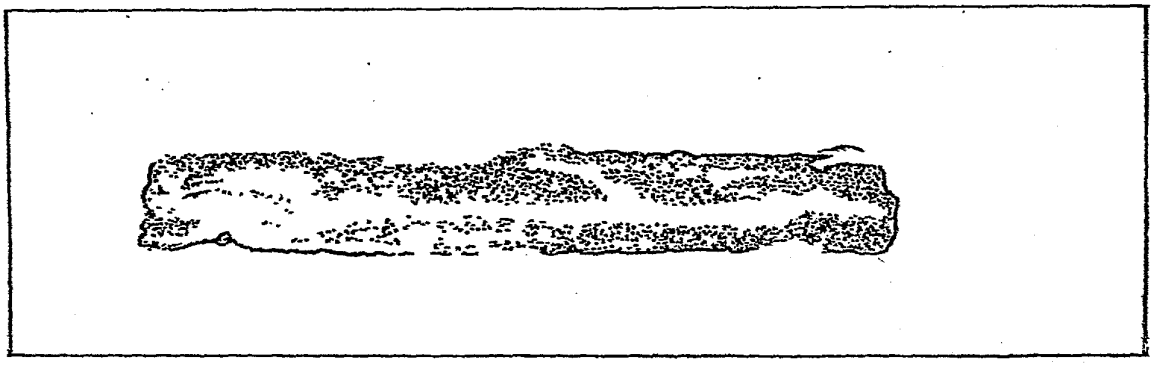


Fig. 16

NSDOCID: <WO 2006136814A1 | >

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002264

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N33/12 A22B5/00 B26D5/00
ADD. B26D7/30

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)
G01N A22B B26D

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/120844 A1 (WEBER GUNTHER) 9 June 2005 (2005-06-09) paragraphs [0009], [0012], [0038], [0052], [0053], [0056]; figure 1	1-28
Y	US 5 054 345 A (WEBER ET AL) 8 October 1991 (1991-10-08) column 3, lines 30-39	1-28
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A	EP 0 449 514 A (THURNE ENGINEERING CO LTD) 2 October 1991 (1991-10-02) the whole document	1-28

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 September 2006	25/09/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Wimmer, Martin

Form PCT/ISA/210 (second sheet) (April 2005)

BNSDOCID: <WO_____2006136814A1 | >

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002264

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/194605 A1 (WEBER GUNTHER) 7 October 2004 (2004-10-07) the whole document	1-28
A	GB 2 377 362 A (* AEW ENGINEERING COMPANY LIMITED) 15 January 2003 (2003-01-15) the whole document	1-28

NSDOCID: <WO_____2006136814A1_I_>

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2006/002264

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D4

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 324 522 A1**

(12) EUROPEAN PATENT APPLICATION

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(51) Int. Cl.[4]: A22C 17/00 , A22C 17/12

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19.07.89 Bulletin 89/29

(84) Designated Contracting States:
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(54) Device for cutting loose a bacon- and/or fatlayer from meat.

(57) Device for cutting loose a bacon- and/or fatlayer from meat, consisting of a frame with a transportation surface (1) for the meat to be processed and in which transportation surface a gripping roll (2) has been arranged or to which transportation surface a gripping roll adjoins, by means of which the meat may be drawn against and past a cutting knife (4) mounted near the gripping roll and which cutting knife is adjustable under the control of a , the separating plane between the meat and the bacon- or faltlayer detecting sensing device (6).

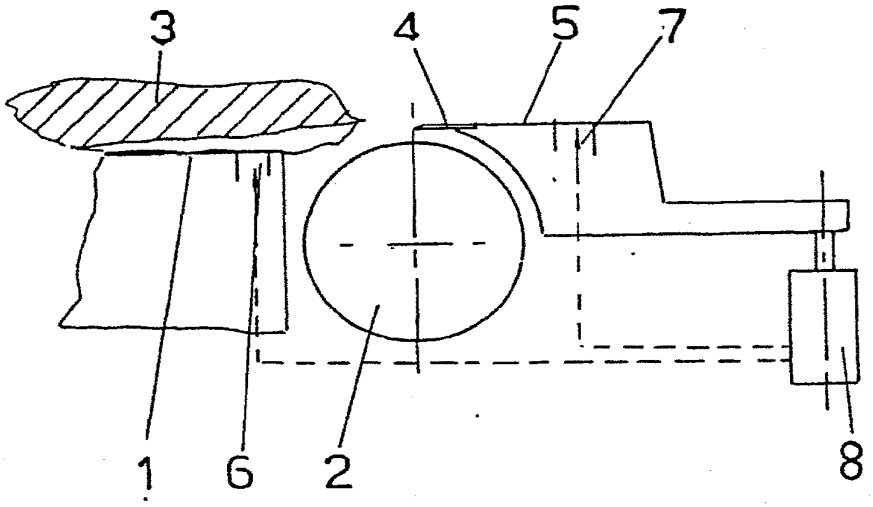


FIG. 1

EP 0 324 522 A1

BNSDOCID: <EP_____0324522A1_I_>

Device for cutting loose a bacon- and/or fatlayer from meat.

The invention relates to a device for cutting loose a bacon- and/or fatlayer from meat, consisting of a frame with a transportation surface for the meat to be processed and in which transportation surface a gripping roll has been arranged or to which transporting surface a gripping roll adjoins, by means of which the meat may be drawn against and past a cutting knife arranged near the gripping roll, while this cutting knife may be adjustable in height direction with regard to the gripping roll to adapt the knife to the thickness of the bacon- or fatlayer to be cut loose.

Such a device is known.

When applying this known device the average thickness of the bacon- or fatlayer to be cut off from the meat is estimated or measured and on the basis of this average thickness the cutting knife is adjusted with regard to the gripping roll.

This method has the disadvantage that the bacon- or fatlayer to be removed, which naturally does not have a same thickness everywhere, is only locally cut away to an optimum.

The meat processed by the known device shows local bacon-or fat layers there, where the original layerthickness was greater then the estimated or measured average thickness on basis of which the cutting knife was adjusted with respect to the gripping roll.

The invention intends to obviate this disadvantage of the known device.

The device according to the invention is thereto characterized in that the cutting knife may be adjusted in height direction under control of at least one sensing device for detecting the separating plane between the meat and the pork- or fatlayer.

This sensing device may have been mounted favourably immediately in front of the cutting knife, so that by moving on the meat to be processed over the transportation surface, the cutting knife is continuously adjusted in height direction with regard to the gripping roll, by which considerable less bacon- or fat remainders will be left on the meat.

The sensing device may be carried out in various ways. So, the position of the separating plane between the meat and the bacon- or fat layer present thereon may be determined by measuring the electrical conductivity, that in the bacon- or fat layer differs considerably from that of the underlying meat.

In a favourable embodiment of the device according to the invention, the sensing device is formed by an ultra-sonic measuring device, and by means of which output signal the height adjustment of the cutting knife may be controlled.

Besides in that thickness of the bacon- or fat layer to be cut loose may vary in the direction of transport, such may also be the case in the direction perpendicular to the direction of transport.

In order to be able to cut away the locally in thickness differing bacon- or fat layers transverse to the direction of transport in a favourable manner, the cutting knife, according to a further feature of the invented device, is subdivided into sections, which each separately may be adjusted in height direction under control of an associated sensing device.

As already remarked herebefore, the sensing device as seen in the direction of transport, favourably may have been mounted in front of the cutting knife.

In a further working out of the device according to the invention, a second sensing device is arranged behind the cutting knife, and which in inverse feed back is coupled to the first sensing device.

The height adjustment of the cutting knife or the cutting knife sections may be carried out in a known way, such as for instance by means of a hydraulic cilinder or hydraulic cilinders.

In another embodiment of the device according to the invention, the cutting knife is flexible transverse to the direction of transport, and is mounted onto a number, over de length of the knife distributed supporting elements, which each may be adjusted in height direction under the control of an associated sensing device.

In this embodiment of the device according to the invention, the bacon- or fat layers, of which the separating plane generally extend undulating, are cut off in a corresponding manner during the operation.

The invention will now be further explained by way of example with reference to the accompanying drawing.

Fig. 1 is a schematic side view of this embodiment.

Fig. 2 is a top view of the embodiment according to Fig. 1.

As is shown in Fig. 1, the device is provided with a transportation surface 1 to which a toothed rotatable gripping roll 2 adjoins, and by means of which a piece of meat 3 provided with a bacon layer may be drawn against and past a cutting knife 4, and during which the bacon layer is cut loose from the meat.

Immediately behind the cutting knife a further transportation surface 5 is present, over which the processed meat may be carried off.

NSDOCID: <EP 0324522A1 I >

As is shown in Fig. 2 , the cutting knife 4 is subdivided into a number of sections 4 a, b, a, etc. and which each separately may be adjusted in heigh direction in respect to the gripping roll 2 under the control of an ultra-sonic transducer or sensor 6 a, b, c, etc.

With the height adjustments of the knife sections 4, a,b, c, etc. under control of the associated sensors 6, a, b, c, etc. the bacon layer present in a generally not flat plane may be cut loose from the meat in a relatively selective manner.

In the device according to this embodiment the depth adjustments of the succeeding knife sections will generally take place gradually.

As is further shown in the drawing, a second sensor 7 a, b, c, etc. has been arranged behind each knife section, and of which the output signal has been coupled in inverse feed back in respect to the output signal of the first sensors 6, a, b, c, etc.

The knife sections each may be adjusted in heigh direction in a known manner, such as for instance by means of hydraulic cilinders 8 a, b, c etc.

Claims

1. Device for cutting loose a bacon- or fatlayer from a piece of meat, consisting of a frame with a transportation surface for the meat to be processed, and in which transportation surface a gripping roll has been arranged or to which transporting surface a gripping roll adjoins, by means of which the meat may be drawn against and past a cutting knife located near the gripping roll, while this cutting knife may be adjusted in height direction with regard to the gripping roll for the adaptation to the thickness of the bacon- or fatlayer to be cut loose, characterized in that the cutting knife may be adjusted in height direction under the control of at least one, the separating plane between the meat and the bacon- or fatlayer detecting sensing device.

2. Device as claimed in claim 1, characterized in that the sensing device is an ultra-sonic measuring device, by means of which output signal the height adjustment of the cutting knife may be controlled.

3. Device as claimed in claim 1 or 2, characterized in that the cutting knife is subdivided into a number of sections, each of which being adjustable in height direction under the control of an associated sensing device.

4. Device as claimed in one of the preceeding claims, characterized in that the sensing device, as seen in the direction of transport, is mounted before the cutting knife.

5. Device as claimed in one of the preceeding claims, characterized in that behind the cutting knife a second sensing device is mounted, and which in inverse feedback is coupled to the first sensing device.

6. Device as claimed in one of the preceeding claims, characterized in that the cutting knife has been carried out flexible transverse to the direction of transportation and further is mounted onto a number of supporting elements distributed along the length of the knife, and which separately may be adjusted in height direction under the control of a associated sensing device.

BNSDOCID: <EP_____0324522A1_i_>

FIG. 1

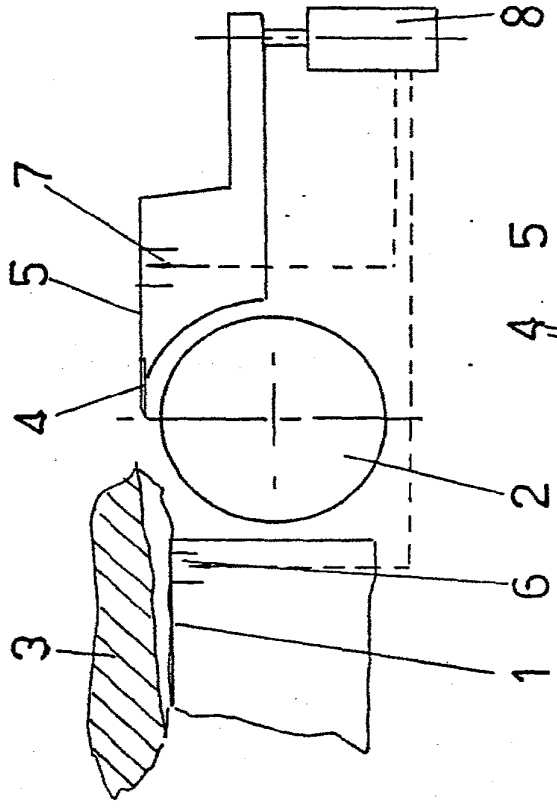
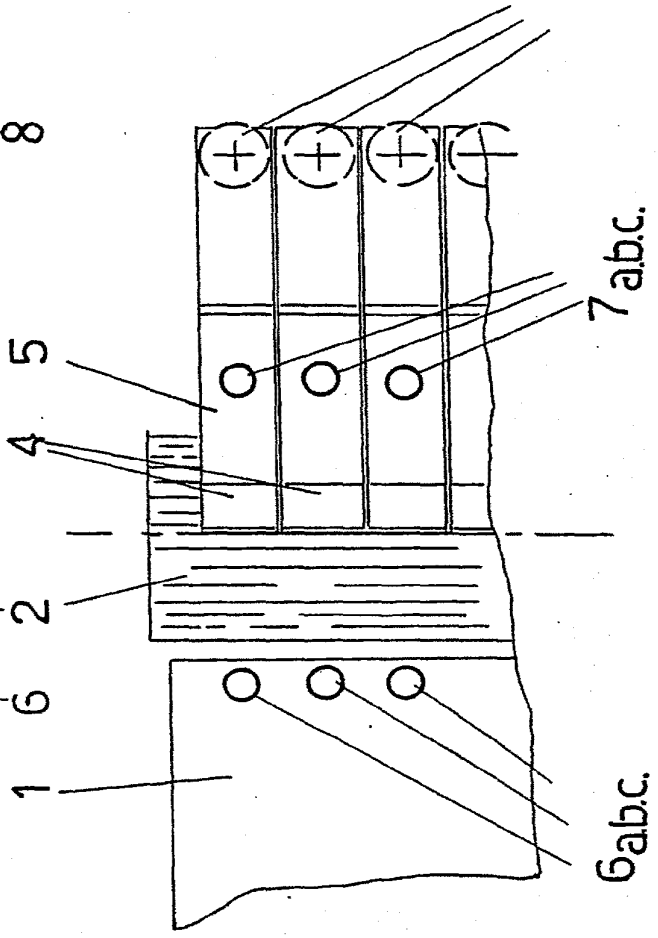


FIG. 2



INSDOCID: <EP_____0324522A1_I_>

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 20 0032

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	NL-A-7806657 (HAVERHILL MEAT PRODUCTS) * the whole document *	1-4	A22C17/00 A22C17/12
Y	US-A-2373361 (WALTER) * the whole document *	1-4	
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TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A22C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 FEBRUARY 1989	DE LAMEILLIEURE D.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)

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D5

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

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(12) EUROPEAN PATENT APPLICATION

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(51) Int Cl.[6]: **G05B 19/19**, F15B 15/20, A22C 17/00

(21) Application number: **97309968.2**

(22) Date of filing: **10.12.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
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AL LT LV MK RO SI

(30) Priority: **12.12.1996 GB 9625796**

(71) Applicant: **MEAT AND LIVESTOCK COMMISSION**
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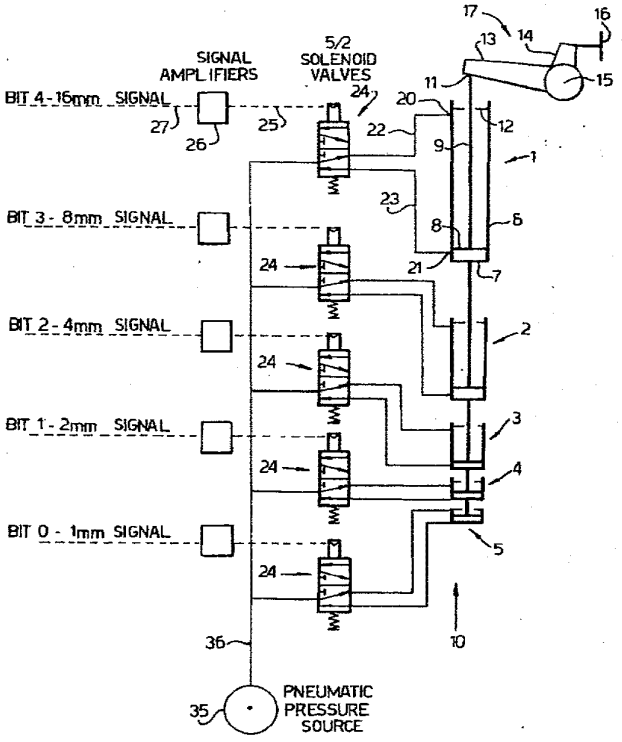
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(54) Positioning system

(57) A positioning system comprising at least two position control assemblies (41-44), each assembly being independently actuable between contracted and expanded configurations defining a respective stroke length. The assemblies (41-44) are coupled together such that actuation of one of the assemblies causes movement of another assembly. The stroke lengths of at least two of the position control assemblies (41-44) are different.

Fig.1.



EP 0 848 308 A1

BNSDOCID: <EP_____0848308A1_I_>

Description

The present invention relates to a method and apparatus for controlling the position of an object.

Accurate control of position is required in a number of fields of industry. For instance in an automated assembly production line, an item to be assembled may need to be accurately positioned, using for example a robotic arm.

Common problems of conventional positioning systems include lack of accuracy (i.e. coarse positioning resolution), low range of movement, high cost of components, lack of robustness and complexity of control requirements.

In accordance with a first aspect of the present invention there is provided a positioning system comprising at least two position control assemblies, each assembly being independently actuable between contracted and expanded configurations defining a respective stroke length, wherein the assemblies are coupled together such that actuation of one of the assemblies causes movement of another assembly, and wherein the stroke lengths of at least two of the position control assemblies are different.

The positioning system according to the present invention is cheap, robust and simple to construct and operate. The total length of the positioning system defines a controlled point, the position of which can be controlled by actuating one or more selected ones of the position control assemblies. The stroke length of each assembly is generally defined by the distance travelled by a movable part of the assembly when the assembly is actuated. The present invention maximises the positional resolution of the system by the provision of assemblies with different stroke lengths.

Typically the system comprises three or more position control assemblies coupled in series. By providing more than two position control assemblies, the range of movement and positioning resolution of the system is increased.

The positioning system may include two or more control assemblies having the same stroke length. Preferably however the stroke length of each assembly is different. This achieves the greatest possible positioning resolution for a given number of position control assemblies.

In a preferable embodiment the different stroke lengths define a binary power series (e.g. 1,2,4,etc.). In this case, a positioning system with n assemblies gives a range of movement of 2^n-1 length units with a resolution of one length unit (as defined by the smallest stroke length). A binary system of this type has the advantages of providing equal increments within the range of movement, and being easily controllable by generating a binary number, each binary digit actuating a respective assembly.

The stroke lengths may be arranged in any order (e.g. 1, 8, 4, 2 or 2, 1, 4, 8 etc.) but preferably the stroke lengths are arranged in ascending or descending order.

The positioning system may be actuated manually. Typically however the system further comprises an input device for inputting a required position, a processor for selecting one or more assemblies in accordance with the required position, and actuating means for actuating the selected assemblies.

The assemblies may be provided by any suitable expandable element, for instance flexible pipes, air bags etc. However preferably each assembly comprises a support and a positioning member mounted to the support for movement between the contracted and expanded configurations, wherein each support is coupled to an adjacent support by a respective positioning member.

The assemblies may coupled end-to-end whereby the strokes of each assembly do not overlap. Alternatively the assemblies may be coupled whereby the strokes of each assembly overlap, thus making the system more compact in the stroke direction. In an overlapping system the assemblies may be arranged side-by-side but preferably the assemblies are nested, thus making the system more compact in a direction transverse to the stroke direction.

The assemblies may be driven between their expanded and contracted configurations by any suitable drive means, for instance by a motor. Preferably however the assemblies are driven by a fluid such as air. In a preferable embodiment each assembly comprises a piston and a cylinder in which the piston is housed, and the piston is moved in use by the action of fluid pressure across the piston. The cylinder may be double-acting (i.e. the piston being driven in both directions by fluid pressure) or single acting (i.e. driven in one direction by fluid pressure and in the other direction by a spring return). Since air is nontoxic and non-flammable, a pneumatic system has advantages in food processing applications and in hazardous environments.

Adjacent cylinders may be coupled by a piston rod attached to a respective piston, or by a carriage which is magnetically coupled to a respective piston. The carriage may be mounted on the exterior of the cylinder, and magnetically coupled to the piston through the cylinder wall.

The assemblies may be constructed and coupled such that they provide positional control along a substantially straight line. Alternatively the assemblies may be suitably shaped and coupled such that they provide positional control along a circular or otherwise shaped non-linear path.

The positioning system may provide positional control in a single dimension. Alternatively the positioning system may provide positional control in two or three dimensions. For instance two or three one dimensional positioning systems may be connected orthogonally to provide control of position along respective orthogonal axes.

The assemblies may be actuable between more than two discrete configurations and at an extreme may be continuously controllable, eg. actuable to any intermediate point between the contracted and expanded configurations. In

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this case means for measuring the configuration of the assemblies may be provided, along with a feedback system which controls the configuration of the assemblies in accordance with the measured configuration. The measurement can be achieved by a variety of sources including limit switches which detect the throw of each cylinder, back pressure sensing, or an external position transducer.

Preferably however, the system is provided without any position measurement or feedback. In this case the assembly is typically only driven between its contracted and expanded configurations. This enables the assemblies to be actuated by a simple ON/OFF signal. Typically each assembly is fully contracted in its contracted configuration, and fully expanded in its expanded configuration. For instance in the case of a double-acting pneumatic cylinder the rear and front walls of the cylinder limit the extent of movement of the piston.

The positioning system according to the present invention may be utilized in a wide variety of applications. The apparatus is particularly applicable in any application which requires a low cost, reliable positioning system. For instance the system may be used in a system for moving products in a factory, for instance on a production line. However the system is particularly applicable for use in food processing applications in which the positioning system is coupled to a guide which, in use, abuts an item of food. The robustness of the system makes it suitable in a food processing environment. The system may be utilized in a meat processing apparatus, for example for positioning a carcase into a desired position relative to a cutting device. In a preferred embodiment there is provided apparatus for trimming surplus fat from a cut of meat comprising an abutment wall for engagement by the outer surface of a fat layer on the cut of meat; a cutter which, in use, moves along a cutting path extending along the fat layer; and one or more positioning systems according to the first aspect of the present invention engaging the abutment wall or the cutter for varying the distance between the abutment wall and the cutting path at one or more points along the length of the cutting path.

Where an input device is provided for inputting a required position, the input device typically comprises means for determining a thickness of the fat layer. The thickness may be input manually but in a preferable embodiment is determined automatically, for instance by a TV camera and image processing means for determining the fat thickness from an image collected by the TV camera.

In accordance with a second aspect of the present invention there is provided a method of positioning an object, the method comprising selecting one or more position control assemblies in a positioning system according to the first aspect of the present invention coupled to the object, and actuating the selected assemblies to position the object.

The method according to the second aspect of the invention provides a particularly simple method of providing control of position of an object.

The method may be carried out as part of any suitable application, but preferably the method is employed in a method of positioning an item of food, the method comprising coupling the positioning system to an item of food, selecting one or more of the position control assemblies, and actuating the selected assemblies. In a preferable embodiment the item of food is an item of meat such as a carcase or cut of meat.

In a preferable embodiment the method is provided as part of a method of trimming surplus fat from a cut of meat, the method comprising engaging the outer surface of a fat layer on the cut of meat with an abutment; passing a cutter through the fat along a cutting path; and varying the distance between the abutment wall and the cutting path at one or more points along the length of a cutting path using one or more positioning systems according to the first aspect of the invention which engage the abutment wall or the cutter.

A number of embodiments of the present invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a schematic diagram of a first embodiment of a positioning system according to the present invention;
Figures 2A-E show a positioning system of the type shown in Figure 1 in a variety of configurations;
Figure 3 shows a positioning system of the type shown in Figures 1 and 2 illustrating the use of a binary address;
Figure 4A illustrates a first alternative positioning system;
Figure 4B illustrates a second alternative positioning system;
Figures 5A-D show the system of Figure 4B in a variety of different configurations;
Figure 6 shows an example of a lamb chop;
Figure 7 shows another example of a lamb chop;
Figure 8 shows, in diagrammatic form, the chop of Figure 6 installed in equipment for trimming surplus fat;
Figure 9 is a schematic diagram showing a fat trimming system; and
Figure 10 illustrates a third alternative positioning system.

Referring to Figure 1, a positioning system 10 is illustrated comprising five serially coupled position control assemblies 1-5. Each assembly 1-5 is of similar construction and the front assembly 1 will be described below by way of example. Assembly 1 comprises a cylinder 6 having a cylinder base 7, the cylinder 6 housing a piston head 8 and a piston shaft 9. The piston shaft 9 of each of the assemblies 2-5 is attached to the cylinder base 7 of an adjacent assembly. The cylinder 6 of the rear assembly 5 is fixed to a support (not shown). The stroke of each assembly (defined

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by the distance between the retracted piston position shown in Figure 1 which is limited by the cylinder base 7, and a fully extended position not shown which is limited by the cylinder front wall 12) varies in the form of a binary power series. In this example the strokes of assemblies 1-5 are 80mm, 40mm, 20mm, 10mm and 5mm respectively. The end 11 of the piston shaft 9 of assembly 1 is positioned as required by independently actuating selected ones of the assemblies 1-5 as described below.

Each cylinder 6 is a double-acting cylinder comprising a pair of ports 20,21 which communicate with the cylinder chamber on opposite sides of piston head 8. The ports 20,21 are in pneumatic communication with respective pneumatic lines 22,23. Pneumatic lines 22,23 are connected to a 5/2 solenoid valve 24 of a known type. The 5/2 solenoid valves 24 are connected in parallel to pneumatic pressure source 35 via supply line 36.

Figure 1 illustrates the positioning system 10 in its datum position. That is, each piston head 8 is fully retracted and each 5/2 solenoid valve 24 is in its datum position. Each 5/2 solenoid valve 24 is controlled by a binary control signal on a respective control line 25 connected to signal amplifier 26. The amplifiers 26 amplify a binary signal input on a respective input line 27. In the datum position shown in Figure 1, each input line 27 carries a binary zero. In the datum position, the 5/2 solenoid valve 24 supplies pneumatic pressure to pneumatic line 22 and vents pneumatic line 23. When the signal on input line 27 changes to a binary one, the valve 24 is driven to a second position in which input line 23 is connected to the pneumatic pressure source 35, and pneumatic line 22 is vented. Thus, by changing the control signal on input line 27 from zero to one, the piston head 8 is driven between a first, retracted position, and a second, extended position.

Similarly, by changing the control signal on input line 27 from one to zero, the valve 24 is returned to the datum position and the piston head 8 is driven back to its retracted position.

The end 11 of the piston shaft 9 of assembly 1 defines a point which is positioned by the positioning system 10. In the example shown in Figure 1, the end 11 is attached to lever arm 13 of a 5:1 lever system 17 comprising a lever arm 14 which pivots with lever arm 13 about pivot point 15. Lever arm 14 is attached to a positioned object 16. By suitably selecting the ratio of the lengths of lever arms 13,14, the movement of the end 11 of piston shaft 9 can be converted into a desired range and resolution of movement of positioned object 16.

Figure 2 illustrates the principle of the positioning system illustrated in Figure 1. Positioning system 40 is of a similar construction to positioning system 10. System 40 comprises four serially coupled position control assemblies 41-44 which control the position of a point 45. The system 40 is shown in its datum position in Figure 2A. The assemblies 41-44 have stroke lengths of 8, 4, 2, and 1 units respectively.

In the position shown in Figure 2B, assembly 42 has been actuated and point 45 has been moved by four units.

In the position shown in Figure 2C, assemblies 42, 43 and 44 have been actuated and point 45 has been moved by seven units.

In the position shown in Figure 2D, assembly 41 has been actuated and point 45 has been moved by eight units.

In the position shown in Figure 2E, assemblies 43 and 44 have been actuated, and point 45 has been moved by three units.

As illustrated by Figure 2, the positioning system 40 has a range of movement of fifteen units, with a resolution of one unit. Any position in the range can be achieved by actuating selected ones of the assemblies 41-44.

Thus for a system of desired range 0 -31mm with a desired resolution of 1mm:-

$$\frac{range}{resolution} = no.\ of\ steps;$$

and

$$2^{n-1} < no.\ of\ steps \leq 2^{n}$$

where n is the required number of assemblies.

Thus: no. of steps = (31-0)/1 = 31; and $2^4 < 31 <= 2^5$

Hence, cylinders required are:

2^0 = 1mm
2^1 = 2mm
2^2 = 4mm
2^3 = 8mm
2^4 = 16mm

The range, resolution and mechanical advantage can also be suitably adjusted by the use of a lever system 17 of

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the type illustrated in Figure 1 or other suitable gearing system.

A positioning system of the type illustrated in Figures 1 and 2 is particularly suited to be controlled by a processor (such as a personal computer (PC)) with a digital output facility operating the solenoid valves 24. It is typical of a PC digital output board that each line of output is one bit of a memory address. This principle is illustrated in Figure 3. Memory address 50 comprises eight bits 51 which are coupled to drive electronics 59 and solenoid valves 70. The system of Figure 3 makes use of the binary address with the shortest assembly 52 (with a stroke of 1mm) being attached to the least significant bit 57 (bit 0) of the address, 2mm assembly 53 being attached to next most significant bit 58 (bit 1) etc. Thus a value written to the memory address 50, expressed in binary form, creates a high signal on the bits required to build up a position equivalent to the value written to the address, as illustrated in Table 1 below.

Table 1

address value	binary value	byte 7654 3210	high bits	strokes extended (mm)	total position (mm)
0_{10}	0_2	0000 0000	none	0	0
2_{10}	10_2	0000 0010	1	2	2
3_{10}	11_2	0000 0011	0,1	1,2	1+2=3
9_{10}	1001_2	0000 1001	0,3	1,8	1+8=9
19_{10}	10011_2	0001 0011	0,1,4	1,2,16	1+2+16=19
27_{10}	11011_2	0001 1011	0,1,3,4	1,2,8,16	1+2+8+16=27

Figures 4A and 4B illustrate alternative positioning systems.

In Figure 4A three positioning assemblies 80-82 are arranged side-by-side. Each assembly comprises a double-acting cylinder 86 housing a piston comprising a piston head 87 and a piston shaft 88. The piston shaft 88 of the two upper assemblies 80,81 are coupled to the front edge of an adjacent cylinder 86 whereby the strokes 83-85 of the three assemblies overlap. As can be seen by comparing Figure 1 and Figure 4A, the overlapping arrangement of Figure 4A achieves greater compactness in the stroke direction.

The system of Figure 4B comprises a series of four nested position control assemblies 71-74. The largest assembly 74 comprises a single acting pneumatic cylinder 60 attached to a base 61. Mounted for reciprocal movement within the cylinder 60 is a piston 62 having a piston head 63.

Position control assemblies 71-73 are of a similar construction to assembly 74 and have a different stroke length, which decreases in a binary series in a similar manner to the systems shown in Figures 1-3. That is, position control assembly 74 has a stroke length of eight units, assembly 73 has a stroke length of four units, assembly 72 has a stroke length of two units, and assembly 71 has a stroke length of one unit.

The nested telescopic system of Figure 4B can be seen to be more compact than the end-to-end system of Figure 1 in the stroke direction, and more compact than the stacked telescopic system of Figure 4A in a direction transverse to the stroke direction.

Figure 5A shows the system of Figure 4B extended by four units. In this case, piston 64 of position control assembly 73 has been actuated and piston 64 has been driven from the retracted position shown in Figure 4B to the extended position shown in Figure 5A. The assemblies are driven by a pneumatic control circuit similar to the circuit shown in Figure 1. However, since the cylinders are single acting, 3/2 solenoid valves are required instead of the 5/2 solenoid valves 24 shown in Figure 1.

Figures 5B, 5C and 5D show the positioning system driven by seven units, eight units and three units respectively.

Figure 10 illustrates a further, alternative positioning system according to the present invention. Three position control assemblies 220-222 of differing stroke lengths are coupled in series to position a point 212. Each assembly comprises a double-acting pneumatic cylinder 200-202, housing a respective rodless magnetic piston 203-205. Each piston 203-205 is driven between the left-hand position shown in Figure 10 and a right-hand position (not shown) by applying fluid pressure on either side of the piston. A cylindrical carriage 206-208 is slidably mounted on the exterior of each cylinder. Each carriage 206-208 carries a magnetic ring 209-211 which couples magnetically with a respective piston 203-205 through the cylinder walls. The carriages 206,207 are each mounted to an adjacent cylinder 201,202. The last carriage 108 is mounted to the positioned point 212.

In use, as each piston 203-205 is driven between its left and right hand positions, the associated carriage 206-208 is driven between its retracted and extended positions.

The positioning systems illustrated in Figures 1 to 5 and 10 can be implemented in a number of different positioning applications. A single illustrative example in a system for trimming surplus fat from a cut of meat will now be described with reference to Figures 6 to 9.

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In Figures 6 to 8, lean meat is represented by cross-hatching, bone is represented by single line diagonal hatching, and areas of fat are shown unhatched.

The chops shown in Figures 6 and 7 are typical of a loin chop (Figure 6) and a cutlet (Figure 7). They are taken from the same carcass, but it will be appreciated that they have different patterns of fat coverage from each other.

The difference in fat thickness also varies considerably from animal to animal and, as can be appreciated from Figures 6 and 7, the fat thickness varies along the length of the chop. For example, the fat thickness in the region of arrow A in Figure 7 is significantly less than that in the region of the arrow B.

To be acceptable to major retailers, such as supermarket chains, the fat cover on a cut of meat such as a lamp chop must be substantially uniform from chop to chop and over the length of each chop. The preferred thickness of the fat cover is typically 5mm. The desired fat thickness in the chops shown in Figures 6 and 7 is indicated by dashed line X. To meet the requirements of the retailers, the surplus fat beyond the line X must be trimmed off. It is difficult to perform this trimming operation accurately by hand, yet inadequate trimming can lead to the meat being rejected by the retailer.

Figure 8 illustrates the principle of equipment for trimming the surplus fat from a lamb chop in a fast and accurate manner. The equipment comprises a cutter in the form of a trimming knife 102 mounted on a radius arm 104 which is pivotable about a pivot point 106. The radius arm 104 is powered, so as to drive the trimming knife 102 along an arcuate cutting path 108. An example of a system of this type is described in GB-A-2302008.

Situated just outside the cutting path 108 is an abutment wall 100. The abutment wall 100 is made from a relatively thin, flexible material, such as strip steel.

The abutment wall 100 is acted upon by a plurality of positioning actuators of the type illustrated in Figures 1 to 5 and 10 indicated diagrammatically by arrows 120. Further actuators, indicated by arrows 140, act in the direction towards the abutment wall 100 from its inner surface and, as can be appreciated from Figure 8, the actuators 140 serve to press a chop C (which is the chop shown in Figure 6) against the abutment wall 100.

In the processing of a chop to remove surplus fat, the chop is first assessed to determine how much fat should be removed from each portion along its length. This assessment can be performed in several different ways, but a preferred arrangement is for the chop to be pictured by an image scanning device such as a TV camera. The resulting image is then processed to determine the thickness of fat at different locations. For example, the fat thickness may be determined at the locations a to f in Figure 6. From the measured thickness at each location a to f is then subtracted the desired fat thickness (e.g. 5mm) and the resulting difference measurement is then applied to the respective actuators 120 to cause the abutment wall 100 to be displaced away from the cutting path 108 by the respective distance measurement. The resulting configuration of the abutment wall 100 is shown in Figure 8.

The chop C is placed with the outer surface of the fat layer in contact with the abutment wall 100 and is pressed firmly into position by means of the actuators 140. This causes the chop to be deformed, the intention being that the desired thickness line X shown in Figure 6 lies as close as possible to the cutting path 108 of Figure 8. Consequently, operation of the trimming knife 102 results in the correct amount of fat being trimmed from the chop along its length to leave the desired thickness of fat covering on the lean meat.

It will be noted that, at the location d in Figure 6, there is no lean meat, and consequently, unless an adjustment is made, a very large fat thickness measurement will be obtained. The image processing equipment is preferably adjusted so that a fat thickness measurement above a predetermined level results in a default measurement being applied to the appropriate actuator 120.

Figure 9 shows details of a fat trimming system of the type illustrated diagrammatically in Figure 8. A conformable wall 100 is acted upon by a plurality of positioning systems 152. Preferably the positioning systems 152 are of the type illustrated in any of Figures 1-5 or 10. Each positioning system 152 is driven by a respective valve 150 which is controlled by a binary signal on a respective control line 151 from amplifier electronics 156.

The wall 100 is constructed in segments constrained at both ends by pins connected to a respective positioning system. One end of each segment is free to rotate and the other end is able to rotate and slide in a slot in the segment. This wall construction allows for the expansion, contraction and shape changes required for meat section configuration.

A blade (not shown) is driven by a blade cylinder 153 and a main clamp 154 and secondary clamp 155 act towards the wall 100 to press a chop (not shown) against the wall 100.

Amplifier electronics 156, blade cylinder 153, main clamp 154 and secondary clamp 155 are each connected to an input/output card 157 controlled by a conventional PC.

Blade cylinder 153 has end of travel sensors 158,159 which are attached to input/output card 157. Operator buttons 160,161 for providing operator input are also connected to input/output card 157.

TV camera 170 images a chop to be trimmed and the resulting image is processed by vision decoder 171 to provide an input to rule base system 172. Rule base system 172 generates a desired configuration of each of the positioning systems 152 as follows. A gauge line aligned with actuator motion is defined in screen co-ordinates and the intensity of each pixel on the gauge line is determined. The gauge line is sited to cross the light-dark or dark-light feature to be detected. Examination of pixel intensity change and rate of change along the gauge is used to locate dark-light or light

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dark features. An additional filter feature can be used to ignore features below a particular size. The resulting gauge line coordinates are output to supervisory controller 173. The supervisory controller then outputs a control signal on output line 174 to actuate the positioning systems 152 as required.

In an alternative method of fat trimming (not shown), the fat thickness profile of a lamb chop (or other 2D meat section) is captured using XY vision or linescan camera technology. Then as the chop is conveyed forward past a cutting edge the relative distance between the fat-lean interface and the cutting means is dynamically altered (by moving the chop or the cutting means using a positioning system such as the system illustrated in Figures 1-5 or 10) with respect to the fat thickness profile to leave a consistent fat thickness remaining on the meat section.

The fat thickness profile can either be stored or captured in-line with the cutting means with the position changes taking place instantaneously in real-time.

It should be noted that the solenoid valves 24 in Figure 1 may be driven by means other than solenoids, e.g. by compressed air or manual operation. The valves 24 are connected in parallel to a single pneumatic pressure source 35 but in an alternative each valve 24 may be connected independently to a respective pneumatic pressure source.

The positioning system of Figures 1-5 and 10 are all constructed to position a point along a straight line. However each positioning system could be constructed to position a point along a curved or other non-linear path. For instance the cylinders 6 and rods 9 in Figure 1, or the cylinders 200-202 and carriages 206-208 in Figure 10 could be curved or otherwise shaped to give incremental rotary movement.

Claims

1. A positioning system comprising at least two position control assemblies, each assembly being independently actuable between contracted and expanded configurations defining a respective stroke length, wherein the assemblies are coupled together such that actuation of one of the assemblies causes movement of another assembly, and characterised in that the stroke lengths of at least two of the position control assemblies are different.

2. A system according to claim 1 wherein the different stroke lengths define a binary power series.

3. A system according to any of the preceding claims further comprising an input device for inputting a required position, a processor for selecting one or more assemblies in accordance with the required position, and actuating means for actuating the selected assemblies.

4. A system according to claims 2 and 3 wherein the processor generates a binary number in response to the required position, each digit of the binary number defining whether or not a corresponding assembly is actuated.

5. A system according to any of the preceding claims wherein each assembly comprises a support and a positioning member mounted to the support for movement between the contracted and expanded configurations, wherein each support is coupled to an adjacent support by a respective positioning member.

6. A system according to any of the preceding claims wherein each assembly is fully contracted in its contracted configuration, and fully expanded in its expanded configuration.

7. A system according to any of the preceding claims wherein the assemblies are coupled whereby the strokes of each assembly overlap.

8. A system according to claim 7 wherein the assemblies are nested.

9. Food processing apparatus comprising a guide which abuts an item of food, and a positioning system according to any of the preceding claims which is coupled in use to the guide.

10. Apparatus for trimming surplus fat from a cut of meat comprising an abutment wall for engagement by the outer surface of a fat layer on the cut of meat; a cutter which, in use, moves along a cutting path extending along the fat layer; and one or more positioning systems according to any of claims 1 to 8 engaging the abutment wall or the cutter for varying the distance between the abutment wall and the cutting path at one or more points along the length of the cutting path.

11. Apparatus according to claim 10 and at least claim 3 wherein the input device comprises means for determining the thickness of the fat layer.

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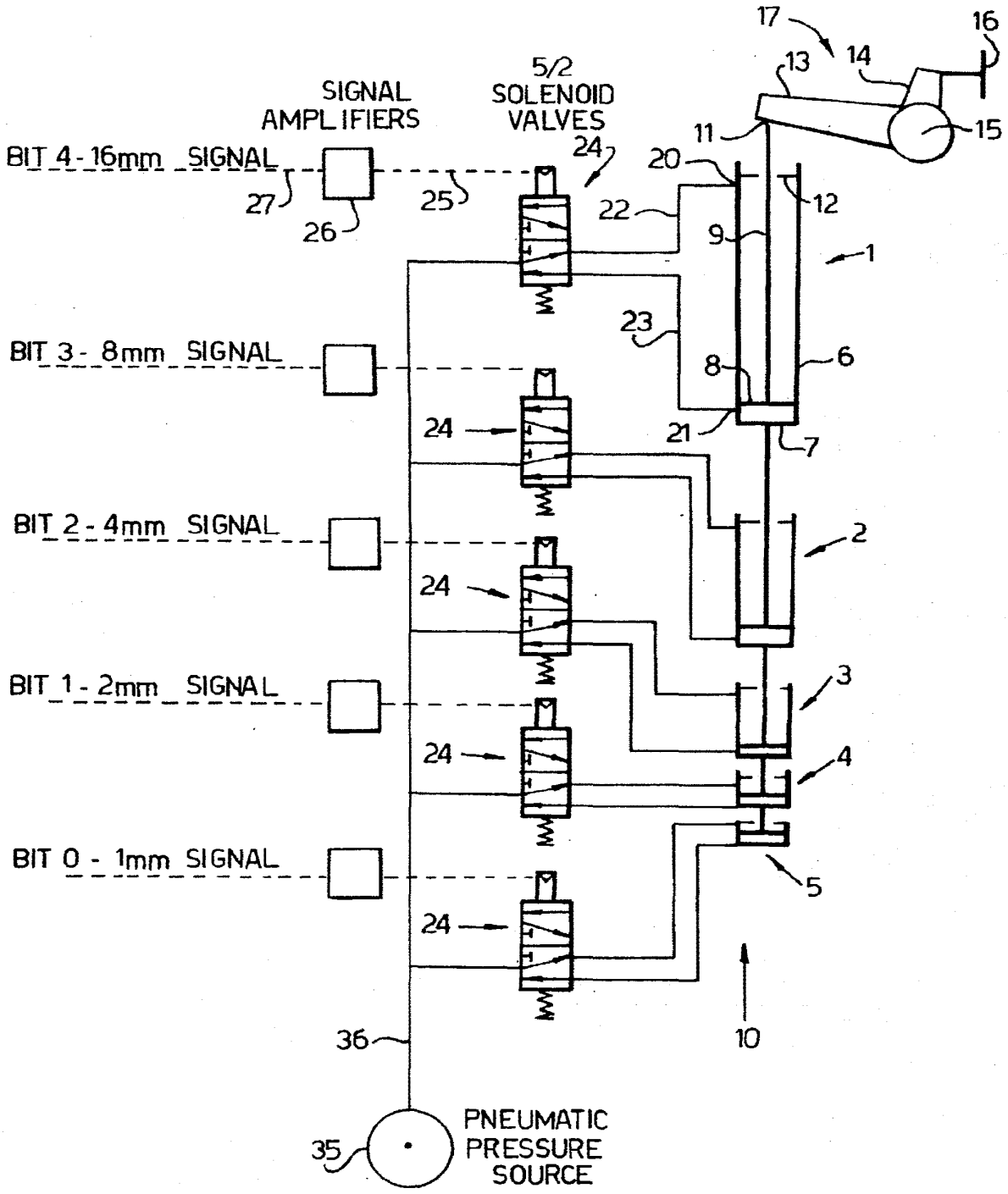
12. A method of positioning, the method comprising selecting one or more position control assemblies in a positioning system according to any of claims 1 to 8, and actuating the selected assemblies.

13. A method of positioning an item of food, the method comprising coupling a positioning system according to any of claims 1 to 8 to the item of food, selecting one or more of the position control assemblies, and actuating the selected assemblies.

14. A method of trimming surplus fat from a cut of meat, the method comprising engaging the outer surface of a fat layer on the cut of meat with an abutment; passing a cutter through the fat layer along a cutting path; and varying the distance between the abutment wall and the cutting path at one or more points along the length of a cutting path using one or more positioning systems according to any of claims 1 to 8 engaging the abutment wall or the cutter.

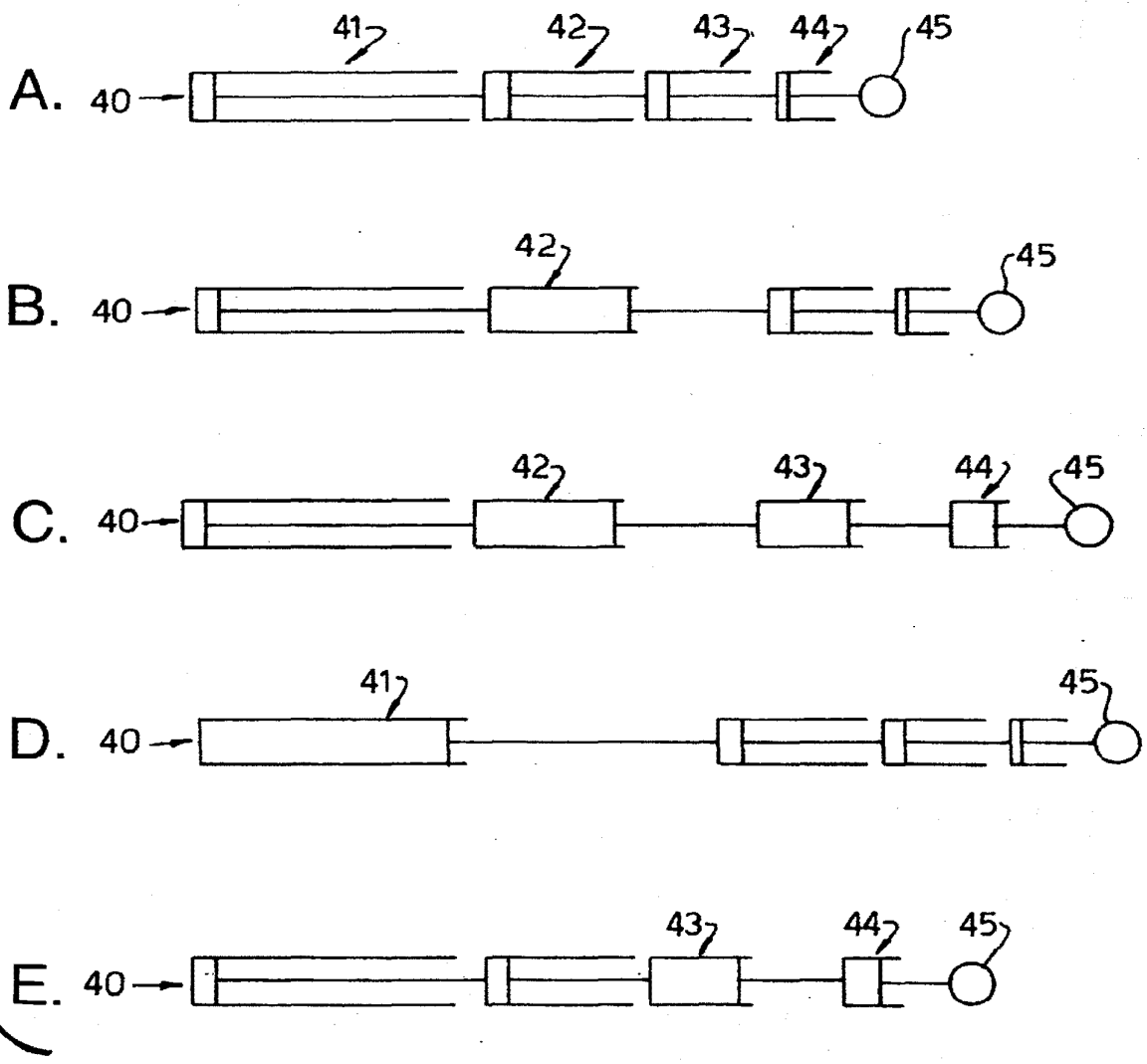
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Fig.1.



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Fig.2.



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Fig.3.

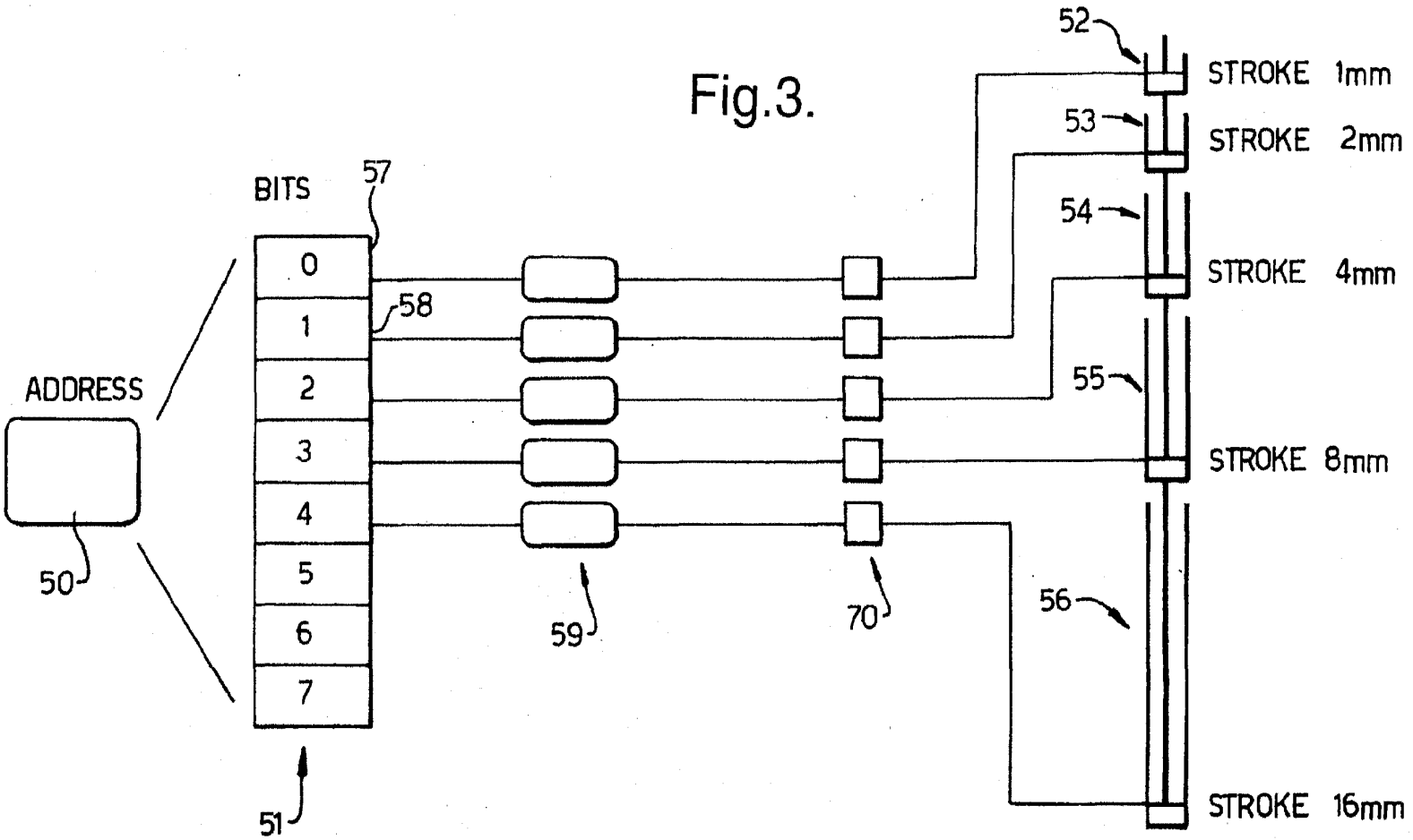


Fig.4A.

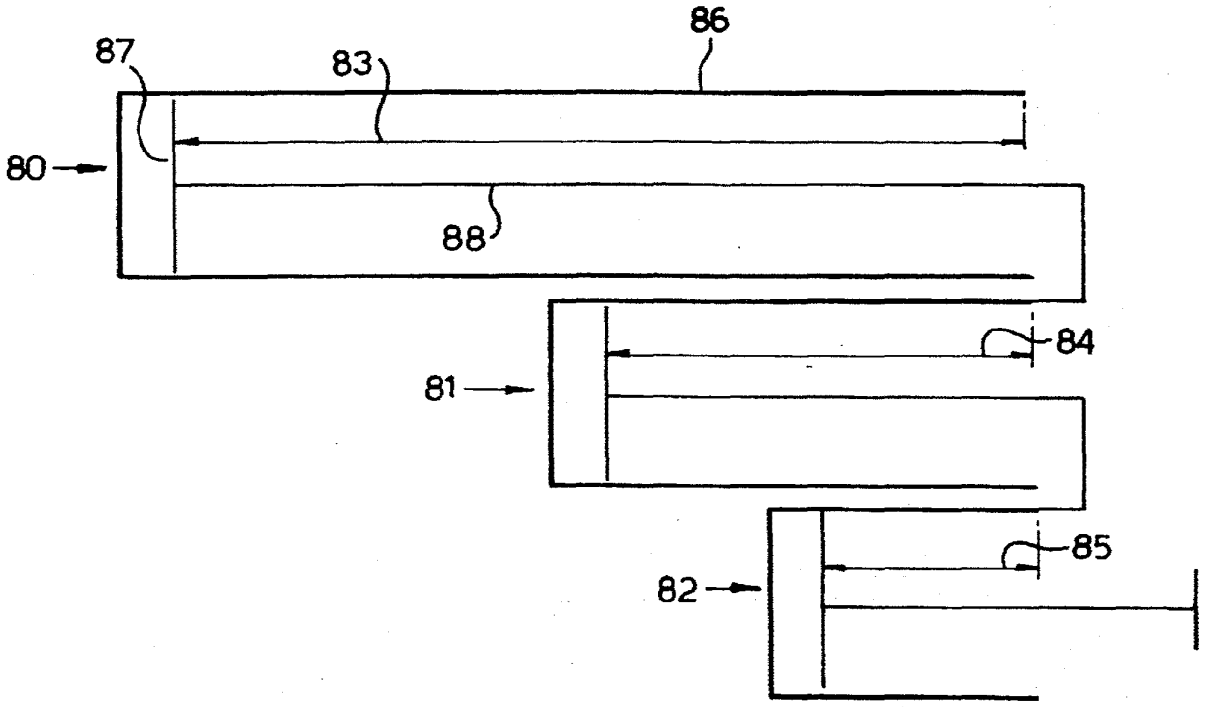
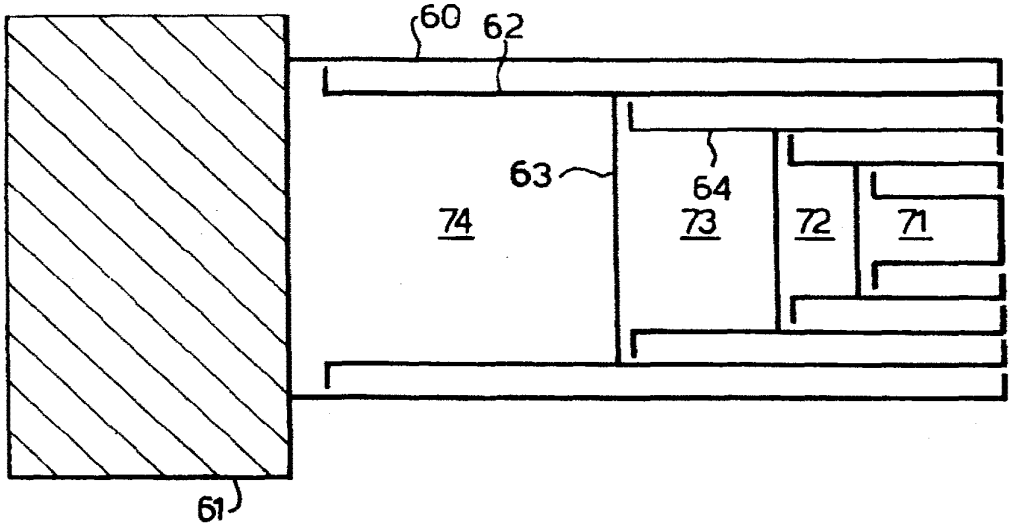
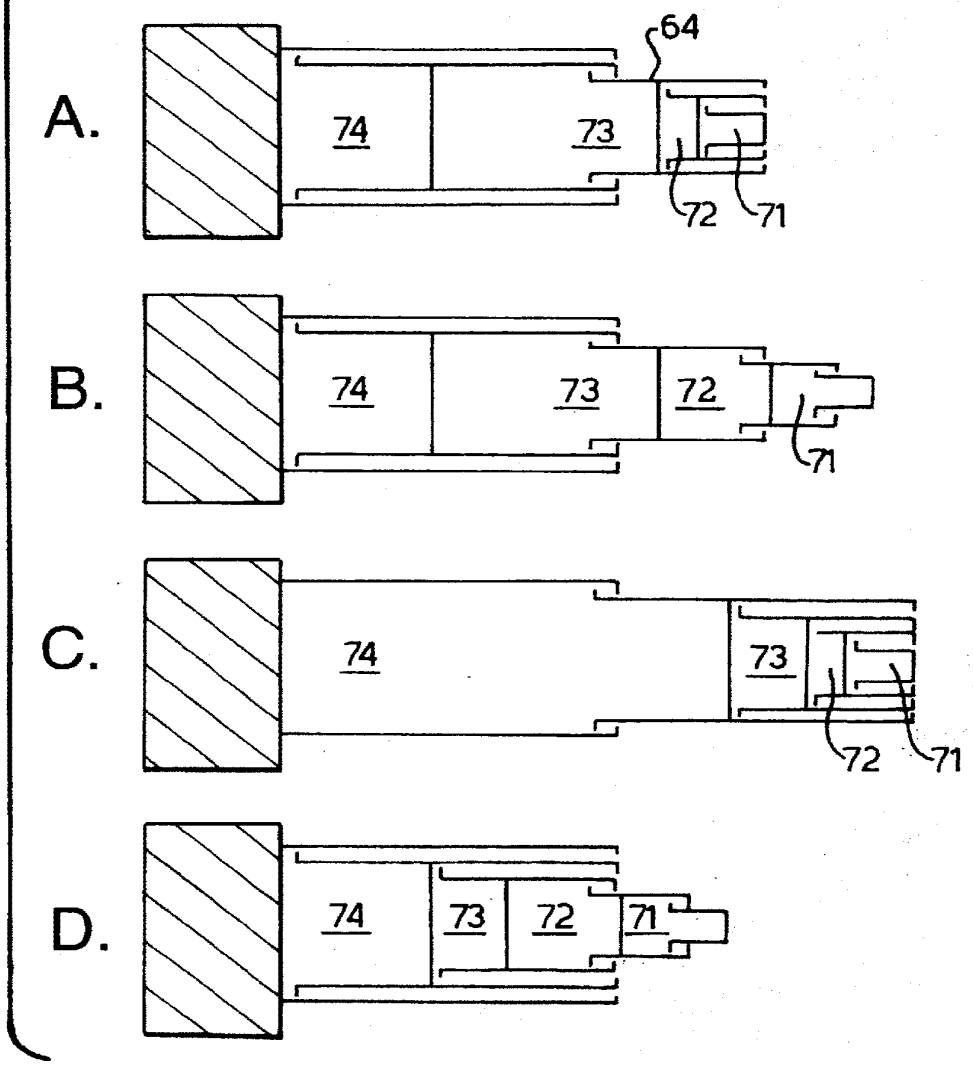


Fig.4B.



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Fig.5.



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Fig.6.

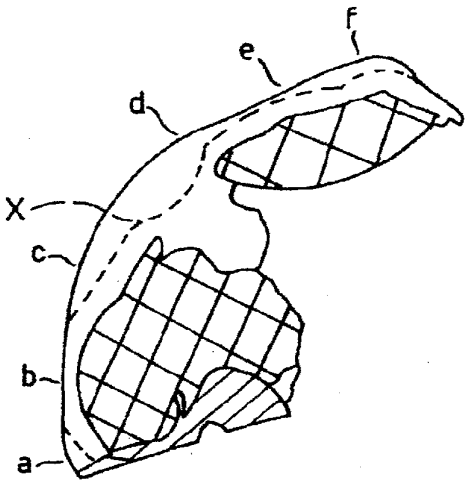


Fig.7.

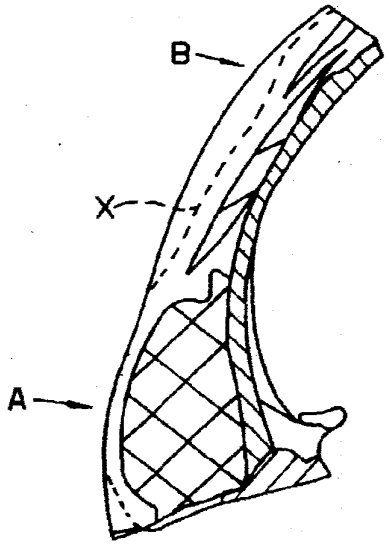
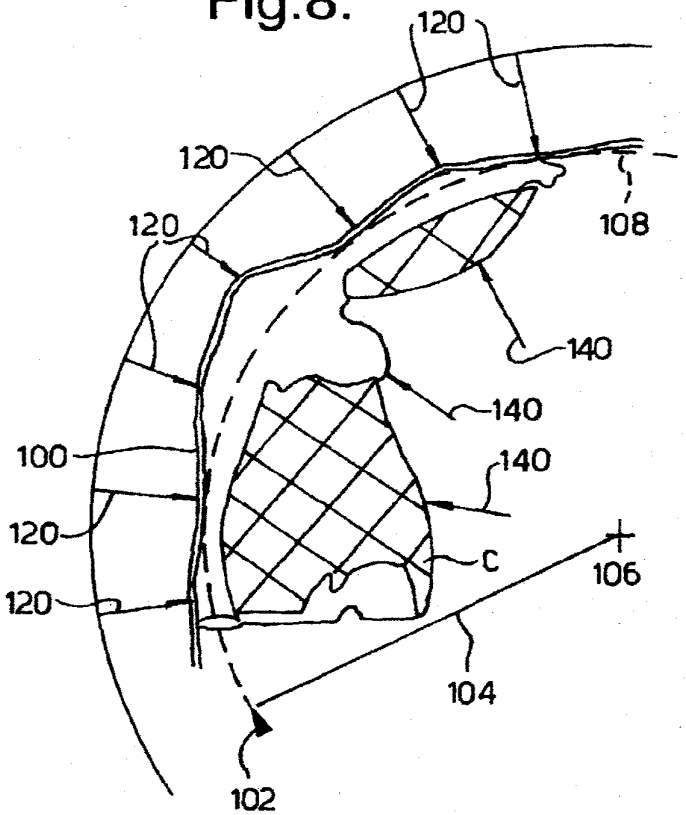


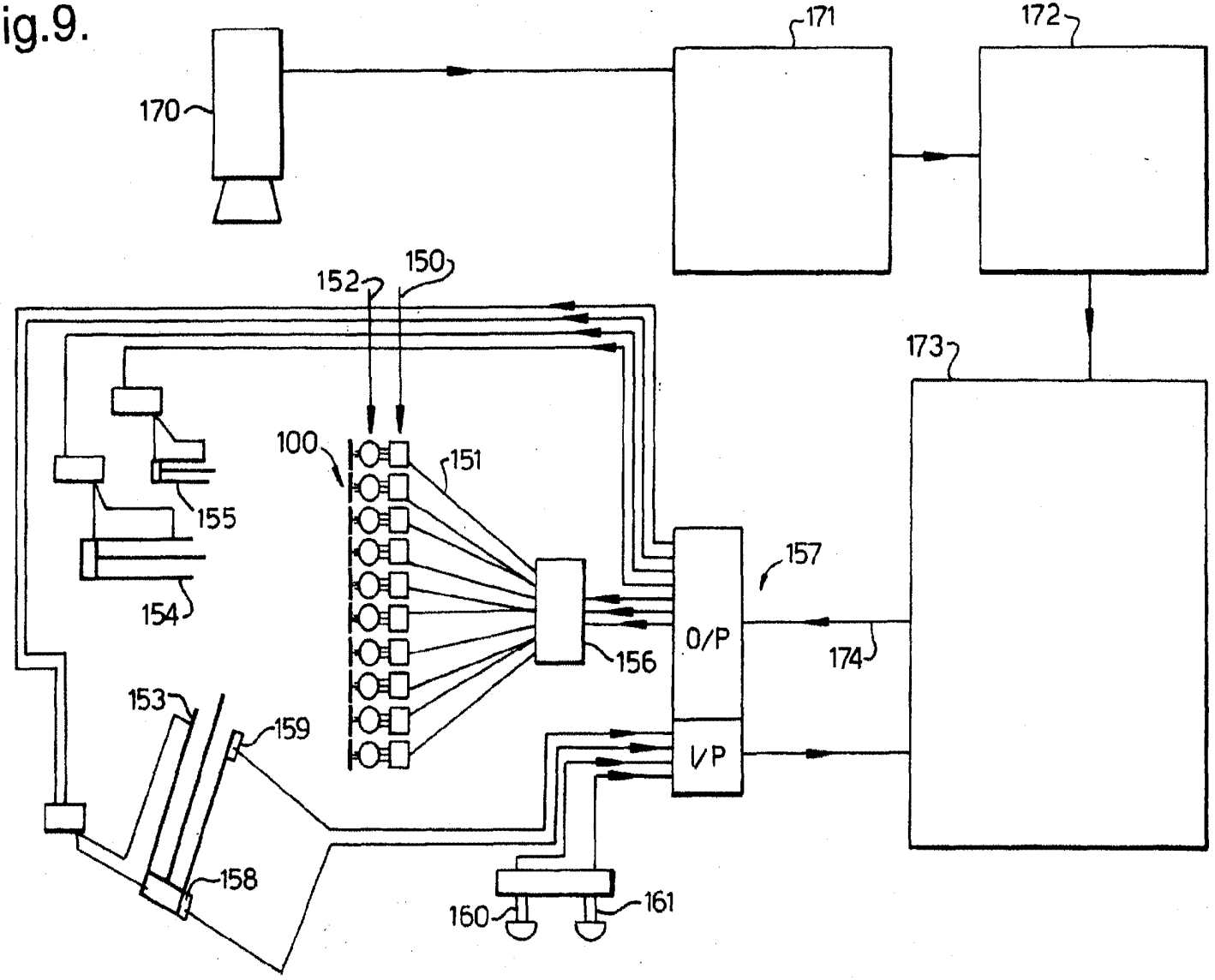
Fig.8.



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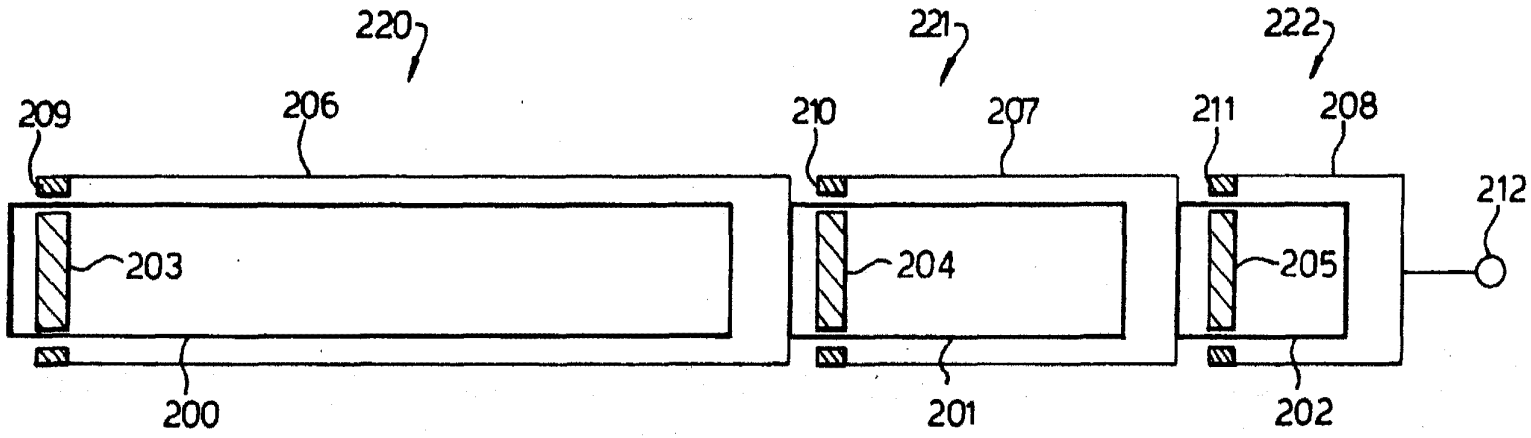
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Fig.9.



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Fig.10.



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 9968

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 94 15513 A (MELDERICK CORP N V ;BIAGIO CARLO DI (IT)) 21 July 1994 * page 5, line 3 - page 7, line 32; claims 1-4; figures 1-3 *	1-3,5,7, 12-16, 20,21	G05B19/19 F15B15/20 A22C17/00
P,X	GB 2 302 008 A (LLOYD MAUNDER LTD) 8 January 1997 * page 3, line 24 - page 8, line 12; figures 1-7 *	17-23	
X Y	DE 38 06 390 A (HUNGER WALTER) 7 September 1989 * column 2, line 23 - column 5, line 1; figures 1,2 *	1-3, 12-14 5,7-9, 11,16-23	
Y	GB 2 000 961 A (KJ MASKINFABRIKEN A S) 24 January 1979 * page 2, line 36 - page 3, line 79; claims 1,6,10; figures 1,2 *	5,7-9, 11,16-23	
A	EP 0 494 935 B (UNIV BRISTOL) 1 March 1995 * column 2, line 54 - column 6, line 16; figures 1-3 *	1-23	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G05B F15B A22C
A	US 4 125 974 A (KAY CHRISTOPHER G ET AL) 21 November 1978 * column 4, line 4 - column 10, line 34; figures 1,10 *	1-15	
A	US 5 341 724 A (VATEL BRONISLAV) 30 August 1994 * column 2, line 36 - column 4, line 65; figures 1-6 *	1-15	
A	EP 0 324 522 A (BOEKEL CORNELIS DIRK) 19 July 1989 * the whole document *	1-23	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 March 1998	Tran-Tien, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

BNSDOCID: <EP_____0848308A1_I_>

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 9968

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 5 324 228 A (VOGELEY JR ARTHUR W) 28 June 1994 * column 2, line 24 - column 7, line 50; figures 1,2 * _____	16-23	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 March 1998	Tran-Tien, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

NSDOCID: <EP_____0848308A1_I_>

Electronic Acknowledgement Receipt

EFS ID:	8056063
Application Number:	12738969
International Application Number:	
Confirmation Number:	6367
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Customer Number:	20350
Filer:	J. Georg Seka/William Chinn
Filer Authorized By:	J. Georg Seka
Attorney Docket Number:	088000-006700US
Receipt Date:	20-JUL-2010
Filing Date:	30-JUN-2010
Time Stamp:	19:26:01
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Manitz_088000_006700US_IDS.PDF	159166 233c6cdef901f60de0bc04630b300b74754921a1	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	2	
	Information Disclosure Statement (IDS) Filed (SB/08)		3	4	
Warnings:					
Information:					
2	NPL Documents	Manitz_088000_06700US_German_Search_Report.PDF	177280 57c3309b710701eaaefeb9af8703f6c010905562	no	4
Warnings:					
Information:					
3	NPL Documents	Manitz_088000_006700US_German_Search_Report_English_Translation.PDF	186703 b658de11ee297f36dc4d5afab5e4a89f7233a8d1	no	5
Warnings:					
Information:					
4	NPL Documents	Manitz_088000_006700US_International_Search_Report.PDF	118594 668768c45feabdbd835faa1ce9d140a036f3b9f0	no	3
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Information:					
5	Foreign Reference	Manitz_088000_006700US_AE.PDF	459246 fcaa0deb05cd24b24b6f45857afa3be67c1653d6	no	6
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Information:					
6	Foreign Reference	Manitz_088000_006700US_AF.PDF	457417 173308d8138aae190754b875be7aa52295d355bc	no	6
Warnings:					
Information:					
7	Foreign Reference	Manitz_088000_006700US_AG.PDF	986419 996e68aeb11ee68cdc34789da3f81413af4cfb42	no	10
Warnings:					
Information:					
8	Foreign Reference	Manitz_088000_006700US_AH.PDF	772973 1d35a8e4d9a86fd2f14308e03729e4b278c50c31	no	12
Warnings:					
Information:					

9	Foreign Reference	Manitz_088000_006700US_AI.PDF	2463333 703cb2f36b0b52549f3f39d55a09804052a5f1fd	no	48
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Information:					
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13	Foreign Reference	Manitz_088000_006700US_AM.PDF	275695 381f713137d209cffec94803dcfc940040d59f34	no	6
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Information:					
14	Foreign Reference	Manitz_088000_006700US_AN.PDF	927277 c6a0d128d1294d039aa9921c30638baff5e5f709	no	18
Warnings:					
Information:					
			Total Files Size (in bytes):	12190421	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on July 20, 2010.

TOWNSEND and TOWNSEND and CREW LLP

By: William Chinn

PATENT
Attorney Docket No. 088000-006700US
Client Reference No. W10078PWOUS - Jr/Sh/Ru

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No. 6367
GUENTHER WEBER	Examiner: (not yet assigned)
Application No.: 12/738,969	Art Unit: (not yet assigned)
Filed: April 20, 2010	INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.97 and §1.98
For: FAT COVER MEASUREMENT DEVICE	
Customer No. 20350	

San Francisco, CA 94111
July 20, 2010

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

The references cited on attached form PTO/SB/08A and PTO/SB/08B are being called to the attention of the Examiner. Copies of the references in compliance with the requirements of 37 CFR §1.98(a)(2) are enclosed. It is respectfully requested that the cited references be expressly considered during the prosecution of this application, and the references be made of record therein and appear among the "references cited" on any patent to issue therefrom.

Also enclosed is a copy of the German Search Report of July 8, 2008 and English translation thereof, and the International Search Report of December 12, 2008 thereof. corresponding.

As provided for by 37 CFR §1.97(g) and (h), no inference should be made that the information and references cited are prior art merely because they are in this statement and no representation is being made that a search has been conducted or that this statement encompasses all the possible relevant information.

Applicant believes that no fee is required for submission of this statement. However, if a fee is required, the Commissioner is authorized to deduct such fee from the undersigned's Deposit Account No. 20-1430. Please deduct any additional fees from, or credit any overpayment to, the above-noted Deposit Account.

Respectfully submitted,



J. Georg Seka
Reg. No. 24,491

TOWNSEND and TOWNSEND and CREW LLP
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San Francisco, California 94111-3834
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JGS:wlc
62779178 v1

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/738,969	06/30/2010	Guenther Weber	088000-006700US

CONFIRMATION NO. 6367

20350
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

PUBLICATION NOTICE

OC000000044115595

Title: Fat Cover Measurement Device

Publication No.US-2010-0267320-A1
Publication Date:10/21/2010

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/738,969	06/30/2010	Guenther Weber	088000-006700US	6367

20350 7590 11/26/2012

KILPATRICK TOWNSEND & STOCKTON LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER	
PRICE JR, RICHARD THOMAS	
ART UNIT	**PAPER NUMBER**
3643	

NOTIFICATION DATE	DELIVERY MODE
11/26/2012	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ipefiling@kilpatricktownsend.com
jlhice@kilpatrick.foundationip.com

Office Action Summary	Application No.	Applicant(s)	
	12/738,969	WEBER, GUENTHER	
	Examiner	Art Unit	
	RICHARD PRICE JR	3643	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 July 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-21* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-21* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *7-20-2010*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-21 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by ***Christensen et al (US Patent 7,918,718).***

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RICHARD PRICE JR whose telephone number is (571)272-6892. The examiner can normally be reached on M-F from 6:30a.m. to 3:00p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Peter Poon can be reached on 571-272-6891. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Thomas Price/
Primary Examiner, Art Unit 3643

Notice of References Cited	Application/Control No. 12/738,969	Applicant(s)/Patent Under Reexamination WEBER, GUENTHER	
	Examiner RICHARD PRICE JR	Art Unit 3643	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,918,718	04-2011	Christensen et al.	452/157
*	B	US-7,853,046	12-2010	Sharony, David	382/110
*	C	US-7,399,220	07-2008	Kriesel et al.	452/157
*	D	US-7,214,124	05-2007	Kobayashi et al.	451/57
*	E	US-7,039,220	05-2006	Kriesel, Marshall S.	382/110
*	F	US-6,974,373	12-2005	Kriesel, Marshall S.	452/157
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

PTO/SB/08a (07-09)

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/738,969
				Filing Date	April 20, 2010
				First Named Inventor	Weber, Guenther
				Art Unit	
(Use as many sheets as necessary)				Examiner Name	
Sheet	1	of	2	Attorney Docket Number	088000-006700US

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number: Number Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	AA	US-7,110,572 B1	09-19-2006	Alan Benn	
	AB	US-5,937,080 A	08-10-1999	Arthur W. Vogeley, Jr., et al.	
	AC	US-5,944,598 A	08-31-1999	Alan Kwai-Wah Tong, et al.	
	AD	US-6,104,827 A	08-15-2000	Alan Benn, et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document: Country Code[3]	Number[4]	Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	AE	DE	10 2006 007 490	A1	08-17-2006	Weber Maschinenbau GmbH & Co. KG		☐
	AF	DE	10 2004 017 037	A1	10-21-2004	MAJA-Maschinenfabrik Hermann Schill GmbH & Co. KG		☐
	AG	DE	100 50 836	A1	06-27-2002	Axel Hinz; Horst Eger		☐
	AH	EP	1 174 034	A1	01-23-2002	FMC		☐
	AI	WO	2006/136818	A1	12-28-2006	AEW Delford Systems		☐
	AJ	WO	2004/106020	A1	12-09-2004	Scanvaegt International A/S		☐
	AK	GB	2 364 894	A	02-13-2002	FMC		☐
	AL	WO	2006/136814	A1	12-28-2006	AEW Delford Systems		☐
	AM	EP	0 324 522	A1	07-19-1989	Boekel, Cornells Dirk		☐
	AN	EP	0 848 308	A1	06-17-1998	Meat and Livestock Commission		☐

Examiner Signature	/Richard Price/	Date Considered	11/19/2012

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of U.S. Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.P./

PTO/SB/08b (07-09)

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/738,969
				Filing Date	April 20, 2010
				First Named Inventor	Weber, Guenther
				Art Unit	
(Use as many sheets as necessary)				Examiner Name	
Sheet	2	of	2	Attorney Docket Number	088000-006700US

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]

Examiner Signature	/Richard Price/	Date Considered	

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PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12/738,969
	Filing Date	June 30, 2010
	First Named Inventor	Guenther Weber
	Art Unit	3643
	Examiner Name	Richard Thomas Price
	Attorney Docket Number	66234-785420

U.S. PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

U.S. PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1.	04-084850	JP		03-18-1992	MAYEKAWA MFG CO LTD	English Translation of The Abstract Only	
	2.	06-242102	JP		09-02-1994	SNOW BRAND MILK PROD CO LTD SNOW BRAND FOOD CO LTD	English Translation of The Abstract Only	

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12/738,969
	Filing Date	June 30, 2010
	First Named Inventor	Guenther Weber
	Art Unit	3643
	Examiner Name	Richard Thomas Price
	Attorney Docket Number	66234-785420

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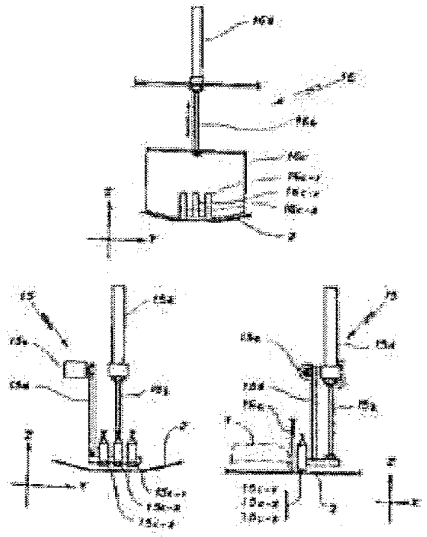
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(54) DEVICE FOR AUTOMATICALLY MEASURING FAT LAYER OF EDIBLE MEAT

(57)Abstract:

PURPOSE: To automatically measure the thickness dimension of a fat layer sticking to an edible meat lump with a high accuracy and efficiency by providing a construction for stopping an edible meat lump on a belt conveyor with a shutter plate, passing the lump through notches provided in the bottom of the shutter plate and discriminating the color of the meat lump with color sensors.



CONSTITUTION: The aforementioned device is an automatic measuring device 15 for a fat layer used in equipment for excising part of the fat layer sticking to an edible meat lump 1 conveyed on a belt conveyor 2 by leaving the fat layer of a prescribed thickness and the following construction is used. That is orthogonal three axes (X), (Y) and (Z) taking the conveying direction of the belt conveyor 2 as the X-axis and the vertical direction as the Z-axis are supposed and the device is provided with a shutter plate (16c), arranged on the belt conveyor 2, driven in the vertical directions with a piston rod (16b), parallel to a plane (Y-Z) and used as a stopper; slotlike notches (16c-1), (16c-2) and (16c-3) directing from the lower edge of the shutter plate (16c) to the upper part; color sensors (15c-1) to (15c-3), arranged on the downstream side of the shutter plate (16c) in the conveying direction of the belt conveyor 2 so as to face in the upstream side direction and capable of discriminating white and red colors; a means (15b) for driving the color sensors in the vertical directions while facing the color sensors to the slots and means (15e) and (15d) for sensing the positions of the color sensors in the vertical directions.

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⑭発明の名称　食肉の脂肪層自動計測装置

⑳特　願　平2－194870

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明　細　書

1．発明の名称

食肉の脂肪層自動計測装置

2．特許請求の範囲

1．ベルトコンベア上を搬送されている食肉塊から、該食肉塊に付着している脂肪層のうち一定厚さの脂肪層を残して該脂肪層を切除する設備に用いられる脂肪層自動計測装置であって、

前記ベルトコンベアの搬送方向をX軸とし、鉛直方向をZ軸とする直交3軸X，Y，Zを想定し、

コンベア上に設けられて上下方向に駆動される、Y－Z面に平行なストッパ用シャッタ板と、

上記シャッタ板の下縁から上方に向かう溝孔状の切欠と、

上記シャッタ板に比して、ベルトコンベアの搬送方向下流側に設けられ、上流方向に向けて設置された、白色と赤色とを識別し得る色センサと、

上記の色センサを、前記の溝孔に臨ませつつ上下方向に駆動する手段と、

上記色センサの上下方向の位置を検出する手段と、

を具備していることを特徴とする、食肉の脂肪層自動計測装置。

3．発明の詳細な説明

〔産業上の利用分野〕

本発明は、脂肪層が付着している獣肉から、ほぼ一定の厚さに脂肪層を残して余分の脂肪層を切除する装置に用いられる、脂肪層厚さ寸法の自動計測装置に関するものである。

〔従来の技術〕

獣肉、例えば豚のロース肉は屠体から切り離され、厚い脂肪層が付着したままの状態で食肉加工場に供給される。

第9図は豚のロース肉を主体とする獣肉1の断面を示す模式図である。

1aはロース肉、1bは心と呼ばれる部位である。

ロース肉1aの片面にB脂1cと呼ばれる脂肪

層が付着している。

このＢ脂はラードになる部分であって、この層は比較的薄く、比較的一様な厚さである。

上記Ｂ脂１ｃの外側に、Ａ脂１ｄと呼ばれる脂肪層が付着している。

このＡ脂は、前記のＢ脂と比較して厚く、その層厚寸法は比較的不均一である。そして、このＡ脂はＢ脂よりも経済的価値の高い部分である。

第９図に示したような状態の獣肉は、これを一般の食用に供するにはＡ脂１ｄの付着量が過多であるため、鎖線で示した線ａ－ｂのごとく、一定の厚さ寸法ｔの脂肪を残して切り取られる。

上記の脂肪層の一部切除作業に関しては、従来一般に、ナイフを用いて手作業で行われていた。

このため、作業員に熟練を必要とし、多大の時間と労力とを費していた。

また、熟練者であっても、脂肪層を取り残す厚さ寸法を目測で定めるので正確を期するためには高度の精神的負荷が有った。

その上、切り取られたＡ脂１ｄは断片状となり、その経済的価値が損われた。

上述の事情に鑑み、食肉塊に付着している脂肪層を、自動的にほぼ一定の厚さを残して切除し得る装置として、下記のような構成が考えられる。

すなわち、

ほぼ水平なＸ軸と、

Ｘ軸に直交する垂直なＺ軸と、

上記Ｘ，Ｚ両軸に直交する水平なＹ軸とを想定し、

前記の食肉塊を乗せてＸ軸方向に搬送するベルトコンベアと、

上記のベルトコンベア上を搬送される食肉塊を覆って、該食肉塊をＸ軸方向に滑らせながらこの食肉塊をベルトコンベアに向けて押しつけるワーク押えと、

上記の食肉塊を押えつけて、Ｘ軸方向にワーク押えの下方へ送り込む、平歯車状の歯を有する入口上部ローラと、

上記の食肉塊をほぼＹ軸方向に挟みつけて、Ｘ軸方向にワーク押えの下方へ送り込む、少なくとも一対の、平歯車状の歯を有する入口サイドローラと、

上記の食肉塊を押えつけて、Ｘ軸方向にワーク押えの下方から引き出す、平歯車状の歯を有する出口上部ローラと、

上記の食肉塊をほぼＹ軸方向に挟みつけて、Ｘ軸方向にワーク押えの下方から引き出す、少なくとも一対の、平歯車状の歯を有する出口サイドローラと、

Ｙ－Ｚ面上の円弧に沿い、Ｘ軸方向の幅を有する板バネ状のカッタ刃と、

上記カッタ刃を支持して、これを円弧方向に往復駆動する駆動機構と、

前記の食肉塊に付着している脂肪層の厚さ寸法を計測する手段と、

上記計測手段による計測結果に応じて、前記板バネ状のカッタ刃の位置をＺ軸方向に調整する手段と、

を設ける。

上記の構成によれば、

食肉塊は脂肪層の付着した状態でベルトコンベアに載せられてＸ軸方向に搬送され、

脂肪層の厚さ寸法計測手段によって脂肪層の厚さを計測され、

入口上部ローラと入口サイドローラとによってワーク押えの下方に送り込まれるとともに、

出口上部ローラと出口サイドローラとによってワーク押えの下方から引き出され、

該ワーク押えによってベルトコンベアに押しつけられながら該ワーク押えの下方をＸ軸方向に通過せしめられる。

前記の食肉塊がワーク押えの下方を通過する際、前記の円弧状カッタは脂肪層の厚さに応じて上下方向の位置を調節されており、円弧方向に往復駆動されて、脂肪層の一定厚さ部分を残して切断する。

このようにして、人手によらずに切除作業が行われ、

Ａ脂が細片に切断されることなく１枚の脂肪板をなす形に切り取られるので、その経済的価値を

損わない。

〔発明が解決しようとする課題〕

上述のごとき構成よりなる食肉用の自動脂肪切除装置を開発して実用価値あるものとするためには、ベルトコンベア上を搬送されている食肉塊に付着している脂肪層の厚さ寸法を、自動的に計測することが要望される。

本発明は上述の事情に鑑みて為されたもので、ベルトコンベア上を搬送されている食肉塊に付着している脂肪層の厚さ寸法を、自動的に、高精度、かつ高能率で計測し得る装置を提供することを目的とする。

〔課題を解決するための手段〕

上記の目的を達成するため、本発明の装置は、

ベルトコンベア上を搬送されている食肉塊から、該食肉塊に付着している脂肪層のうち一定厚さの脂肪層を残して該脂肪層を切除する設備に用いられる脂肪層自動計測装置であって、

前記ベルトコンベアの搬送方向をＸ軸とし、鉛直方向をＺ軸とする直交３軸Ｘ，Ｙ，Ｚを想定し、

コンベア上に設けられて上下方向に駆動される、Ｙ－Ｚ面に平行なストッパ用シャッタ板と、

上記シャッタ板の下縁から上方に向かう溝孔状の切欠と、

上記シャッタ板に比して、ベルトコンベアの搬送方向下流側に設けられ、上流方向に向けて設置された、白色と赤色とを識別し得る色センサと、

上記の色センサを、前記の溝孔に臨ませつつ上下方向に駆動する手段と、

上記色センサの上下方向の位置を検出する手段と、

を設けたものである。

〔作用〕

上記の構成によれば、

ベルトコンベア上を搬送されている食肉は、シャッタ板によって進行を阻止され一時的に停止する。

上記シャッタ板には上下方向の溝孔状の切欠が設けられているので、色センサは上記の切欠を通して食肉の色調を検出してロース肉と脂肪とを識別する。

上記の色センサは上下方向に駆動されるとともに、その位置が検知されるので、脂肪層の厚さ寸法を算出することができる。

〔実施例〕

第３図は本発明に係る計測装置１５を備えた自動脂肪切除装置を側面から視た模式図である。

２はベルトコンベアであって、脂肪付きの食肉塊１を載せてＸ軸方向に、図の右方へ搬送する。

９は門形フレームで、シリンダ３を介してワーク押え４を上下駆動可能に支持している。

上記ワーク押え４の付近をＸ軸方向に視たところを第４図（Ａ）に示すとともに、Ｙ軸方向に視たところを第４図（Ｂ）に示す。この第４図（Ｂ）は第３図の部分的拡大図に相当する。

３はシリンダで、そのシリンダボトムを上方に向けて固定的に支持されており、そのピストンロッド３ａの先端にワーク押え４を固着されて吊持している。

このワーク押え４は後述するごとくワークである食肉塊（本図において図示省略）を矢印Ｐ方向に、ベルトコンベア２に向けて押しつけながら、該食肉塊をＸ軸方向に滑らせて通過させる部材であって、円筒状の平滑な内面を有する天井部４ａと、該食肉塊を滑り込ませるように案内するためにラッパ状に開いた円錐面を有する案内部４ｂとを設けてある。４ｃはシリンダ３のピストンロッド３ａに取り付けるためのブラケットである。

前記シリンダ３のピストンロッド３ａが伸長せしめられるとワーク押え４が矢印Ｐ方向に下降し、収縮せしめられると反矢印Ｐ方向に上昇する。

第３図に示した５は、入口上部ローラ装置であって、入口上部ローラ５ａを有している。

この入口上部ローラ５ａは図において反時計回り方向に回転せしめられて、図示しない食肉塊をＸ軸方向に、ワーク押え４の下方に押し込む作用をする。

第５図（Ａ）は上記入口上部ローラ装置５付近をＸ軸方向に視たところを示し、第５図（Ｂ）は同じくＹ軸方向に視たところを示している。この第５

図（B）は第３図の入口上部ローラ装置５の部分的拡大図に相当する。

入口上部ローラ５ａはローラ軸５ｂに固着されており、該ローラ軸５ｂはアーム状の側板５ｃによって支持されている。

上記のアーム状の側板５ｃはＹ軸方向の固定軸５ｄにより上下傾動自在に支承されるとともに、シリンダ５ｅによって上下駆動される。

上記のアーム状の側板５ｃが下降傾動すると、入口上部ローラ５ａが下降せしめられ、ベルトコンベア２上の食肉塊（本図において図示省略）を圧下する。

第３図から理解されるように、出口上部ローラ装置６は上記の入口上部ローラ装置５と対称をなすように構成されている。

第３図に示した７は入口サイドローラであり、８はこれと対称形に構成された出口サイドローラである。

前記の入口上部ローラ５ａおよび入口サイドローラ７付近をＸ軸方向に視たところを第６図に示す。

出口上部ローラ装置６および出口サイドローラ８をＸ軸方向に視たところも上記第６図と同様であるから図示を省略する。

第６図において、５ａは前述の入口上部ローラ、５ｂはローラ軸、５ｃは側板、５ｅはシリンダであり、７，７はＹ軸方向に対向する１対の入口サイドローラである。

モータ９は、伝動軸９ａを介して１対の入口サイドローラ７，７を回転駆動するとともに、伝動軸９ｂを介して入口上部ローラ５ａを回転駆動する。

これにより、ベルトコンベア２上の食肉塊１（仮想線で示す）は、Ｘ軸方向に強力に送られる。上記の入口上部ローラ５ａ，入口サイドローラ７，７は、食肉塊を強力に送るため平歯車に類似した歯を全周に設けてある。

ただし、これらのローラ部材は歯車状の動力伝達を行うものではないから噛合伝動用の歯の形状とする必要は無い。本発明において平歯車状の歯とは、円筒状の部材の周囲に、該円筒の軸心とほぼ平行に設けられて、適宜の丸みを有する凹凸の意である。上記の丸みとは、食肉を傷つけないようにエッジ部に設けたアールをいう。

第７図は、前記一対の入口サイドローラ７の支持，駆動機構を説明するため、Ｘ軸方向に見た部分的拡大図である。

１対の入口サイドローラ装置７は、それぞれ平歯車状の歯を有するローラ７ａのローラ軸７ｂを軸受７ｃで支承している。

一方、ガイドバー７ｄは、その根本部を球継手７ｅによりベース部材に対して傾動自在に支承されるとともに、前記の軸受７ｃを軸心方向の摺動自在に支持している。

前記ガイドバー７ｄは外嵌された圧縮コイルスプリング７ｆは、上記の軸受７ｃを先端側に向けて付勢している。

これにより、一対のローラ７ａは互いに接近する方向に付勢され、食肉塊１をＹ軸方向に挟みつける。

前記のローラ軸７ｂは自在継手７ｇを介してモータ９（第６図参照）によって回転駆動される。

ローラ軸７ｂと共にローラ７ａも回転し、ベルトコンベア２上の食肉塊１をＸ軸方向に出口部へ送る。

第３図に示した出口サイドローラ８の支持，駆動機構も、第７図に示した入口サイドローラ７の支持，駆動機構と同様である。

第３図に示した１３はカッタ機構である。これをＸ軸方向に視た詳細図を第８図に示す。

９は前述の門形フレームであって、カッタ機構１３を搭載している。

１１は、上記カッタ機構１３を搭載するための傾動ベースであって、ベース部材１１ａが軸１１ｂにより門形フレーム９に対して傾動可能に支持されている。

上記の軸１１ｂはＸ軸方向に設置されている。従って前記ベース部材１１ａはＹ－Ｚ面内で傾動する。

門形アーム９に固定されたＺ軸方向のレール９

aが、ベース部材１１ａに取り付けられたローラ１１ｃをＺ軸方向に案内して、該ベース部材１１ａをＹ－Ｚ面内に拘束している。

上記ベース部材１１ａの中央部に、カッタ機構１３の揺動アーム１３ａが軸１３ｂによって傾動自在に支承されている。

そして上記揺動アーム１３ａは、板バネ状のカッタ刃１３ｃの幅方向をＸ軸方向ならしめ、Ｙ－Ｚ面内の円弧に沿って湾曲せしめて、その両端を把持している。上記カッタ刃１３ｃの円弧は、前述の軸１３ｂを中心としている。

前記の揺動アーム１３ａにはドリブンアーム１３ｄが固着されている。

上記のドリブンアーム１３ｄには長孔が穿たれていて、この長孔に嵌合するクランクピン１３ｅを介してモータ１３ｆにより往復傾動せしめられる。

ドリブンアーム１３ｄの往復傾動により、前記の円弧状のカッタ刃１３ｃは矢印ｅ－ｆのごとく円弧方向に往復駆動される。

カッタ刃１３ｃの往復動により、ベルトコンベア２の上をＸ軸方向に送られる脂肪付き食肉塊（本図において図示せず）は、その脂肪層を切断される。

図示の２ａはベルトコンベア２を支承しているプーリである。２ｂは、該ベルトコンベア２がカッタ刃１３ｃに対向する浅いＵ字状断面を呈するように、これを支持しているトラフプレートである。

第８図に示した１２は、前記のベース部材１１ａを軸１１ｂの回りに傾動させてカッタ機構１３の位置を上下方向に調節するための駆動機構である。

Ｚ軸方向に配設されたボールネジ１２ａは、モータ１２ｂにより、傘歯車室１２ｃ内の傘歯車を介して回動せしめられる。

上記のボールネジ１２ａは、ベース部材１１ａに取付けられたボールナット１２ｄに螺合していて、該ボールネジ１２ａの正，逆転によりベース部材１１ａが上，下傾動する。これに伴ってカッタ機構１３が上下方向に移動し、カッタ刃１３ｃとベルトコンベア２との間の距離が増減調節される。

上記の調節は、第３図に示した脂肪層厚さ寸法の計測装置１５によって計測された値に基づいてモータ１２を正，逆転させて行われる。

上記計測装置１５による脂肪層厚さの計測は、ベルトコンベア２上を搬送されている食肉塊１の移動をストッパ１６によって阻止し、該食肉塊１をベルトコンベア２に対して一時的に停止させて行うようになっている。

第１図は上記ストッパ１６をＸ軸方向に視たところを描いてある。

シリンダ１６ａは装置のベース部材に対して固定され、そのピストンロッド１６ｂの先端にシャッタ板１６ｃが固着されている。

上記シャッタ板１６ｃはＺ－Ｙ面に沿って配設され、前記ピストンロッドの伸縮に伴ってＺ軸方向に下降，上昇する。

上記シャッタ板１６ｃが下降したとき、該シャッタ板１６ｃの下端の縁はベルトコンベア２に対して微小間隙を介して対向する。

上記の下端の縁から上方に向けて溝孔状の切欠１６ｃ-1，１６ｃ-2，１６ｃ-3が設けられている。

本発明を実施する際、この切欠を設ける個数は、第８図について後述するセンサの設置個数に合わせることが望ましい。

前記計測装置１５をＸ軸方向に視たところを第２図（Ａ）に示し、Ｙ軸方向に視たところを第２図（Ｂ）に示す。

シリンダ１５ａは装置のベース部材に対して固定され、このピストンロッド１５ｂの先端に３個のセンサ１５ｃ-1，１５ｃ-2，１５ｃ-3を並べて支持してある。

上記３個のセンサのそれぞれはＸ軸方向に向けられ、これら３個のセンサはＹ軸方向に配列されている。

上記のセンサ１５ｃ-1，１５ｃ-2，１５ｃ-3は相互に同様の部材であって、これに対向している物体の色調が赤色系統であるか白色系統であるか

を、非接触で識別する機能を有している。

本発明を実施する場合、上記センサの設置個数は任意に設定し得るが、第９図に示したロース肉１ａとＢ脂１ｃとの境界、およびＢ脂１ｃとＡ脂１ｄとの境界、並びにＡ脂１ｄの層の形は不定形で非幾何学的形状をなしているので、複数個のセンサを設けて平均値を求め得るように構成することが望ましい。

第２図（Ｂ）に示した１６ｃは前述のシャッタ板であり、１は該シャッタ板１６ｃで停止せしめられている食肉塊である。

シリンダ１５ａのピストンロッド１５ｂを伸縮させてセンサ１５ｃ-1～１５ｃ-3を上下方向に走査すると、これに対向している食肉塊１の色調の変化によってロース肉と脂肪層とを識別することができる。

上記センサ１５ｃ-1～１５ｃ-3の上下方向の位置は、これに取り付けられたラック１５ｄを介してエンコーダ１５ｅにより検出され、図示しない演算器によって脂肪層の厚さ寸法Ｔ（第９図参照）が算出される。

上記の演算器は、第８図に示したカッタ刃１３ｃの高さ位置Ｈが、

Ｈ＝Ｔ－ｔ

となるようにモータ１２ｂを、正，逆転制御する。

ただし、ｔは第９図に示したごとく、ロース肉１ａに付着させて残すべき脂肪層の厚さ寸法である。

〔発明の効果〕

以上説明したように、本発明に係る食肉の脂肪層自動計測装置によれば、ベルトコンベア上で搬送されている食肉塊に付着している脂肪層の厚さ寸法を自動的に計測することができる。

４．図面の簡単な説明

第１図は本発明に係る脂肪層自動計測装置の一実施例におけるシャッタ板の正面図である。

第２図は上記実施例におけるセンサ付近の外観図で、同図（Ａ）はＸ軸方向に視たところを描き、同図（Ｂ）はＹ軸方向に視たところを描いてある。

第３図は上記実施例を備えた食肉の自動脂肪切除装置を示す全体的な模式図である。

第４図（Ａ），（Ｂ）は上記自動脂肪切除装置のワーク押えの外観図である。

第５図は同じく入口上部ローラ装置を示す外観図で、同図（Ａ）はＸ軸方向に視たところを描き、同図（Ｂ）はＹ軸方向に視たところを描いてある。

第６図は同じく入口サイドローラ付近をＸ軸方向に視た模式図、第７図はその拡大詳細図である。

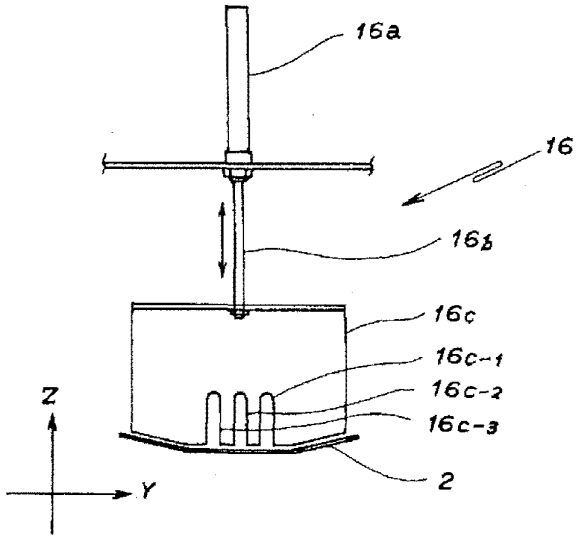
第８図は同じくカッタ機構付近をＸ軸方向に視た外観図である。

第９図は脂肪層が付着した食肉塊の１例を示す断面図である。

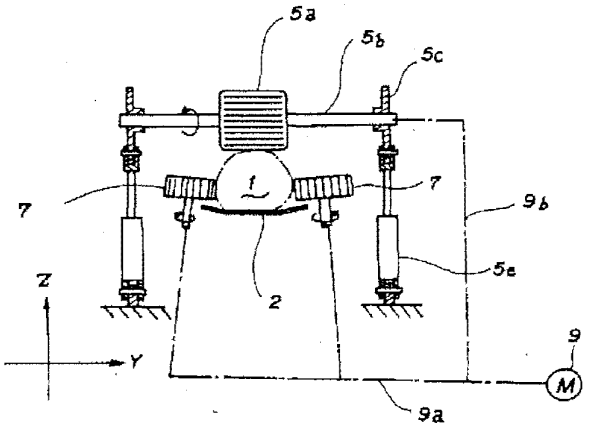
１…食肉塊、２…ベルトコンベア、３…シリンダ、４…ワーク押え、５…入口上部ローラ装置、６…出口上部ローラ装置、７…入口サイドローラ、８…出口サイドローラ、９…門形フレーム、１５…計測装置、１５ａ…シリンダ、１５ｂ…ピストンロッド、１５ｃ-1～１５ｃ-3…センサ、１５ｄ…ラック、１５ｅ…エンコーダ、１６…ストッパ、１６ａ…シリンダ、１６ｂ…ピストンロッド、１６ｃ…シャッタ板、１６ｃ-1～１６ｃ-3…切欠。

特許出願人　株式会社前川製作所
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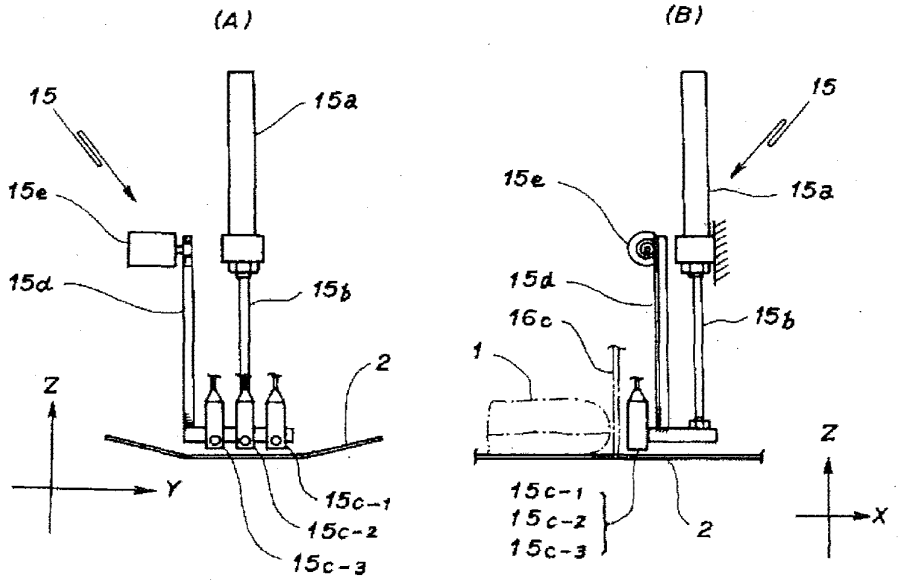
第 1 図


16a
16
16b
16c
16c-1
16c-2
16c-3
2
Z
Y

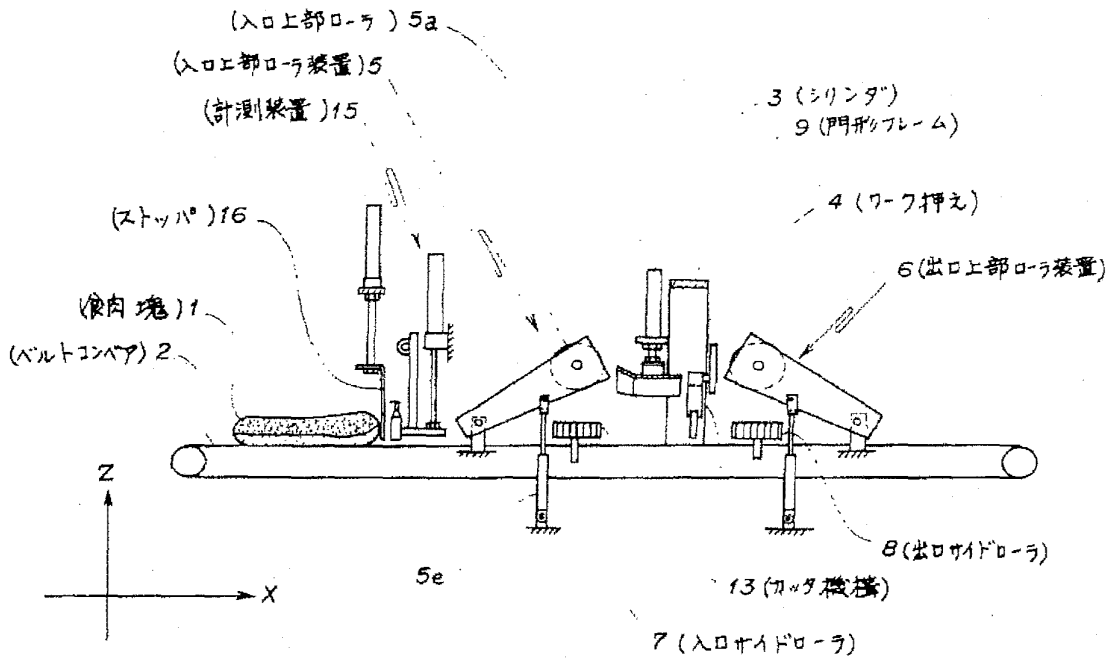
第 6 図


5a
5b
5c
7
7
9b
5e
1
2
Z
Y
9
M
9a

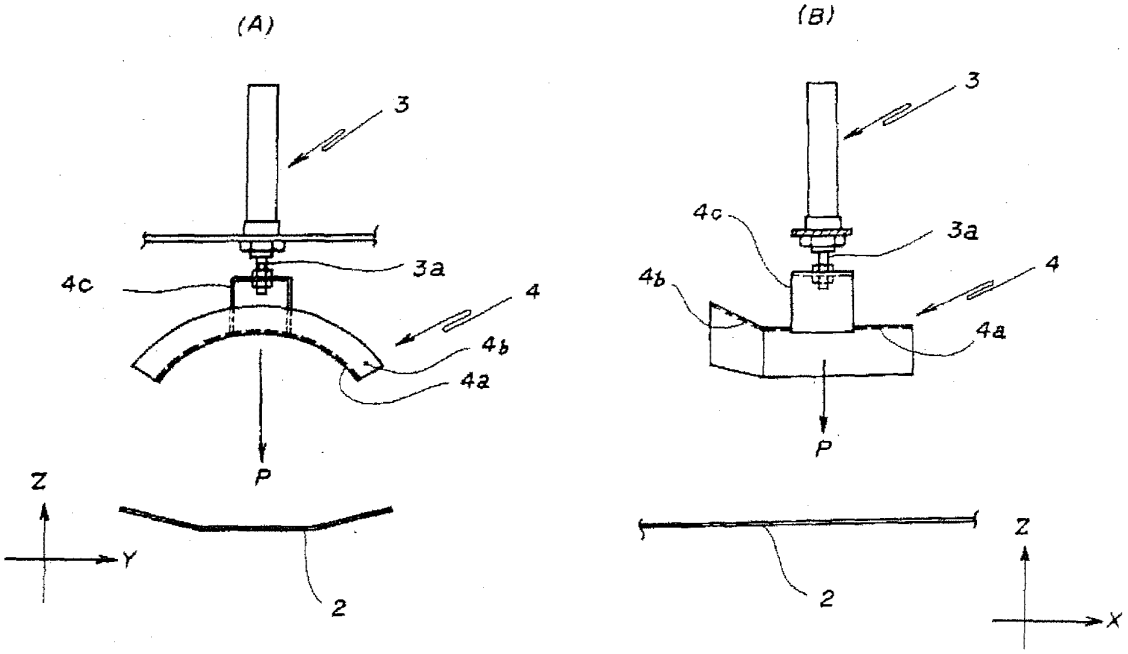
第 2 図


(A)
(B)
15
15a
15e
15d
15b
2
Z
Y
15c-1
15c-2
15c-3
16c
1
X

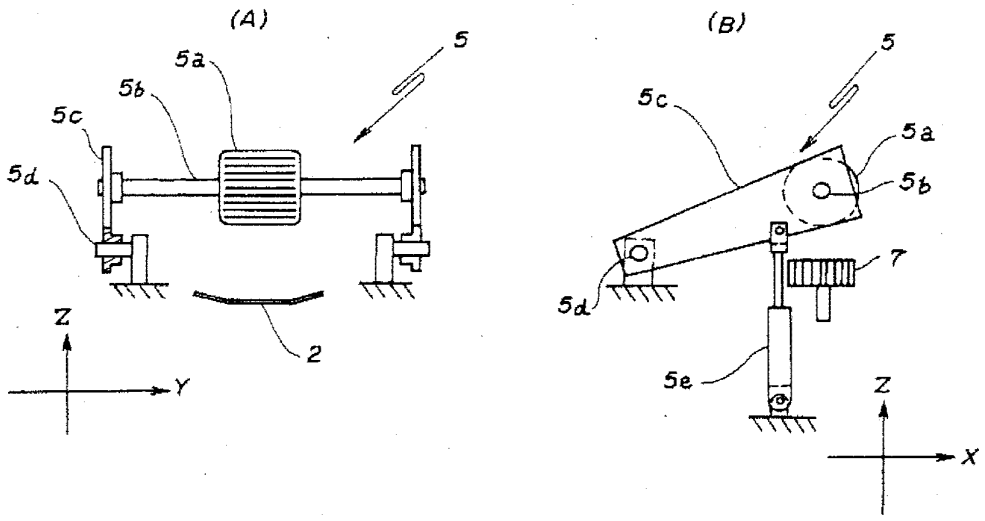
第 3 図


(入口上部ローラ) 5a
(入口上部ローラ装置) 5
(計測装置) 15
3 (シリンダ)
9 (門形フレーム)
4 (ワーク押え)
(ストッパ) 16
6 (出口上部ローラ装置)
(食肉塊) 1
(ベルトコンベア) 2
Z
X
5e
8 (出口サイドローラ)
13 (カッタ機構)
7 (入口サイドローラ)

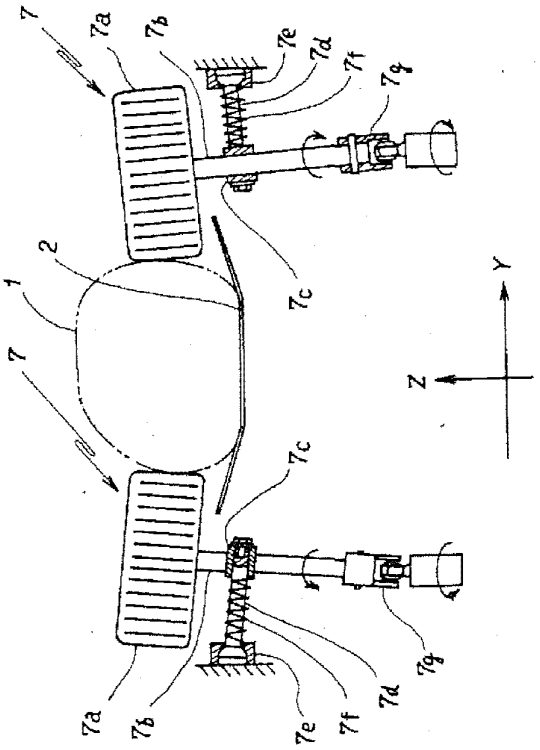
第 4 図


(A)
(B)
3
4c
3a
4
4b
4a
P
Z
Y
X
2

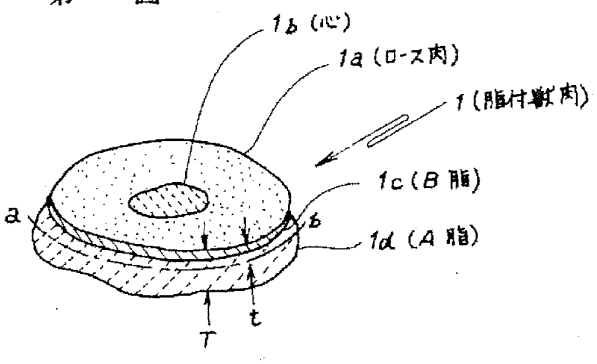
第 5 図


(A)
5
5a
5b
5c
5d
2
Z
Y
(B)
5
5c
5a
5b
7
5d
5e
Z
X

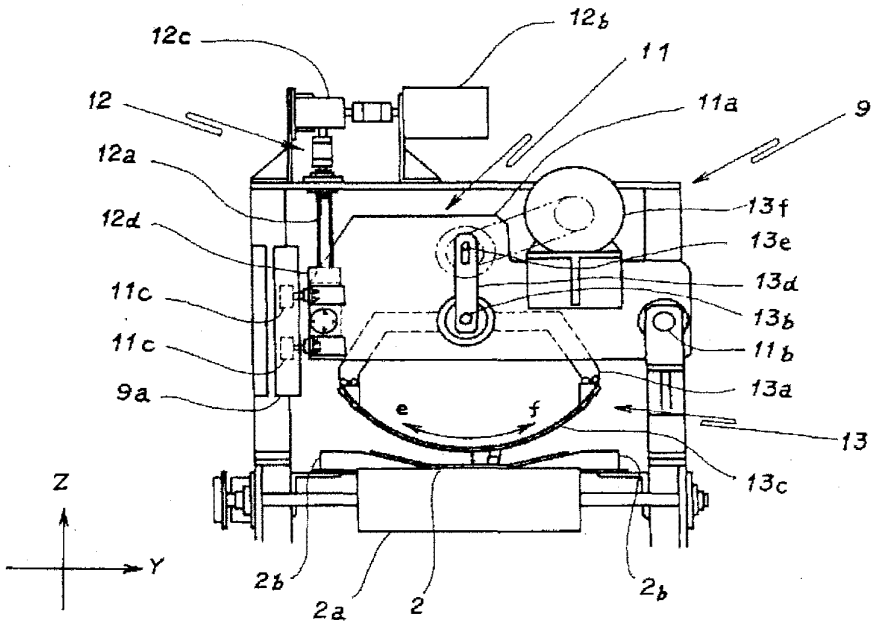
第 7 図


7
7a
7b
7e
7d
7f
7g
2
1
7c
Y
Z

第 9 図


1b (芯)
1a (ロース肉)
1 (脂付赤肉)
1c (B 脂)
a
b
1d (A 脂)
T
t

第 8 図


12c
12b
11
12
11a
9
12a
13f
12d
13e
13d
11c
13b
11c
11b
9a
13a
e
f
13
13c
Z
Y
2b
2a
2
2b

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SNOW BRAND FOOD CO LTD

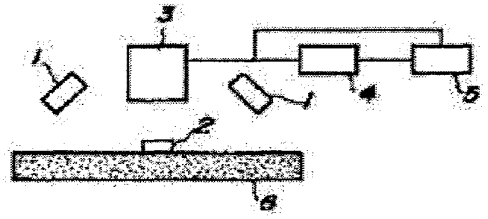
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(54) INSPECTION METHOD AND APPARATUS FOR FLESH TISSUE

(57)Abstract:

PURPOSE: To mechanically detect a muscle of flesh by detecting the position of a muscle of flesh by an optical device and clearly expressing the same as a two-dimensional coordinate.

CONSTITUTION: A reflected light applied 1 to a sample flesh 2 is detected and image-analyzed by an image processor 5. That is, an input image is separated into three primary colors, the densities thereof are obtained, and then the image is binarized by threshold values of the respective colors to take the fatty tissue as 1 and flesh tissue as 0. Subsequently, the blue image showing the flesh tissue is extracted, the contrast is emphasized by an equalizer to clarify the boundary between flesh tissue and fatty tissue. The image is masked by the first binary image to create an image where only the fatty part is extracted, and the outline is highlighted by space filter Laplacian to clarify the form of fatty tissue. Image data obtained by inverting and binarizing the above and the first binary data are added to create an image of a muscle. The image of the muscle is filtered to remove noise of background and taken as a two-dimensional coordinate to decide the position of the muscle.



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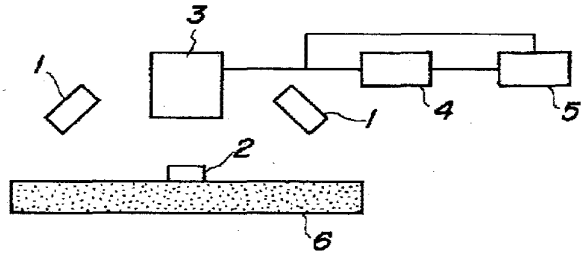
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(54)【発明の名称】　肉組織の検査方法及び装置

(57)【要約】

【目的】　肉内における筋の検出を、肉眼による方法から光学的装置を用いることにより、その位置を自動的に適確に行うにある。

【構成】　肉に照射した可視光線の反射画像を３原色に分離し、この各色の濃度分布の閾値により脂肪組織を２値化で表して青の要素のみを抽出し、これをエクアライザーにより脂肪組織の境界を明確にし、これで得た画像を最初の３原色の画像でマスクし、脂肪組織のみを抽出した画像を作成する。この画像を空間フィルターラプラシアンで輪郭を強調して全体の形を明瞭化した後、この画像の反転して得た画像を２値化して作成した画像と最初の２値化した画像との論理積をとった画像を、フィルター処理してバックグランドのごみを取り除き、この最終の画像の筋の位置を２次元の座標として表すことにより、筋を検出するようにしたものである。



1

【特許請求の範囲】
【請求項１】　下記の手順により肉組織を検査し肉の筋を検出する方法。
(1)肉に照射した可視光線の反射画像を、３原色に分離し、それぞれの濃度分布を求めた後、各色の閾値で脂肪組織を２値化で表す。
(2)青の要素のみを抽出し、エクアライザーで脂肪組織境界を明確にする。
(3)(2)で得た画像を（１）の画像でマスクし、脂肪組織のみを抽出した画像を作成する。
(4)(3)の画像を空間フィルターラプラシアンで輪郭を強調し、全体の形を明瞭化した後、この画像を反転した画像を得る。
(5)(4)に画像を２値化した画像を作成し、この画像(1)の論理積をとった画像を作成する。
(6)(5)の画像をフィルター処理を行い、バックグランドのごみを取り除き、肉の筋を座標化する。
【請求項２】　反射画像を３原色に分離し、脂肪組織のみを抽出する際の各色の階調範囲を０－２５５とし、その閾値が、赤１２５－２５５、緑０－２５５、青１２５－２５５である請求項１記載の方法。
【請求項３】　肉がステーキ用にカットされた凍結肉である請求項１または請求項２記載の方法。
【請求項４】　肉の載置台と、これに対する可視光線発生部と、肉の載置台よりの反射光検出部と、この反射光検出部よりの反射光の画像解析部とから構成される肉の筋の検出装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、可視光線による反射画像分析による肉の筋の検出方法及び肉の筋の検出装置に関する。さらに詳しくは、本発明は、食肉中の不食部分の検出方法に関する。
【０００２】
【従来の技術】食肉は、屠殺、解体後、種々形態に加工される。加工の際に骨や、腱などの不食部分が取り除かれ、さらに適当な大きさに切断されて市販あるいは凍結保存される。枝肉の加工段階で、主要な筋は取り除かれるが、筋肉組織内の筋はそのまま残ってしまう。これらの筋の切断を目的とした筋切り装置や、筋を取り除くための筋取り装置が種々提案されている。例えば特開平３－４９６３９号公報には、食肉中に肉眼で確認できる筋が存在する場合、その筋を下にして載置台に載置し、筋を機械的にはぎ取る方法と装置が開示されている。
【０００３】また食品加工においては、一般的にテンダライザーと呼ばれる装置を用いて、肉の軟化と筋の切断を行っている。これは多数の針を備え、肉のマッサージを行うとともに、この針により筋の切断を行い、インジェクターからプロテアーゼ含有液を注入し、肉の軟化を行う装置である。特開昭６３－２１６４２６号公報、特

2

開平３－１６４１３０号公報、特開平４－１４８６３９号公報には多数の針もしくは刃を備え、この針もしくは刃を肉に突き刺して、肉の筋を切断する目的に使用することのできるようこのような装置が開示されている。しかしこれまでに述べてきた筋取り装置や、筋切断のための装置は、肉の筋を検出し、それを選択的に切断するものではない。特開平３－４９６３９号に代表されるように、肉眼的に筋の有無を検査し、その筋を物理的に取り除いたり、あるいはテンダライザーのように、肉に全くランダムに鋭利な針や刃を多数突き刺して、肉の筋を切る方法が一般的である。特にテンダライザーの場合には、肉を柔らかくするという目的以上に、筋の切断のため、肉組織が切断されてしまい、ステーキ肉として販売するに適当でない肉になってしまうこともしばしば発生した。特にステーキ肉のように肉の風味を直接味わう場合には、肉の適当な弾力性を保持することが重要であった。従ってステーキ肉の処理としてはテンダライザーによる加工は好ましくなかった。
【０００４】このように、これまでの技術では、肉の筋の検出を肉眼的に行う以外には、まったくランダムに切断処理しており、肉中の筋を自動的に検出する技術は開示されていない。
【０００５】
【発明が解決しようとする課題】上記したように食肉の加工においては、肉の筋を切断しながら、肉組織自身は切断しないような技術の開発がのぞまれていた。しかしこれまでの技術では、肉の筋を検出する方法としては肉眼による検出以外は行われていなかった。このため肉眼により筋を検出した後、特開平３－４９６３９号に開示されているように、筋を取り除くために、肉を再配置し、筋取り装置にかけられるようにする必要があった。またテンダライザーの場合は、筋の実際の位置とは全く無関係に針や刃を差し込んで、不必要に筋以外の他の肉組織を切断してしまい、肉のドリップを流出させてしまっていた。
【０００６】本発明においては、このような肉の筋取り、筋切り作業に必須であった肉の筋の検出を肉眼による方法から、光学的装置を用いて自動的に検出し、肉の筋の位置を読み取り、これを２次元座標として明示する肉の筋を自動的検出し、座標化する方法及びその方法を実施するための装置を提供することを課題とする。
【０００７】
【課題を解決するための手段】本発明の方法を充填するために提供される装置の概要は、肉の載置台、可視光線照射装置、反射可視光線検出装置、可視光線反射画像入力装置、画像処理装置から構成される。概念図を図１に示す。本発明により検出することのできる筋は肉表面に肉眼で検出されるものであり、さらにこの筋の位置を光学的に検出し、その位置を２次元に座標化する。本発明による検査対象としては、もも肉などのブロック肉やス

テーキ用にカットされた肉であれば筋の検出を行うことができる。また肉は冷凍保存されたものであってもよい。またＴボーンステーキ肉のように骨がついたままカットされたものであっても検査上差し支えがない。

【０００８】検査の際の温度は室温もしくは、肉の凍結保存の温度で検査することができる。特に肉がステーキ肉のような形態に凍結加工されたものは、凍結状態を維持するような温度条件で行うことが作業上、品質維持上好ましい。肉は載置台の上に固定されるが、載置台はコンベアー等の上で移動するような形態であって差し支えない。この肉に可視光線を照射する。光源としては、白色光源であればどのようなものであっても使用可能であるが、望ましくは蛍光灯や白色電球が好ましい。光源の強度は肉の表面で１０ルックス－６０００ルックスであればよい。この光源は肉に対して斜上方向から照射するように設置し、反射光ができるがぎり反射光検出装置に効率良く入射するようにする。

【０００９】反射光検出装置としてはＩＴＶのような検出装置や、市販のＣＣＤを使用したビデオカメラのようなものであっても良い。この反射光検出装置により検出された反射光は直接あるいは可視光線反射画像入力装置を経て画像処置装置へと入力され画像解析される。また画像処理装置としては市販の画像解析装置であればどのようなものでも使用可能である。ステーキ肉の形態にカットされた肉の場合、筋は肉の脂肪と境界部分、特に脂肪組織に入り込んだ状態で存在する。このような肉を上記の装置に載せ、可視光線を照射して得られた反射光線画像を画像分析装置に入力して、筋の検出を行う。

【００１０】まず入力画像を３原色に分離し、それぞれの０－２５５階調の濃度を求める。赤の閾値を１２５－２５５階調に設定し、同じく緑の閾値０－２５５階調、青の閾値１２５－２５５階調として、画像を２値化する。本発明においては、このような閾値を設定した場合、脂肪組織は１、脂肪組織以外の組織即ち肉組織は０となる。３原色の内青の要素をのみ抽出する。この青の要素は肉片の脂肪部分の強度が低く、脂肪の分布を反映している。青の要素、即ち脂肪組織を示す画像をエクアライザーでコントラストを強調して、肉組織と脂肪組織の境界を明確する。この画像をさらに始めの２値化画像でマスクすることにより、さらに脂肪部分のみを抽出した画像を作成する。

【００１１】脂肪部分のみを抽出した画像を空間フィルターラプラシアンで輪郭を強調し、脂肪組織の形を明瞭化する。この画像をさらに反転した後、２値化するため、２５５で割り（脂肪組織１、他の組織０）、得られた画像データと最初の２値化データによる画像データの論理積をとり、筋の画像を作成する。この筋の画像をさらにオーダーフィルター（Ｏｒｄｅｒ　ｆｉｌｔｅｒ）もしくはローパスフィルター（Ｌｏｗ－ｐａｓｓ　ｆｉｌｔｅｒ）などによりバックグランドのノイズを除去し、最終の筋の画像とする。この筋の位置を２次元の座標として決定する。以上の操作は画像処理装置にあらかじめ条件を入力して置くことにより、検査対象の肉を載せると同時に筋の位置が検出される。

【００１２】このようにして得られた筋位置の情報が、上述のレーザービームや、ウオータージェットの水流の制御に用いて、肉の筋のみを選択的に切断することができる。本発明による肉筋の検出装置は、肉を載せ、座標を確定するために肉がその位置から動かないようにするための、肉載せ台、可視光線を照射する可視光線発生部位、肉からの反射光線を検出する反射光線検出部、反射光線画像を処理する画像解析部から構成される。画像分析装置はさらに２次元データに画像解析データを加工できるものが望ましい。

【００１３】本発明において、肉内の筋を自動的に２次元座標として表すことは、この座標位置のみに切断用の針や刃を差し込んだり、あるいはウオータージェットの細い水流やレーザー切断装置などの細かい切断ビームにより、選択的に切断することが可能となる。またこのようにして、筋のみを選択的に切断することにより、筋の多いことで低級に格付けされていた肉を良好な外観を保ちながら柔らかい高級肉にすることが可能となる。本発明は肉と筋の検知のみならず骨と肉の区別や、肉と脂肪の検知も可能であり、肉の加工に有利である。特に、内蔵肉等の加工に本方法を採用することにより効果よく不食部を取り除くことができる。

【００１４】

【実施例】以下に実施例を示しさらに本発明を詳細の説明する。図１に示す構成の筋検出装置のうち、１は可視光線発生装置、２は測定試料の肉、３は反射可視光線検出装置、４は可視光線反射画像入力装置、５は反射像処理装置、６は試料の肉の載台で、この装置を用いて肉の筋の検出を行った。

(1)凍結肉を用いた筋の検出

厚さ１cm直径１０cmの円盤状に成形した肉（品温　－５℃）を図１に示した本発明の筋の検出装置に設置し、可視光線反射画像を得た。この画像を画像処理し、図２に示す青成分の反射画像を得た。得られた画像から青成分を抽出後、背景をマスク処理により削除し、さらに脂肪部分をマスク処理により抽出した。この画像に濃淡強調処理を施し、筋のみを抽出し２値化画像を得た。その結果を図３に示した。この図と目視した肉の筋とを比較したところ、本発明方法、および装置を用いた筋の検出装置は正確に肉中の筋を検出していることが確認できた。さらに上記２値化画像を３２×３２の２次元座標により筋の位置を表し、出力した結果を図４に示した。この図４に示す２次元座標に相当する位置を筋切断用の刃を備えたニードルで処理したところ、肉の筋以外を切断せずに筋のみ選択的に切断することができた。さらに不定型の肉についても同様な操作手順で行ったところ、筋の検

5

出が可能であった。

【００１５】(2)生肉を用いた筋の検出

厚さ１．５cm直径１０cmの円盤状に成形した肉（品温１０℃）を図１に示した本発明の筋検出装置に設置し、可視光線反射画像を得た。この画像を画像処理し、図５に示す青成分の反射画像を得た。得られた画像から青成分を抽出後、背景をマスク処理により削除し、さらに脂肪部分をマスク処理により抽出した。この画像に濃淡強調処理を施し、筋のみを抽出し２値化画像を得た。その結果を図６に示した。この図と肉の筋を実際に肉眼および手で触れて確認し、比較したところ、本発明方法、および装置を用いた筋の検出装置は正確に肉中の筋を検出していることが確認できた。さらに上記２値化画像を３２×３２の２次元座標により筋の位置を表し、出力した結果を図７に示した。この図７に示す２次元座標に相当する位置をウオータージェットにより０．５cm間隔で切断で処理した後調理したところ、肉の筋以外を切断せずに筋のみを選択的に切断することが確認できた。

【００１６】

【発明の効果】本発明の実施により、従来人手により行っていた肉の筋の検出を機械的に行うことが可能となる。また、筋の検出を行う装置が提供される。さらに本発明で提供される筋の位置を示す座標情報により、肉の＊

6

＊筋を選択的に切断し、筋のない肉を調製することができる。本発明は、骨つき肉から肉を切り離す装置にも応用可能である。

【図面の簡単な説明】

【図１】肉の筋検出装置の概念図を示す。

【図２】凍結肉の可視反射光の青成分抽出画像を示す。

【図３】図２の青成分抽出画像を適切な画像処理を施して得られた２値化画像を示す。

【図４】図３の画像をさらに３２×３２の２次元座標に変換し、筋の位置を座標化した画像を示す。

【図５】生肉の可視反射光の青成分抽出画像を示す。

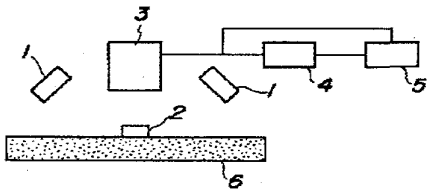
【図６】図５の青成分抽出画像を適切な画像処理を施して得られた２値化画像を示す。

【図７】図６の画像をさらに３２×３２の２次元座標に変換し、筋の位置を座標化した画像を示す。

【符号の説明】

1　可視光線発生装置
2　試料肉
3　反射可視光線検出装置
4　可視光線反射画像入力装置
5　画像処理装置
6　試料肉載せ台

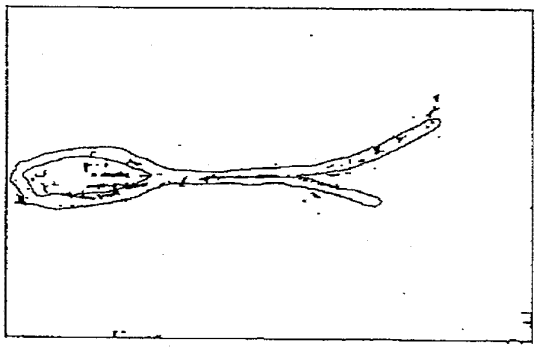
【図１】



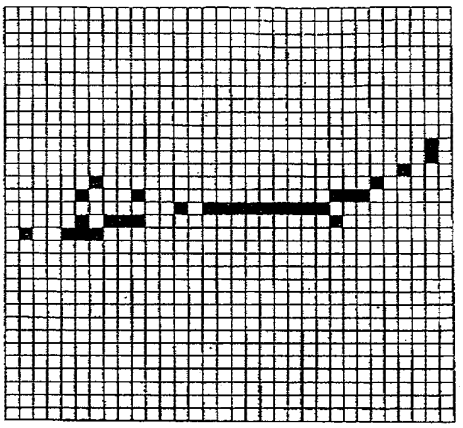
【図２】



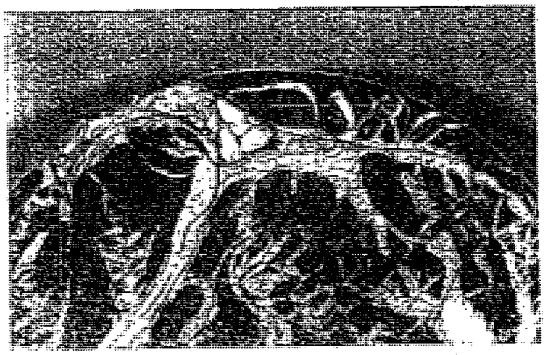
【図３】



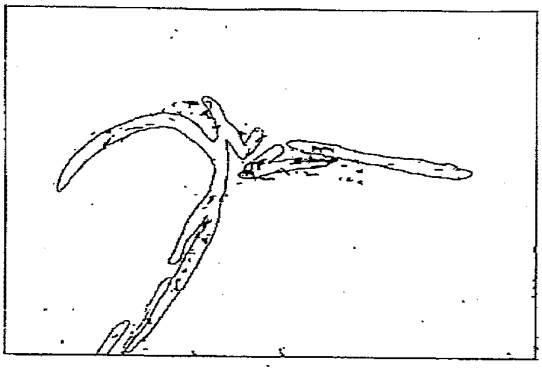
【図４】



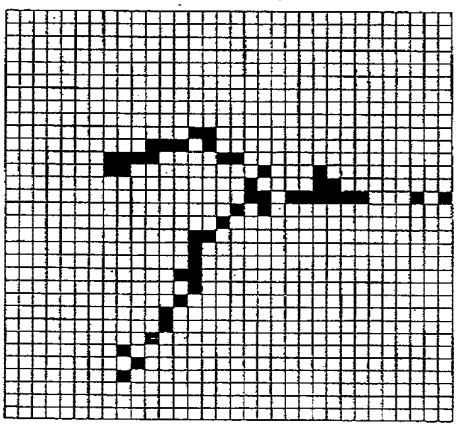
【図５】



【図６】



【図７】



フロントページの続き

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Electronic Acknowledgement Receipt

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Application Number:	12738969
International Application Number:	
Confirmation Number:	6367
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Customer Number:	20350
Filer:	Jessica C. Stahnke/Raymond Rollan
Filer Authorized By:	Jessica C. Stahnke
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Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IDS_66234_785420_03_19_2013.pdf	156241 ef7159106b6bda8e4ccb873ce8d1f835ab72937c	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	2
	Information Disclosure Statement (IDS) Form (SB08)	3	4

Warnings:					
Information:					
2	Foreign Reference	JP04084850.pdf	847663 91e08b04cec8de45e5f4a138068b122213897348	no	11
Warnings:					
Information:					
3	Foreign Reference	JP06242102.pdf	464280 0cc008853c56088547cc298ecd2aef5802940c3f	no	7
Warnings:					
Information:					
		Total Files Size (in bytes):	1468184		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on MARCH 27, 2013.

KILPATRICK TOWNSEND & STOCKTON LLP

By: /Raymond R. Rollan/

PATENT
Attorney Docket No.: 66234-785420 (006700US)
Client Ref. No.: W10078PWOUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 6367
Guenther Weber	Examiner: Richard Thomas Price
Application No.: 12/738,969	Technology Center/Art Unit: 3643
Filed: June 30, 2010	
For: FAT COVER MEASUREMENT DEVICE	INFORMATION DISCLOSURE STATEMENT
Customer No.: 20350	

Mail Stop IDS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

The references cited on attached form PTO/SB/08A are being called to the attention of the Examiner. Copies of the references in compliance with the requirements of 37 CFR § 1.98(a)(2) are enclosed.

It is respectfully requested that the cited references be expressly considered during the prosecution of this application, and the references be made of record therein and appear among the "references cited" on any patent to issue therefrom.

As provided for by 37 CFR § 1.97(g) and (h), no inference should be made that the information and references cited are prior art merely because they are in this statement and no representation is being made that a search has been conducted or that this statement encompasses all the possible relevant information.

CERTIFICATION

I hereby certify that each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement.

Applicant believes that no fee is required for submission of this statement. However, if any additional fees are due for the submission of this Information Disclosure Statement, please deduct those fees from Deposit Account No. 20-1430.

Respectfully submitted,

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Attachments

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on April 26, 2013.

KILPATRICK TOWNSEND & STOCKTON LLP

By: Lisa Jeanetta
Lisa Jeanetta

PATENT
Attorney Docket No.: 66234-785420-006700US
Client Ref. No.: W10078PWOUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 6367
Guenther Weber	Examiner: Richard Thomas Price
Application No.: 12/738,969	Technology Center/Art Unit: 3643
Filed: June 30, 2010	
For: FAT COVER MEASUREMENT DEVICE	AMENDMENT
Customer No.: 20350	

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In response to the Office Action mailed November 26, 2012, please enter the following amendments and remarks:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

A petition for a two-month extension of time accompanies this response.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Canceled).

2. (Currently Amended): ~~A measurement device (18) in accordance with claim 1, characterized in that~~ The apparatus of claim 8, wherein the determination of the thickness of the fat cover takes place optically.

3. (Currently Amended): ~~A measurement device (18) in accordance with claim 1, characterized by~~ The apparatus of claim 8, further comprising a light detector~~, in particular a camera,~~ for the detection of light reflected at the meat product ~~(12)~~.

4. (Currently Amended): ~~A measurement device (18) in accordance with claim 1, characterized by~~ The apparatus of claim 8, further comprising a light source ~~illuminating~~ configured to illuminate a region of the meat product ~~(12)~~.

5. (Currently Amended): ~~A measurement device (18) in accordance with claim 1, characterized in that~~ The apparatus of claim 4, wherein the light source ~~includes~~ comprises at least one light emitting diode~~, in particular a light emitting diode emitting in the blue wavelength spectrum~~.

6. (Currently Amended): ~~A measurement device (18) in accordance with claim 1, characterized in that~~ The apparatus of claim 8, further comprising a transport device ~~(20) is provided~~ configured to transport the meat product ~~(12), in particular continuously,~~ through the measurement device ~~(18)~~.

7. (Currently Amended): ~~A measurement device (18) in accordance with claim 6, characterized in that~~ The apparatus of claim 6, further comprising a light source and a light detector ~~are arranged~~ disposed laterally next to the transport device ~~(20)~~ when viewed in the transport direction.

8. (Currently Amended): An apparatus for ~~the~~ separation of a fat cover of a meat product ~~(12)~~ from a flesh component of the meat product ~~(12) having~~ , comprising:

a measurement device ~~(18), in particular a measurement device (18) in accordance with claim 1,~~ for ~~the~~ automatic determination of the thickness of the fat cover, wherein the determination of the thickness of the fat cover takes place in a contactless manner; and ~~having~~

a cutting device ~~(10)~~ coupled to the measurement device ~~(18)~~ for ~~the~~ automatic separation of the fat cover from the flesh component in dependence on the ~~measured data~~ thickness determined by the measurement device ~~(18)~~ , wherein the cutting device comprises:

a cutting blade whose position is variable relative to a product support; and

a control unit for control of the position of the cutting blade in dependence on the thickness determined by the measurement device, wherein at least one travel profile is stored in the control unit in accordance with which the position of the cutting blade relative to the product support is to be set in dependence on a product feed.

9. (Currently Amended): ~~An~~ The apparatus ~~in accordance with~~ of claim ~~8, characterized in that a~~ 6, wherein the transport device ~~(14, 20)~~ is ~~provided to transport the meat product (12), in particular continuously, through the measurement device (18) and~~ further configured to supply [[it]] the meat product to the cutting device ~~(10)~~.

10. (Currently Amended): ~~An~~ The apparatus ~~in accordance with~~ of claim 8, ~~characterized in that the cutting device (10) includes a~~ wherein the cutting blade~~, in particular~~ is a cutter bar~~, whose position, and in particular whose height, is variable relative to a product support~~.

11-13. (Canceled).

14. (Currently Amended): ~~A method in accordance with claim 13, characterized in that~~ The method of claim 19, wherein determining the thickness of the fat cover ~~is determined by means of~~ comprises an optical measurement.

15. (Currently Amended): ~~A method in accordance with claim 13, characterized in that~~ The method of claim 19, wherein determining the thickness of the fat cover ~~is determined~~ takes place during a transport movement~~, in particular a continuous transport movement,~~ of the meat product ~~12~~.

16. (Currently Amended): ~~A method in accordance with claim 13, characterized in that only a~~ The method of claim 21, wherein the part ~~section~~ of the ~~meat product (12), in particular~~ length is a frontmost part ~~section viewed~~ in ~~a transport~~ the feed direction~~, is measured for the determination of the thickness of the fat cover~~.

17. (Currently Amended): ~~A method in accordance with claim 13, characterized in that~~ The method of claim 19, wherein the meat product defines a length along the feed direction, the method further comprising determining the shape of the fat cover ~~is determined~~ over the total length of the meat product ~~(12) by a measurement of the meat product (12)~~ at characteristic measurement points and by subsequent interpolation or extrapolation.

18. (Currently Amended): ~~A method in accordance with claim 13, characterized in that~~ The method of claim 19, further comprising comparing the determined ~~measured values are compared~~ thickness with ~~measured~~ thickness values ~~experience has shown~~ that are to be expected for the meat product ~~(12)~~, and displaying an error message ~~is displayed on a deviation of~~ when the determined ~~measured values~~ thickness deviates from the ~~measured~~ thickness values that are to be expected.

19. (Currently Amended): A method for ~~the~~ separation of a fat cover of a meat product ~~(12)~~ from a flesh component of the meat product ~~(12) in which~~, comprising:

determining the thickness of the fat cover ~~is determined, in particular by means of a method in accordance with claim 13, and~~ in a contactless manner;

~~the fat cover is separated from the flesh component~~ setting a position of a cutting blade in dependence on the determined thickness of the fat cover in accordance with a preset travel profile and in dependence on a feed of the meat product, wherein the setting comprises setting the position in a direction transverse to the feed direction; and

with the cutting blade, separating the fat cover from the flesh component, wherein during the separating, the cutting blade is at the set position according to the travel profile.

20. (Canceled).

21. (Currently Amended): [[A]] The method ~~in accordance with~~ of claim 19, ~~characterized in that~~, wherein the meat product defines a length aligned in the feed direction,

wherein determining the thickness comprises selecting only a part ~~section~~ of the length of the meat product ~~(12), in particular a front part section viewed in a transport direction, is measured for the determination of~~, and measuring the thickness of the fat cover only at the part of the length, and

wherein setting the position of the cutting blade comprises selecting the preset ~~a stored~~ travel profile ~~is selected~~ only in dependence on the measured thickness taken only at the part of the length ~~result in accordance with which the position, and in particular the height, of the cutting blade relative to a product support is set in dependence on a product feed~~.

22. (New): The apparatus of claim 8, wherein the position of the cutting blade comprises the height of the cutting blade relative to the product support, wherein the travel profile comprises instructions for the height of the cutting blade along a length of the meat product.

23. (New): The apparatus of claim 3, wherein the light detector comprises a camera.

24. (New): The apparatus of claim 5, wherein the light emitting diode is configured to emit light in the blue wavelength spectrum.

25. (New): The apparatus of claim 8, wherein the position of the cutting blade is variable relative to the meat product.

REMARKS/ARGUMENTS

Claims 2-10, 14-19, and 21 are amended; claims 1, 11-13, and 20 are canceled; claims 22-25 are new; and claims 2-10, 14-19, and 21-25 are pending, upon entry of the Amendment. Specifically, claim 8 is amended into independent form, incorporating the features of claim 1, from which it previously depended, as well as incorporating some features of claim 10 and the features of claims 11-12. Claims 1, 11, and 12 are accordingly canceled and claim 10 is amended for consistency. Claim 19 is also amended into independent form, incorporating the features of claim 13, from which it previously depended, as well as the features of claim 20. Claims 13 and 20 are accordingly canceled. The claims are also amended herein for further clarity, for purposes unrelated to patentability concerns. As such, no new matter has been added, and no new issues are raised, because independent claims 8 and 19 are substantively similar to previously presented claims 12 and 20, respectively. Reconsideration of the present application in view of above amendments and remarks made herein is respectfully requested.

Claim Rejections – 35 USC § 102

Claims 1-21 are rejected under 35 U.S.C. 102(e) as allegedly being anticipated by Christensen (US Patent 7,918,718), hereinafter "Christensen." Reconsideration and withdrawal of these rejections is respectfully requested, in light of the foregoing amendments and following remarks.

The disclosed embodiments of the presently claimed invention are directed to an apparatus and method in which one or more travel profiles of a cutting blade are stored in a control unit. Thickness of a fat cover of a meat product is measured only along a relatively small portion of the length of the meat product, and this thickness is unambiguously associated with one of several known anatomies of the meat product. An appropriate travel profile is then selected, and the height of the cutting blade is varied over the length of the meat product, based on the stored travel profile associated with the determined anatomy of the meat product. In other words, based on a very small number of measurements taken, for example, at the frontmost end of the meat product, the entire travel profile of the cutting blade is selected.

Christensen, on the other hand, measures "[t]he lean meat content...with great accuracy" (column 13, lines 62-63) by taking, *e.g.* 130 CT sectional images along the entire length of each carcass (column 14, lines 2-3 and 12-13). Based on this "very detailed information," the plan of use for the derinding/fat trimming machines is adjusted (column 14, lines 24-28). In other words, "detailed information on...the shape and extent of the fat layer [is used to] control the subsequent...derinding/fat trimming machines" (column 14, lines 40-43). The actual shape of the fat layer is input so that the derinding/fat trimming machine will follow this contour. This is in direct contrast to the presently claimed "travel profiles" (*i.e.* contours of the fat trimming blade), a finite number of which are stored in the control unit and selected based on a small number of measurements of the thickness of the fat cover at, *e.g.*, the frontmost end of the meat product.

Thus, Christensen does not disclose or in any way suggest at least the following features called for by the presently pending claims:

> *at least one travel profile is stored in the control unit in accordance with which the position of the cutting blade relative to the product support is to be set in dependence on a product feed* (claim 8) or
>
> *setting a position of a cutting blade in dependence on the determined thickness of the fat cover in accordance with a preset travel profile and in dependence on a feed of the meat product,...and*
> *with the cutting blade, separating the fat cover from the flesh component, wherein during the separating, the cutting blade is at the set position according to the travel profile* (claim 19).

Claim 8 and 19 are thus patentable over Christensen. Dependent claims 2-7, 9, 10, 14-18, and 21-25 are patentable at least due to the dependence of each on either claim 8 or claim 19. These claims further include additional features of the invention which are considered independently patentable. For example, claim 21 additionally calls for

> *wherein determining the thickness comprises selecting only a part of the length of the meat product, and measuring the thickness of the fat cover only at the part of the length, and*
> *wherein setting the position of the cutting blade comprises selecting the preset travel profile only in dependence on the measured thickness taken only at the part of the length.*

Thus, all claims are considered patentable over Christensen.

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Further, the Commissioner is hereby authorized to charge any additional fees or credit any overpayment in connection with this paper to Deposit Account No. 20-1430.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-273-7513 (direct dial).

Respectfully submitted,

Jessica C. Stahnke

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64838785V.1

PTO/AIA/22 (03-13)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 66234-785420
Application Number 12/738,969	Filed June 30, 2010
For FAT COVER MEASUREMENT DEVICE	
Art Unit 3643	Examiner Richard Thomas Price

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
☐ One month (37 CFR 1.17(a)(1))	$200	$100	$50	$____
☒ Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$600
☐ Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$____
☐ Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$____
☐ Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$____

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☒ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 20-1430.

☒ Payment made via EFS-Web.
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☒ attorney or agent of record. Registration Number 57,570

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____

Jessica C. Stahnke
Signature

April 26, 2013
Date

Jessica Stahnke
Typed or printed name

(415) 576-0200
Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Patent Application Fee Transmittal

Application Number:	12738969
Filing Date:	30-Jun-2010
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Filer:	Jessica C. Stahnke/Lisa Jeanetta
Attorney Docket Number:	088000-006700US

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 2 months with $0 paid	1252	1	600	600

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**600**

Electronic Acknowledgement Receipt

EFS ID:	15629878
Application Number:	12738969
International Application Number:	
Confirmation Number:	6367
Title of Invention:	Fat Cover Measurement Device
First Named Inventor/Applicant Name:	Guenther Weber
Customer Number:	20350
Filer:	Jessica C. Stahnke/Lisa Jeanetta
Filer Authorized By:	Jessica C. Stahnke
Attorney Docket Number:	088000-006700US
Receipt Date:	26-APR-2013
Filing Date:	30-JUN-2010
Time Stamp:	21:24:47
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$600
RAM confirmation Number	8629
Deposit Account	201430
Authorized User	KILPATRICK TOWNSEND & STOCKTON, LLP

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Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2013_04_26_AMD_EXT_66234-785420.pdf	583872 6e7554c9054549ddf7bdd08bb4778be7e8c4f857	yes	9

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	8
Extension of Time	9	9

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30346 2e42b066328d692d4af0061e7cbf5ecae83ccc08	no	2

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/738,969	Filing Date 06/30/2010	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☒ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	**330**
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	* 0	X $ =		OR	X $52 =	**0**
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	* 0	X $ =			X $220 =	**0**
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	**330**

APPLICATION AS AMENDED – PART II

AMENDMENT	**04/26/2013**	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	X $ =		OR	X $80=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $420=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**0**

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/JESSICA GAYNOR/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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20350 7590 05/16/2013

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SAN FRANCISCO, CA 94111-3834

EXAMINER
PRICE JR, RICHARD THOMAS

ART UNIT	PAPER NUMBER
3643	

DATE MAILED: 05/16/2013

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/738,969	06/30/2010	Guenther Weber	66234-006700US-785420	6367

TITLE OF INVENTION: FAT COVER MEASUREMENT DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1780	$300	$0	$2080	08/16/2013

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

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Alexandria, Virginia 22313-1450
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CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20350 7590 05/16/2013
KILPATRICK TOWNSEND & STOCKTON LLP
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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/738,969	06/30/2010	Guenther Weber	66234-006700US-785420	6367

TITLE OF INVENTION: FAT COVER MEASUREMENT DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1780	$300	$0	$2080	08/16/2013

EXAMINER	ART UNIT	CLASS-SUBCLASS
PRICE JR, RICHARD THOMAS	3643	452-134000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29	NOTE: Absent a valid certification of Micro Entity Status (see form PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
❑ Applicant asserting small entity status. See 37 CFR 1.27	NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
❑ Applicant changing to regular undiscounted fee status.	NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

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12/738,969	06/30/2010	Guenther Weber	66234-006700US-785420	6367

20350 7590 05/16/2013

KILPATRICK TOWNSEND & STOCKTON LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER	
PRICE JR, RICHARD THOMAS	

ART UNIT	PAPER NUMBER
3643	

DATE MAILED: 05/16/2013

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 395 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 395 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 12/738,969	Applicant(s) WEBER, GUENTHER	
	Examiner RICHARD PRICE JR	Art Unit 3643	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *an amendment filed on 4-26-2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *2-10,14-19 and 21-25*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

   Interim copies:

   a) ☐ All b) ☐ Some c) ☐ None of the: Interim copies of the priority documents have been received.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 3-27-2013
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/Thomas Price/
Primary Examiner, Art Unit 3643

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Field

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	12/738,969
Filing Date	June 30, 2010
First Named Inventor	Guenther Weber
Art Unit	3643
Examiner Name	Richard Thomas Price
Attorney Docket Number	66234-785420

U.S. PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

U.S. PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1.	04-084850	JP		03-18-1992	MAYEKAWA MFG CO LTD	English Translation of The Abstract Only	
	2.	06-242102	JP		09-02-1994	SNOW BRAND MILK PROD CO LTD SNOW BRAND FOOD CO LTD	English Translation of The Abstract Only	

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.P./

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Field

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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Filing Date	June 30, 2010
First Named Inventor	Guenther Weber
Art Unit	3643
Examiner Name	Richard Thomas Price
Attorney Docket Number	66234-785420

EXAMINER SIGNATURE

Examiner Signature	/Richard Price/		Date Considered	05/05/2013	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at **www.USPTO.GOV** or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document.
[4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.P./

Issue Classification

Application/Control No.	Applicant(s)/Patent Under Reexamination
12738969	WEBER, GUENTHER
Examiner	**Art Unit**
RICHARD PRICE JR	3643

CPC

Symbol				Type	Version
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CPC Combination Sets

Symbol				Type	Set	Ranking	Version
			/				
			/				

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
452	134

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				

INTERNATIONAL CLASSIFICATION

CLAIMED					NON-CLAIMED				
A	2	2	C	17 / 16 (2006.01.01)					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/RICHARD PRICE JR/ Primary Examiner.Art Unit 3643 05/05/2013 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12738969	WEBER, GUENTHER
	Examiner	**Art Unit**
	RICHARD PRICE JR	3643

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/RICHARD PRICE JR/ Primary Examiner.Art Unit 3643	05/05/2013	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12738969	WEBER, GUENTHER
	Examiner	**Art Unit**
	RICHARD PRICE JR	3643

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1	17	17												
2	2	18	18												
3	3	14	19												
5	4		20												
6	5	19	21												
8	6	12	22												
9	7	4	23												
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10	9	13	25												
11	10														
	11														
	12														
	13														
15	14														
16	15														
20	16														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/RICHARD PRICE JR/ Primary Examiner.Art Unit 3643 (Primary Examiner)	05/05/2013 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	9190	"452"/$.ccls.	USPAT; UPAD	OR	ON	2013/05/05 19:48
L2	647	1 and fat	USPAT; UPAD	OR	ON	2013/05/05 19:49
L3	441	2 and cutting	USPAT; UPAD	OR	ON	2013/05/05 19:49
L4	132	3 and measure$4	USPAT; UPAD	OR	ON	2013/05/05 19:49

5/5/2013 7:49:33 PM
C:\Users\rprice\Documents\EAST\Workspaces\Default EAST Workspace 1600x1200.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12738969	WEBER, GUENTHER
	Examiner	Art Unit
	RICHARD PRICE JR	3643

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
452	125	5-5-2013	rtp
	134		
	149		
	150		
	156		
	157		

SEARCH NOTES		
Search Notes	Date	Examiner

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
text search	attached	5-5-2013	rtp

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 6367

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/738,969	06/30/2010 RULE	452	3643	66234-006700US-785420

APPLICANTS
Guenther Weber, Gross Nemerow, GERMANY;

**** CONTINUING DATA ***************************
This application is a 371 of PCT/EP2008/007567 09/12/2008

**** FOREIGN APPLICATIONS **************************
GERMANY 10 2007 050 857.5 10/24/2007

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
07/14/2010

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☑ Yes ☐ No	☑ Yes ☐ No	/RICHARD THOMAS PRICE JR/ Examiner's Signature	☐ Initials	GERMANY	1	21	2

ADDRESS

KILPATRICK TOWNSEND & STOCKTON LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834
UNITED STATES

TITLE

Fat Cover Measurement Device

FILING FEE RECEIVED		
1162	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

PART B - FEE(S) TRANSMITTAL

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P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20350 7590 05/16/2013
KILPATRICK TOWNSEND & STOCKTON LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

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Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Whitney Escalanti	(Depositor's name)
/Whitney Escalanti/	(Signature)
August 7, 2013	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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1 Kilpatrick Townsend & Stockton LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

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(A) NAME OF ASSIGNEE: Weber Maschinenbau GmbH

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Breidenbach, Germany

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☑ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☑ Issue Fee
☑ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
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Authorized Signature Jessica C. Stahnke Date August 7, 2013

Typed or printed name Jessica C. Stahnke Registration No. 57,570

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Electronic Patent Application Fee Transmittal

Application Number:	12738969
Filing Date:	30-Jun-2010
Title of Invention:	FAT COVER MEASUREMENT DEVICE
First Named Inventor/Applicant Name:	Guenther Weber
Filer:	Jessica C. Stahnke/Whitney Escalanti
Attorney Docket Number:	66234-006700US-785420

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	1780	1780
Publ. Fee- Early, Voluntary, or Normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**2080**

Electronic Acknowledgement Receipt

EFS ID:	16530679
Application Number:	12738969
International Application Number:	
Confirmation Number:	6367
Title of Invention:	FAT COVER MEASUREMENT DEVICE
First Named Inventor/Applicant Name:	Guenther Weber
Customer Number:	20350
Filer:	Jessica C. Stahnke/Whitney Escalanti
Filer Authorized By:	Jessica C. Stahnke
Attorney Docket Number:	66234-006700US-785420
Receipt Date:	07-AUG-2013
Filing Date:	30-JUN-2010
Time Stamp:	19:07:54
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$2080
RAM confirmation Number	6377
Deposit Account	201430
Authorized User	KUSHA, BABAK

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	2013_08_07_ISSUEFEE_66234-785420.pdf	123032 f2cd5631aa858f7caa923a1106f0f8d53e0f01a0	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32171 c79a7d60760f0f8691596a42fda1c2c467d85fdf	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	155203		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/738,969	09/10/2013	8529321	66234-006700US-785420	6367

20350 7590 08/21/2013

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ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 532 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Guenther Weber, Gross Nemerow, GERMANY;

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