



(51) International Patent Classification:

B23K 26/06 (2014.01) G06K 1/00 (2006.01)

B23K 26/08 (2014.01) G06K 7/10 (2006.01)

B23K 26/361 (2014.01) G06K 15/00 (2006.01)

B65B 61/02 (2006.01) B65B 3/02 (2006.01)

(21) International Application Number:

PCT/EP2019/068137

(22) International Filing Date:

05 July 2019 (05.07.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

18181913.7 05 July 2018 (05.07.2018) EP

(71) Applicant: TETRA LAVAL HOLDINGS & FINANCE

S.A. [CH/CH]; 70, Avenue Général-Guisan, CH-1009 PULLY (CH).

(72) Inventors: BERGHOLTZ, Lars; Lerbergsvägen 90, 263

51 HÖGANÄS (SE). SCARABELLI, Paolo; Via Bellesia 15, Villa Sesso, 42020 Reggio Emilia (IT). PALM, Lars; Södervägen 2, 232 52 Åkarp (SE). MELONI, Gian Paolo; Via Ridolfi, 40, 41124 Modena (IT).

(74) Agent: TETRA PAK - PATENT ATTORNEYS SE; AB

Tetra Pak, Patent Department, Ruben Rausingsgata, 22186 LUND (SE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available):

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available):

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

(54) Title: A LASER ABLATION MARKING SYSTEM FOR AND A METHOD OF PROVIDING AN IMAGE TO A WEB OF PACKAGING MATERIAL

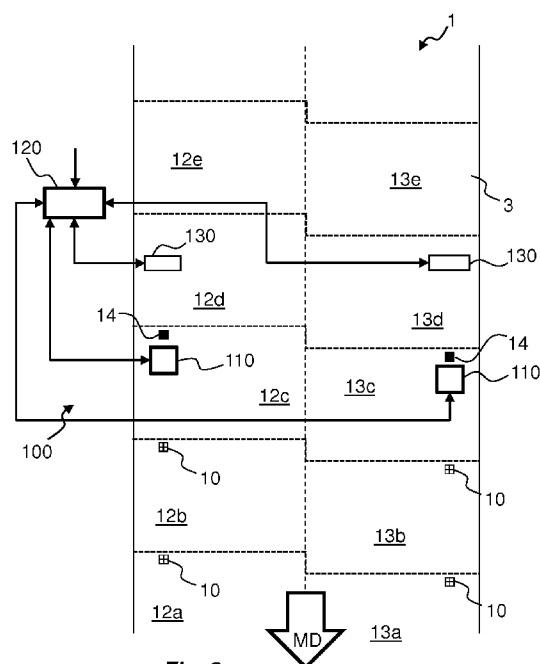


Fig. 3

(57) Abstract: A laser ablation marking system (100) for providing an image (10) to a web (1) of packaging material (3) is provided. The marking system (100) comprises at least one marking device (110) having at least one laser comprising a plurality of individually controlled light outputs arranged in the cross-wise direction of the web (1) of packaging material (3), each light output having a power output of at least 60 W and being configured to emit light to provide laser ablation, and a controller (120) being connected to the marking device (110) and configured to control the light outputs based on the speed of the web (1) of packaging material (3) such that the emitted light will always hit the web (1) of packaging material (3) at the same angle.

Published:

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

Technical Field

The invention relates to a marking system for web-based material, such as packaging material. In particular the present invention relates to a stationary system for providing laser ablated marks on a web of packaging material.

5

Background Art

In the packaging industry, especially for producing individual consumer packages for content such as liquid food, the packages are manufactured by forming and sealing a planar packaging material. The packaging material, which typically
10 comprises a core layer of bulk material being covered on both sides by one or more polymer layers, is produced as a continuous web.

The filling machine receives one end of the web of the laminated packaging material and a plurality of stations provide the required processing of the packaging material in a continuous manner. Such stations may e.g. include feeding, sterilization,
15 tube forming, filling, sealing and cutting, and final forming in order to provide a flow of individual ready-to-use packages.

The web of packaging material is running at extremely high speed; machine speeds allowing for up to 40.000 packages per hour are commercially available. Also during lamination and production of the packaging material high speed are utilized,
20 whereby the speed of the web is in the order of e.g. 400 m/min and above.

Manufacturing of the web of packaging material, as well as transportation of the web through the filling machine, requires high precision position control. For example, manufacturing of the packaging material may include the step of providing folding crease lines, pre-cut holes, and printed patterns such as register marks and/or décor.
25 Especially the printing step may be performed in separate steps, and the appearance of the final package will be dependent on the alignment of the different features. Uncontrolled variations in the positioning of the packaging material during production in the converting factory or in the filling machine may induce various types of errors.

Hence it is not only desirable to provide high precision alignment between the
30 pre-laminated hole and the crease lines, but also to provide high precision alignment of the printed pattern relative the crease lines, the pre-cut hole, external devices such as caps and similar, as well as relative previous printed patterns.

Yet further it is desirable to add unique information to the web of packaging material. Such information may e.g. be related to manufacturing date, the converting

factory, etc. for traceability and/or authentication purposes. The information may e.g. be provided in a coded format, or characters or images may be used.

A unique code can also be used for tracking errors and/or deviations in converting, and such marks may additionally facilitate defect removal.

5 Marking of the packaging material may thus be performed for different purposes, i.e. either to provide unique information or to provide reference marks for positioning. By reading the reference mark it may thus be possible to adjust for the position of the web of packaging material, especially in lateral or cross-wise direction, or to read encoded information. Subsequent printing, made by continuous printing
10 techniques such as off-set printing, may thus be positioned correctly relative the reference mark, and hence also relative other features added to the packaging material.

One system for providing marks on packages is disclosed in WO2016166379. In this system an image to be printed is divided in two or more parts, and a laser is
15 configured to ablate at least one of the image parts to form a corresponding mark on the package. Optionally, several lasers are provided to ablate respective parts of the image.

Each laser emits light through an optical system having two mirrors which can be moved to divert the laser beam in x-y directions. As the package passes the laser
20 the moveable mirrors thus assist in providing a two-dimensional ablated mark corresponding to an image part.

The system described above suffers from two major drawbacks. Firstly, as the moveability of the mirrors is limited several lasers and associated mirrors are provided to extend the lateral, or cross-wise dimensions of the ablated mark.

25 Secondly, for high-speed application control of the mirrors will be practically impossible since the time required for physically moving the mirrors will result in a curved ablation; during the time needed for moving the mirrors the package has moved in the feeding direction whereby the mark will be tilted relative the cross-wise direction of the package.

30

Summary

It is an object of the invention to at least partly overcome one or more of the above-identified limitations of the prior art. In particular, it is an object to provide a system and method being capable of providing unique laser ablated marks with high

precision on a web of packaging material running at very high speed, such as 400 m/min or above.

To solve these objects a laser ablation marking system for providing an image to a web of packaging material is provided. The marking system comprises at least one marking device having at least one laser comprising a plurality of individually controlled light outputs arranged in the cross-wise direction of the web of packaging material. Each light output is capable of emitting light to provide laser ablation, and the power of the emitted light is for this purpose in the range of 60 W or higher, such as 100 W or higher, such as 200 W or higher. The laser ablation marking system further comprises a controller being connected to the marking device and configured to control the light outputs based on the speed of the web of packaging material such that the emitted light will always hit the web of packaging material at the same angle.

In an embodiment, the power of the emitted light from each light output is in the range of 60-1000 W, such as 60-500 W.

The marking system may further comprise at least one coating device configured to provide a coated area onto the web of packaging material.

The at least one coating device may be arranged upstream the at least one marking device.

The plurality of light outputs may be arranged in a linear array.

The linear array may extend in a direction being perpendicular to the travel direction of the web of packaging material.

The number of light outputs may be above ten, such as above fifteen, preferably above twenty.

Each light output may be connected to an optical fiber having a distal end at which a laser beam is allowed to exit.

The dimension of the outputted laser beam, when hitting the web of packaging material, may be 1mm² or less.

The controller may be configured to activate the marking device in a pulsed manner.

For each pulse, the plurality of light outputs may be controlled individually.

The controller may be configured to controlling each light output binary to either emit light or not.

The controller may be configured to controlling the marking device in order to remove, or ablate selected parts of a coating substance arranged on a coated area on said web of packaging material.

The controller may be configured to controlling the marking device to ablate the entire layer of coating substance at said selected parts.

The controller may be configured to controlling the marking device to ablate only a part of the layer of coating substance at said selected parts.

5 The web is moving at a constant speed, i.e. continuously travelling forward, in the lengthwise direction of the web.

According to a second aspect, a method for laser ablation of an image to a web of packaging material is provided. The method comprises i) providing at least one marking device having at least one laser and a plurality of individually controlled light
10 outputs connected to said at least one laser, wherein each light output is capable of emitting light to provide laser ablation; the power of the emitted light is for this purpose in the range of 60 W or higher, ii) providing a controller being connected to the marking device and configured to control the light outputs based on the speed of the web of packaging material, and iii) controlling at least one of the light outputs to emit light in
15 order to ablate selected parts of a coating substance arranged on a coated area on said web of packaging material such that the emitted light will always hit the web of packaging material at the same angle.

Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.
20

Brief Description of the Drawings

Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1 is a top view of a packaging material forming a part of a web.

25 Fig. 2 schematically shows a method according to an embodiment.

Fig. 3 is a schematic view of a laser ablation marking system according to an embodiment.

Fig. 4 is a schematic view of a marking device for use with the laser ablation marking system shown in Fig. 3.

30 Fig. 5a is a cross-sectional view of a packaging material after laser ablation marking.

Fig. 5b shows a first example of a mark provided by the laser ablation marking system shown in Fig. 3.

Fig. 5c shows a second example of a mark provided by the laser ablation
35 marking system shown in Fig. 3.

Fig. 6a-b are schematic views of parts of a marking device.

Fig. 7 is a schematic view of a laser ablation marking system according to another embodiment.

5 Detailed Description

In Fig. 1 parts of a web 1 of a packaging material 3 is shown. The packaging material 3 is provided with several features for facilitating forming of individual packages. Such features may e.g. include crease lines 5, pre-laminated holes 7, and one or more laser ablated marks 10. As can be seen in Fig. 1 during manufacturing of
10 the packaging material 3 the web 1 is dimensioned to accommodate several segments 12a-c, 13a-c, whereby each segment 12a-c, 13a-c is dimensioned to produce a single package. The segments are arranged in sequence, both in lengthwise direction, machine direction MD and cross-wise direction CD. Preferably the segments 12a-c, 13a-c are staggered in the cross-wise direction CD, as further shown in Fig. 3, for
15 reducing vibrations during creasing and allowing smoother operation of the rotary creasing tool across the width of the packaging material web.

The mark 10 may be provided for various purposes, as explained above. It may e.g. form a reference mark for future handling of the packaging material, or it may include some kind of information which may be read and used for traceability or
20 authentication.

The packaging material 3 is preferably manufactured in a converting facility, where a core layer of a paper-based material is laminated with one or more polymer layers on both sides. Typically the packaging material 3 comprises a core material layer, an outer layer, and an inner layer.

25 The outer layer applied to one side of the core material layer is adapted to provide the outer surface of the package to be produced, which outer surface and outer layer faces the surroundings of the package. The inner layer is applied to the other side of the core material layer and is adapted to provide the inner surface of the package to be produced which is in contact with the product contained in the package.

30 The core material may be a sheet for providing rigidity to the packaging material 3, and may preferably be made of material such as paper board or cardboard.

The outer layer may comprise at least one layer of polymer material, which is applied to the core material layer in a lamination process. Moreover, one of the layers making up the outer layer may be a decorative layer making up the outer appearance
35 of the package to be formed. The process of laminating the outer layer to the core

material layer is preferably performed after the mark(s) 10 has been added to the packaging material 3, such as in the manufacturing line for production of laminated packaging material. Alternatively, the operation of laser ablating marks in a coated layer may take place after the lamination and manufacturing of the packaging material, 5 e.g. in a filling machine.

The inner portion of the laminated packaging material, on the inner, opposite side of the core layer, may comprise at least one layer of polymer material. The inner portion of the packaging material intended for the inside of the finished package, may e.g. comprise (starting from the core material layer): a lamination layer, a protective 10 layer such as an Aluminum foil, functioning as a barrier against gases, such as oxygen gas, and a sealing layer. The lamination layer enables the core material to stick to any protective layer applied, while the sealing layer enables package heat sealing.

The polymer layers of the packaging material 3 may be of any suitable type of polymer material, preferably a thermoplastic material such as a polyolefin, such as 15 polyethylene.

Before describing details of the marking system used for providing laser ablated marks to the packaging material 3, a method 20 will be briefly described with reference to Fig. 2. When adding a laser ablated mark 10 to the packaging material 3 a number of subsequent steps are performed. Starting in step 21, the packaging material 20 3 is coated such that a coated area is arranged at the location of the desired mark. Coating may e.g. be accomplished by printing. The specific dimensions of the coated area is of less importance, as long as the mark to be formed may fit within the outer boundaries of the coated area.

When the area is coated, a marking device is activated in step 22. The marking 25 device, being a laser device having multiple outputs being individually controllable as will be further described below, receives upon activation data relating to the intended position of the mark as well as data relating to the intended pattern. The position of the created mark will preferably be in register with one or more crease patterns and the remaining printed design of the packaging material. Controlling the marking device, i.e. 30 setting operation parameters in order to activate one or more of the multiple outputs at specific times, is performed in step 23. In operation, i.e. when the marking device is emitting light according to the set control scheme, the emitted light will ablate the coating substance of the coated area whereby the underlying core material layer will be exposed. A contrast between the coated area (i.e. the unexposed portions of the 35 coated are) and the core material layer (i.e. the ablated portions of the coated area) will

thereby result in a pattern being readable by optical means such as a camera, a scanner, or human eyes.

This step of operating the marking device to emit light, and thereby ablate selective portions of the coated area, thus forms a step 24 of providing the mark 10
5 onto the packaging material 3.

The above-described method is suitable for high speed applications, still maintaining good accuracy and high resolution of the ablated mark. The marking device may e.g. have at least ten individually controllable outputs arranged in the cross-wise direction of the web of packaging material, each output being stationary
10 relative the moving packaging material.

The web is thus moving at a constant speed, i.e. continuously travelling forward, in the lengthwise direction of the web, while operating the laser ablation marking system. The web travelling speed may be 300 m/min and higher, such as 400 m/min and higher, such as 600 m/min and higher. The higher the web speed, the higher
15 power light output will be needed from the laser light sources.

In order to perform laser ablation of high speed as typically required in modern production facilities, high power light output is required. As will be further explained in the following, it has been proven that each light output must be configured to emit light having a power of at least 60 W, such as in the range of 60 – 1000 W, such as from 60
20 to 500 W, depending on packaging material specifications, manufacturing conditions, etc.

An example of a laser ablation marking system 100 is shown in Fig. 3. The laser ablation marking system 100 is configured to operate in conjunction with a web 1 of packaging material 3, which is fed forward in a lengthwise direction MD, indicated by
25 the arrow in Fig. 3. Importantly, this configuration allows the laser ablation marking system 100 to fit with existing converting stations which typically converts a core material layer (such as a paper board or carton board) to a packaging material 3 by lamination. Preferably, the laser ablation marking system 100 is provided upstream a lamination station used to provide the outer layer onto the core material layer.

30 The purpose of the laser ablation marking system 100 is to provide one or more laser ablated marks 10 onto the packaging material 3. This is achieved by one or more marking devices 110, each marking device 110 being connected to a controller 120.

Each marking device 110 is arranged at a fixed position relative the surrounding equipment. This means that each marking device 110 will have a fixed position, i.e. in
35 the cross-wise direction, also relative the web of packaging material 3 being fed

through the marking system 100. Laser ablation marking thus enables an efficient way of marking a substrate, in comparison to conventional printing techniques, such as ink-jet printing, in particular of codes and the like, such as QR-codes or bar codes.

As can be seen in Fig. 3 the web of packaging material 3 is dimensioned so that
5 the entire width of the web 1 corresponds to the required width for forming two packages. Segments 12a-e are longitudinally aligned, while segments 13a-e are longitudinally aligned and arranged adjacent to segments 12a-e. This configuration is applied for increasing the throughput during converting; before feeding the packaging material 3 to a filling machine, segments 13a-e are normally separated from segments
10 12a-e by a longitudinal cutting operation. As already explained, each segment 12a-e, 13a-e is designed to form one package.

As the web 1 of packaging material 3 travels forward, each marking device 110 will be activated to ablate an optical pattern into a coated area 14 which is arranged on the packaging material 3. If each package is intended to have a mark 10, each
15 segment 12a-e, 13a-e is provided with a coated area 14. In Fig. 3 the coated areas 14 are made by means of coating devices 130. Each coating device 130 is configured to apply a coating substance onto the packaging material 3, preferably directly onto the core material layer before it is ablated and thereafter laminated with an outer layer. The coating devices 130 may e.g. be configured as printing rollers or similar. As the coated
20 area 14 should be homogenous and fully covered, simple equipment may be used. It should also be readily understood that the coating devices 130 could be implemented as a single device extending across the web 1.

Preferably the coating devices 130 are controlled by the controller 120. The controller may e.g. receive input relating to web speed, whereby the coating devices
25 130 can be controlled accordingly so that the coated areas 14 are located at its respective desired positions.

The coating substance used for coating the areas 14 may be any suitable substance which may ablate when absorbing laser energy. Various types of inks or toners have been shown to fulfill this requirement. In particular, the selected coating
30 substance should have a comparably high rate of absorption of infrared light having a wavelength below 1 μ m. Optionally the coating substance may be provided with magnetizable particles such that the mark may be magnetically detectable. Such coating substance may e.g. comprise Magnetite.

Details of the marking device 110 are shown in Fig. 4. In this example the
35 marking device 110 has twenty-one outputs 112, each output 112 being coupled to a

laser 117. The number of outputs is generally preferred to be 16 or more, such as 21 or more, to have the information capacity desired for the purpose of marking and information-carrying in the packaging business. Each output is thus individually controllable by the controller 120, which is connected to one or more laser drivers 118.

5 Each output 112 is further coupled to an optical fiber 114 which extends away from the device housing 115 and towards the web 1 of packaging material 3. At the distal end 116 of each fiber a laser beam will be allowed to exit, whereby it will hit a delimited portion of the coated area 14 to laser ablate the coated area 14. A multi-output marking device suitable for this configuration may e.g. include a series of laser diodes emitting

10 light in a wavelength range of approximately 850-980 nm. Depending on the particular choice of coating substance, each laser diode has a light output of at least 60 W; preferably each laser diode may have a light output in the range of 60-1000 W in order to ablate the coating substance of a thickness of e.g. 5 μm . It should be realized that the selection of coating substance as well as the selected coating substance thickness

15 will influence the absorption and consequently also the ablation properties.

The laser diodes should preferably be selected to operate at a wavelength which is fully, or at least to a major extent, absorbed by the coating substance. Additionally, absorption of the emitted light by the underlying core material layer should be avoided.

20 Hence each output 112 could be associated with a unique laser 117, or a single laser 117 could be coupled to a plurality of outputs 112, each output 112 being individually controllable.

The distal ends 116 are preferably arranged in a linear array, as shown in Fig. 4, extending perpendicular to the feeding direction of the packaging material i.e. in the cross-wise direction of the packaging material. When activated, each laser output 112

25 will emit light in a fixed direction, meaning that no dynamic deflection of the laser beam is provided. The emitted light will thus always hit the web 1 of packaging material 3 at the same angle.

Further, each distal end 116 is dimensioned such that each output 114 will

30 ablate only a delimited area, or module, of the coated area 14. For example, the width of the laser beam being emitted from each distal end 116 is below 1 mm, such as in the order of 0.5 mm. Hence, the cross-wise resolution of the marking device 110 is in such case 0.5 mm. The module height is not fixed, but it varies with the speed of the web 1 of packaging material 3 as well as on the exposure time of the marking device 110.

35 Assuming that the laser beam has a constant width of 0.4 mm, it may be preferred to

apply an exposure time such that the web 1 of packaging material travels 0.1 mm during exposure. If the web 1 travels by a speed of 400 m/min, the exposure time will in such case be in the order of 0,15 ms. For the suggested module size of 0.5*0.5 mm and a web speed of 400m/min the laser 117 of the marking device 110 may thus be
5 pulsed using a pulse time of approximately 0,15 ms. However, in practice it may be preferred to utilize even shorter pulse times for providing more evenly ablated areas. Hence, a pulse time may e.g. be selected as 20µs – for the above-mentioned example one consecutive pulse is occurring 0,15 ms after the previous pulse.

In the shown example the marking device 110 has a lateral width of 10.5 mm,
10 the total width being defined by the twenty-one outputs.

In Fig. 5a the packaging material 3 is shown after ablation. As can be seen the coating substance 30 is applied directly onto the core material layer 32 such that a coated area 14 is formed. Preferably the coated area 14 has a dark colour, primarily to achieve IR absorption of the laser beam, but also such that high contrast is achieved
15 relative to the much brighter colour of the surface of the core material layer 32. The mark 10 is formed by ablating one or more recesses 34 into the coating substance 30 as explained above. The recesses 34 do not necessarily extend all the way down to the core material layer 32, but sufficient contrast may in fact be realized also if some coating substance 30 remains.

As is evident, the level of contrast of the mark will be dependent on the power of the laser light. As described above high power light output (i.e. > 60 W) is required in order to achieve a robust ablation of the coating substance 30, especially for the high speed applications of packaging material manufacturing. As a comparison, prior art laser marking systems operating by activating colour transformable ink rather than
25 ablating off substances from a coating 30, will not be suitable, or even compatible, with the design and configuration of the laser ablation marking system described herein.

In Fig. 5b and 5c two different examples of marks 10 are shown. In Fig. 5b the mark 10 forms a bar code 50 which can be read by a suitable scanner. In Fig. 5c the mark 10 is in the form of a 2D-code 60, such as a QR code or similar. For both
30 examples the mark 10 is square shaped, i.e. the resolution in cross-wise direction is equal to the resolution in lengthwise direction (21*21 pixels). This is however not required. The cross-wise resolution is determined by the number of laser outputs 112, while the lengthwise resolution is determined by the number of consecutive laser pulses as the web 1 of packaging material 3 passes the marking device 110. A mark 10

can thus have other longitudinal extensions, such as to provide rectangular shaped marks, whereby the limitation is set by the dimensions of the coated area 14.

In Fig. 6a and 6b an example of a control scheme for a marking device 110 is shown. In these figures the laser outputs 112 are shown as circles, and an active circle
5 is marked as black. It should be noted that only a few of the outputs 112 are provided with reference numerals.

When the marking device 110 is activated, i.e. when a coated area 14 of a web
1 of packaging material 3 passes the marking device 110, the marking device 110 controls the emission of light through the respective outputs 112. Importantly, the
10 outputs 112 are individually controllable. In Fig. 6a fourteen outputs are activated to emit light, while the remaining seven outputs are inactive. The pulse time is e.g. 0.15 ms in accordance with the above-mentioned example.

The next pulse will be emitted immediately after the first pulse, and the outputs
112 are controlled accordingly. As can be seen in Fig. 6b for this pulse another set of
15 outputs 112 is activated to emit light. By continuing emitting pulses the mark matrix will grow in the lengthwise direction until the entire mark 10 is provided onto the packaging material 3.

Although the above-described example is directed to a laser ablation marking
system using several consecutive laser pulses, the laser ablation marking system may
20 in some embodiments be configured to ablate full lines without any intermissions by keeping the laser in an active, or light emitting mode as the web of packaging material passes by the marking system 100.

So far the laser ablation marking system 100 has been described to provide
marks 10 at fixed positions on the packaging material. However, as will be understood
25 from the following the marking system 100 can also be used to provide marks 10 at different positions, especially for ensuring the correct position of the mark 10 relative other features of the packaging material 3.

In Fig. 7 another example of a laser ablation marking system 100' is shown. The
laser ablation marking system 100' comprises a marking device 110' extending across
30 the entire width of the packaging material 3. As for the marking device 110 described above a plurality of light outputs are provided facing the moving packaging material 3, the sideways alignment of each output being individually controllable by the controller 120. The web 1 of packaging material 3 is provided with a plurality of coated areas 14, in the shown example the coated areas 14 are distributed such that each final package
35 will be provided with one coated area 14. The power levels of the marking device 110'

is similar to the marking device 110 described above, i.e. each light output is configured to emit light in the range of 60 – 1000 W, such as from 60 to 500 W.

The packaging material 3 is also provided with one or more reference marks 140. The reference marks 140 are provided to assist in correct positioning of the ablated marks 10. A sensor 150 is included in the marking system 100' and detects the position of the reference mark 140, especially the lateral or cross-wise position. The position of the detected reference mark 140 is transmitted to the controller which then associates the position of the reference mark 140 with the position of the already applied coated areas 14. As illustrated in Fig. 7 the dimensions of the coated areas 14 may be extended compared to the final dimensions of the mark 10. Hence, the controller 120 may subsequently determine a set of outputs 112 of the marking device 110' to be activated in order to ablate a desired portion of the coated area 14 in order to locate the mark 10 at its intended position.

It should be noted that for a downstream portion of the web 1, one set of outputs 112a is used for providing marks 10 on the left portion of the web 1, while another set of outputs 112b is used for providing marks 10 on the right portion of the web 1. Within each set of outputs 112a-b specific outputs are activated in a pulsed manner in order to form a growing mark 10 as the web 1 moves forward. Each output 112a-b is configured to emit light having and having a power output in the range of 60 – 500 W.

As indicated in Fig. 7 the web is shifted to the right after a certain time. This may be caused by a number of different reasons, such as unintentional misalignment in the feeding equipment or similar. If this shifting occurs the sensor 150 will detect a different lateral position of the reference mark 140, whereby the controller 120 will consequently determine new sets of outputs 112c-d of the marking device 110' so that the marks 10 are located correctly relative the reference mark 140.

From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

CLAIMS

1. A laser ablation marking system (100, 100') for providing an image (10) to a
5 web (1) of packaging material (3), comprising
at least one marking device (110, 110') having at least one laser (117)
comprising a plurality of individually controlled light outputs (112) arranged in the cross-
wise direction (CD) of the web (1) of packaging material (3), each light output (112)
having a power output of at least 60 W and being configured to emit light to provide
10 laser ablation, and
a controller (120) being connected to the marking device (110, 110') and
configured to control the light outputs (112) based on the speed of the web (1) of
packaging material (3) such that the emitted light will always hit the web (1) of
packaging material (3) at the same angle.
15
2. The marking system according to claim 1, wherein each light output (112)
has a power output in the range of 60 – 1000 W, such as from 60 to 500 W.
3. The marking system according to claim 1 or 2, further comprising at least
20 one coating device (130) configured to provide a coated area (14) onto the web (1) of
packaging material (3).
4. The marking system according to claim 3, wherein the at least one coating
device (130) is arranged upstream the at least one marking device (110, 110').
25
5. The marking system according to any one of the preceding claims, wherein
the plurality of light outputs (112) are arranged in a linear array.
6. The marking system according to claim 5, wherein the linear array extends
30 in a direction being perpendicular to the travel direction of the web (1) of packaging
material (3).
7. The marking system according to any one of the preceding claims, wherein
the number of light outputs (112) is above fifteen, preferably above twenty.
35

8. The marking system according to any one of the preceding claims, wherein each light output (112) is connected to an optical fiber (114) having a distal end (116) at which a laser beam is allowed to exit.

5 9. The marking system according to any one of the preceding claims, wherein the dimension of the outputted laser beam, when hitting the web (1) of packaging material (3), is 1mm^2 or less.

10 10. The marking system according to any one of the preceding claims, wherein the controller (120) is configured to activate the marking device (110, 110') in a pulsed manner.

15 11. The marking system according to claim 10, wherein for each pulse, the plurality of light outputs (112) are controlled individually.

 12. The marking system according to any one of the preceding claims, wherein the controller (120) is configured to controlling each light output (112) binary to either emit light or not.

20 13. The marking system according to any one of the preceding claims, wherein the controller (120) is configured to controlling the marking device (110, 110') in order to ablate selected parts of a coating substance arranged on a coated area (14) on said web (1) of packaging material (3).

25 14. The marking device according to claim 13, wherein the controller (120) is configured to controlling the marking device (110, 110') to ablate the entire layer of coating substance at said selected parts.

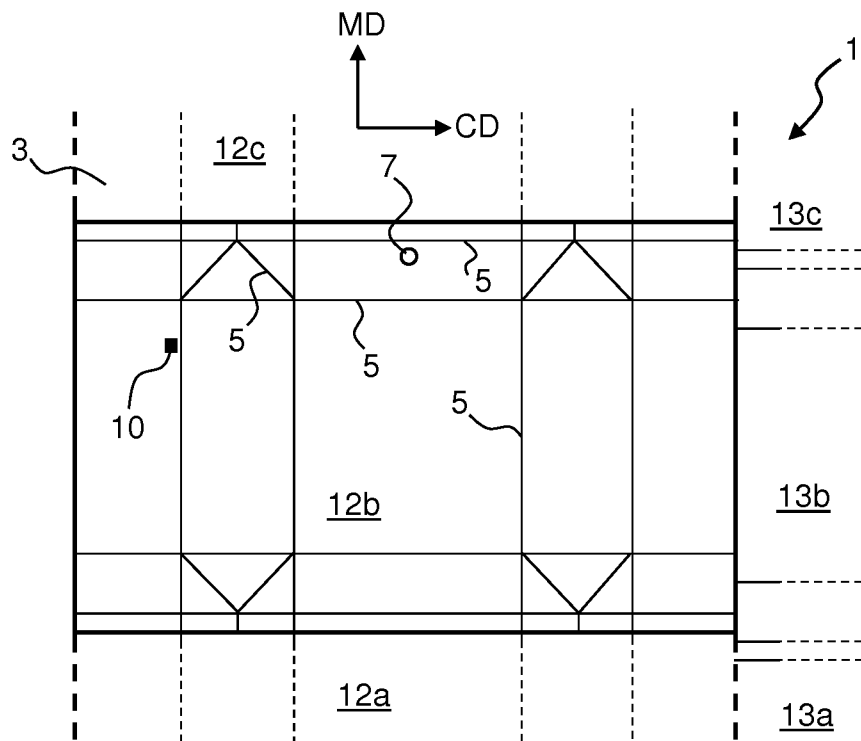
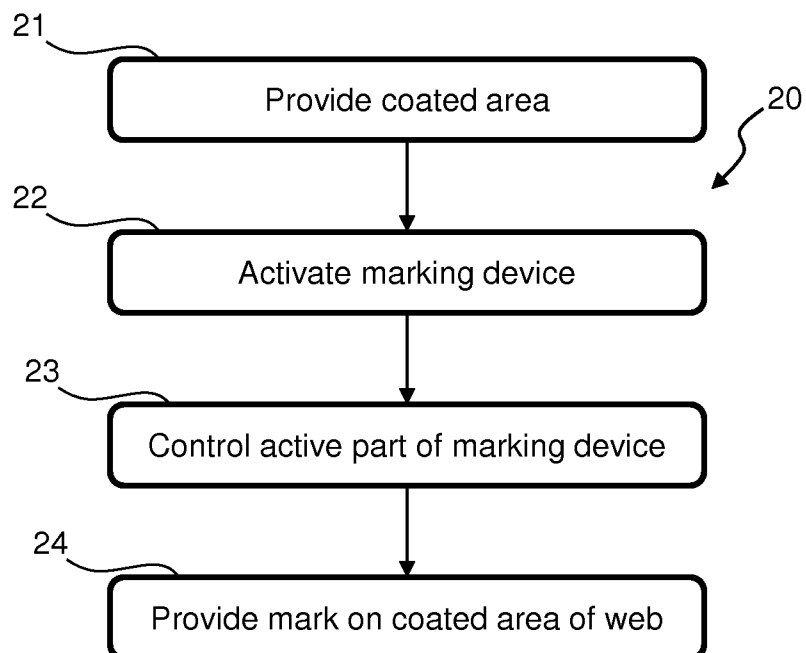
30 15. The marking device according to claim 13, wherein the controller (120) is configured to controlling the marking device (110, 110') to ablate only a part of the layer of coating substance at said selected parts.

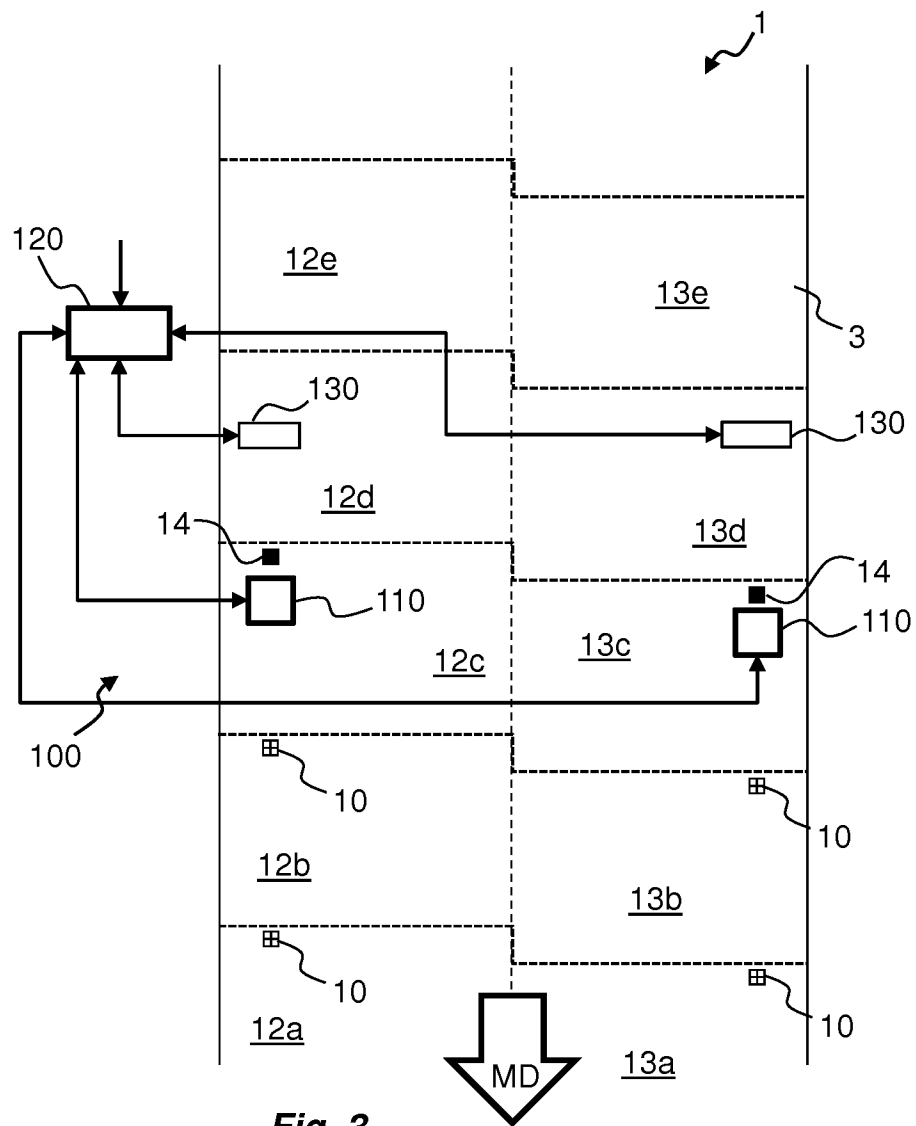
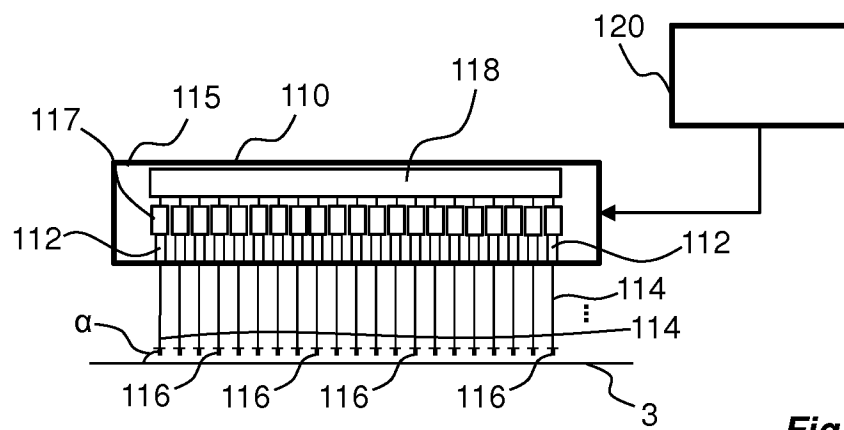
 16. A method for providing an image (10) to a web (1) of packaging material (3), comprising

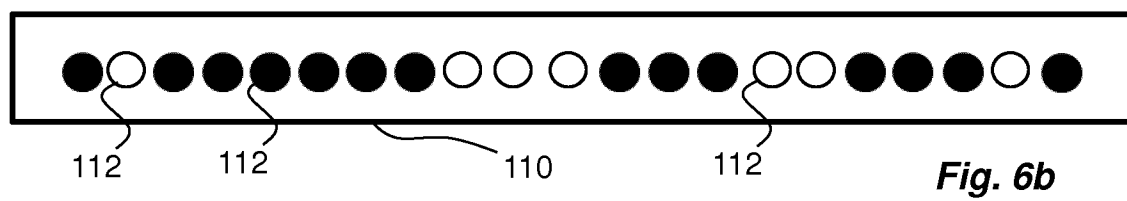
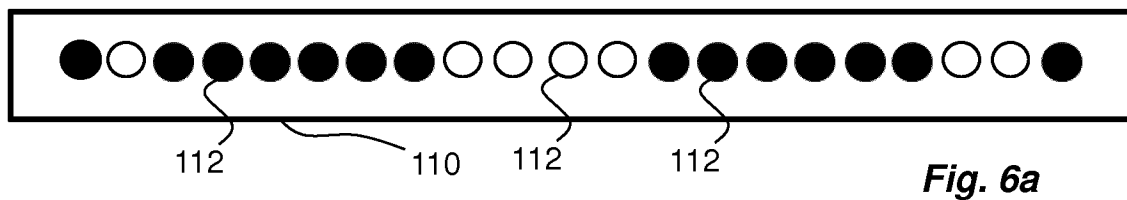
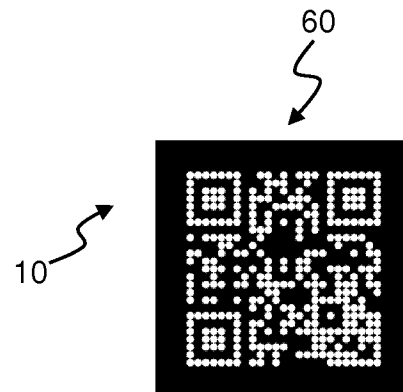
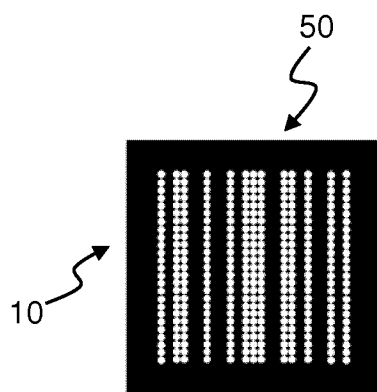
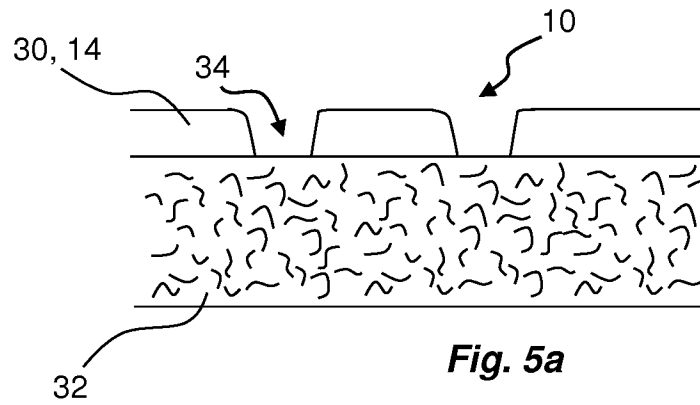
providing at least one marking device (110, 110') having at least one laser (117) and a plurality of individually controlled light outputs (112) connected to said at least one laser (117), wherein each light output (112) is configured to emit light having a power output of at least 60 W in order to provide laser ablation,

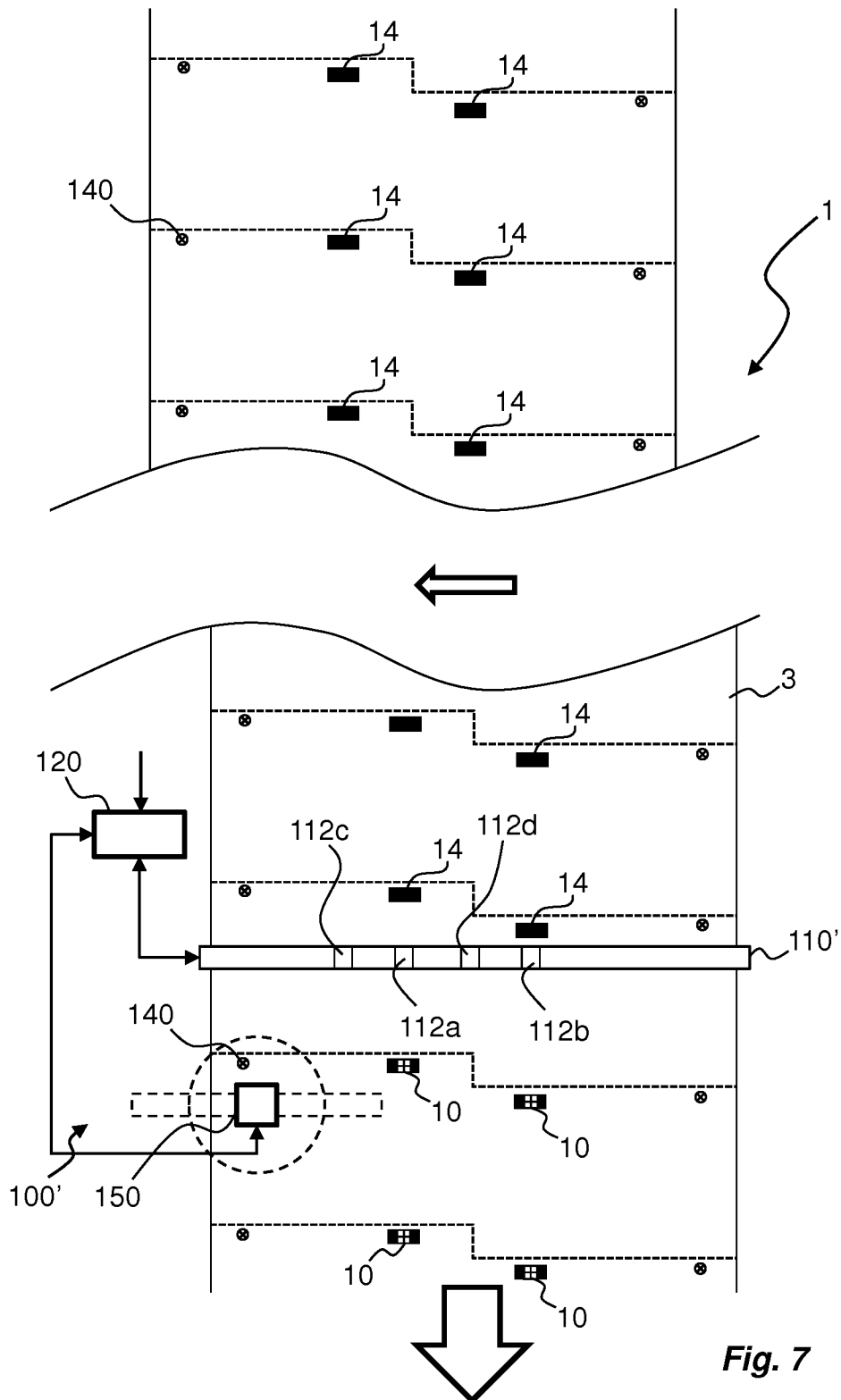
5 providing a controller (120) being connected to the marking device (110, 110') and configured to control the light outputs (112) based on the speed of the web (1) of packaging material (3), and

controlling at least one of the light outputs (112) to emit light in order to ablate selected parts of a coating substance arranged on a coated area (14) on said
10 web (1) of packaging material (3) such that the emitted light will always hit the web (1) of packaging material (3) at the same angle.

**Fig. 1****Fig. 2**

**Fig. 3****Fig. 4**





INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/068137

A. CLASSIFICATION OF SUBJECT MATTER INV. B23K26/06 B23K26/08 B23K26/361 B65B61/02 G06K1/00 G06K7/10 G06K15/00 B65B3/02 ADD. According to International Patent Classification (IPC) or to both national classification and IPC																				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B23K B65B G06M G06K Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data																				
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>EP 0 950 973 A2 (MACSA ID SA) 20 October 1999 (1999-10-20) paragraphs [0033] - [0034]; figures -----</td> <td>1-16</td> </tr> <tr> <td>Y</td> <td>US 8 164 025 B1 (B. KUNAS ET AL) 24 April 2012 (2012-04-24) column 5, lines 3-13; figures -----</td> <td>1-16</td> </tr> <tr> <td>Y</td> <td>EP 2 565 124 A1 (SWISSLOG ITALIA SPA) 6 March 2013 (2013-03-06) claims 11,12; figures -----</td> <td>3,4, 13-15 16</td> </tr> <tr> <td>A</td> <td>US 2016/301064 A1 (B. BARTHE ET AL) 13 October 2016 (2016-10-13) paragraph [0050]; figures -----</td> <td>1-16</td> </tr> <tr> <td colspan="2" style="text-align: center;">-/-</td> <td></td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	EP 0 950 973 A2 (MACSA ID SA) 20 October 1999 (1999-10-20) paragraphs [0033] - [0034]; figures -----	1-16	Y	US 8 164 025 B1 (B. KUNAS ET AL) 24 April 2012 (2012-04-24) column 5, lines 3-13; figures -----	1-16	Y	EP 2 565 124 A1 (SWISSLOG ITALIA SPA) 6 March 2013 (2013-03-06) claims 11,12; figures -----	3,4, 13-15 16	A	US 2016/301064 A1 (B. BARTHE ET AL) 13 October 2016 (2016-10-13) paragraph [0050]; figures -----	1-16	-/-		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																		
Y	EP 0 950 973 A2 (MACSA ID SA) 20 October 1999 (1999-10-20) paragraphs [0033] - [0034]; figures -----	1-16																		
Y	US 8 164 025 B1 (B. KUNAS ET AL) 24 April 2012 (2012-04-24) column 5, lines 3-13; figures -----	1-16																		
Y	EP 2 565 124 A1 (SWISSLOG ITALIA SPA) 6 March 2013 (2013-03-06) claims 11,12; figures -----	3,4, 13-15 16																		
A	US 2016/301064 A1 (B. BARTHE ET AL) 13 October 2016 (2016-10-13) paragraph [0050]; figures -----	1-16																		
-/-																				
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.																				
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family																				
Date of the actual completion of the international search 30 August 2019		Date of mailing of the international search report 09/09/2019																		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Jeggy, Thierry																		

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/068137

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2016/166379 A1 (FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E V) 20 October 2016 (2016-10-20) cited in the application abstract; claims; figures -----	1-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/068137

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0950973	A2	20-10-1999	EP 0950973 A2 20-10-1999
		ES 2140341 A1	16-02-2000
		US 6201210 B1	13-03-2001

US 8164025	B1	24-04-2012	US 8164025 B1 24-04-2012
		US 8168921 B1	01-05-2012
		US 8212178 B1	03-07-2012
		US 9895773 B1	20-02-2018
		US 10099316 B1	16-10-2018

EP 2565124	A1	06-03-2013	NONE

US 2016301064	A1	13-10-2016	EP 3079197 A1 12-10-2016
		FR 3034913 A1	14-10-2016
		JP 2016201359 A	01-12-2016
		US 2016301064 A1	13-10-2016

WO 2016166379	A1	20-10-2016	DE 102015207032 A1 20-10-2016
		EP 3284023 A1	21-02-2018
		US 2018114083 A1	26-04-2018
		WO 2016166379 A1	20-10-2016
