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(71) Applicant:
TETRA LAVAL HOLDINGS & FINANCE SA
1009 Pully (CH)

(72) Inventors:
- **Dewaelsche, Koen**
  9700 Oudenaarde (BE)
- **Cornelis, Eric**
  9700 Oudenaarde (BE)
- **Helsloot, Theo**
  9700 Oudenaarde (BE)

(74) Representative:
Quintelier, Claude et al
Gevers & Vander Haeghen,
Patent Attorneys,
Rue de Livourne 7
1060 Brussels (BE)

(54) A method for printing on a closure and a method for manufacturing a closure suitable for laser printing

(57) A method for printing by means of a laser beam a character on an inside of a mono-component recipient closure, said closure being made of a plastic material comprising between 0,10 % by weight and 1,5 % by weight of a laser beam absorbent additive and a high density polyethylene or polypropylene and wherein said character is printed by having said material absorbing an energy emitted by said laser beam and situated in a range of 1J/cm^2 to 12J/cm^2, in particular between 2J/cm^2 and 5J/cm^2 so as to cause a colour change on the location where the laser beam is incident.

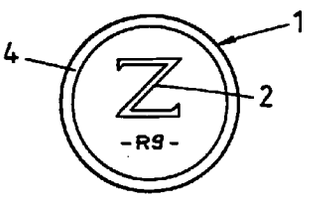

Fig.1

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Description

[0001] The present invention relates to a method for printing by means of a laser beam a character on the inside of a mono-component recipient closure, said closure being made of a plastic material comprising a high density polyethylene or polypropylene.

[0002] Printing one or more characters on the inside of a recipient closure is known and used for example for promotional purposes. Because the characters are on the inside, generally on the backside of the top, they can not be read without removing the closure from the recipient, which is generally a bottle. The customer is thus obliged to buy the recipient and remove the closure to see which character or characters he randomly selected. By printing the characters inside the closure, the random aspect of the promotion is safeguarded. With the known printing method applied on a mono-component closure, a mask and a laser are used, which mask determines the shape of the character to be printed. According to another known method a two-component closure is used i.e. a closure provided with a liner on the inside. In the latter case no laser is used whereas ink is used to print the character on that part of the closure which is covered by the liner in order to avoid that the ink gets into contact with the contents of the recipient. In particular when the recipient contains food or a drink, contamination of the food or the drink by the ink should be avoided.

[0003] A drawback of the known method is that the use of a mask is also not suitable for printing a limited number of closures, which is the case for a promotion campaign. Indeed for each different character to be printed a dedicated mask is required and such masks are expensive to manufacture. As for a promotion campaign a plurality of characters and thus of masks is required in order to safeguard the random aspect, the known method is rather expensive to apply. On the other hand printing with ink on a mono-component closure that is not provided with a liner forming a barrier between the contents of the recipient and the ink of the printed character, has to be avoided for health reasons.

[0004] The object of the invention is to propose a method which enables to print, in an economical way, a variety of characters on the inside of a mono-component closure.

[0005] A method according to the present invention is therefore characterised in that the plastic material of said closure further comprises between 0,10 % by weight and 1,5 % by weight of a laser beam absorbent additive and wherein said character is printed by having said material absorbing an energy emitted by said laser beam and situated in a range of 1J/cm^2 to 12J/cm^2, in particular between 2J/cm^2 and 5J/cm^2 so as to cause a colour change on the location where the laser beam is incident. The addition of a laser additive to the base material of the closure, opens the possibility to have the energy emitted by the laser beam absorbed by that additive causing a colour change at the point of impact of the laser beam on the material. The selected range of the added additive and the energy range cause the colour change to take place without damaging the material neither diminishing the closure properties. As the character is printed by the laser beam having the colour of the material changed on the point of impact, a mask is no longer needed. The printing further enables to print a large variety of characters by simply controlling the laser beam and having the incident laser beam applied at the required location. Moreover no ink is used as the printing is realised by the colour change of the material at the impact location of the laser beam.

[0006] Preferably said character is dotwise printed. The dotwise printing of the characters enables an easy printing of a large variety of characters by simple orientation of the laser beam.

[0007] A first preferred embodiment of a method according to the invention is characterised in that said laser beam is pulsed with a pulse frequency of at least 5 kHz, in particular 14 kHz. A higher printing speed is thus obtained as the energy of the pulses is higher.

[0008] A second preferred embodiment of a method according to the invention is characterised in that said laser beam is produced by a Nd : Yag-laser. Such a laser enables to emit a high energy causing a high resolution print of high quality.

[0009] Preferably a predetermined number of said closures is linewise set up and immobilised during printing. This enables to print in a continuous manner and to buffer the closures so as to enable a standing still of the closures during the printing process.

[0010] The invention also relates to a method for manufacturing a mono-component closure to be printed with the method of the invention described here before. Such a method is characterised in that said plastic material is mixed with at least 0,10 % by weight and at most 1,5 % by weight of a laser additive provided for absorbing laser light and changing colour upon absorption of the laser light.

[0011] Preferably said laser additive comprises titandioxide and antimonium dotted zincoxide. This laser additive has proved to be particularly suitable for laser printing on plastic material.

[0012] Preferably said colour substance comprises at least 50 % by weight of a carrier material, 25 % by weight pigment, 4 % by weight of a slip-additive and 5 % by weight of said laser additive. The thus obtained closure is still economic to be manufactured without affecting the printing properties.

[0013] The invention will now be described in more detail by means of the drawings illustrating the printing process. In the drawings :

figure 1 illustrates the inside of a recipient closure on which a character has been printed;

figure 2 illustrates a cross-section through a closure;

figure 3 illustrates schematically the printing on the closure according to the method of the invention;

figure 4 illustrates the laser beam deflection enabling the printing according to the invention;

figure 5 illustrates the buffering of the closures during the printing process.

[0014] In the drawings a same reference has been assigned to a same or analogous element.

[0015] Figure 1 illustrates a recipient closure 1, on which inside a character 2 has been printed. The closure is provided with screw thread 3 (figure 2) for enabling a screwing on the recipient. The closure is a mono-component closure and is therefore provided with a seal 4, which upon closure of the recipient enters in contact with the top of the recipient's neck in order to provide a tight closure. Such a mono-component closure is for example described in US-PS 8602754.

[0016] Since the closure is a mono-component closure, the character 2 to be printed on the inside of the closure can not be printed with ink. Indeed with mono-component closures, the backside 5 of the closure's top is in direct contact with the substance inside the recipient. If ink should be used, the ink could contaminate the substance or if the substance is acid, which is the case with some soft drinks, the ink would dissolve therein.

[0017] The method according to the present invention does not use ink as the beam 6 of a laser 7 is used for printing on the inside of the closure 1 as illustrated in figure 3. The printing is realised by having the plastic material, of which the closure 1 is made, absorbing the light of the laser beam incident on the closure. This however requires that the plastic material of which the closure is made can absorb the energy of the laser beam and change colour due to this absorption, so that the printed character becomes visible.

[0018] The closures are generally made of a plastic material such as high density polyethylene or polypropylene. For enabling laser printing, laser additives have however to be added to the material. According to the invention 0,10 % by weight to 1,5 % by weight of the material is formed by a laser beam absorbent additive. The total amount of laser additive is dependent on the colour of the closure. In order to enable a good mixture and a homogeneous distribution of the laser additive, the latter is mixed with a colour substance comprising a carrier material, preferably a low density polyethylene and the pigment for colouring the closure. A slip-additive is preferably also included in the colour substance in order to facilitate the opening of the closure. Preferably the colour substance forms at least 1 % of the total material of which the closure is made. The total amount of colour substance varies however in function of the desired colour and forms 2 to 4 %, preferably 3 % of the total plastic material of which the closure is made. The carrier material forms at least 50 % of the total colour substance and the pigment 25 to 30 %, whereas the slip-additive ranges from 0 to 6 %, preferably 5 % and the laser additive ranges from 5 to 20 % preferably 13 %. In the case when 97 % of the material is formed by the high density polyethylene or polypropylene, and the remaining 3 % is formed by the colour substance, the laser additive forms preferably 0,39 % of the total material. Increasing the laser additive above 1,5 % by weight leads to a saturation whereas under 0,10 % by weight it does not provide a homogeneous mixture.

[0019] Experiments have been carried out on closures having a yellow colour and made of 97 % high density polyethylene (Hoechst Hostalen GF 4760 or Borealis HE 8331) and 3 % colour additive Buhler Maxithen (registered trademark). The colour additive comprises 13 % by weight of the laser additive Iriodin (registered trademark) LS 820 of Merck. The latter laser additive comprises titandioxyde and antimonium dotted zincoxide. The used colour additive is suitable to be used for closures applied on food packaging. The experiments have proven to obtain a high resolution print when use was made of a laser beam emitting an energy in the range of 1J/cm^2 to 12J/cm^2 in particular a range of 2J/cm^2 to 5J/cm^2, more particularly 3J/cm^2.

[0020] As is illustrated in figure 3 and 4, the printing on the closure is realised by means of a laser beam 6 produced by a laser 7. In order to obtain the required energy range an Nd : Yag-laser manufactured by Tampoprint was preferably used. This laser proved to be able to write with a high resolution on a 20 x 20 mm surface, which is enough as the inner surface of a closure generally has a diameter of +/-20 mm.

[0021] The laser beam 6 emitted by the laser is incident on a first mirror 8 mounted on the axis of a first galvanometer scanner 9. The beam reflected by the first mirror is oriented towards a second mirror 10 mounted on the axis of a second galvanometer scanner 11. The beam is then oriented by the second mirror towards a lens 12, preferably an F-theta lens, which focuses the light of the beam on the inside of the closure 1. The first 9 and second scanner 11 are controlled by a data processing unit 13, in order to move the mirrors 8 and 10 for enabling to write the desired character. The data processing unit 13 is also connected to the laser 7 in order to control the operation of the latter.

[0022] When a character has to be printed on the closure, that character is furnished to the data processing unit or randomly selected by the latter among a predetermined series of characters. The latter feature is of particular interest for promotional purposes when the character to be printed is an element of a competition. For the application of the method according to the present invention, the word character not only includes letters of the alphabet but also numbers, digits, symbols, figures and so on. The data processing unit then generates a series of control signals which are supplied to the scanners 9 and 11 in order to orient the mirrors 8 and 10. By this latter orientation the beam 6 is deflected according to the character to be printed.

[0023] The used Nd : Yag laser output a beam with a

maximum power of 90 W and a wave length of 1.064 μm. However in order to avoid damaging of the closure and to enable a high writing speed, the maximum output energy of the laser is preferably not used. During tests only 68 % of the output energy was used. The laser beam was pulsed with a pulse frequency of at least 5 kHz, preferably 14 kHz and a pulse width of 50 μs rather than using a continuous wave beam. In such a manner the energy is accumulated in pulses and pulsewise shot on the closure so that the printing is dotwise realised. A higher printing speed is thus obtained as well as an improved resolution as only small high energy dots are successively printed. With such a laser set up an energy of 3J/cm^2 was obtained. Lowering the energy beneath 1J/cm^2 has not much sense as this led to an insufficient printing quality, whereas raising the energy above 12J/cm^2 caused a burning of the closure material.

[0024] The printed dots are of course very small so that the dotted character is not visible to the human eye. The successive dots are obtained by pulsewise applying the energy of the laser beam. Alternatively the dots could also be obtained by emitting a continuous beam and having the mirrors 8 and 10 stepwise moved.

[0025] Depending on the colour of the closure on which the character has to be printed and the required energy, the laser is used either in mono-mode or in multi-mode condition.

[0026] Preferably the printing is realised on a continuous supply of closures in order to reach a high throughput. However to realise a correct printing, the closure has to be fixed during printing in such a manner that the laser beam can be deflected according to the pattern of the character to be printed. Figure 5 illustrates a device enabling to buffer the closures 1 supplied continuously at the input 14. The supplied closures are divided by a first division station 15 into two channels 16 and 20. Channel 16 is then further divided by a second division 17 into channels 18 and 19 which extend in parallel with channel 20.

[0027] The closures then travel along the channels 18, 19 and 20 to reach a first stopper 21. A second stopper 22 is placed downstream stopper 21.

[0028] Stoppers 21 and 22 serve to stop the stream of closures in the channels and thus to block the closures in the space between both stoppers during printing. When stopper 21 is open, the closures can reach stopper 22, which is closed so as to stop the progression of the closures. The latter are then aligned according to a matrix. When the predetermined number of closures, twelve in the present example (3 x 4) are matrixwise aligned before stopper 22, stopper 21 closes. The subsequently arriving closures are then buffered upstream stopper 21. Now that the closures are aligned and kept immobile between the stoppers, the printing process can start. The laser beam is oriented along the first row in channel 18 and prints the closures 1 A - D. Consequently the closures in channels 19 and 20 are successively printed. Once the closures 1 A - D are printed the stopper 22 opens channel 18 in order to remove the closures from that channel. Stopper 22 closes once that all the closures 1 A - D have been removed and thereafter stopper 21 is opened in order to supply a new series of closures. The same process is applied on channels 19 and 20 after printing. In such a manner the closures are linewise set up in order to enable a linewise printing. In such a manner it is possible to print the closure in one channel and to fill another channel simultaneously.

[0029] Experiments have proven that a high resolution print quality was obtained by application of the described method. The printed characters were clearly readable.

Claims

1. A method for printing by means of a laser beam a character on an inside of a mono-component recipient closure, said closure being made of a plastic material comprising a high density polyethylene or polypropylene, characterised in that the plastic material of said closure further comprises between 0,10 % by weight and 1,5 % by weight of a laser beam absorbent additive and wherein said character is printed by having said material absorbing an energy emitted by said laser beam and situated in a range of 1J/cm^2 to 12J/cm^2, in particular between 2J/cm^2 and 5J/cm^2 so as to cause a colour change on the location where the laser beam is incident.

2. A method as claimed in claim 1, characterised in that said character is dotwise printed.

3. A method as claimed in claim 1 or 2, characterised in that said laser beam is pulsed with a pulse frequency of at least 5 kHz, in particular 14 kHz.

4. A method as claimed in claim 1, 2 or 3, characterised in that said laser beam is produced by a Nd : Yag-laser.

5. A method as claimed in any one of the claims 1 to 4, characterised in that a predetermined number of said closures is linewise set up and immobilised during printing.

6. A method as claimed in any one of the claims 1 to 5, characterised in that a further predetermined number of said closures is set up according to a matrix for said printing.

7. A method for manufacturing a mono-component closure to be printed according to a method as claimed in any one of the claims 1 to 6, characterised in that said plastic material is mixed with at least 0,10 % by weight and at most 1,5 % by weight of a laser additive provided for absorbing laser light and changing colour upon absorption of the laser

light.

8. A method as claimed in claim 7, characterised in that said laser additive comprises titandioxide and antimonium dotted zincoxide.

9. A method as claimed in claim 7 or 8 characterised in that said closure comprises at least 96 % by weight of said polyethylene or polypropylene and at least 1 % colour substance comprising said laser additive.

10. A method as claimed in claim 9, characterised in that said colour substance comprises at least 50 % by weight of a carrier material, 25 % by weight pigment, 4 % by weight of a slip-additive and 5 % by weight of said laser additive.

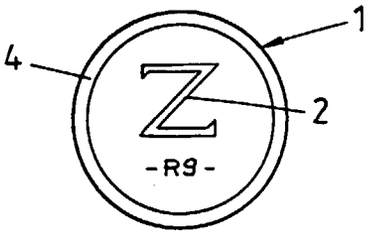

Fig.1

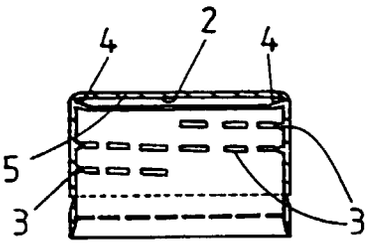

Fig.2

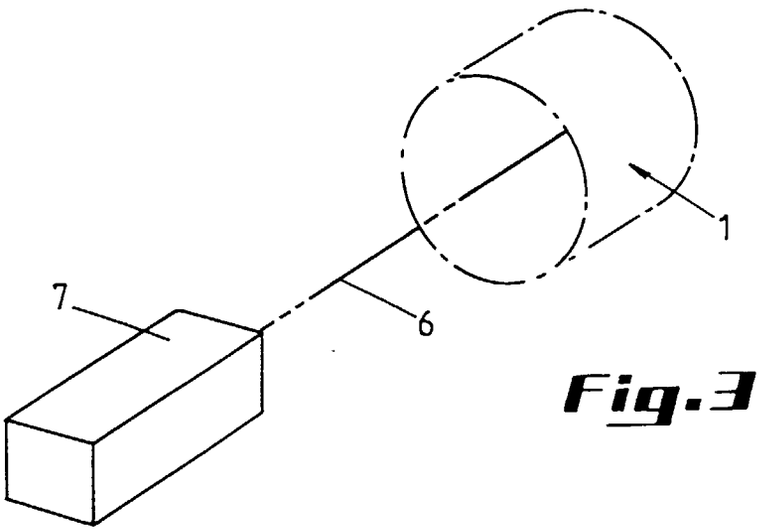

Fig.3

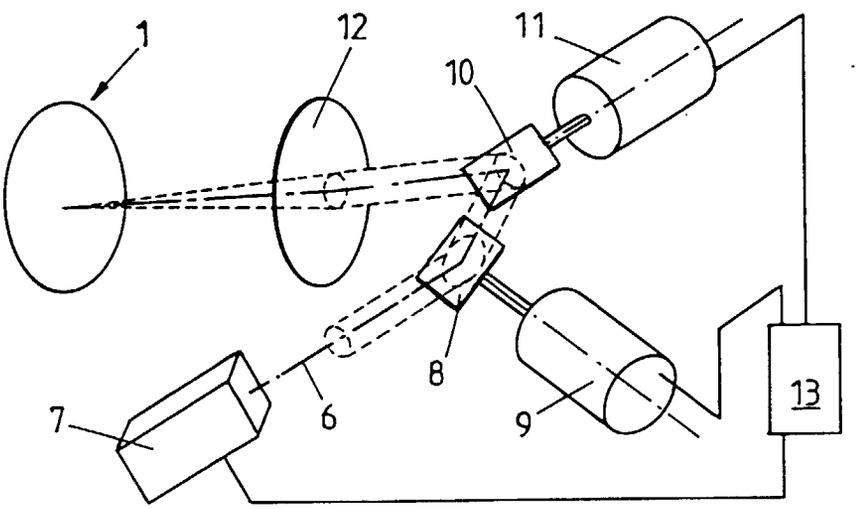

Fig.4

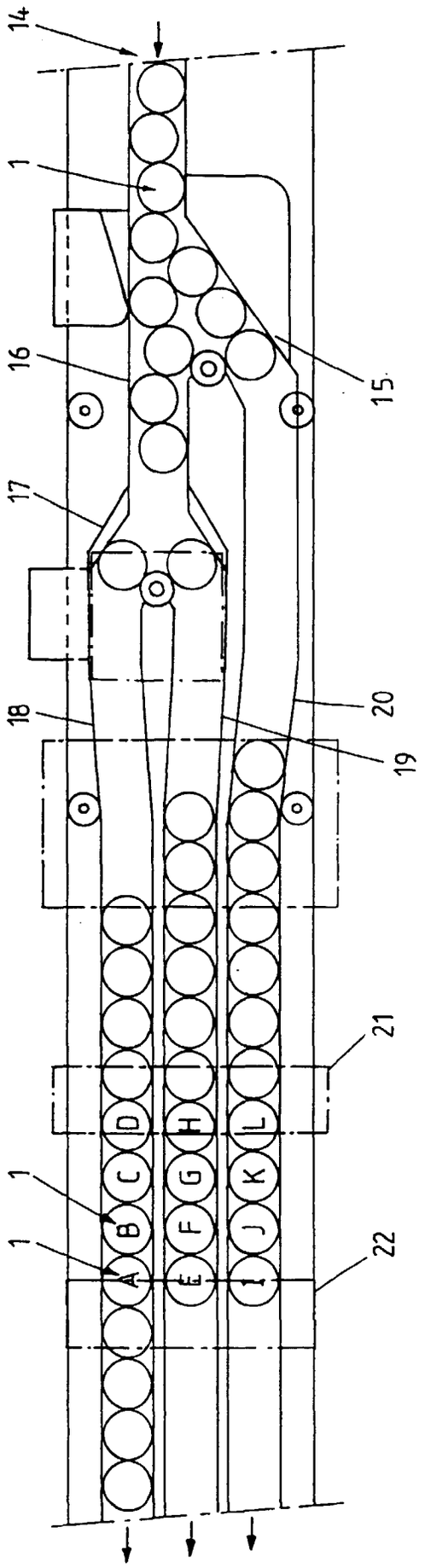

Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 1057

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,Y	EP 0 754 562 A (QUARWERKE GMBH) 22 January 1997 * page 2, line 1 - line 11 * * page 2, line 43 - page 3, line 20 * * page 4, line 2 - line 25 * * claims 1-4,11-17; examples 1-9 *	1-10	B41M5/36 B65D51/24
Y	EP 0 684 144 A (SODIREP SARL) 29 November 1995 * page 2, line 1 - line 4 * * page 2, line 28 - page 3, line 26 * * page 4, line 17 - page 5, line 17 * * claims 1-19; examples 1-13 *	1-10	
Y	GRAFF G: "ADDITIVES MAKE POSSIBLE LASER MARKING OF POLYOLEFIN COMPONENTS" MODERN PLASTICS INTERNATIONAL, vol. 26, no. 4, April 1996, page 24/25 XP000627075 * page 24, line 1 - page 25, line 6 *	1-10	
Y	MVERS J: "LASERS MAKE THEIR MARK ON VARIETY OF PLASTICS PARTS" MODERN PLASTICS INTERNATIONAL, vol. 23, no. 10, 1 October 1993, page 29/30, 32 XP000397542 * page 29, line 1 - page 30, line 18 * * page 30, line 44 - line 140 *	1-10	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B41M B65D B23K B29C C08K
A	DE 295 08 096 U (K.KUCHENBECKER) 3 August 1995 * claims 1-5; figures 1-3 *	1-10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 August 1998	Bacon, A

CATEGORY OF CITED DOCUMENTS

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05-08-1998

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 754562 A	22-01-1997	DE 19525958 A	23-01-1997
		DE 19525960 A	23-01-1997
EP 684144 A	29-11-1995	FR 2720402 A	01-12-1995
DE 29508096 U	03-08-1995	NONE	

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