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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 July 2001 (05.07.2001)

PCT

(10) International Publication Number
WO 01/47688 A2

(51) International Patent Classification[7]: B29C 49/64, 49/00

(21) International Application Number: PCT/BE00/00155

(22) International Filing Date: 22 December 2000 (22.12.2000)

(25) Filing Language: Dutch

(26) Publication Language: English

(30) Priority Data:
9900840 24 December 1999 (24.12.1999) BE

(71) Applicant *(for all designated States except US)*: **RESILUX** [BE/BE]; Damstraat 4, B-9230 Wetteren (BE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **DE CUYPER, Dirk** [BE/BE]; Molenweidestraat 5, B-9070 Heusden (BE).

(74) Agent: **VAN CUTSEM, Paul**; Avenue Winston Churchill 152/6, B-1180 Bruxelles (BE).

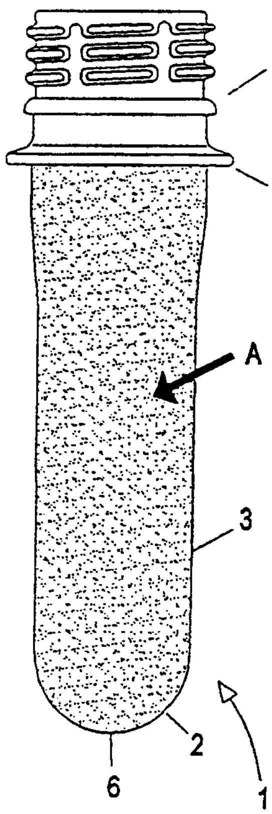
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *Without international search report and to be republished upon receipt of that 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: PROCESS AND APPARATUS FOR TREATING PLASTIC PREFORMS




(57) **Abstract:** Process for manufacturing hollow articles (1), particularly of plastic preforms, intended for being transformed subsequently to plastic receptacles, wherein the preforms are blown to a receptacle and heated before the blowing operation to a determined blowing temperature by means of heating elements, remarkable in that the wall of the preform is treated by applying a structure operation or modification in the surface roughness and apparatus therefor.

WO 01/47688 A2

# PROCESS AND APPARATUS FOR TREATING OF PLASTIC PREFORMS

This invention relates to a process for manufacturing hollow objects, in particular plastic preforms, intended for being processed subsequently to plastic receptacles, wherein the preforms are blown to receptacles. It relates more particularly to PET packaging, such as receptacles of the bottle type for an extended range of products such as oils, more particularly eatable oils, water, drinkable water, and other beverages, such as soft drinks either carbonated or not. However, it relates also to less liquid materials of the type mayonnaise, ketch-up, vinegar sauce, and shampoos, cosmetics, pharmaceuticals e.a. as well. These materials have a higher viscosity and consistency.

It is generally known that the preforms are heated to a determined blowing temperature before the blowing operation.

In the manufacturing of preforms for receptacles, there is the problem of limited capacities of the blowing machines on the one hand and of the appropriate heating on the other hand. These blowing machines are used for the final transformation of preforms to the final products as receptacles, such as bottles and so on, as described in document EP 0 720 566. This transformation may occur in one or two main steps. In the stage which preceeds the blowing of the preforms, the latter are heated so that they get into the blowing moulds at the suitable temperature, in which moulds they are blown up to the final receptacles. The conveying speed of the preforms in the heating line of the blowing machine must be adapted to the constraints which presrcribe the appropriate heating temperature of the preforms. This creates a limitation of the capacity of such blowing machines.

The object of this invention is to offer a solution to the above-mentioned problem. To this end, there is proposed, according to the invention, a process in which the preforms are blown up to a receptacle and wherein the preforms are heated before the blowing operation to a determined blowing temperature by means of heating elements, said process being remarkable in that the wall of the preform is treated by applying a structure operation or respectively unpolishing operation to the surface roughness.

An optimisation of the blowing process is thus achieved when manufacturing the preforms and the receptacles obtained by transforming the latter, which results in a shorter occupation of the blowing machine, thus enhancing an increased capacity thereof. Thanks to the implementation of a change in the surface roughness structure on the preforms, a local structure modification is achieved by matting the preform and/or through a global surface enlargement. A structure modification is thus implemented on the wall of the preform, i.e. outside or inside or both, with an increased local surface so that the heat originating from the radiation of the preforms as proposed according to a further embodiment of the invention is absorbed much better thanks to the irregular surface of the preform wall.

According to a further preferred embodiment of the invention, the preform used is coloured such that there is a still better absorption of the energy. An outstanding preform is obtained by a combination of colouring and matting, wherein the colouring provides a better general absorption of energy and the matt character provides an increased local absorption of energy by the preform wall.

In traditional preforms having an even wall surface, a relatively large quantity of the infrared radiation is reflected by the preform so that the absorption of the heat originating from this infrared radiation is substantially smaller, whereby a loss of heat occurs. This generates the problem of an unefficient absorbation of heat.

According to a still further preferred embodiment of the invention, additives are added to the composition of the material of the preform so that the absorbtion of radiation is still more enhanced.

It is remarkable that the process according to the invention can be implemented in all the cases where energy can be saved, whereby in addition to PET other materials can be considered as well, provided that they allow the manufacturing of a preform, such as polypropylen.

An additional advantage resulting from the process according to the invention consists in that a better removal of the preform from the mandrel of the forming mould is achieved, in other words a better removal of the preform is achieved when mouldinjecting in the first shaping stage, as described in document EP 0 686 081, the teachings of which are considered to be incorporated in this application by way of reference.

According to a specific embodiment of the invention, the process is applied along determined selected areas. When blowing the preforms, one part thereof is not blown, the neck part. The bottom area of the preform is not blown either strictly spoken. When heating up the preforms in the stage preceding the blowing up, quantifying the heat is a particularly sensitive problem. In case the heating is too strong, this causes a deformation of the preform and thus of the bottle as well, resulting in that a rubbish product is generated. In contrast, in case the supply of heat is too small, the blowing operation becomes inefficient so that in such cases blowing up does not provide the desired shape.

In addition, this heating occurs in a classical way in a so-called heating line, at least at one side of which an arrangement of heating lamps is provided. Smaller preforms which do not extend over the complete radiating height of said heating line may cause an efficiency problem, since no specific area heating can be generated by means of infrared lamps.

According to a specific embodiment of the invention, the aforementioned selectivity is achieved by a selective treatment of the preform.

Said selected areas may advantageously be choosen in all varying and/or discontinuous areas of the preform, such as transition areas and/or having variating wall thicknesses. This occurs for laterally flattened receptacles which are thinner at said flattened sides to provide a better pinching capacity thereof, whereas the extreme sides have a thickened profile in order to enhance the stiffness of the receptacle.

Consequently, the geometry of the preform is quite important. Limitations in this case are prescribed by the basic material which is choosen and by the geometry of the preform with respect to the bottle. The aim here consists in modifying a physical characteristic of the basic material, i.e. its surface roughness. On the other side, the chemical action is so little as possible, which means that the action on the composition of the material itself is so little as possible.

When manufacturing receptacles from preforms, biaxial stretching is quite important. In this case, two stretchings occur, on the one hand in the longitudinal direction and on the other hand in the radial or peripheral direction. However, there are limitations which may go up to 4 times in the length direction and 4,5 times in the width direction. The greater the product of those two values obtained, the stronger is the bottle achieved. In case the stretching bounds are exceeded, the bottle will loose its transparency with a characteristic white appearance. When aiming at achieving a value of said product which is as big as possible, it will be necessary to proceed very selectively, thereby resulting in a stronger need for said selective treatment.

This invention also relates to an apparatus for implementing the aforementioned process. In the blowing process, the preforms are oriented and conveyed successively to the blowing machine. Afterwards, the preforms are brought into a rotary movement and conveyed before heating boxes having heating lamps with a specific area heating, resulting in that the preforms achieve a heating profile which is different for each preform and/or bottle and/or receptacle. After this heating in areas, there is still a determined balancing time in order to let the heat penetrate the preforms, after which said preforms are blown to a bottle or receptacle in a blow mould.

Further advantages and particularities of this invention are defined in further sub-claims.

Additional details are described hereafter in the description of an exemplary embodiment which is illustrated with the appended drawings.

Figure 1 is a front view of a preform which is virtually completely treated according to a first embodiment of the invention.
Figure 2 is a front view of a preform which is partly treated according to a second embodiment of the invention.
Figure 3 is a front view of a preform which is partly treated according to a third embodiment of the invention.
Figure 4 represents a diagrammatic view of the heating circuit for the process according to the invention.
Figure 5 is a diagrammatic view of the efficiency curves of the heating elements which are used in the process according to the invention.
Figures 6 and 7 are respective diagrammatic views of the mutual arrangement of preforms to be treated according to the process according to the invention on the one hand and heating elements thereby used on the other hand.

A preform 1 is represented in Figure 1 which was Isubmitted to a complete treatment of the part which is intended to be blown, i.e. a part out of the neck 4. This full treatment state is represented on the Figure with the reference sign A. The advantage thereof is that the preform absorbs more heat over its entire body, possibly between 10 and 20% more heat absorption. Thanks to this, blowing machines with a limited heating capacity can produce a higher output, in particular for preforms requiring much heating, for example refillable and other thickwalled products, and so on. For thickwalled preforms which are harder to blow at first sight, the treatment occurs preferably on the inner and the outer wall as well. This also generates an energy saving for the blowing machines, possibly between 10 and 20% of the heating capacity.

Figure 2 shows a selective treatment of the preform which has the advantage that areas of the preforms with problems absorbs additional heat in the prospect of an optimization of the blowing. The treatment state of said problem areas is represented on the figure by means of the reference signs B and C respectively. Problem areas for preforms are for instance the bottom 2 and the neck 4 thereof. In the neck part 4, there is a disturbing influence from the neck ring 5 which is most of the time cooled off and which needs to maintain its original shape after the blow operation and it is therefore isolated with a cooling shield. The bottom has the problem that this side which shows the so-called injection point 6 is located further from the heating lamps which are arranged laterally respective to the preforms as visible on figure 7 for instance and thus receives less radiating heat.

In this application of selective treatment, there is a greater energy saving since thanks to said selective treatment precisely those parts requiring the most heat absorb the most heat as well. In this way, an optimal use of the supplied energy may be achieved.

Figure 3 shows another treatment area of the preform which may essentially be adapted on any desired part of the preform. The treatment state for this case is represented with the reference sign D. This example however offers the advantage that for certain types of bottles, such as oval or rectangular bottles for instance, an additional heat absorption area can be created so that it becomes easier to blow them. In addition, a great energy saving can be achieved for this treatment application as well in an analogous way since the parts requiring the most heat absorb more heat. In this way problems which are created because of a specific shape of the receptacle can be solved efficiently thanks to the implementation of the process according to the invention.

The selective treatment B and/or C and/or D of the preforms makes it possible to parametrise the treatment in an optimal way and to bring into account an extremely wide range of possibilities for implementing this process.

A particular case here is the one of the flattened receptacles, particularly receptacles having a substantially oval cross-section. They have thinner sides making the pinching thereof easier for the user. The extreme sides on the contrary show a thicker section providing the required stiffness to the receptacle.

In the diagrammatic representation of figure 4 there is shown a instanteneous position of a preform 1 during the heating process thereof in a heating line respective to a heating box 13 with heating lamps 12 which are arranged according to the longitudinal direction I of the preform. The heating boxes are started through a fuse 11 connected to a source 10. The temperature is represented through a unit 14 which is connected to a PLC unit 15. Said unit 15 is connected to a pyromat 16 on which a pyrometer 17 is connected. A branch having a thyristor 18 and controlling units 19, 20 is incorporated in the heating circuit.

The preblowing together with the temperature profile determine the material distribution in the bottle. There are three setting options available : time, pressure and flow. These three magnitudes determine the distribution of material together with the stretching.

Alternative embodiments of selective area treatments are set out hereafter. In the blowing process, the preforms 1 are orientated and conveyed successively to the blowing machine in a heating line 13 along direction of arrow F represented diagramatically with the conventional cross sign in a circle on the figure. After this the preforms are moved in a rotary motion and conveyed before heating boxes. The latter have heating lamps 12 with a specific area heating which is represented on figure 5. In this way, the preforms get a heating profile which is different for each bottle or receptacle. When incorporating suitable reflectors 22, 23, 24 e.g. between the infrared lamps 12, the radiating pattern can be modified depending on the needs of the case. In addition, a top reflector 21 may further be used for supplying radiating energy from the laterally arranged lamps to the bottom 2 of the preforms.

After this heating along areas, some balancing time is still required in order to have the heat absorbed in the preforms as clearly represented in the differently hatched areas of figure 6, the processing state whereof is indicated by reference letters E and F, having a respective etching over the whole wall thickness 3 or merely a part thereof, depending on the wavelength λ and/or the power of the radiating sources 12 used. Subsequently the preforms 1 are blown to a bottle or receptacle in a blow mould.

The blowing operation is usually carried out in two steps : a first blowing pressure (between 4 and 20 bar) is applied for preforming the bottle or receptacle followed by a second blowing pressure (between 10 and 45 bar) for finalizing the shaping of the bottle or receptacle.

During the blowing operation the product is stretched bi-axially in order to achieve an optimal strength. This is usually performed by means of the blow pressure and a stretch rod. The stretch rod provides a pre-orientation in the length direction and also allows the bottom or the injection point to remain in the middle, resulting in that the wall thickness variation of the bottom remains limited.

Subsequently the bottom or receptacle is removed from the blow mould and it is thus ready for use.

There are two setting options available : pressure and time.
With pressure : the second blowing pressure is essentially intended to press the bottle well against the mould wall so that the cooling off occurs in the most efficient way. The second blowing pressure is preferably comprised between 20 and 40 bar, depending on the receptacle type.
With time : in order to achieve the best efficiency of the cooling cycle, the second blowing pressure needs to be applied as soon as possible after the fore-blowing. However, the bottle must be shaped almost or completely for preventing overstretching.

## CLAIMS

1. Process for manufacturing hollow objects (1), particularly plastic preforms, intended for being processed subsequently to plastic receptacles, wherein the preforms are blown to a receptacle and wherein the preforms are heated before the blowing operation to a determined blowing temperature by means of heating elements, characterised in that the wall of the preform is processed by applying a structure modification or operation respectively of the surface roughness.

2. Process for manufacturing hollow objects (1), particularly of plastic preforms, more particularly of PET preforms, intended for being processed subsequently to plastic receptacles, wherein the preforms are blown to a receptacle and wherein the preforms are heated before the blowing operation to a determined blowing temperature by means of heating elements, characterised in that the wall of the preform is processed by applying an unpolishing operation thereon.

3. Process according to one of the preceding claims, characterised in that a local surface enlargement of the preform is generated by applying said surface roughness structure operation or respectively unpolishing operation, in particular at the external wall (7) of the preform.

4. Process according to one of the preceding claims, characterised in that said treatment is performed selectively so that merely predetermined parts (B, C and/or D) of the preform are etched.

5. Process according to the preceding claim, characterised in that said areas (B, resp. C) are treated at the bottom (2) and/or the neck (4) of the preform respectively.

6. Process according to one of the claims 4 or 5, characterised in that transition areas (D) of the preform and/or areas having a varying wall thickness (3) are treated.

7. Process according to the preceding claim, characterised in that mutually opposite sections (D) which extend in a substantially longitudinal direction of the receptacle, are submitted to said treatment.

8. Process according to one of the preceding claims 4 to 7, characterised in that said selective treatment is completely parameterised depending on non chemical characteristics, in particular the geometry of the preform.

9. Process according to one of the preceding claims, characterised in that said preform is stretched biaxially during the blowing operation.

10. Process according to the preceding claim, characterised in that the preform is stretched biaxially during the blowing operation up to four times in its longitudinal direction and up to 4,5 times in its width direction.

11. Process according to one of the preceding claims, characterised in that said preforms are heated by an infrared light radiation originating from infrared lamps (12).

12. Process according to one of the preceding claims, characterised in that additives are added to the material previously according to a determined percentage.

13. Process according to one of the preceding claims, characterised in that the radiation pattern of the heating elements is modified by arranging reflection elements (21; 22, 23, 24) at determined locations respective the preform itself (1) and/or respective the heating elements (12) respectively.

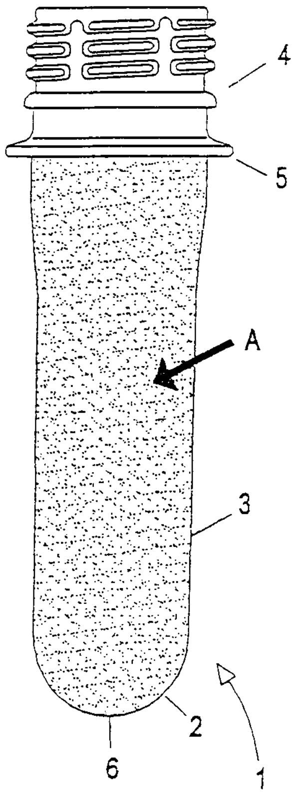
14. Apparatus for implementing the process as defined in one of the preceding claims, characterised in that radiating elements (12, 12', 12") having mutually different wavelengths (λ, λ', λ") are provided.

15. Apparatus for implementing the process according to claim 13, characterised in that a set of reflectors (22, 23, 24) is provided which are arranged substantially crosswise to the mean longitudinal direction (l) of the arranging direction of the heating sources (12), possibly with a top reflector (21).

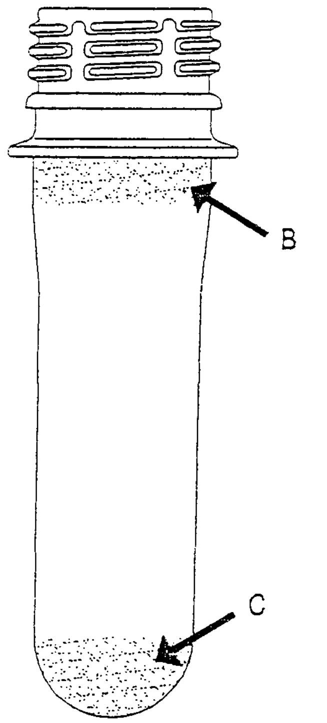
16. Receptacle manufactured with the process according to one of the claims 1 to 11, characterised in that the receptacle has a laterally flattened shape.

17. Receptacle according to the preceding claim, characterised in that the receptacle has a substantially oval cross-section at the blown part of the receptacle.

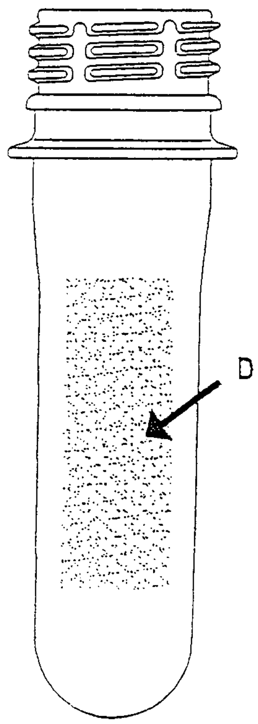
Figuur 1



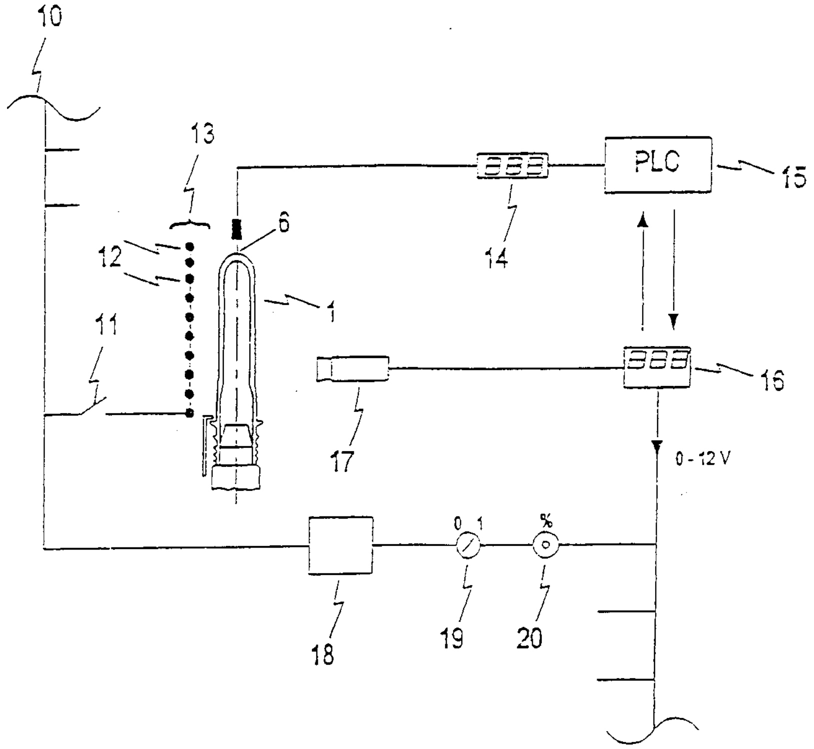

Figuur 2



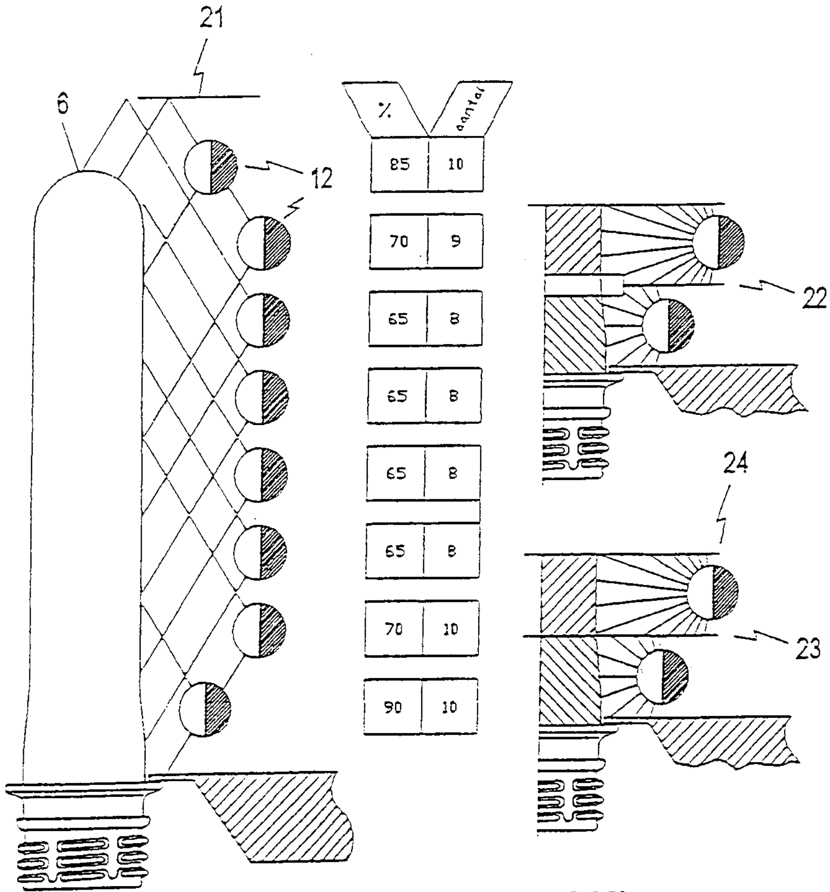

Figuur 3



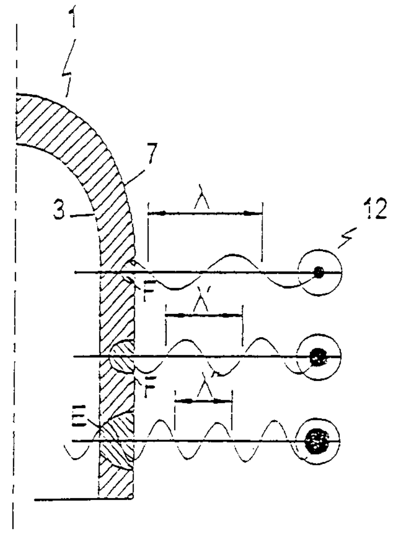
Figuur 4




Figuur 5



Figuur 6




Figuur 7