(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 934 029 B9**

(12) **CORRECTED EUROPEAN PATENT SPECIFICATION**

(15) Correction information:
Corrected version no 1 (W1 B1)
Corrections, see
Claims EN 1

(48) Corrigendum issued on:
08.06.2011 Bulletin 2011/23

(45) Date of publication and mention of the grant of the patent:
19.01.2011 Bulletin 2011/03

(21) Application number: **06793444.8**

(22) Date of filing: **12.09.2006**

(51) Int Cl.:
B29B 13/02 *(2006.01)* ***B29C 49/64*** *(2006.01)*
B29C 49/68 *(2006.01)* ***H05B 6/02*** *(2006.01)*

(86) International application number:
PCT/EP2006/066268

(87) International publication number:
WO 2007/031509 (22.03.2007 Gazette 2007/12)

(54) PREFORM HEATING DEVICE

VORFORMHEIZVORRICHTUNG

DISPOSITIF DE CHAUFFAGE DE PREFORMES

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

(30) Priority: **13.09.2005 IT RM20050466**

(43) Date of publication of application:
25.06.2008 Bulletin 2008/26

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Description

Technical Field

[0001] The present invention refers to a preform heating device, suited in particular for induction heating of preforms for the production of bottles and containers by means of blow moulding in accordance with claim 1.

State of the Art

[0002] Different devices are known for heating preforms used in the production of hollow bodies in plastic material by means of the blow moulding technique.

[0003] One example of such devices is described in document WO92/15442. This device provides additional heat by irradiation and convection, by means of a dedicated heating element, to a transition region in the preform wall between portions of wall subject to different degrees of expansion during blowing, in particular between one region subject to little or even no expansion and another region in which expansion is far greater.

[0004] However, in the known devices, this heating element is in turn heated by direct conduction, thus causing overheating problems with significant temperatures reached by the components of the entire device; the presence of electric resistances entails wear thereof over time and, consequently, greater maintenance.

[0005] The thermal profile of the components, determined by the design of such devices also entails a high dissipation of power in order to allow the reaching of the project temperature in the element heating the preform. This also leads to a non-precise focalisation of heat flow, due also to a structure difficult to customise, poor rapidity of preform heating due to a significant thermal inertia of the structure and at the maximum temperature limit that can be achieved with traditional resistances.

[0006] Document EP-A-0 849 067 discloses also a heating device for heating preforms in accordance to the preamble of claim 1. An innovative preform heating device is therefore required that makes it possible to overcome the above drawbacks.

Summary of the Invention

[0007] One primary purpose of the present invention is that of making a preform heating device that allows a precise and strongly localised heating of the preforms before the blow moulding phase of the plastic bottle or container production process.

[0008] A further purpose is to provide a preform heating device that presents an innovative construction configuration, thus allowing better performance with respect to the solution with hot air conditioning systems, thanks to the reduction in the energy required to reach the project temperatures in the heating element.

[0009] Lastly, a further purpose is to provide an infra-red heating device with a simple and easily replaceable irradiating component.

[0010] The present invention therefore proposes to achieve the purposes described above by making a preform heating device for the production of plastic hollow bodies that, according to claim 1, comprises at least one induction means (2) suitable for inducing, when current passes therein, a magnetic flow on at least one heat transmission means (4), in order to transmit by irradiation a predefined quantity of heat to at least one preform (10) suitable for being inserted into said device.

[0011] Advantageously, this device is able to guarantee, within predetermined tolerances, a thermal profile assigned both along the thickness and in the direction of the length of the piece to heat, usually in PET. The inductor does not directly heat the piece, also because the preform is constituted by a non-conductive material but, by means of a magnetic flow, it takes to temperature a ring of conductor material with an opportune section that, by irradiation, in turn heats the PET preform area.

[0012] Advantageously, a flow concentrator may be provided suited to better concentrating the useful magnetic flow to the heating element. This further improves the thermal profile of the invention device components, in order to avoid overheating drawbacks and to considerably improve the performance and efficiency of the entire system.

[0013] In certain applications it is in any case possible to avoid the use of the flow concentrator, thus simplifying the structure of the device.

[0014] The dependent claims describe preferred embodiments of the invention.

Brief Description of the Figures

[0015] Further characteristics and advantages of the invention will be further evident in view of the detailed description of a preferred, though not exclusive, embodiment of an illustrated preform heating device, such as illustrated by way of

non limiting example with the aid of the appended drawings wherein:

Fig. 1 shows a section of a first embodiment of the heating device according to the present invention;
Fig. 2 shows a section of the heating device in Fig. 1 with a variant relating to a component;
Fig. 3 shows a section of a second embodiment of the invention device;
Fig. 4 shows a section of the device in Fig. 3 with a variant relating to a component;
Fig. 5 shows an axonometric view of a section of the invention device;
Fig. 6 shows an axonometric view of several devices, according to the device, arranged linearly.
Figures 7 and 7a show a different embodiment of the inductors 2' with a different arrangement of the power connection to the inductors.

Detailed Description of a Preferred Embodiments

[0016] With reference to Figures from 1 to 4, different embodiments of a preform heating device are illustrated, comprising:

- an inductor 2,
- an optional flow concentrator of magnetic dielectric material 3,
- a heater ring 4,
- at least 1 support 5 of said ring.

[0017] This device further comprises a support base 1, generally in steel, and at least one external centring support 6 of the device, preferably in aluminium. Said base 1 and said at least one centring support 6 are joined by means of clamping means, such as screws, bolts or other similar elements.

[0018] The inductor 2, preferably in copper, crosses the external centring support 6 and presents inside the device a configuration that is preferably, but not necessarily, circular.

[0019] The passage of electric current in the inductor produces a magnetic field wherein the flow is advantageously conveyed, also by means of the flow concentrator 3, on the heater ring 4, for example in high electrical resistance alloys that are resistant to high temperatures, such as, for instance, Ni-Cr-Fe alloys, in such a way as to allow this ring to reach a predetrmined temperature, preferably higher than 800°C. This temperature of the ring 4 is suitable for transmitting heat, by irradiation, to a preform 10, for a predefined time suitable for an appropriate preheating of the preforms used in the blow production of plastic bottles and containers. The cover of the device in fact has a hole of appropriate dimensions for introducing the preform 10 inside, in the area surrounded by the heater ring 4.

[0020] Advantageously, the inductor 2 can be cooled by means of flowing of water or another coolant fluid inside thereof.

[0021] In the embodiment in Fig. 1 the ring 4, with a polygonal section, is held in position by an anchorage system, simple from the constructive point of view, that firmly fixes together the flow concentrator 3 and the inductor 2 and has a support 5 of the ring provided with individually isolated metal tabs 7. This solution makes it possible to have good thermal insulation between the heater ring 4 and the remaining device components, especially if the phenomena of conduction and convection are considered.

[0022] In Fig. 2 an even simpler embodiment of the anchorage system has the extremities 8 of the support 5 trapped in housings provided in the ring 4. In the devices in Figs. 1 and 2, the concentrator 3 has a form such as to house the inductor 2 inside the device. Between the inductor-concentrator block and the ring 4 there is a gap 9.

[0023] One advantageous embodiment, illustrated in Fig. 3, determines a sturdier configuration of the invention device and a greater protection of the other irradiation components of the heater ring 4. The support 5 of the ring, in this embodiment, is in fact thicker and is constituted by one or more plates 5', with a complementary form, constituted by a refractory material, such as oxides, ceramic or fibre-reinforced refractory cement, able to resist at the operating temperature of the heating ring. The temperature of the ring is strongly influenced by its thermal conductibility, which is therefore preferably lower than 1 W/mK.

[0024] In this case, the inductor-concentrator block and the ring are joined to one another by said refractory plates that at the same time however prevent the direct contact thereof.

[0025] One advantageous variant, illustrated in Fig. 4, in the embodiment in Fig. 3 has a gap 9' between the ring 4 and refractory plates 5'. The presence of this gap 9' guarantees a further protection from overheating for device components and, therefore, a lower dissipation of energy.

[0026] In order to focus the irradiation, an adjustable screen 13 may advantageously be provided, arranged between the body of the preform 10, inserted into the device, and the internal components of the device itself in such a way as to further improve the focalisation of the heating of a predetermined area of the preform, for example the neck.

[0027] In order to improve the performance of the heating device of the invention, certain embodiments were subject to tests, with components made of different material in each test.

[0028] As a result of these tests, a flow concentrator 3 made of magnetic dielectric material was chosen for the invention device.

[0029] In fact, such material makes it possible to obtain the temperature preset on the ring 4 using a feeder that provides a current less than 40% of that which it would were the concentrator 3 of another material, for example glass-bonded ferrite. Despite the fact that glass-bonded ferrite is a low cost material, the use thereof in this application would entail greater consumption and a higher cost of the same feeder.

[0030] The tests performed on two devices with concentrator 3 in magnetic dielectric and glass-bonded ferrite material respectively, with a frequency generator equal to 10kHz, have made it possible to obtain the following results, which we report as an example, relating to the total active and dissipated power used, to efficiency and to the current dispensed in order to reach in the ring 4 a temperature of 900°C in a stationery non-transient state:

	magnetic dielectric material	glass-bonded ferrite
Current	800 A	1400 A
Active power ring	346 W	355 W
Power dissipated in the inductor	437 W	659 W
Power dissipated in the support base	53 W	130 W
Power dissipated into the supports 6	29 W	148 W
Total dissipated power	519 W	937 W
Total power dispensed	866 W	1292 W
Efficiency	40%	27.5%

[0031] It should be noted how the flow concentrator of magnetic dielectric material significantly improves the efficiency of the device, allows the use of a smaller dimension feeder and a less powerful cooling system as the total power dissipated is lower.

[0032] By analysing the value of the voltage at the ends of the feeder and the phasing between voltage and current and consequently the reactive powers in question, one sees that with the concentrator 3, or nucleus, made of magnetic dielectric material a far lower reactive power is absorbed than with the glass-bonded ferrite.

[0033] By means of in frequency analysis, is can also be observed that the concentrator 3 of magnetic dielectric material allows a higher efficiency even at varying frequency.

[0034] Thermographic analysis showed how the temperatures reached during non transient operation of the device of the different components are perfectly tolerable by the materials used.

[0035] Advantageously for the production of bottles and containers starting from preforms in a dedicated plant, the use of a plate or multi-cavity module is envisaged upstream from the blow moulding machine, able to house in a matricial configuration, or in a row, a series of heating devices according to the present invention, suited to housing the preforms to be heated.

[0036] One example of multicavity module with linear arrangement of the devices according to the invention is illustrated in Fig. 6.

[0037] For the serial powering of twenty devices of the same type, for instance, it is possible to use a generator with a power of just 20 kW, therefore 1 kW of power input per cavity.

[0038] The device of the present invention, for heating the preforms used in the production of bottles for standard type beverages, has a consumption of approximately 0.8kW/cavity with a saving of approximately 20% with respect to the consumption of known hot air jet heating devices. The specific heating power is even higher than that obtained with the known devices and reaches at least 15W/cm^2.

[0039] Further advantages of the invention device with respect to the hot air jet devices are represented by:

- a greater heating precision in an area of the preform that depends only on the device geometry and not on the hot air flows, and therefore a greater heating process stability;
- a control of the process performed considering the temperature parameter alone;
- the presence of a perimeter heating source that makes unnecessary even a partial rotation of the preform.

[0040] From a mechanical point of view, the invention device presents high reliability due to the presence of a few mechanical components and also of high stability in that, with the configurations described in the various variants, no

thermal expansion of the components is observed. The device is also less complex in that for correct heating absolutely no preform rotation is required. Furthermore, the absence of any electrical resistance significantly reduces the maintenance needed for a correct device functioning.

[0041] Lastly, with such device, it is possible to heat preforms of various shapes, such as ovals, with different thickness distributions and even at low axial stretch ratios, such as in the case of containers with long necks.

[0042] The particular embodiments described herein do not restrict the scope of this application, which covers all the invention variants defined in the claims.

Claims

1. Heating device of preforms for the production of plastic objects comprising at least one induction means (2) suitable for inducing, on the passage of current therein, a magnetic flow on at least one heat transmission means (4), in order to transmit by irradiation a predetermined quantity of heat to at least one preform (10) inserted in the heating device, **characterised in that**
there are provided concentration means (3) of said magnetic flow having a ring shape surrounding partly said at least one induction means (2) and arranged around said at least one heat transmission means (4), the latter being constituted by a ring (4) of polygonal section arranged between the induction means (2) and the at least one preform (10).

2. Device according to claim 1, **characterised in that** support means (5) are provided for said ring (4).

3. Device according to claim 2, **characterised in that** said support means (5) comprise metal tabs (7).

4. Device according to claim 2, **characterised in that** said support means (5) comprise extremities (8) arranged in corresponding housings provided on the ring (4).

5. Device according to claim 2, **characterised in that** said support means (5) comprise at least one plate (5') in low thermal conductibility refractory material.

6. Device according to claim 5, **characterised in that** two or more plates (5') are provided with a complementary shape between them.

7. Device according to claim 2, **characterised in that** a gap (9) is provided between said at least one transmission means (4) and said concentration means (3).

8. Device according to claim 5, **characterised in that** a gap (9) is provided between said at least one transmission means (4) and said at least one plate (5').

9. Device according to any of the previous claims, **characterised in that** a base (1) and device centring supports (6) are provided, reciprocally joined by clamping means (11).

10. Device according to any of the previous claims, **characterised in that** there is provided an adjustable screen (13) arranged between the body of the at least one preform (10) and internal components of the device in such a way as to further improve the focalisation of the heating of the preform.

Patentansprüche

1. Heizvorrichtung von Vorformen für die Herstellung von Kunststoffobjekten umfassend
wenigstens ein Induktionsmittel (2), das bei einem Stromdurchfluss darin geeignet ist, einen Magnetfluss auf wenigstens einem Hitzeübertragungsmittel (4) zu induzieren, um eine vorgegebene Hitzemenge an wenigstens eine Vorform (10), die in die Heizvorrichtung eingeführt ist, durch Strahlung zu übertragen, **dadurch gekennzeichnet, dass**
Bündelungsmittel (3) des Magnetflusses vorgesehen sind, die eine Ringform aufweisen, die die wenigstens einen Induktionsmittel (2) teilweise umgeben und die um das wenigstens eine Hitzeübertragungsmittel (4) herum angeordnet sind, wobei das Letztere durch einen Ring (4) mit polygonalem Querschnitt gebildet ist, die zwischen dem Induktionsmittel (2) und der wenigstens einen Vorform (10) angeordnet sind.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** Lagermittel (5) für den Ring (4) vorgesehen sind.

3. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Lagermittel (5) Aufhänger (7) aus Metall umfasst.

4. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Lagermittel (5) Endglieder (8) umfassen, die in entsprechenden Gehäusen angeordnet sind, die an dem Ring (4) vorgesehen sind.

5. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Lagermittel (5) wenigsten eine Platte (5') aus feuerfestem Material mit geringer thermischen Leitfähigkeit umfassen.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** zwei oder mehrere Platten (5') mit einer komplementären Form zwischen ihnen vorgesehen sind.

7. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** ein Spalt (9) zwischen wenigstens einem Übertragungsmittel (4) und den Bündelungsmitteln (3) vorgesehen ist.

8. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** eine Lücke (9) zwischen dem wenigstens einen Übertragungsmittel (4) und der wenigstens einen Platte (5') vorgesehen ist.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Basis (1) und Vorrichtung-Zentrierlager (6) vorgesehen sind, die wechselseitig durch Klemmmittel (11) verbunden sind.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine einstellbare Blende (13) zwischen dem Körper der wenigstens einen Vorform (10) und internen Komponenten der Vorrichtung in solch einer Weise angeordnet ist, um die Fokussierung der Aufheizung der Vorform weiter zu verbessern.

Revendications

1. Dispositif de chauffage de préformes pour la production d'objets en plastique, comprenant :

   au moins un moyen d'induction (2) adapté pour induire, lors du passage de courant dans celui-ci, un flux magnétique sur au moins un moyen de transmission de chaleur (4), de manière à transmettre par rayonnement une quantité prédéterminée de chaleur à au moins une préforme (10) insérée dans le dispositif de chauffage, **caractérisé en ce que**
   des moyens de concentration (3) dudit flux magnétique sont fournis, avec une forme annulaire entourant partiellement ledit au moins un moyen d'induction (2) et agencés autour dudit au moins un moyen de transmission de chaleur (4), ce dernier étant constitué par un anneau (4) de section polygonale agencé entre le moyen d'induction (2) et l'au moins une préforme (10).

2. Dispositif selon la revendication 1, **caractérisé en ce que** des moyens de support (5) sont fournis pour ledit anneau (4).

3. Dispositif selon la revendication 2, **caractérisé en ce que** lesdits moyens de support (5) comprennent des languettes métalliques (7).

4. Dispositif selon la revendication 2, **caractérisé en ce que** lesdits moyens de support (5) comprennent des extrémités (8) agencées en correspondance de logements fournis sur l'anneau (4).

5. Dispositif selon la revendication 2, **caractérisé en ce que** lesdits moyens de support (5) comprennent au moins une plaque (5') en matériau réfractaire à basse conductibilité thermique.

6. Dispositif selon la revendication 5, **caractérisé en ce qu'**au moins deux plaques (5') sont prévues avec un profil complémentaire entre elles.

7. Dispositif selon la revendication 2, **caractérisé en ce qu'**un espace intermédiaire (9) est prévu entre ledit au moins un moyen de transmission (4) et lesdits moyens de concentration (3).

8. Dispositif selon la revendication 5, **caractérisé en ce qu'**un espace intermédiaire (9) est prévu entre ledit au moins un moyen de transmission (4) et ladite au moins une plaque (5').

9. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**une base (1) et des supports de centrage de dispositif (6) sont fournis, assemblés réciproquement par des moyens de serrage (11).

10. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il est prévu un écran réglable (13) agencé entre le corps de l'au moins une préforme (10) et des composants internes du dispositif de manière à améliorer ultérieurement la focalisation du chauffage de la préforme.

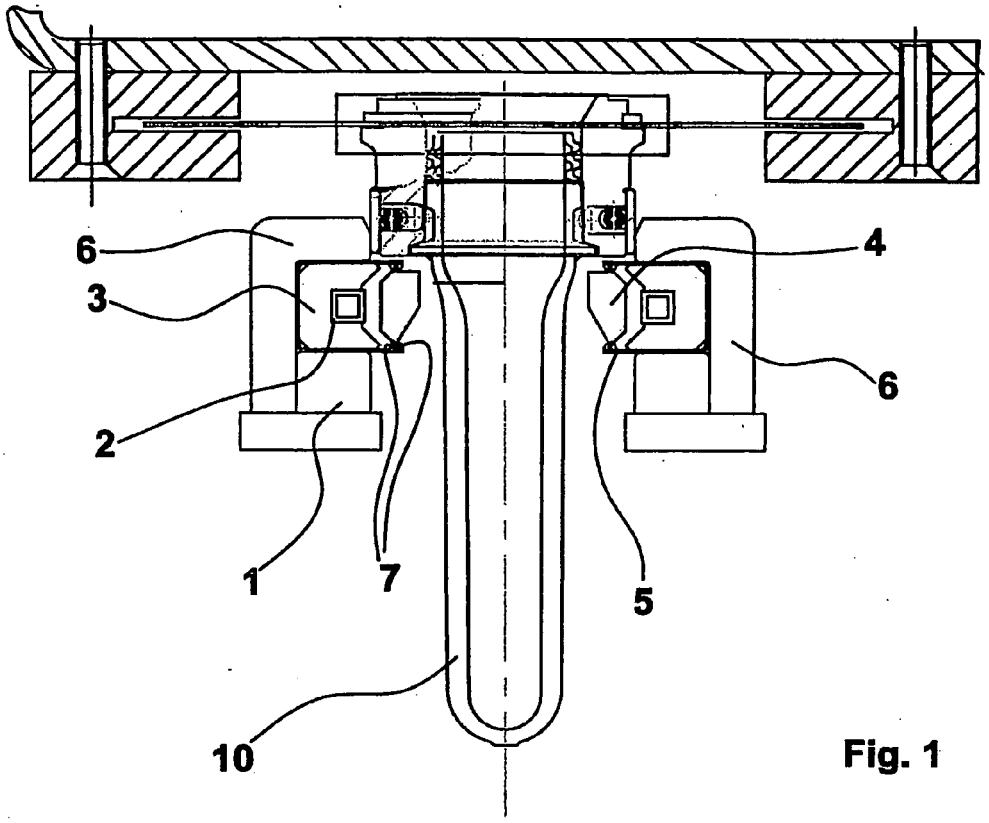

Fig. 1

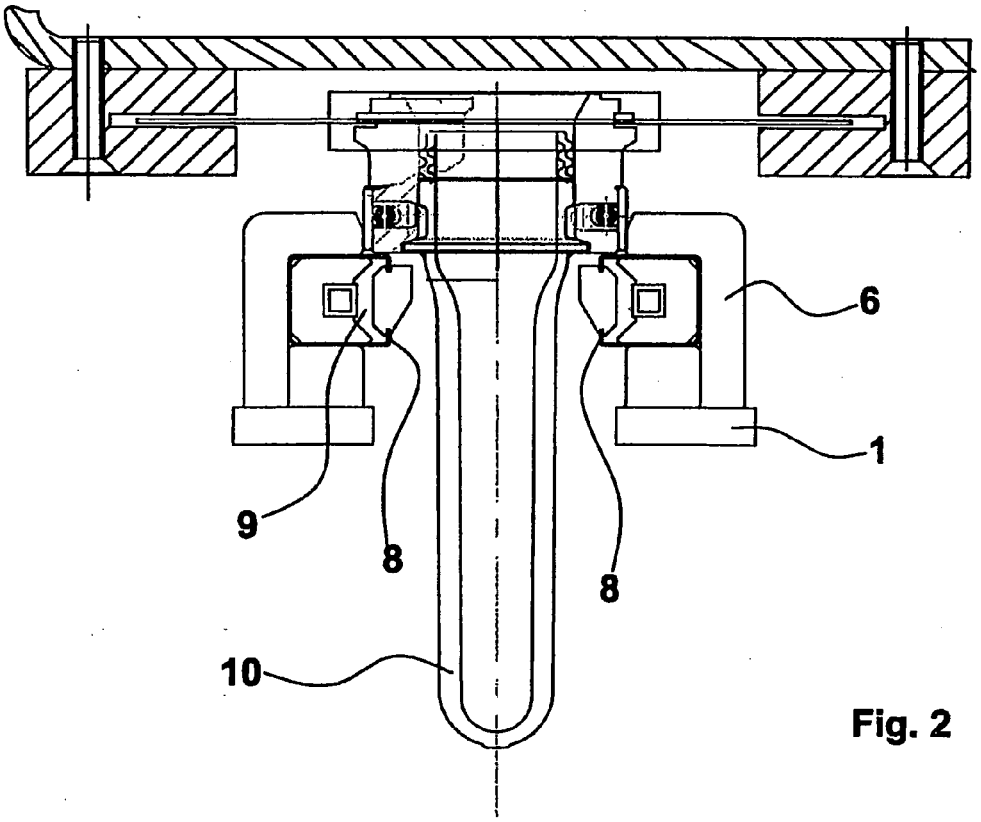

Fig. 2

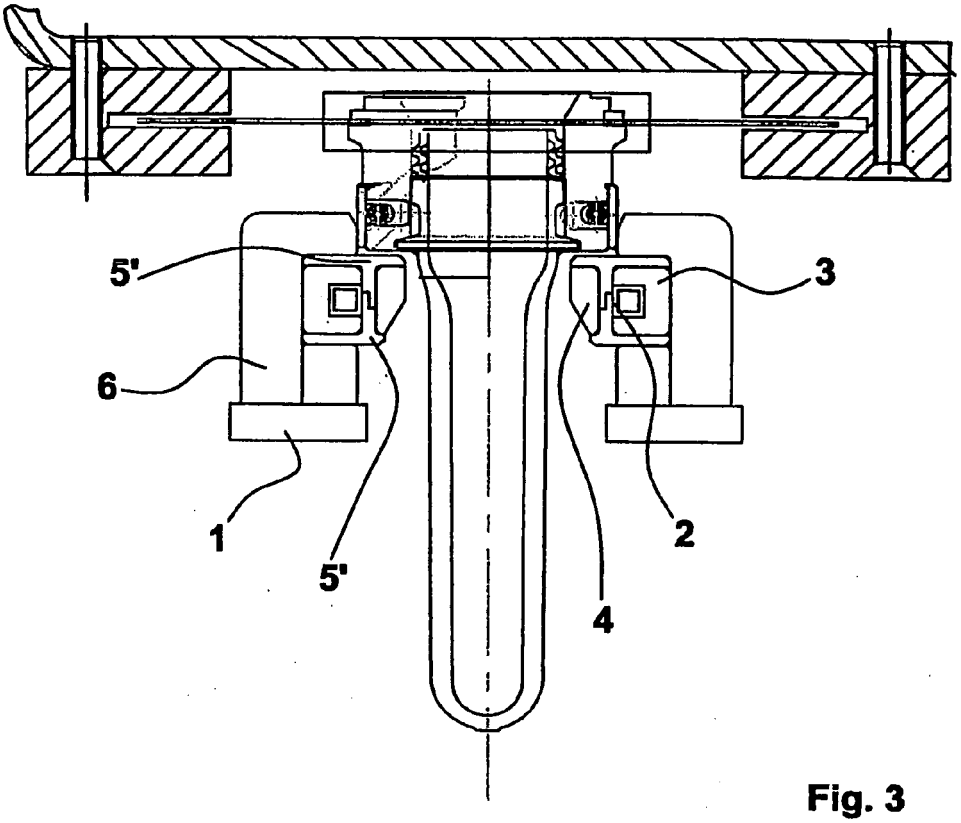

Fig. 3

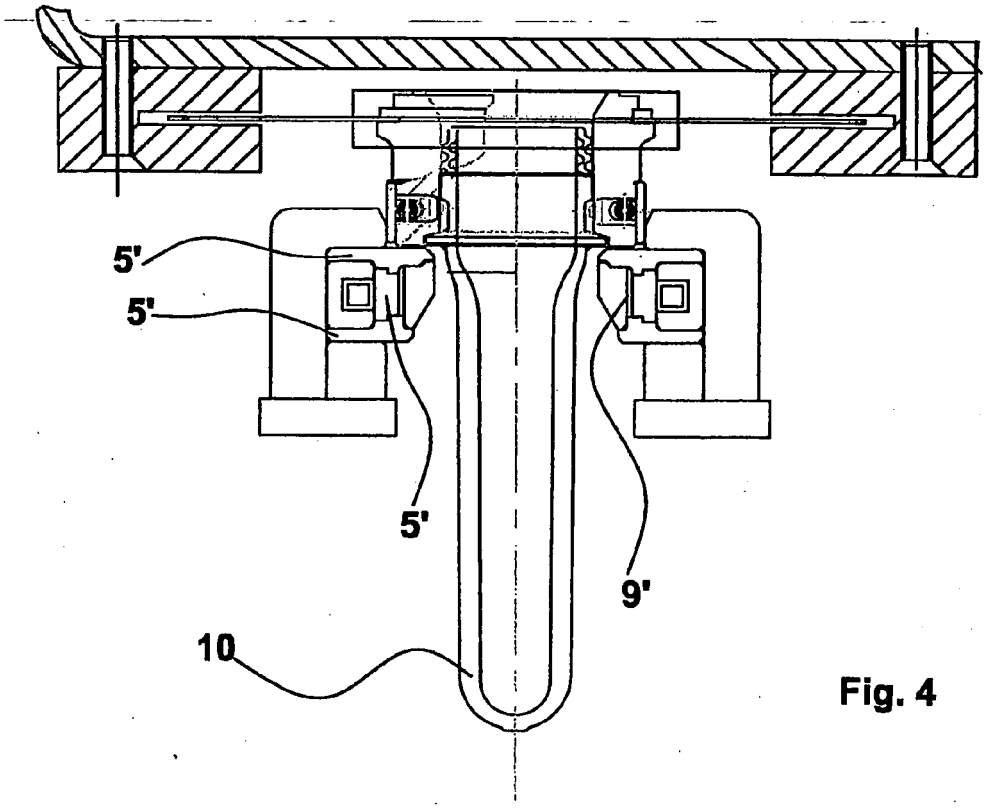

Fig. 4

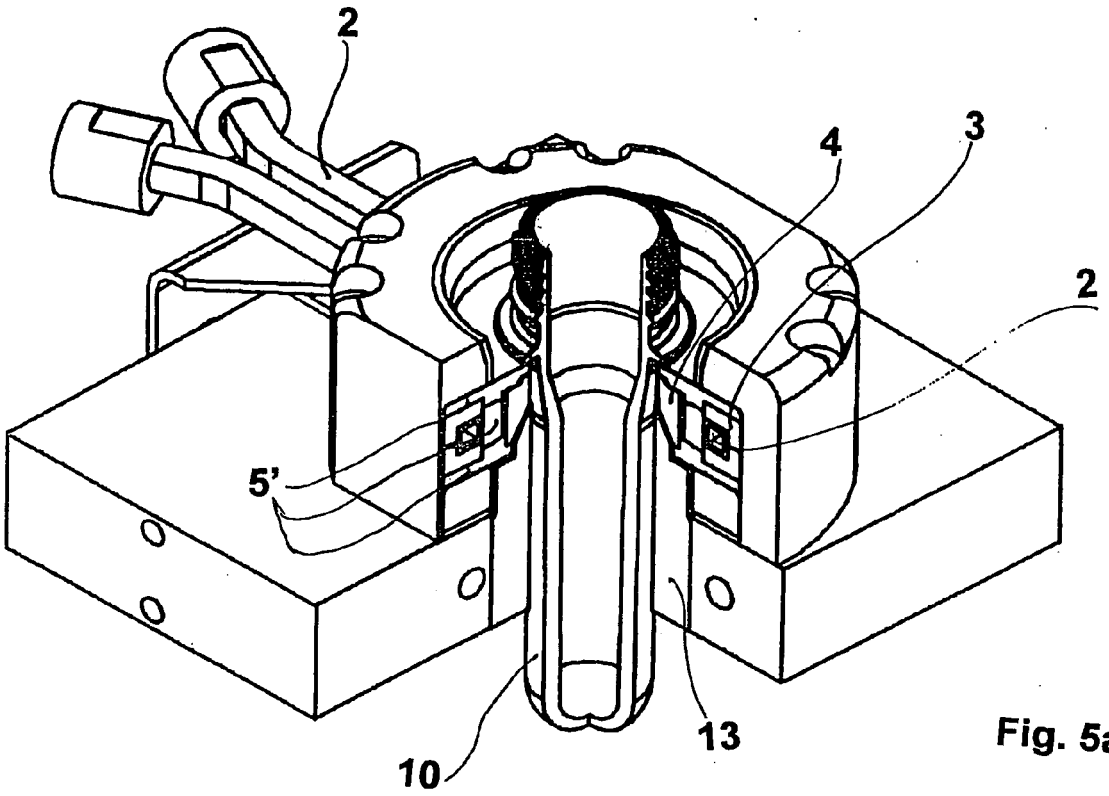

Fig. 5a

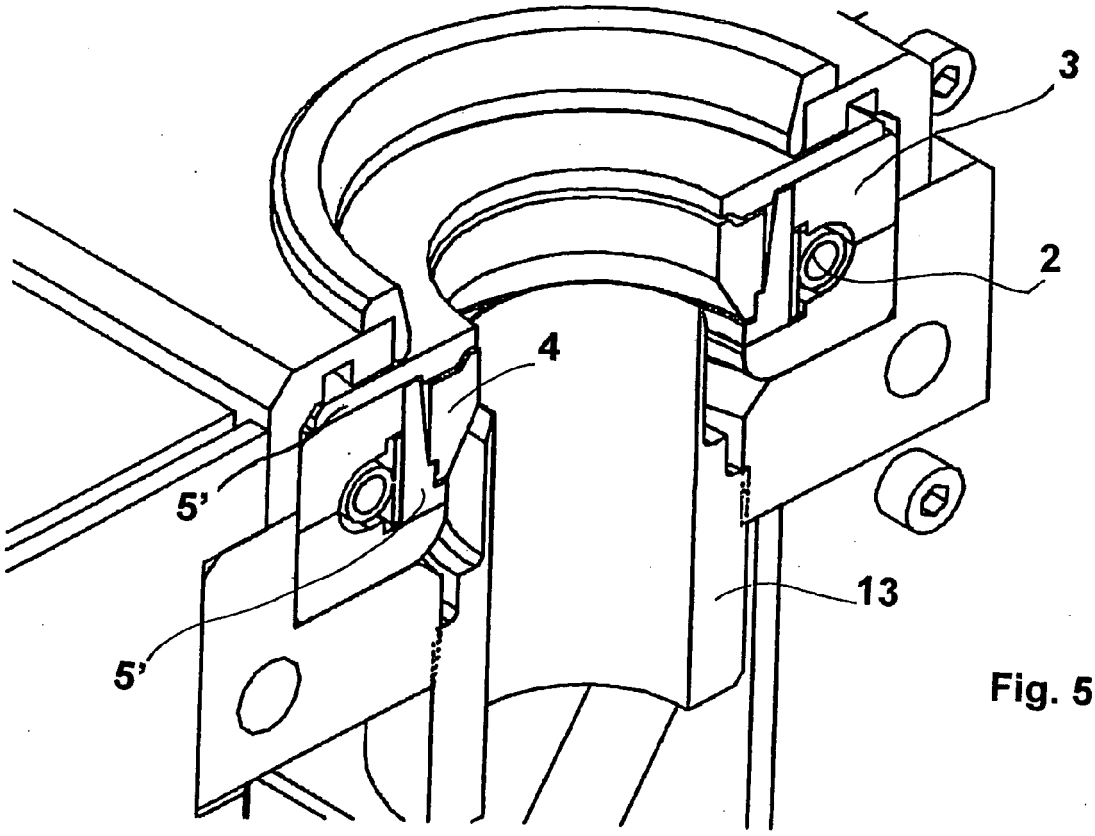

Fig. 5b

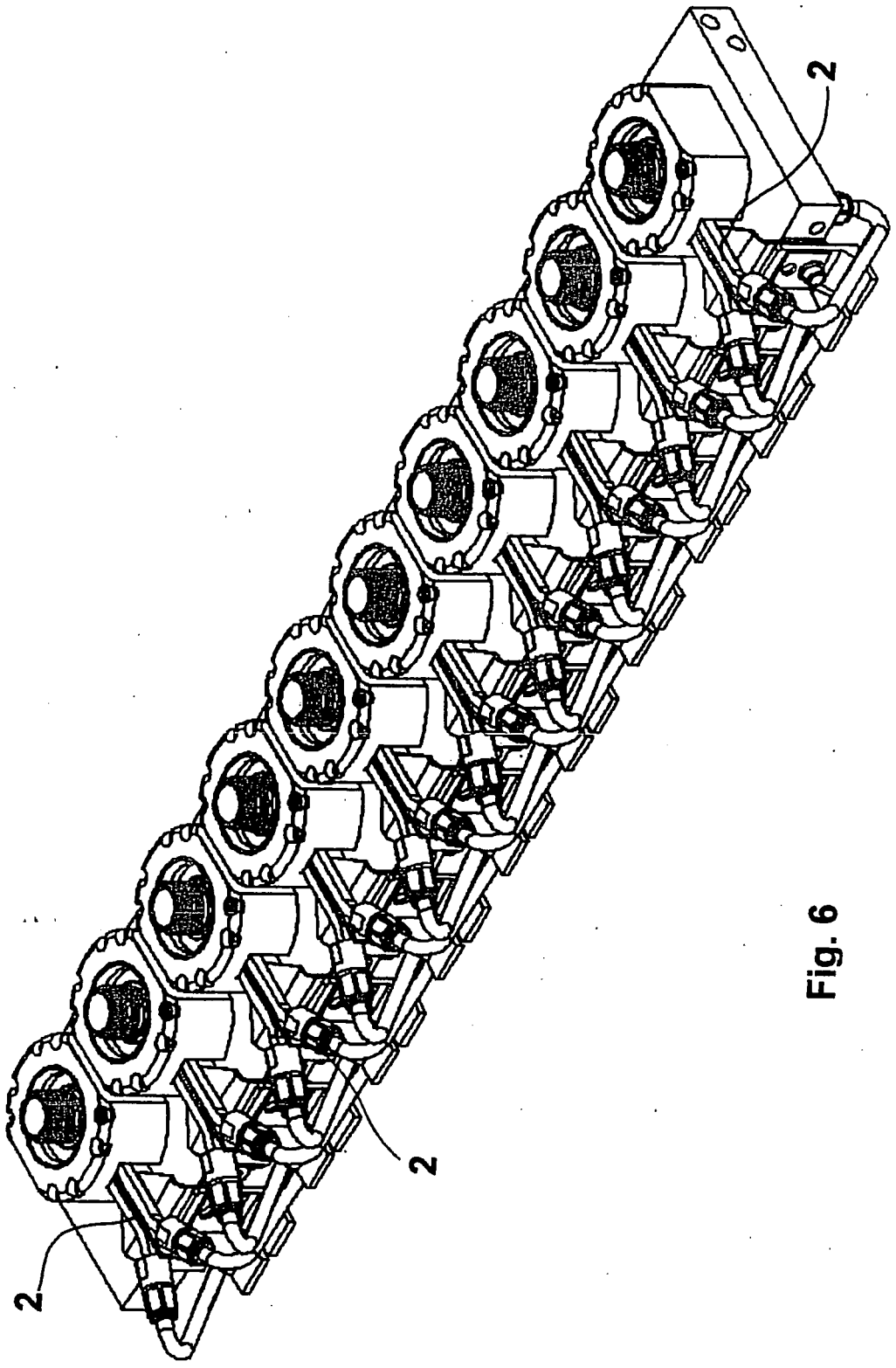

Fig. 6

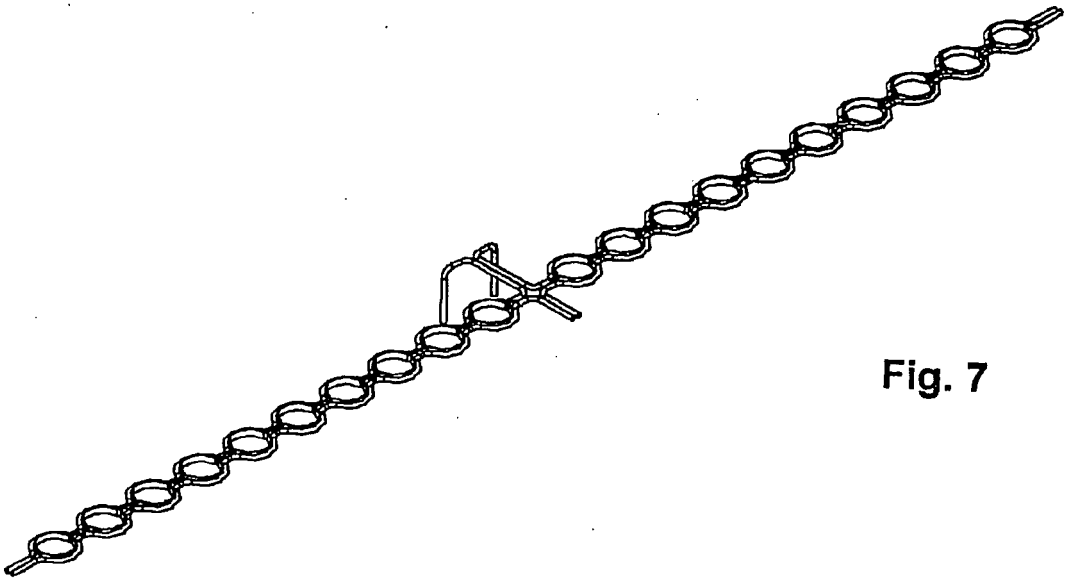

Fig. 7

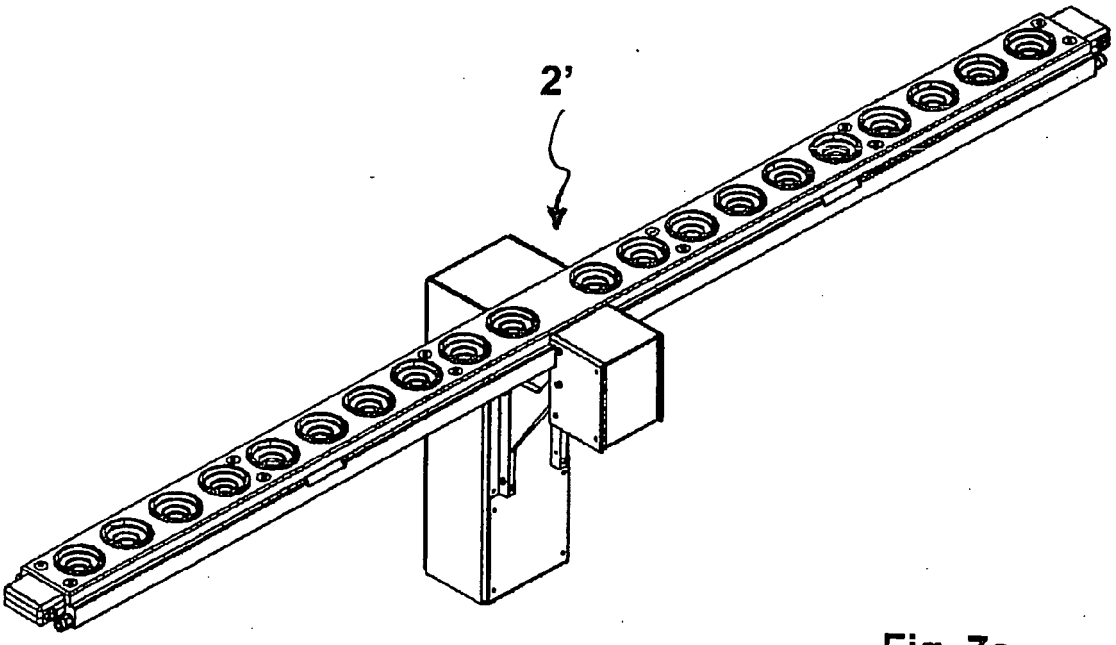

Fig. 7a

REFERENCES CITED IN THE DESCRIPTION

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- EP 0849067 A **[0006]**