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(54) **A spacer for forming a spacing between glass panes and a method for manufacturing such a spacer**

(57) A spacer (1) for forming a spacing between glass panes (41, 42) is basically formed by a plastic part (10) and a metal foil (30). The plastic part (10) has an inner wall part (11) and two lateral legs (12a, 12b) extending away from said wall part (11). The metal foil has an outer wall part (31) and two lateral (32a, 32b) which extends away from said wall part (31). An outer surface (19a, 19b) of said legs (12a, 12b) is at least partially covered by the side walls (32a, 32b) of the metal foil (30).

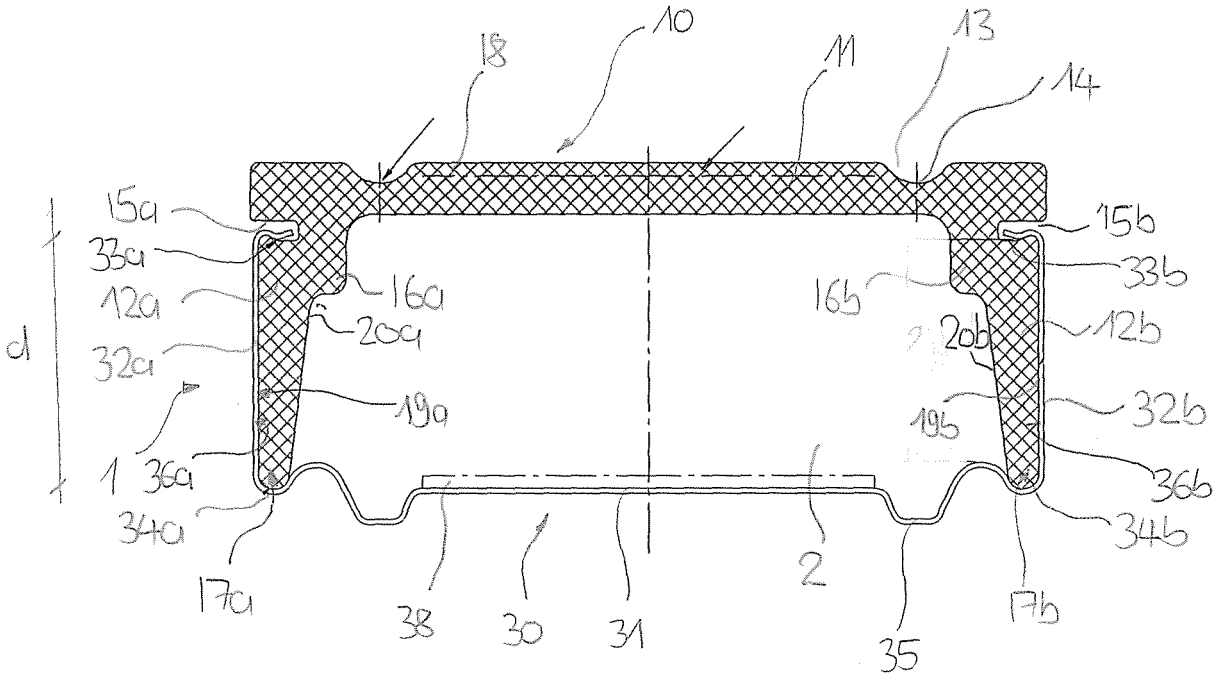

FIG. 1

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Description

[0001] The invention relates to a spacer for forming a spacing between glass panes and a method for producing such a spacer in accordance with the preamble of the independent patent claims.

[0002] It is well known to provide spacers in order to define the spacing between the panes of isolating glazings consisting of a plurality of parallel glass panes spaced by an isolating cavity.

[0003] A plurality of such spacers made of different materials and of different shapes are known in the art. Spacers made by roll forming of a metal foil are widely used in the art and considered to be one of the preferred alternatives because of their stability and their low gas diffusion properties.

[0004] Insulating Glass Units (IG units) having a plurality of glass panes are made by automatic manufacturing machines. Spacers are automatically bent to the desired size and shape and are arranged between two neighbouring glass panes. Spacers made of metal foils can be easily bent and will remain in the bent position.

[0005] Furthermore, spacers made of metal foils have a high resistance against diffusion of gases and moisture penetration. Within the space between the neighbouring glass panes, there is arranged a gas, for instance argon having good isolating properties. In order to avoid any loss of gas, the spacers delimiting the cavity need to be resistant against diffusion of such gaseous elements.

[0006] However, known spacers which are exclusively made of metal such as aluminium and galvanized steel have also some disadvantages. Due to a relatively high heat conductivity of metal, spacers made of a metal foil still have a heat conductivity which under certain circumstances may be too high.

[0007] In order to further reduce the heat conductivity, it has been suggested to use plastic material for forming such spacers. Plastic material has, however, relatively high gas diffusion as compared to metal. It thus has been suggested to provide a metal foil over a plastic body. Such a spacer is e.g. shown in EP 852 280.

[0008] A further problem of spacers made of plastic material is their instability during the manufacturing process. In particular, a spacer bent to the desired frame shape may be slightly deformed during assembly because of the resiliency of plastic material. Misalignments of the spacer during manufacturing thus are possible. In order to avoid this problem, it has been suggested to use glass fibre reinforced plastic material in EP 852 280. Furthermore, plastics spacers including stabilising material in a plastic body have been proposed e.g. in WO 99/15753 or in WO 99/41481. However, these solutions have also some disadvantages. In particular, manufacturing is relatively complicated.

[0009] Similar spacers made from a body of plastic material are further known from DE 9 214 799, EP 1 022 424, EP 947 659 A2, EP 1 233 136 A1, WO 99/42693 or WO 03/074830. In US 5 630 306 there is disclosed an insulating spacer which comprises a main body formed of a plastic material. Metallic leg members are attached to the plastic main body. While the problem of heat conduction and diffusion can be addressed with such spacer, some problems remain in context with bending the spacer into the desired frame shape and later during assembly of an IG Unit. In particular, the lateral legs may be deformed during bending out of their plane so that an irregular shape may result. Such an irregular shape is particularly disadvantageous if a sealing contact between the spacer and a glass pane shall be achieved.

[0010] It is therefore an object of the present invention to provide a spacer and a method for producing such a spacer which has a high resistance with respect to diffusion of gases and moisture penetration which can be easily bent and which has, when bent into a frame, sufficient stability and a well defined form. Furthermore, the heat conductivity shall be reduced as compared to known spacers made of a metal foil. Furthermore, the spacer shall be easy to manufacture without the need of a complicated manufacturing process.

[0011] These and other objects are solved with a spacer and with a manufacturing process for such a spacer having the features of the characterizing portions of the independent patent claims.

[0012] The spacer of the present invention is used for forming a spacing between glass panes. It is typically used for insulating units having a plurality of, typically two or three, glass panes including an isolating space there between which is defined by the spacer.

[0013] The spacer comprises a top part which is made of a plastic material and a lower part made of a metal foil. The plastic part has an inner wall part. This inner wall part is used to form an inner wall delimiting the spacing between the glass panes. The plastic part is provided with two lateral legs extending away from the inner wall part.

[0014] The metal foil comprises an outer wall part. This outer wall part is forming an outer wall of the spacer delimiting the spacing between the glass panes.

[0015] The metal foil is furthermore provided with two lateral side walls. The side walls extend away from the outer wall part of the foil. In accordance with the present invention, the outer surface of the legs of the plastic part is at least partially covered by the side walls of the metal foil. The metal foil of the spacer of the present invention forms the outer wall. It is not simply used as a diffusion barrier foil arranged over a wall of a plastic body as shown e.g. in EP 852 280. The outer wall of the spacer is defined by the metal foil. It is free from any plastic part.

[0016] By the arrangement of the side walls of the metal foil over at least a part of the surface of the legs, a better stability of a frame formed by such spacer and a more clearly defined contact surface for the glass panes may be formed. In particularly, because the metal side walls are supported by the legs of the plastic part, folding of the side walls into a pleated shape can be avoided.

[0017] In a preferred embodiment of the invention, the

legs of the plastic part have rounded outer edges. A transition area between the outer wall part of the metal foil and the side walls is shaped such as to conform to the rounded edge of the legs. Thereby, a clearly defined position of this transition area can be provided. In particular, it is preferred to bend the foil over an angle of more than 90 degrees around the rounded edge of the legs in the transition area. This ensures a very good stability of the metal foil.

[0018] Preferably, the side walls of the metal foil extend over at least 50% of the width of the legs in the direction towards the inner wall part of the plastic part. Preferably, the width of the side wall is selected such that it forms a contact surface for a primary seal when the spacer is mounted between two glass panes. Such a design has several advantages. The metal foil forms a much better adhesive ground for a seal than the plastic part. No pretreatment of the plastic part is thus necessary for application of such a seal. If the side walls of the metallic foil do not extend further towards the inner wall part than the seal, they are covered by the seal and will not be visible when the spacer has been arranged within an IG unit. By adequate selection of the colour of the plastic part, a desired colour of the visible parts of the spacer can be selected. It is not necessary to apply any cover to the metal layer because the metal layer is fully covered by the primary seal.

[0019] According to a further preferred embodiment, the plastic part of the spacer has at least one engagement surface, preferably in each side. The engagement surface is preferably formed by a recess formed in the plastic legs. The side walls of the metal foil are provided with an engagement element. This element is preferably a tongue arranged at the end of the side walls. This engagement element is engage able with the engagement surface of the plastic part. The engagement surface and the engagement element allow for a particularly easy assembly of the two parts. The two parts can be simply snapped together. The position of the side walls arranged over the outer surface of the legs is well defined by a good contact of the walls on the engagement surface on the one hand and on the rounded edge of the leg on the other hand.

[0020] While such assembly is particularly easy, other ways of assembly are conceivable. In particular, it is also possible to connect a plastic part and a metallic foil to each other during extrusion of the plastic part.

[0021] Also, alternative embodiments of engagement between the metal foil and the plastic part are conceivable. In particular, instead of a recess, the engagement surface on the plastic part could be formed by the surface of the inner wall of the plastic part.

[0022] In case of a recess formed in the legs of the plastic part, a reinforcing bead can be preferably arranged on an inner side of the plastic part at a location adjacent to the recess.

[0023] According to a further embodiment of the invention, the outer wall of the foil and the inner wall of the plastic part may be provided with depressions and projections. These depressions and projections are arranged in such a way that if a plurality of spacers are stacked, depressions and projections of neighbouring spacers fit when placed on top of each other. This allows for a particularly stable stacking of spacers. This is preferable during transport and when such spacers are used in an automated manufacturing line.

[0024] According to still a further preferred embodiment of the invention, the side walls of the metal foil are attached to the legs of the plastic part by means of an adhesive. In this case, the engageable mechanical connection between the plastic part and the metal foil is used for initial assembly until the adhesive has been completely cured. The adhesive prevents unintended disassembly of the parts e.g. because of differences in heat expansion between the two parts.

[0025] In the method of manufacturing a spacer in accordance with the invention, in a first step an elongated part made of a plastic material is provided. Preferably, the plastic part is an extruded part. The plastic part has legs which extend away from an inner wall part designed to form an inner wall delimeting a spacing between two glass panes.

[0026] A metal foil forming an outer wall of the spacer is also provided.

[0027] In an assembly step, the metal foil and the plastic part are attached to each other in such a way that the legs of the plastic part are at least partially covered by the metal foil.

[0028] In accordance with a preferred embodiment of the method according to the invention, the metal foil is initially provided as a substantially flat foil. A substantially flat foil in accordance with the invention means a foil were the foil is initially arranged in substantially one plane. However, certain deformations such as for forming tongues or projections as described herein above still may be present.

[0029] The substantially flat foil is rolled around an edge of the plastic legs in such a way that the inner surface of the foil contacts an outer surface of the legs after the rolling process.

[0030] Preferably, an engagement element, preferably a tongue of the side wall of the metal foil is engaged with an engagement surface, preferably a recess of the plastic part at the end of the bending process so as to fix the metal foil on the plastic part.

[0031] Optionally, an adhesive may be applied between an inner surface of the metal foil and an outer surface of the legs of the plastic part for further stability.

[0032] The plastic part may be provided by any known method, e.g. by extrusion.

[0033] In accordance with a preferred aspect of the invention, the plastic part is, however, made from a originally substantially flat sheet of plastic material. This sheet is subsequently shaped into the desired, extended form of a profile for forming a spacer. In particular, shaping can be made by thermoforming processes known for

manufacturing plastic objects, preferably in combination with rollforming methods known to those skilled in the art in context with shaping of metal foils. While such a method is particularly advantageous in context with spacers as described hereinabove, it can also be used for manufacturing a plastic part for any type of spacer.

[0034] The invention will now be explained in more detail with reference to a preferred embodiment and the accompanying drawings, which show:

Figure 1	a cross section through a spacer in accordance with the present invention
Figure 2a	a cross sectional view through two spacers according to the present invention, stacked over each other.
Figure 2b	an enlarged view of an engagement between neighbouring spacers as shown in figure 2a
Figure 3a/b	a schematic representation of a manufacturing process of a spacer in accordance with the present invention,
Figure 4	a spacer according to the present invention arranged between two glass panes and
Figures 5a to 5d	a schematic representation of an alternative manufacturing process.

[0035] Figure 1 shows a spacer 1. The spacer 1 basically consists of a part 10 and a metal foil 30 attached to the part10. The part 10 is formed from a plastic material. Various UV light stable plastic materials such as PCV, PC, PP, PA or PE(I)forming a good ground for adhesives or sealant materials can be used. The metal foil 30 is typically made from stainless steel and has a thickness of 0.05mm to 0.2mm. Other types of metal foils in thicknesses up to 0.4 mm may be used.

[0036] Within the spacer, there is formed a cavity 2. The cavity 2 is used for holding a desiccant material (not shown) when assembled in an IG unit.

[0037] The plastic part 10 of the spacer 1 is formed as a rectangular, substantially U-shaped profile. It has an inner wall part 11. The inner wall part 11 is used for forming an inner wall delimiting a spacing between two glass panes when the spacer is assembled into an IG unit. At the ends of the inner wall part 11, there are arranged two legs 12a, 12b extending away from the inner wall part. In the legs 12a, 12b, recesses 15a, 15b are formed. On an inner side 20a, 20b of the legs 12a, 12b there are formed reinforcing beads 16a, 16b. The reinforcing beads 16a, 16b are arranged close to the recess 15a, 15b so as to reinforce the plastic part 10 in the area of the recesses 15a, 15b.

[0038] The legs 12a, 12b have an outer edge 17a, 17b. The outer edge 17a, 17b has a rounded shape. The spacer 1 is shown only in cross section. The part 10 is preferably an extruded plastic part which has the same cross section along its entire length.

[0039] The metal foil 30 has an outer wall forming part 31 (corrugated shape). The outer wall forming part 31 forms an outer wall of the spacer when the spacer delimits a spacing between two glass panes. The metal foil 30 is provided with two side walls 32a, 32b extending from the outer wall forming part 31. The side walls 32a, 32b have tongues 33a, 33b arranged at their ends. The tongues 33a, 33b snap into the recesses 15a, 15b of the plastic part and therefore fix the metal foil 30 to the plastic part 10.

[0040] The recesses may be provided with a nose behind which the tongues may engage.

[0041] In a transition area 34a, 34b between the outer wall forming part 31 and the side walls 32a, 32b, the metal foil 30 is bent around the rounded edges 17a, 17b of the plastic part in such a way that it conforms to the outer shape of the rounded edge and is in tight contact therewith. The side walls 32a, 32b are contacting an outer surface 19a, 19b of the legs 12a, 12b of the plastic part 10 with their inner surface 36a, 36b. Because of this contact, a tight and well defined position of the metal foil 30 on the plastic part 10 can be ensured. This stability is further improved by the precise definition of contact points delimiting the side walls 32a, 32b. First contact points are formed by the transition area 34a, 34b which is bent around the outer edge 17a, 17b of the legs 12a, 12b. A second contact point is formed by the tongues 33a, 33b snapping into the recesses 15a, 15b.

[0042] The recesses 15a, 15b are arranged in such a way that the width d of the legs 32a, 32b in a direction towards the inner wall part 11 of the plastic part 10 is corresponding to the width of a sealing material (see figure 4).

[0043] The plastic part 10 is furthermore provided with depressions 13 arranged on a surface directed towards the spacing between two window panes. The metal foil is formed with projections 35 projecting outwardly from the outer wall forming part 31. The projections 35 of the metal foil 39 and the depressions 14 of the plastic part 10 are arranged and shaped in such a way that they are engageable with projections and depressions of a neighbouring spacer if such spacers are stacked. Figure 2a shows two spacers 1 forming a stack. Figure 2b shows in an enlarged view a projection 35 of the upper spacer which engages with the depression 13 of the lower spacer. Thereby, a stable stack can be formed.

[0044] In addition, perforations 14 may be arranged in the area of the depressions 13 of the plastic part 10. If a desiccant material is arranged within the cavity 2, humidity present in the spacing between the glass panes may pass through the perforations 14 and may be trapped by the desiccant.

[0045] In order to further enhance the stability, optionally, the spacer can be provided with corrugations 18 on the plastic part 10 and with corrugations 38 on the metal foil 30.

[0046] Figure 3a and 3b schematically show the manufacturing process of a spacer 1 in accordance with the present invention. The same reference numerals as in figure 1 designate the same elements. In a first step (see figure 3a) a separate plastic part 10 is provided as an already finish shaped extruded part before a separate metal foil 30 is provided. In an alternative embodiment, the plastic part can be provided originally as a rectangular plastic sheet. This sheet is subsequently thermal formed into the complex required shape. Thermal forming includes thermoforming and rollforming.

[0047] In an initial position I the metal foil 30 is a substantially flat rectangular sheet. It is first provided with the tongues 33a, 33b and with the depressions 35 close to an intermediate part 37a, 37b.

[0048] In preparation of assembly of the plastic part 10 and the metal foil 30, the metal foil 30 is rolled into an intermediate position. In a first step, the curved portion at the intermediate area 34a, 34b subsequently separating the wall 31 from the side walls 32a, 32b is formed. Furthermore, the depressions 35 as well as the intermediate part 37a, 37b between the depressions 35 and the transition area 34a, 34b is formed. This position is indicated as I' in figure 3a.

[0049] Subsequently, the side walls 32a, 32b are rolled thereby achieving a plurality of temporary positions T shown in figure 3a. For assembly of the plastic part 10 and the metal foil 30, the plastic part 10 is placed with its rounded edges 17a, 17b in the transition area 34a, 34b. The plastic part 10 can thus be put in contact with the metal foil 30 when the side walls 32a, 32b have achieved the last temporary position T' which is also shown in figure 3b.

[0050] In a final assembly step, an adhesive material 3 is placed between the outer surface 19a, 19b of the legs 12a, 12b of the plastic part (see figure 3b) and the inner surface 36a, 36b of the side walls 32a, 32b of the foil. In a final step, the side walls 32a, 32b are rolled such as to snap with their tongues 33a, 33b into the recesses 15a, 15b. This snapping function immobilises the metal foil 30 on the plastic part 10 until the adhesive 3 has been completely dried or cured.

[0051] In order to improve this snapping function, the recess 15a, 15b can be provided with a projection behind which the tongues 33a, 33b will snap.

[0052] Figure 4 shows the spacer 1 shown in figure 1 mounted between two neighbouring glass panes 41, 42. A cavity or spacing 47 is formed between the glass panes 41, 42. A desiccant 46 arranged in the spacer 1 is used for collection of humidity passing through perforations 14 from the spacing 47 to the cavity 2 delimited by the spacer 1. A primary seal 43 and 44 is arranged between the side walls 32a, 32b and the glass panes 41, 42. The primary seal 43, 44 is typically made of a butyle composition. It completely covers the side walls 32a, 32b such that the surface of the side walls 32a, 32b cannot be seen through the glass panes 41, 42. One advantage of the recess is, that the position of the recess and thus the length of the side wall 32a, 32b can be freely chosen, in particular also independence of the required length of the primary seal.

[0053] Figures 5a to 5d show schematically an alternative manufacturing process for the plastic part 10 of the spacer. Originally (see figure 5a) a plastic material is provided as a substantially flat sheet 50. The flat sheet is then placed (see figure 5b) into an oven where it is heated to a temperature where it is thermoplastic and can be formed into a desired shape.

[0054] By tooling such as a matrix or rollers (see figure 5c) the plastic sheet 50 is formed into the desired shape of the plastic part 10. After forming of the plastic part 10, the mould parts such as matrixes and rollers are removed and the plastic part 10 is allowed to cool. Once the original temperature is achieved, the plastic part will assume sufficient stability.

[0055] In addition, a secondary seal 45 e.g. made by silicon, polyurethane or a polysulfide may be formed.

[0056] The spacer in accordance with the present invention may be further provided with additional elements known to those skilled in the art.

[0057] In particular, the plastic material could be provided with a reinforcing element, in particular metallic elements or a glass fibre. Preferably, these elements may be arranged in a neutral area which will neither be stretched nor contracted during bending of the spacer. Furthermore, it is also possible to use a plastic part which is extruded of a suitable material or which is made by coextrusion of different plastic materials, e.g. a PVC part covered by a polyamide surface which will increase the adhesive properties of the plastic part.

Claims

1. A spacer (1) for forming a spacing between glass panes (41, 42), with a part (10) made of a plastic material and
with a metal foil (30),
wherein said part (10) has an inner wall part (11) and two lateral legs (12a, 12b) extending away from said wall part (11),
and wherein said metal foil (30) has an outer wall part (31) and two lateral side walls (32a, 32b) extending from said wall part (31),
characterized in that an outer surface (19a, 19b) of said legs (12a, 12b) is at least partially covered by the side walls (32a, 32b) of said foil (30).

2. A spacer according to claim 1, wherein the legs (12a, 12b) have a rounded outer edge (17a, 17b) and
wherein a transition area (34a, 34b) between said outer wall (31) and said side walls (32a, 32b) of said foil (30) is shaped such as to conform to the rounded

edge (17a, 17b) of said legs (12a, 12b).

3. A spacer according to one of the claims 1 or 2, wherein the foil (30) is bent over an angle of more than 90° in said transition area (34a, 34b).

4. A spacer according to one of the claims 1 to 3, wherein the side walls (32a, 32b) extend over at least 50% of the width (d) of said legs (12a, 12b) in a direction towards said inner wall part (11), and preferably extend towards said inner wall part (11) over a distance (d) such that it forms a contact surface for a primary seal (43, 44) when that spacer (1) is mounted between two glass panes (41, 42).

5. A spacer according to one of the claims 1 to 4, wherein said part (10) has at least one engagement surface, preferably a recess (15a, 15b) formed in said leg (12a, 12b) and
wherein said side walls (32a, 32b) of said foil (30) are provided with an engagement element, preferably with a tongue (33a, 33b) engagable with the engagement surface of said part (10).

6. A spacer according to claim 5, wherein said part (10) has a reinforcing bead (16a, 16b) arranged on an inner side (20a, 20b) of said part (10) adjacent to said recess (15a, 15b).

7. A spacer according to one of the claims 1 to 6, wherein the outer wall part (31) of said foil (30) and the inner wall part (11) of said part (10) are provided with depressions (13) and projections (35) arranged in such a way that when a plurality of spacers (1) are arranged in a stack, the depressions (13) and projections (35) of neighbouring spacers (1) are engagable with each other.

8. A spacer according to one of the claims 1 to 7, wherein the side walls (32a, 32b) of said foil (30) are attached to said legs (12a, 12b) additionally by means of an adhesive (3).

9. A method of producing a spacer (1) for forming a spacing (47) between glass panes (41, 42), in particular for a spacer according to one of the claims 1 to 8, comprising the steps of:

- Providing an elongated part (10) made of a plastic material, preferably an extruded part (10), having legs (12a, 12b) extending from an inner wall part (11),
- Providing a metal foil (30) for forming an outer wall (31) of said spacer (1)
- Attaching said metal foil (30) and said part (10) to each other in such a way the legs (12a, 12b) of said part (10) are at least partially covered by side walls (32a, 32b) of said metal foil (30)

10. A method according to claim 9, wherein the metal foil (30) is provided initially as a substantially flat foil (30) and wherein the foil is rolled around an edge (17a, 17b) of said legs (12a, 12b) in such a way that an inner surface (36a, 36b) of said side walls (32a, 32b) contacts an outer surface (19a, 19b) of said legs (12a, 12b).

11. A method according to claim 10, wherein an engagement element, preferably a tongue (33a, 33b) of said side wall (32a, 32b) is engaged with an engagement surface, preferably in a recess (15a, 15b), formed in said part (10).

12. A method according to one of the claims 10 or 11, wherein an adhesive (3) is applied between an inner surface (36a, 36b) of a metal foil (30) and an outer surface (19a, 19b) of said legs (12a, 12b) of said plastic part (10).

13. A method of producing a spacer (1) for forming a spacing (47) between glass panes (41, 42,), in particular according to one of the claims 9 to 12, wherein the spacer comprises at least one plastic part, the method comprising the steps of

- providing a substantially flat sheet of plastic part material
- shaping the sheet of plastic material into an extended shape forming a profile.

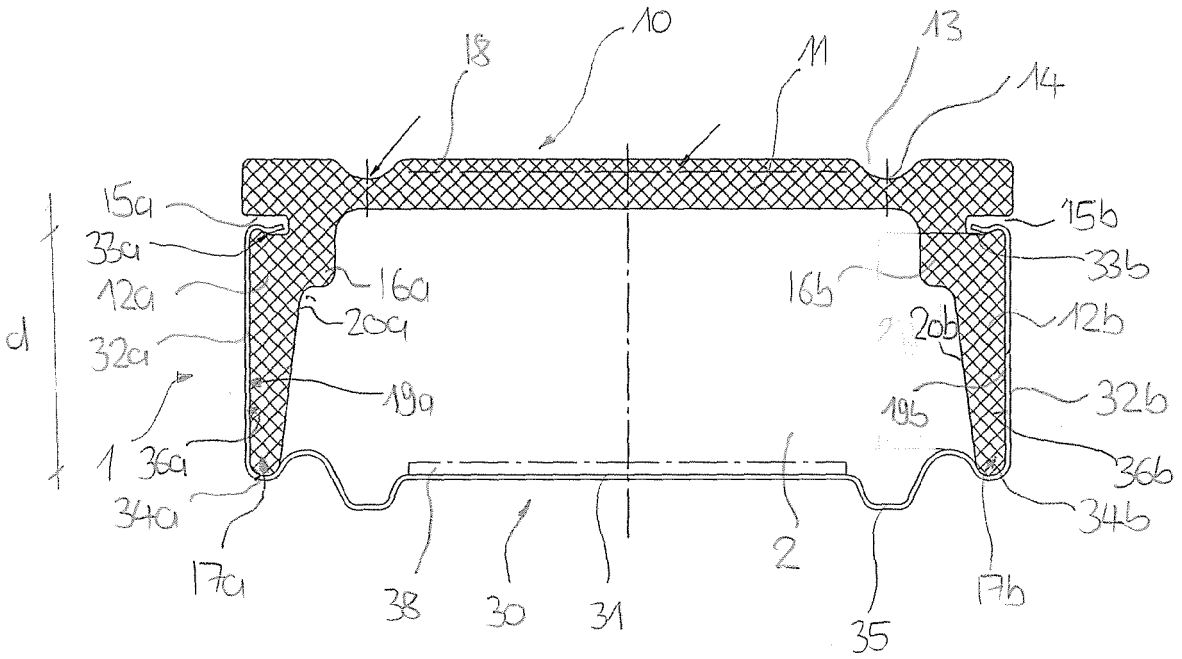

FIG. 1

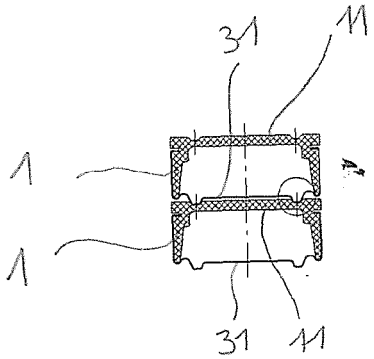

FIG. 2a

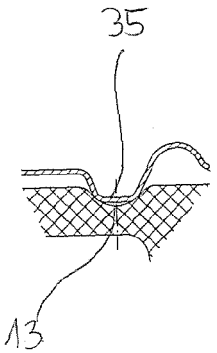

FIG. 2b

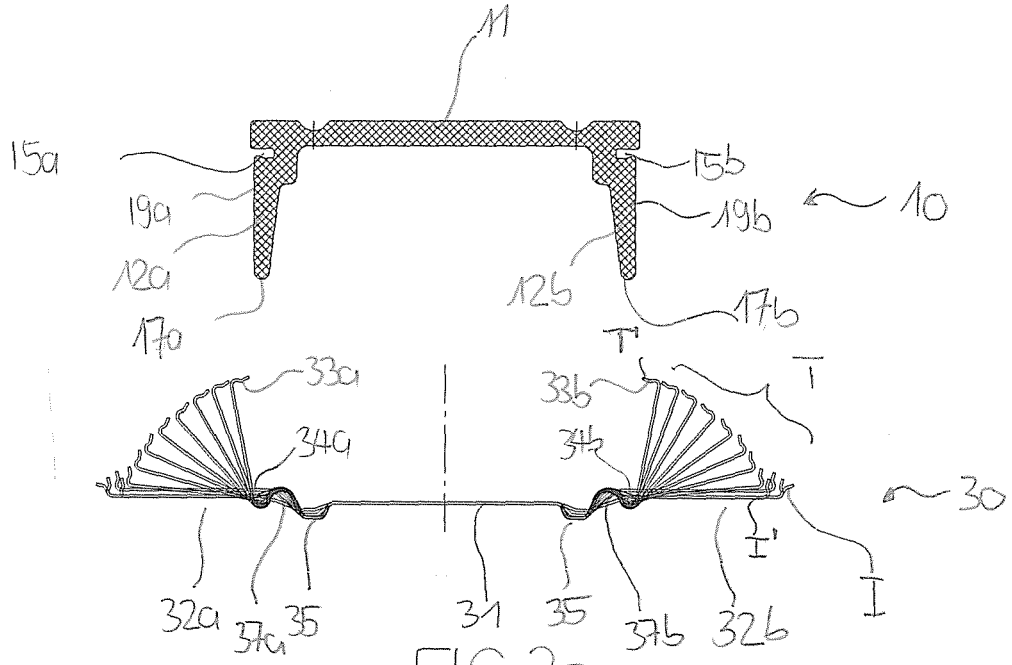
11
15a
15b
19a
19b
10
12a
12b
17a
17b
T'
T
33a
33b
34a
34b
30
I'
I
32a
37a
35
31
35
37b
32b

FIG. 3a

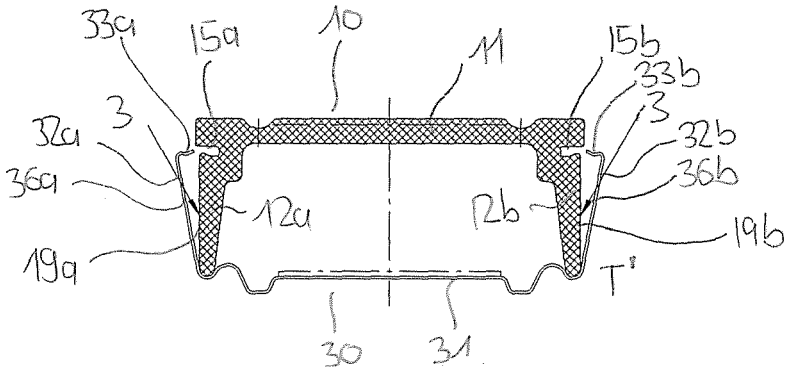
33a
15a
10
11
15b
33b
3
3
32a
32b
36a
36b
12a
12b
19a
19b
T'
30
31

FIG. 3b

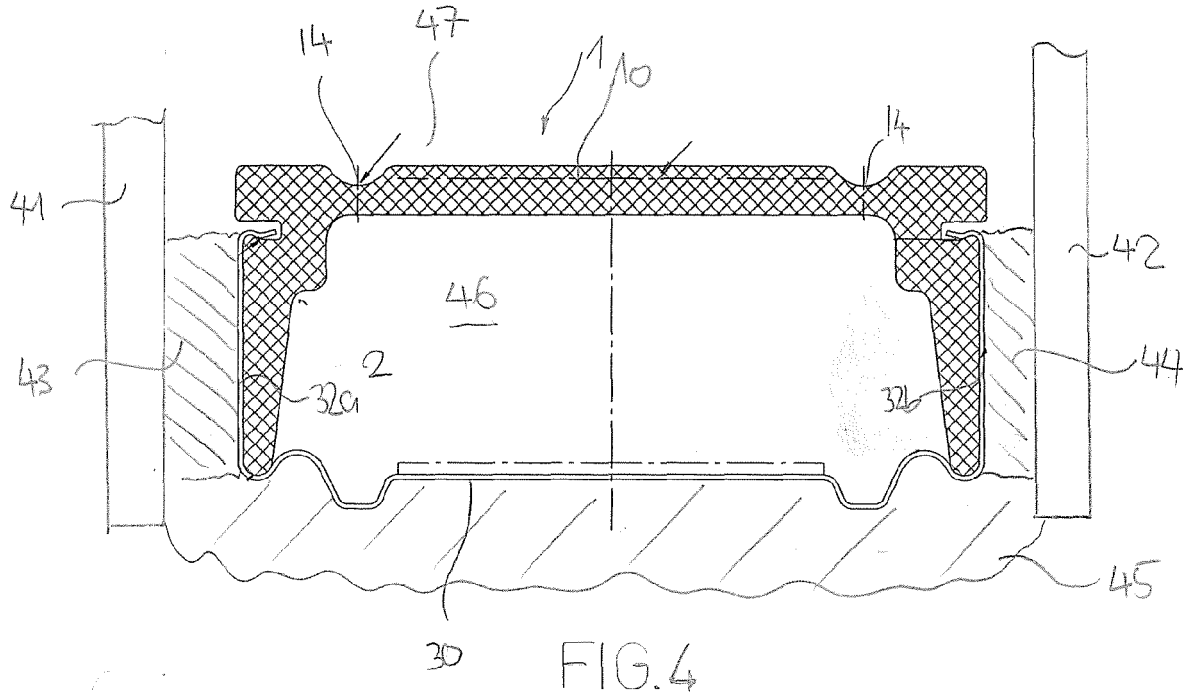

FIG.4

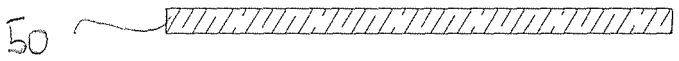

FIG.5a

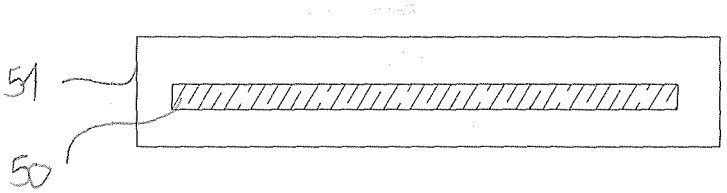

FIG.5b

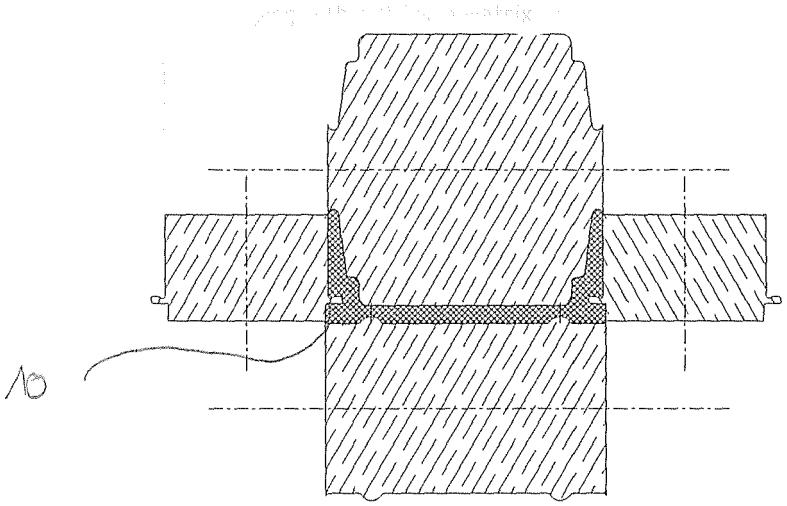

FIG.5c

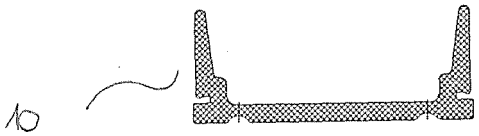

FIG. 5d

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