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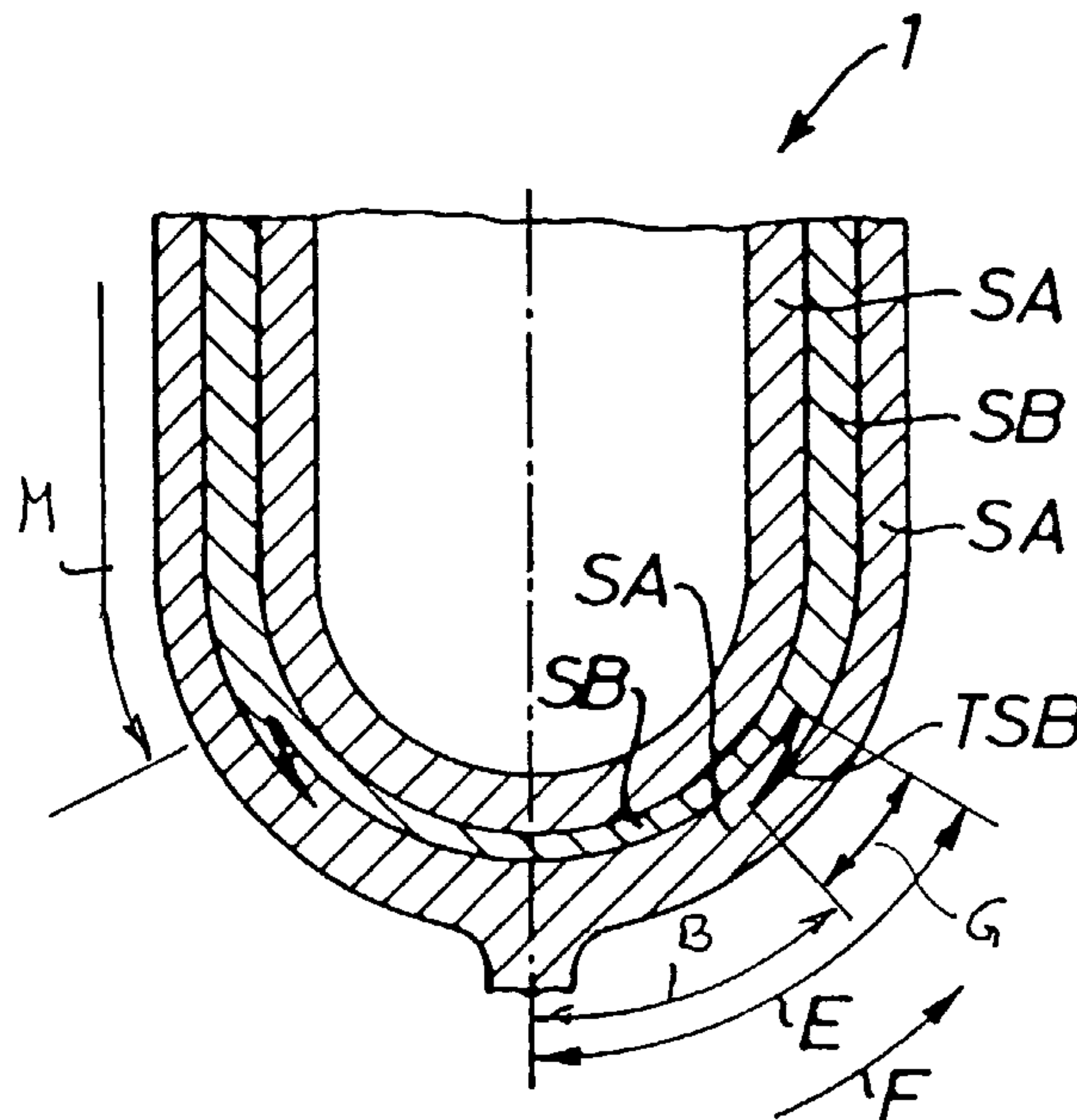
(71) Demandeur/Applicant:
OTTO HOFSTETTER AG, CH

(72) Inventeurs/Inventors:
HOFSTETTER, OTTO, CH;
FERNANDEZ, LUIS, CH

(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : EBAUCHE STRATIFIEE ET SON PROCEDE DE PRODUCTION

(54) Title: MULTIPLE LAYER PREFORM AND METHOD FOR PRODUCING THE SAME



(57) Abrégé/Abstract:

The invention relates to a multi-layered preform (1) that is provided with an inner layer (SB), said inner layer being removed in the base area. The preform further comprises a partial layer (TSB) that is split in a transitional zone and that is unsplit in the surface zone. The split partial layer (TSB) has preferably an irregular shape and is especially crisped.

Summary

The multiple layer preform (1) possesses an inner layer (SB) which is stripped in the base region, has a split away partial layer (TSB) in the transition region and is not split in the casing region. Preferably, the split away partial layer (TSB) exhibits an irregular shape, and in particular is crumpled and corrugated.

(Figure 3c)

AS AMENDED

Multiple layer Preform and Method for Producing the Same.

- 5 The invention relates to a multiple layer preform according to the preamble of Claim 1. Further, the invention relates to a method for the production of a multiple layer preform according to the preamble of claim 8.

Multiple layer preforms composed of PET or other thermoplastic mouldable materials such as
10 PEN, Polyamide, Polycarbonate etc. are generally well known and are used to produce containers, especially bottles for beverages. To do this, the preforms are brought into the desired shape by stretch blow moulding. One such method is known from the publication WO 99/22926 for example. This well-known method enables the production of multiple layer preforms having relatively thin layers, especially a thin outer skin and / or a thin barrier layer.

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A thin outer skin is desired in order to allow the proportion of the core or inner layer, which is made out of economically priced recycling material, to become as large as possible.

A thin barrier layer is desirable since the plastics which are used to produce it, for example
20 PEN, Nylon or EVOH, are relatively expensive. A disadvantage of a preform produced according to this method is the fact that the thickness of the inner layer, especially around the base region of the preform cannot be varied. During the stretch blow moulding of the preform into the final container shape, a beverage bottle for example, the side walls experience a pronounced bi-axial stretching, whereas that part of the preform, which forms
25 the base region of the bottle, experiences a much smaller stretching during stretch blow moulding and thus a much smaller reduction of its layer thickness, so that the individual layers in the base region remain relatively thick.

A so-called three-five layer preform is known from the publication EP 0 596 872 A2, in which
30 an additional material is introduced into the part which forms the base region of the beverage bottle, in such a way that the material forming the barrier layer is filled with this additional material in the base region. The disadvantage of this well-known preform is the fact that a relatively large amount of inner layer material is still present in the base region, which, as has already been mentioned, is comparatively expensive. A reduction in the
35 consumption of inner or barrier layer material is therefore necessary in order to reduce costs. A further disadvantage of this well known preform is the fact that the production process

becomes slower, more complicated and more expensive due to the insertion of an additional material in the inner or barrier layer.

Moreover, it becomes evident that as a rule no or only insufficient adhesion exists between the individual layers. It is in the nature of the plastics used, that they do not mix or only very poorly and therefore do not make an intimate bond to each other. This missing adhesion between the individual layers can lead to flaws or weak points during stretch blow moulding, which in turn can lead to damage or accidents occurring during the normal everyday use of the filled plastic bottles.

- 10 It is the aim of the present invention to provide a more economically advantageous preform and a corresponding method for producing the same.

Furthermore, it is the aim of the present invention to provide a preform in which the adhesion between the individual layers is improved, preferably in the base region.

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Particularly, it is the aim of the present invention to provide a method, which results in an improved attachment / adhesion between barrier layer and A-component in the base region.

- 20 This aim is accomplished by a multiple layer preform having the characteristics of claim 1. The subsidiary claims 2-7 relate to further favourably designed preforms. The aim is further accomplished by a method for producing a multiple layer preform according to claim 8.

- 25 The aim is accomplished particularly by a multiple layer preform, consisting of at least two components, an A-component and a B-component, in which at least one of the layers in the base region of the preform has a section, along which a part of the layer is peeled off and in the transition region a part of the layer is split away, forming a partial layer. In the casing region this one layer is not split away.

- 30 In a favourable design, the B-component is composed of the inner or barrier layer material, in which preferably the section of the preform which approximately forms the base region of the beverage bottle has a separated or split layer, i.e. exhibits a detached partial layer. A preform designed in such a way possesses a very thin inner- or barrier layer in the base region. Furthermore, the detached partial layer can be very thin, e.g. having a thickness between 50µm and 500µm. According to the invention this partial layer is irregularly shaped, in particular having a crumpled corrugated shape. This irregular geometrical shape of the partial layer results in the creation of a larger contact area between this thin partial layer and the neighbouring layers, and thus the adhesive forces between the individual layers are
- 35

increased. The irregular shape of this partial layer leads additionally to a mechanical attachment, i.e. a form-locking connection between the individual layers.

In the design according to the invention the inner layer in the base region is stripped, so that only very little barrier material remains in the base region.

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In a possible design the A-component is composed of new material - PET, whereas the B-component consists of a barrier material like nylon. However, further components can also be introduced, for example a C-component composed of reprocessed recycling material as an additional layer in the preform.

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The method according to the invention for producing the multiple layer preform can be carried out in such a way that in a prephase, material composed of the A-component is injected into the mould cavity bordering the shape of the preform in the direction of material flow until it is partially filled; and in a subsequent main phase, limited amounts of the A-
15 component and B-component are injected. Thus, the B-component, which is to form the barrier layer, is introduced in a parallel process. At the same time the B-component can be surrounded on both sides by a layer of the A-component during the injection process. The B-component flows together with the A-component in the direction of material flow forwards into the mould cavity of the injection mould.

20

In a concluding phase, a limited amount of the A-component is injected into the cavity under such conditions, that part of the B component is stripped from the base region and is split off, i.e. separated or peeled away, while forming a separate partial layer in the transition region. This is particularly achieved by introducing the A-component before the B-component
25 becomes hard. This causes a stripping and a peeling away of the B-component. The B-component, e.g. Nylon, is injected within a short period of time. After that, the A-component is supplied very quickly so that the B-component is still plastically deformable during the subsequent flow of the A-component.

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Thus in the transition region, a layer consisting of A-component is located between the split layers consisting of the B-component. In this way the preform exhibits a five-layer structure in this transition region, in what is otherwise a three-layer structure. A structure having more than five layers is naturally also possible.

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It is to be understood that in the concluding phase a third component can also be introduced.

The transition region of the preform having the five layer structure forms a kind of anchoring section, in which the split away partial layer of B-component acts like an anchor during the stretching of the preform, i.e. it creates an increased adhesion due to its irregular shape and forms a form-locking connection.

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Furthermore, preforms manufactured in such a way have an inner layer, which has an increased thickness in the casing region; a fact that in turn has a positive effect on the strength of the stretch blow moulded bottle.

- 10 This mutual anchoring effect has the advantage that it is also possible to form a beverage bottle having a very thin base, which nevertheless exhibits an uninterrupted barrier layer of Nylon.

- 15 In the following sections the invention is described in more detail with the help of several example designs.

Figure 1 shows a longitudinal section through a well know multiple layer preform, arranged in the moulding cavity of an injection mould.

- 20 Figure 2 shows a longitudinal section through a hot channel (runner) nozzle with needle seal.

Figure 3a shows a partial view of a longitudinal section through the preform according to the invention during the injection process.

- 25 Figure 3b shows a partial view of a longitudinal section of the preform during the injection process when a partial layer starts to be stripped.

Figure 3c shows a partial view of a longitudinal section of the completed preform.

- 30 Figure 3d shows a partial view of a longitudinal section of a further completed preform having an additional C-component.

Figure 5 shows a side view, partly in section, of a beverage bottle produced by stretch blow moulding.

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Figure 6 shows a side view of a preform, partly in section, and

Figure 7 is a representation of the five-layer structure of the beverage bottle according to figure 5.

Figure 1 shows a longitudinal section of the injection mould 2, disclosed in the publication EP 0596 872 A2, in which a preform 1 is arranged in the mould cavity 4 formed by the core 3 and the outer part 6. The heated thermoplastic material is fed into the opening 5 by an injection-moulding device 7. The represented preform 1 is a so-called Three-Five-Layer preform, since the preform 1 exhibits three layers near the neck; a layer of a B-component is surrounded on both sides by one layer each of an A-component. In contrast, the preform 1 exhibits five layers in the base region, where the innermost layer consists of a C-component enclosed on both sides by the B-component, which is itself enclosed by the A-component on the outside.

Figure 2 shows an injection moulding device 7 with an injection nozzle 16, where the injection mould 2 is arranged in succession to the aperture 5. In one preferable arrangement 48 or 96 injection moulds 2 are located next each other, in order to produce 48 or 96 preforms 1 simultaneously pro operation.

The injection nozzle 16 is arranged such, that an A-component of a thermoplastic material from a first container and a B-component of a thermoplastic material from a second container can be injected into the mould cavity 4 through the aperture 5.

To do this, the injection nozzle 16 possesses a first channel 11 in one nozzle part 13, into which the A-component is fed via the supply line 14. The channel 11 surrounds a further channel 12 coaxially, into which the B-component is fed via the supply line 15.

Channel 12 has a gate 9 at the front, which is situated in the direction of flow behind a gate 8 belonging to channel 11. A needle 10, movable in the longitudinal direction, extends through the gates 8 and 9 and, in the represented position, seals the aperture 5. The needle can be controllably retracted to open the aperture 5 as well as the gates 8 and 9.

The A-component, a thermoplastic material, particularly PET, is fed in via the supply line 14. The B-component, a thermoplastic material suitable for forming a barrier layer, is fed in via the supply line 15. This plastic can be PEN, Nylon, EVOH or a polyamide, for example. The materials in the supply lines 14 and 15 can also be interchanged.

The preform 1 is formed by the A-component being injected in a limited amount through the channel 11 into the mould cavity 4 in one step of the method. At this time the needle 10 is in

a partly retracted position. Then, the mould cavity 4 is filled with the A-component only in the sprue region. In a main phase, as shown in figure 3a, a limited amount of a B-material is injected into the mould cavity 4. However, this injection can occur in parallel with the injection of an additional amount of A-component. In this case, the needle 10 is retracted so far, that channel 11 as well as channel 12 are open to the mould cavity 4 at the same time. The A-component as well as the B-component force their way into the mould cavity 4, flowing in the direction of material flow F. At the same time, layers SA, composed of the A-component, and a layer SB, composed of the B-component, are formed.

10 In an intermediate phase, as illustrated in figure 3b, the channel 12 is closed by the needle 10, and the component-A continues to be injected into the mould cavity 4 via the supply line 14. This A-component is injected into the mould cavity 4 in such a way, that a part of the layer SB is stripped or peeled back, as represented in figure 3b. This stripping takes place during the injection of the A-component into the mould cavity 4, so that at the end, the

15 preform exhibits the structure illustrated in Figure 3c. This preform 1 possesses a section E, running in the direction of material flow F, along which a part of the thickness of the layer SB is split off, accompanying the formation of a partial layer TSB. A layer consisting of A-component is situated between the layer SB and the partial layer TSB. In this region the preform 1 exhibits a five-layer structure.

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Figure 3d shows a further design example of a preform 1, in which a new C-component is introduced instead of the A-component in the final phase.

In order to bring about the splitting off of a partial layer TSB, the A- or C- components must be fed in sufficiently quickly, that the B-component is still plastically deformable during the introduction of the A- or C- component. In order to create a split off partial layer, the whole injection process has to be carried out in a relatively short time, for example within a filling time of 3-4 seconds. Additionally, the timing and duration of the injection, the rapid closing of the needle 10, the pressure and temperature of the injected thermoplastic material are particularly important.

30

Using the knowledge of the technical procedure disclosed here, a specialist is in the position to find other suitable times for opening and closing the needle 10, in order to achieve the effect, that part of the layer is separated or peeled away. Additionally, the specialist is in the position to choose the further injection moulding parameters such as temperature, flow speed, pressure etc., according to the requirements. All these parameter settings, which lead to achieving the effect mentioned previously, are included in this disclosure.

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Figure 6 shows a side view of the complete preform 1, which is only partially represented in figure 3c. The preform 1 is a three-five-layer preform design, and has a layer SB composed of the B-component, which is surrounded on both sides by a layer SA, composed of the A-
5 component. The partial layers, arranged in the transition region of the preform 1, are also shown.

The plastic bottle 30, illustrated in figure 5, includes a bottom 31, a side wall 32, as well as a transition region 33 arranged between them. The side wall 32 possesses, as shown
10 magnified, a three-layer structure consisting of a succession of layers SA, SB, SA. The partial layers TSB are preferably arranged in the preform 1 in such a way, that, after the stretch blow moulding of the preform, these partial layers TSB are situated in the transition region 33 of the plastic bottle 30 and there form a five layer structure, having a succession of layers SA, SB, SA, SB, SA, as represented magnified in figure 7. The split off partial layer TSB is generally
15 considerably thinner than the layer SB, from which the partial layer TSB was split off. This aspect is not represented in figure 7.

The advantages of the preform according to the invention, are immediately obvious to the man skilled in the art, and can be especially seen in the fact, that the thickness of the barrier
20 layer in the base region can be varied by a suitable setting of the injection cycle parameters. A significant advantage lies in the improved contact force between neighbouring layers, especially due to an increased adhesion and a form-locking connection.

Patent claims

1. Multiple layer preform (1) for the production of plastic containers, especially plastic bottles, having a base region (B), a casing region (M) and a transition region (G) lying
5 between the base region (B) and the casing region (M), said preform (1) having a split inner layer (SB), wherein this inner layer is partly stripped in the base region (B), has a split away partial layer (TSB) in the transition region (G) and is not split in the casing region (M), and the split away partial layer (TSB) is arranged only in the transition region (G).
- 10 2. A preform according to claim 1, wherein the base region consists of three layers, the transition region consists of five layers and the casing region consists of three layers.
3. A preform according to claim 1, wherein the split away partial layer in the transition region possesses an irregular form.
- 15 4. A preform according to claim 3, wherein the split away partial layer in the transition region possesses a crumpled, corrugated shape.
5. A preform according to claim 1, wherein the partial layer (TSB) has a thickness between
20 50µm and 500µm.
6. A preform according to one of the previous claims, wherein the inner layer is composed of PEN, Nylon, EVOH or a polyamide to form a barrier layer.
- 25 7. A preform according to claim 1, wherein the inner layer exhibits a higher thickness in the casing region than in the transition and/or in the base region.
8. A method for producing a multiple layer preform (1) using an injection moulding device and including the process steps:
30 - Provision of an injection mould (2) having a core (3) and a moulding cavity (4) surrounding the core, as well as an injection nozzle (5),
- Provision of an A-component of a thermoplastic material to form an outer layer (SA) of the preform (1),
- Provision of a B-component of a thermoplastic material to form an inner layer (SB) of the
35 preform (1),
- Injection of the A-component into the mould cavity (4) up to a partial filling, and / or

- Injection of the A-component and the B-component into the mould cavity (4), wherein, in a next step, the A-component is introduced again in such a way, that in the base region a part of the inner layer (SB) is stripped, in such a way that the inner layer is split to form a partial layer only in a transition region (g) arranged between the base region (B) and the casing
5 region (M).

9. A method according to claim 8, wherein, in order to form a form-locking connection between the individual layers, the A-component is introduced in such a way, that an irregular shape of the partial layer thus caused.

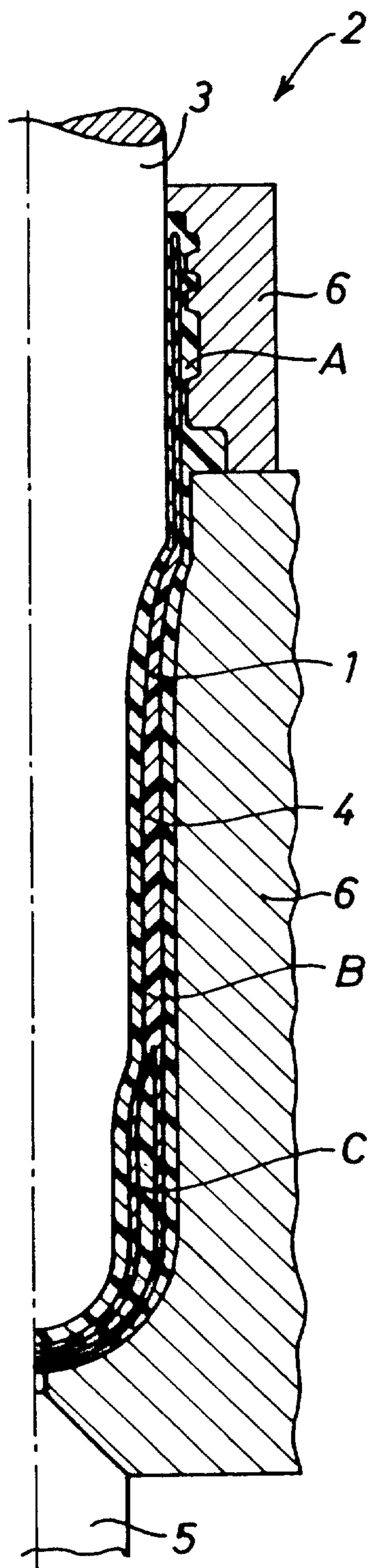


Fig. 1

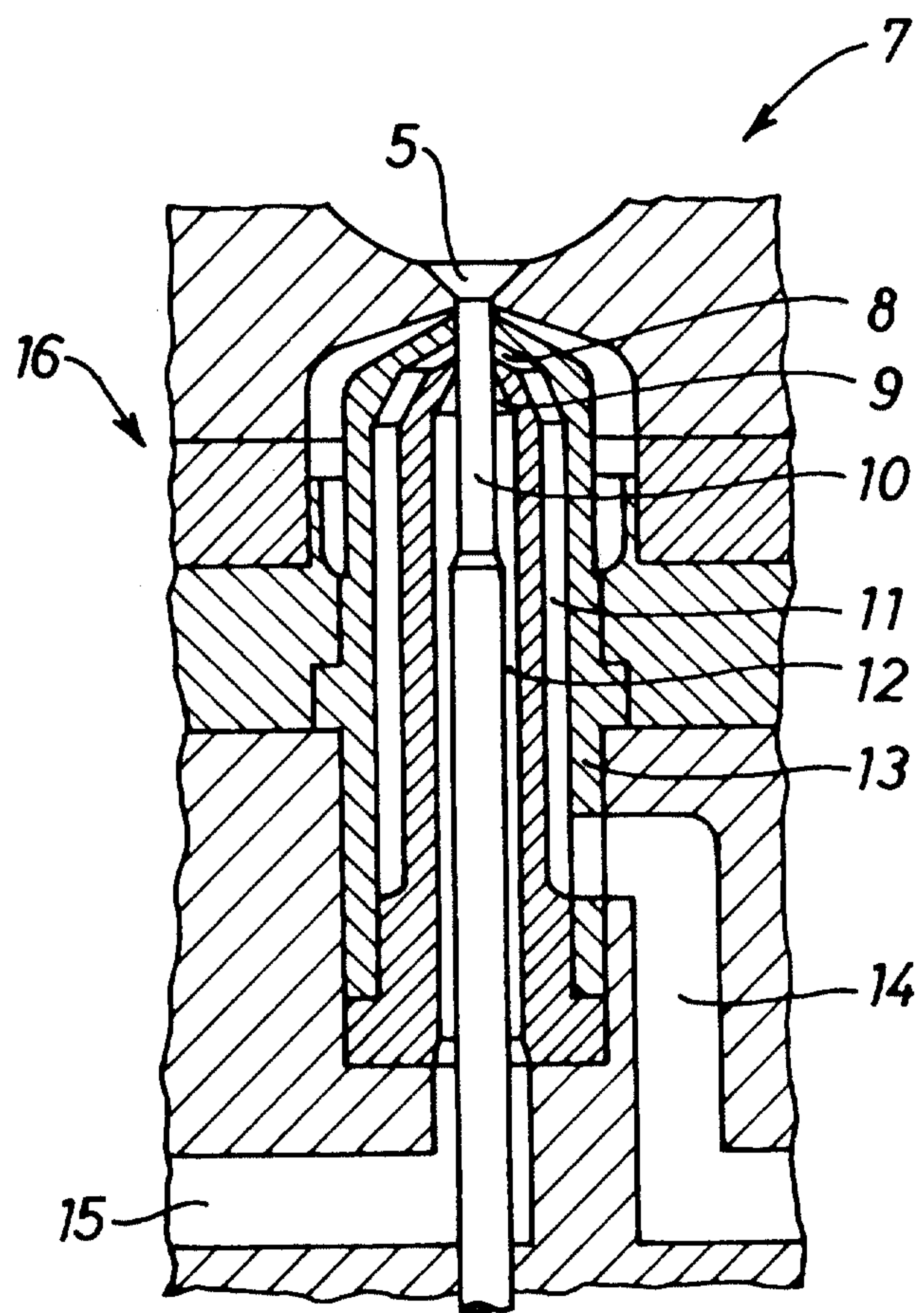


Fig. 2

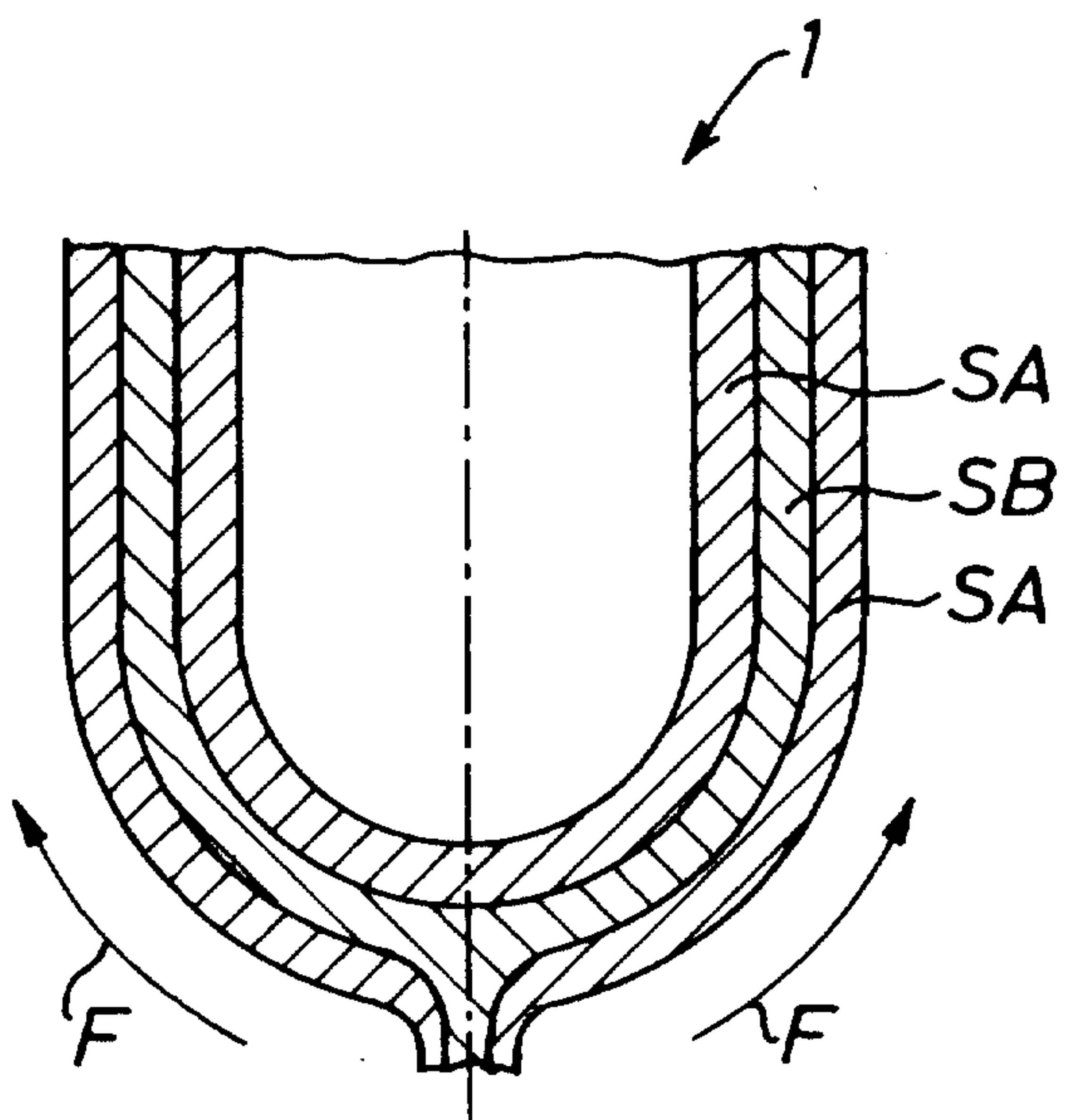


Fig. 3a

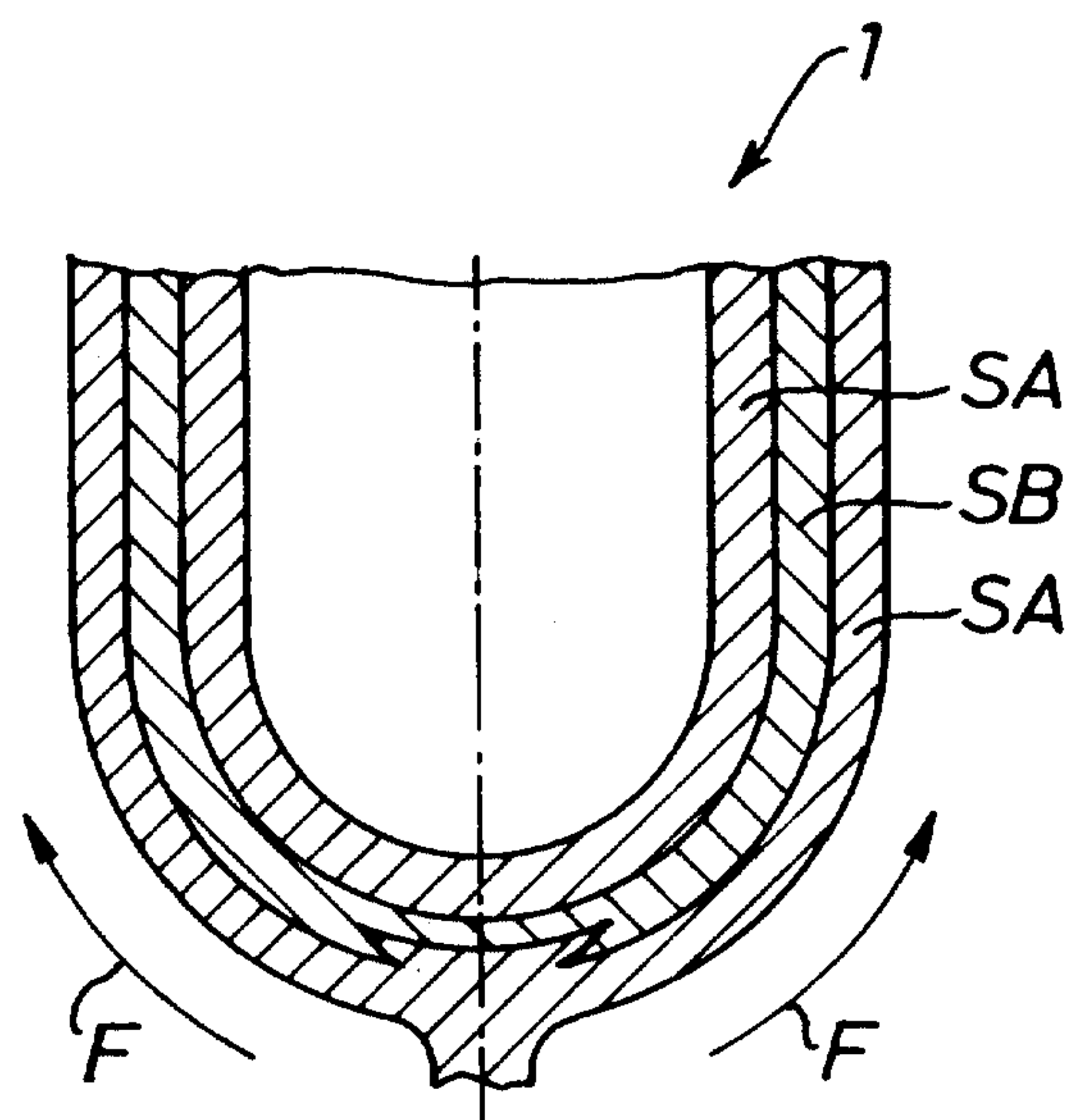


Fig. 3b

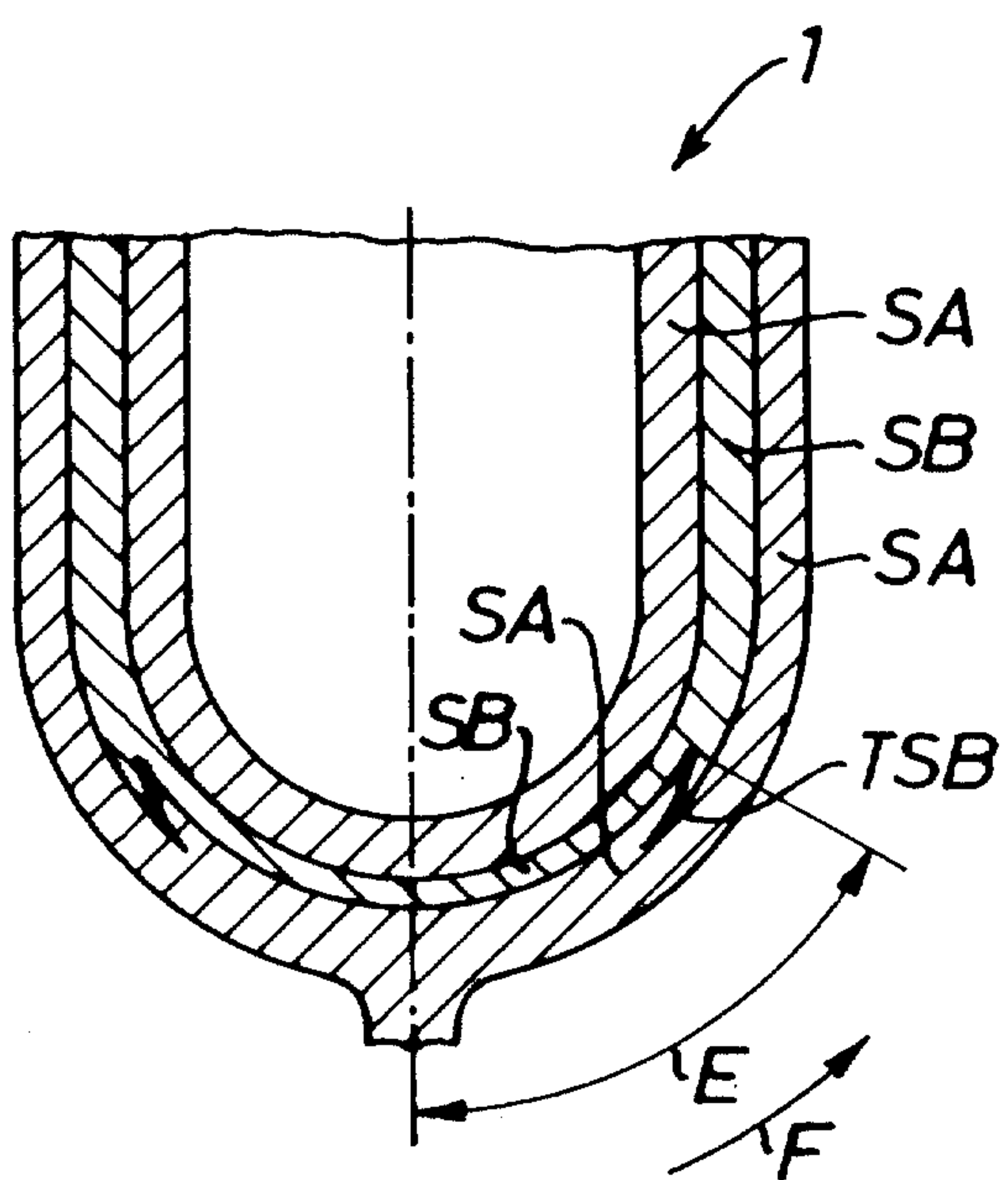


Fig. 3c

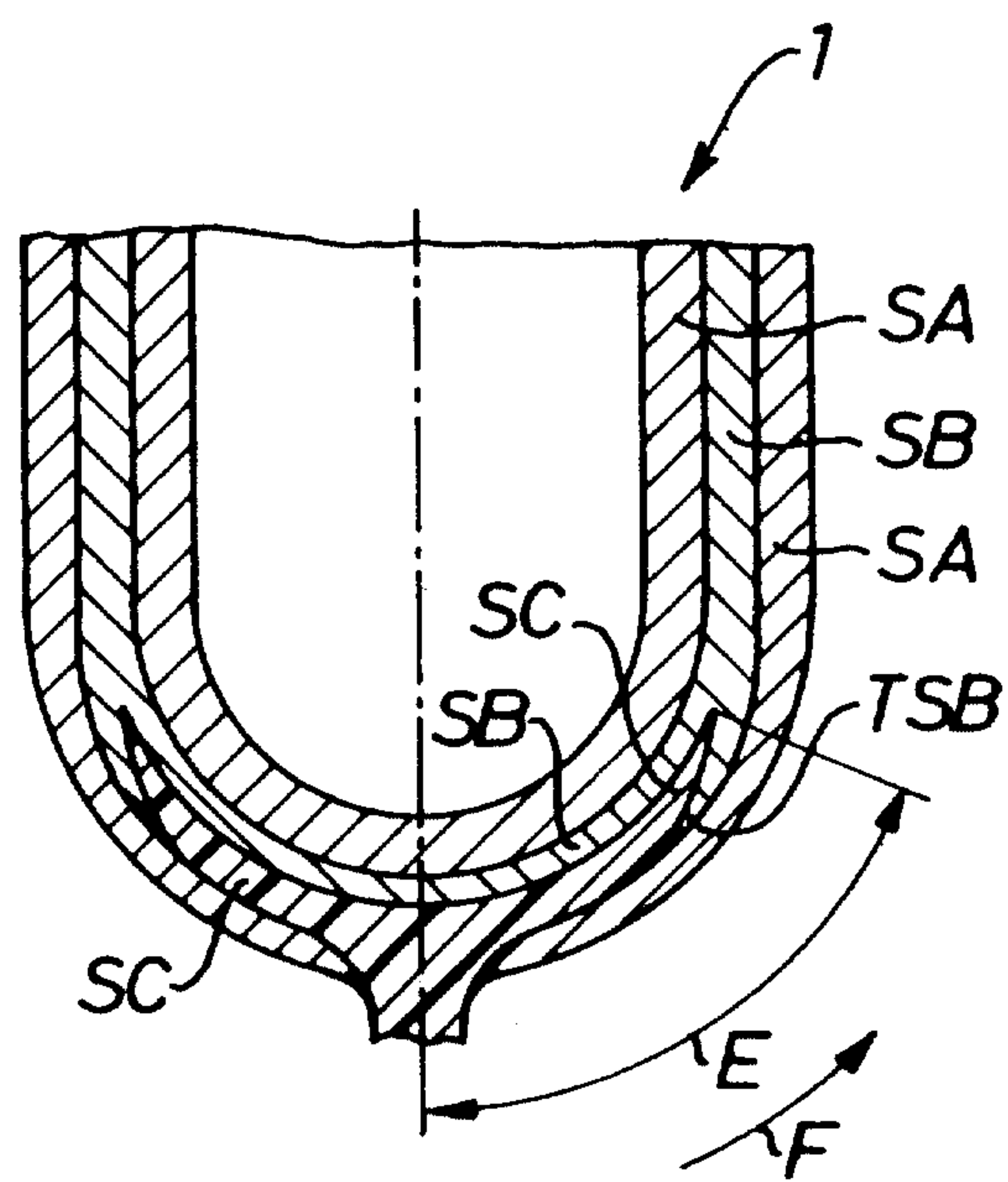


Fig. 3d

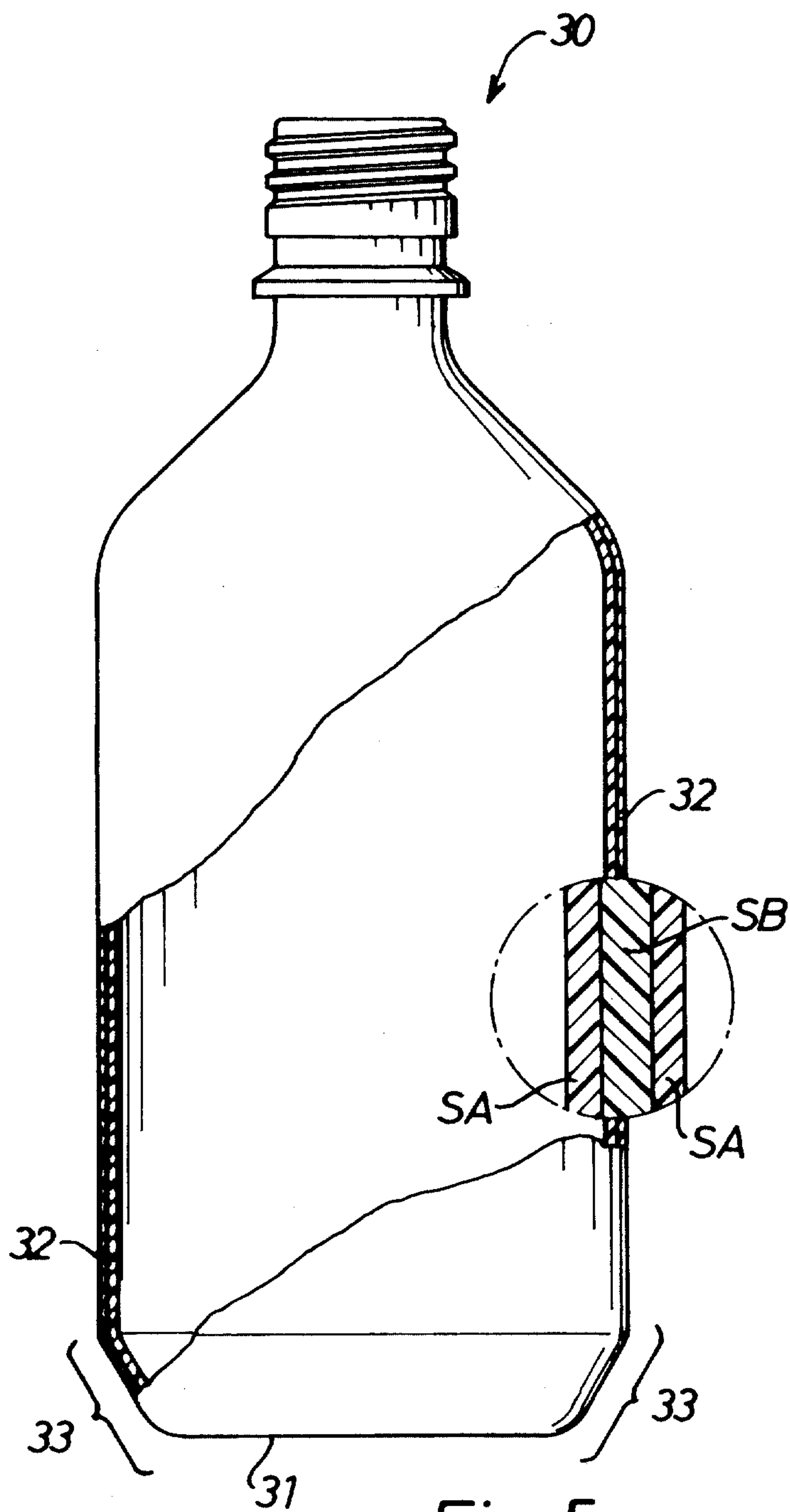


Fig. 5

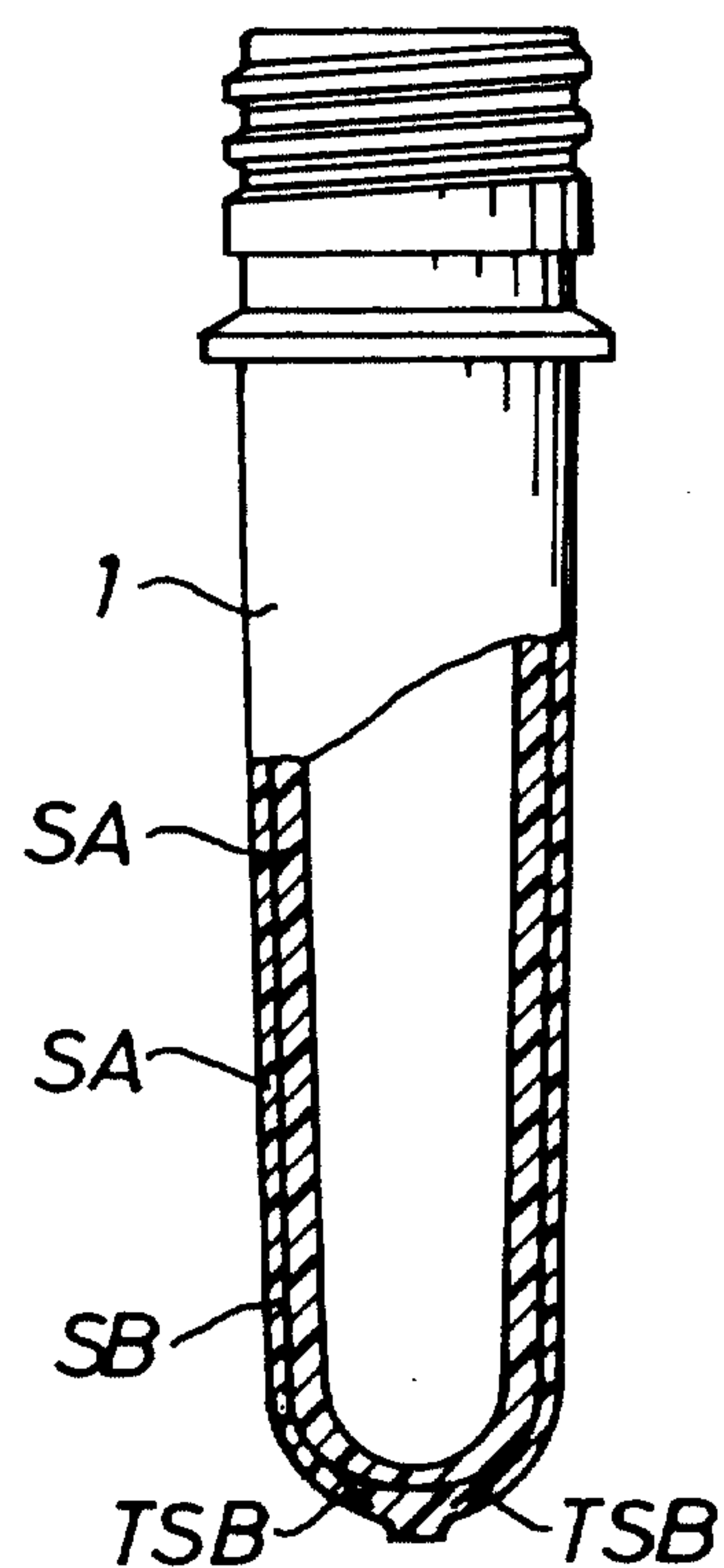


Fig. 6

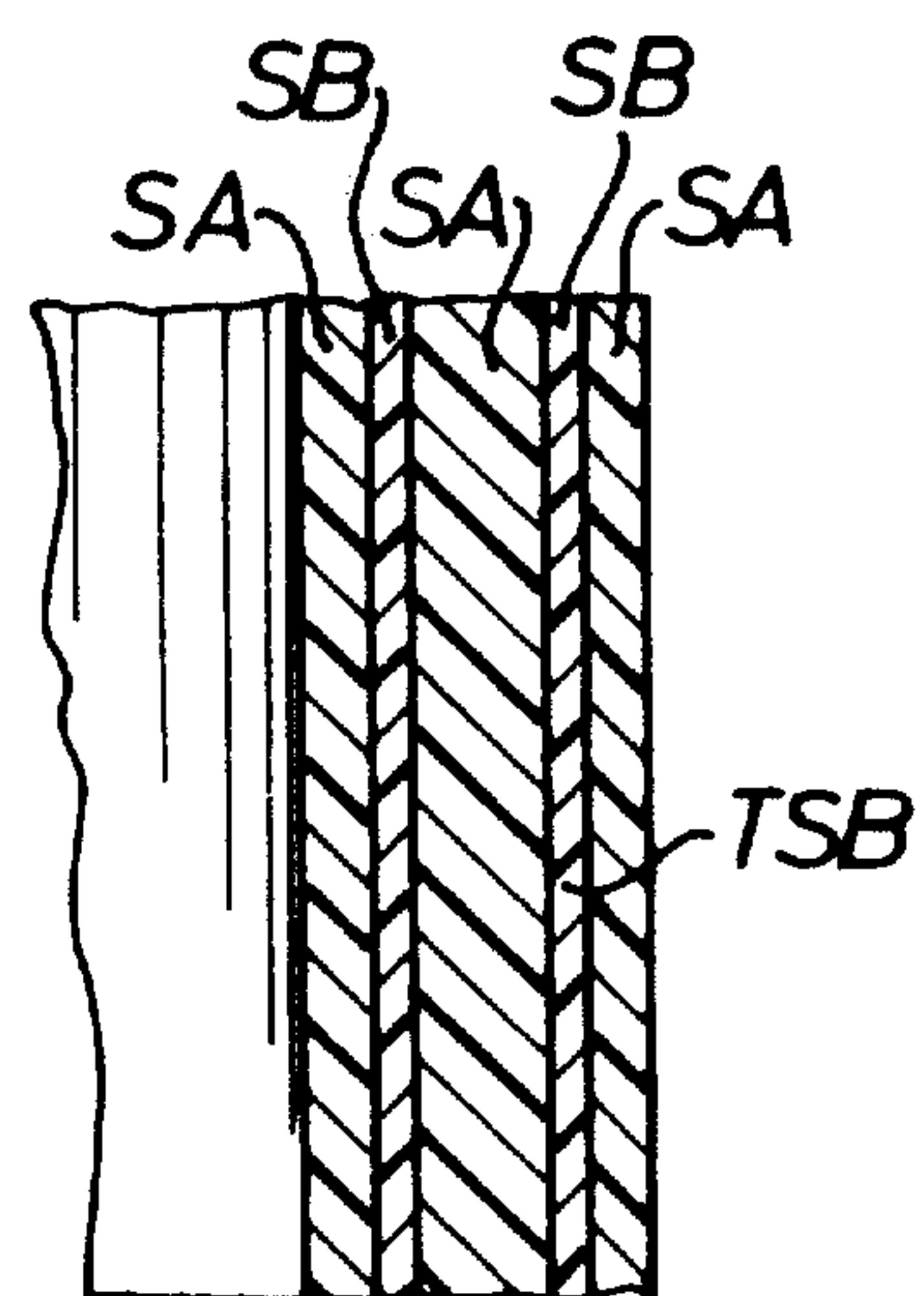


Fig. 7

