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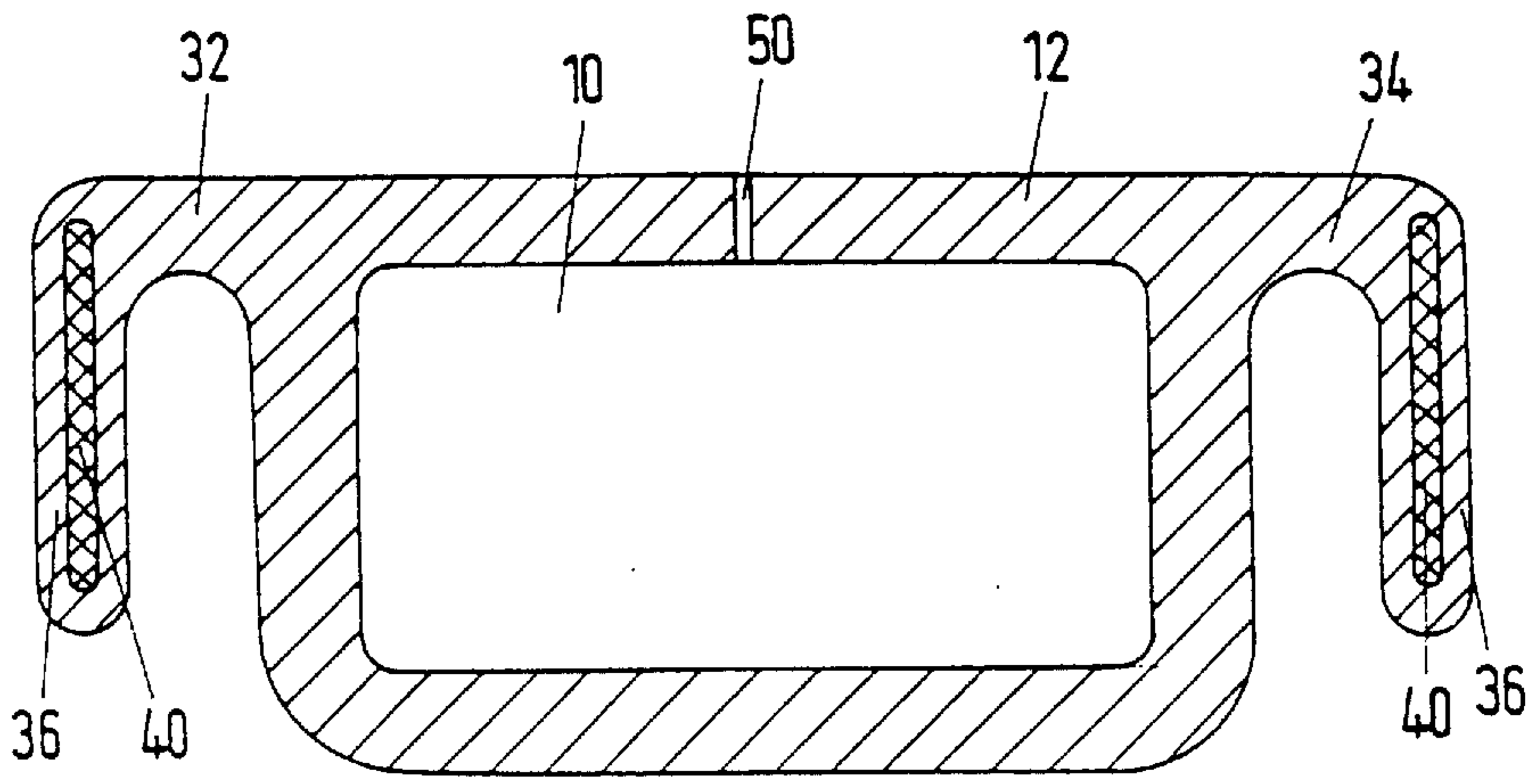
(54) **PROFILE D'ECARTEMENT POUR ENSEMBLE VITRAGE ISOLANT**

(54) **PROFILED SPACER FOR INSULATION GLAZING ASSEMBLY**



(57) L'invention concerne un profilé d'écartement pour un châssis d'écartement, qui est destiné à être placé dans la zone du bord d'un ensemble vitrage isolant pour former un espace intermédiaire entre les vitres, comportant une chambre (10) dans laquelle on place des matériaux hygroscopiques et comprenant au moins une branche d'appui (30, 36) venant reposer sur une face intérieure de vitre, au moins sur un côté de la chambre, cette branche étant reliée à la chambre par l'intermédiaire d'une section en pont (32, 34). Le profilé d'écartement présenté se caractérise en ce que son corps profilé est constitué d'un matériau déformable élastiquement et plastiquement qui est un mauvais thermoconducteur, et en ce qu'au moins la branche d'appui est reliée par liaison de matière à une couche de renforcement (40) plastiquement déformable.

(57) The present invention relates to a profiled spacer for a spacing frame which is placed in the edge area of an insulation glazing assembly for forming an intermediate spacing between window panes. Said spacer comprises a chamber (10) for receiving hygroscopic materials and having at least one support leg (30, 36) resting on the inner surface of the pane at least on one side of said chamber, wherein said leg is connected to the chamber by a bridge section (32, 34). This profiled spacer is characterised in that its profiled body is made of a low thermal conductivity material capable of resilient and plastic deformation. The support leg at least is further connected by material connection to a reinforcing layer (40) capable of plastic deformation.

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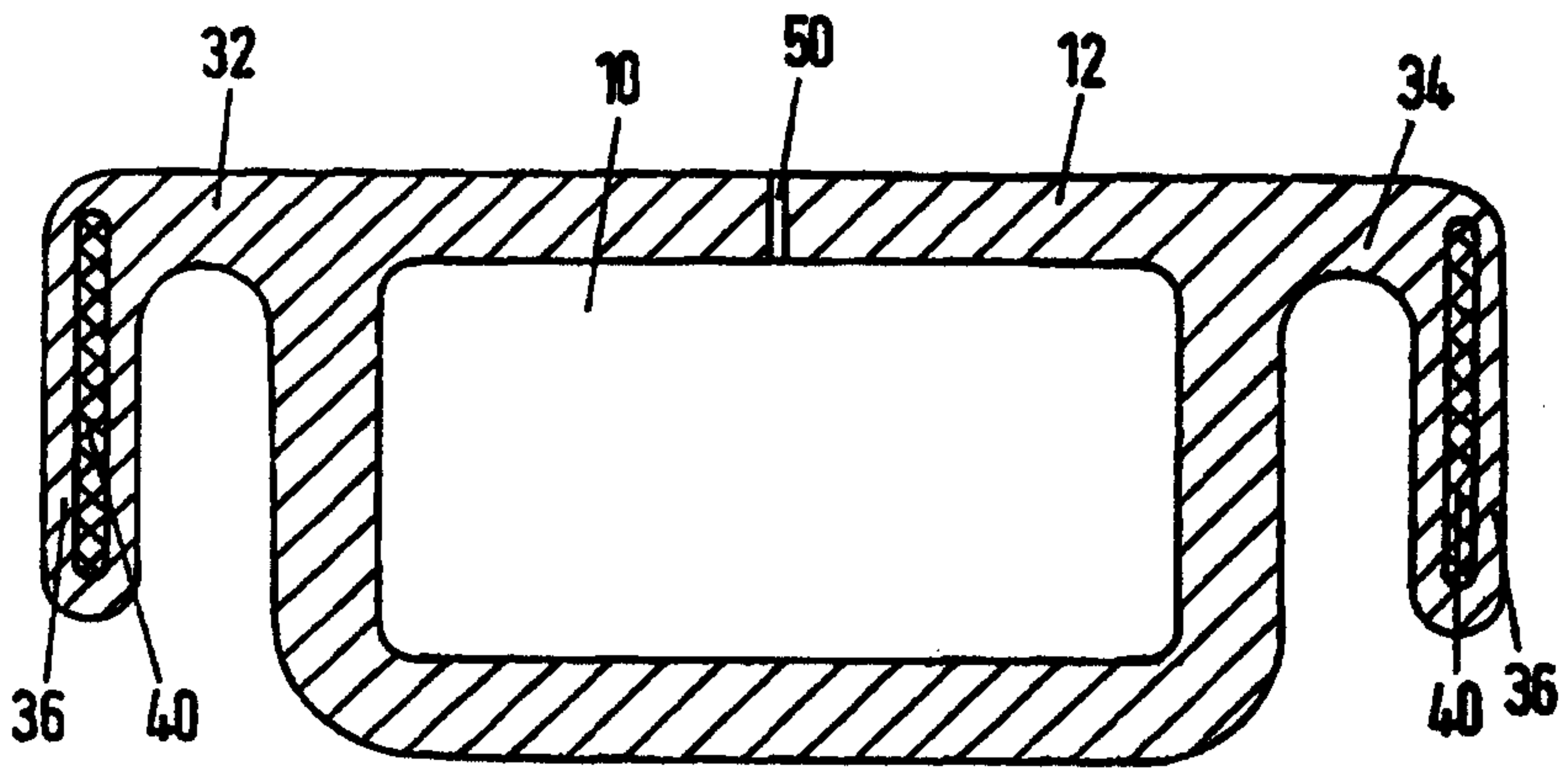

(57) Abstract

The present invention relates to a profiled spacer for a spacing frame which is placed in the edge area of an insulation glazing assembly for forming an intermediate spacing between window panes. Said spacer comprises a chamber (10) for receiving hygroscopic materials and having at least one support leg (30, 36) resting on the inner surface of the pane at least on one side of said chamber, wherein said leg is connected to the chamber by a bridge section (32, 34). This profiled spacer is characterised in that its profiled body is made of a low thermal conductivity material capable of resilient and plastic deformation. The support leg at least is further connected by material connection to a reinforcing layer (40) capable of plastic deformation.

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Specification

SPACER PROFILE FOR INSULATING WINDOW UNITS

The present invention relates to a spacer profile for a spacer frame to be mounted in the marginal area of an insulating window unit, consisting of a profile corpus with a chamber for receiving hygroscopic material and with at least one contact web to be applied to one pane inner side, which is connected via a bridge section with the chamber, whereby the profile corpus has at least one outwardly open area with a U-shaped cross section, whose flanks are formed by the contact web and the adjacent side wall of the chamber and whose base is formed by the bridge section connecting the same.

Within the framework of the invention, the panes of the insulating window unit are normally glass panes of anorganic or organic glass, certainly without limiting the invention thereto. The panes can be coated or finished in any other way, in order to impart to the insulating window unit special functions, such as increased heat insulating or sound insulating capabilities.

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The most important tasks of spacer frames are to space apart the panes of an insulating window units, to insure the mechanical strength of the unit and to protect the space between the panes from external influences. It has to be established that, primarily in insulating window units with high heat insulation, special attention has to be paid to the heat transmission characteristics of the peripheral connection, including the spacer frame, respectively the spacer profiles constituting the same. It has been frequently proven that by using the conventional metallic spacers resulted in a reduction of the heat insulating properties of an insulating window unit. The reduced heat insulation appears clearly visible in the area of the peripheral connection, in the formation of condensation water at the margin of the inner pane at low external temperatures. There are general attempts to eliminate such formation of condensation water even at low external temperatures by keeping the temperature in the area of the peripheral connection at the inner pane as high as possible. Developments in this direction are known under the term of "warm edge" techniques.

In addition to metallic spacer profiles, for quite a long time spacer profiles of plastic materials have been used, thus taking advantage of the low heat conductivity of these materials. However plastic spacer profiles have the disadvantage that they can be bent only with considerable efforts or not at all for the production of spacer frames made in one piece. Therefore plastic profiles are cut in straight bars to the size of the respective insulating window unit and interconnected to form a spacer frame by means of several corner brackets. Compared to metal, as a rule such plastic materials also have a low diffusion tightness. Therefore in the case of plastic spacers special measures have to be taken insuring that air humidity existing in the surroundings does not penetrate the intermediate space between the panes to the extent that it depletes the absorption capability of the drying agents normally provided in the spacer profiles, impairing the function of the insulating window unit.

Furthermore a spacer profile has also to prevent the filling gases in the intermediate pane space, such as argon, krypton, xenon, sulfur hexafluoride from escaping. Vice versa, nitrogen, oxygen etc. contained in the outer atmosphere should not penetrate the intermediate pane space. Insofar as diffusion tightness is subsequently mentioned, it applies to vapor diffusion tightness, as well as to gas diffusion tightness for the mentioned gases.

In order to improve the vapor diffusion tightness, DE 33 02 659 A1 proposes to provide a plastic spacer profile with a vapor

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barrier, by applying a thin metal foil or a metalized plastic foil to the plastic profile on its surface which in assembled state faces away from the space between the panes. This metal foil has to span across the intermediate pane space as completely as possible, insuring the desired vapor barrier effect. The disadvantage here is that the metal foil creates a path of high heat conductivity from one pane of the insulating widow unit to the other. This considerably reduces the effect intended by using a plastic material for the profiles, namely the reduction of heat conductivity of the peripheral connection.

Other spacer profiles, for instance the ones which meet the aforementioned "warm-edge" conditions, use special stainless steels, which in comparison to other metals have a lower heat conductivity, for profile materials. Examples are mentioned in "Glaswelt" 6/1995, pages 152 - 155. The spacer frames made thereof consist of one piece and are closed at all corners.

A spacer profile of the kind mentioned in the introduction is known from DE 78 31 818 U1. The contact webs, there named flanks, to be connected via a sealing adhesive with the panes of the insulating window unit, form the force application points for a specially designed tool fixing the contact webs during bending.

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The spacer profile is made in one piece of the same material, presumably a metal, which can be bent at right angles obviously only by means of the indicated procedure. Indications as to heat insulation or even measures for improving the heat insulation can not be found in the publication.

Known is also a closed spacer profile (EP-A-601 488) of thermoplastic material with a metallic reinforcement inlay.

It is the object of the present invention to create a spacer profile which can be produced on a large scale and at low cost, with high heat insulating characteristics, whereby from such a spacer profile it should be possible to make a one-piece spacer frame, so that when cold, or in any case only slightly warmed, the profile will be bendable in such a manner as to avoid deformation. Thereby the spacer profile should also be advantageously in a position to admit to a limited extent relative motions of the glass panes, for instance through inner pressure or shearing strain.

This object is achieved due to the spacer profile with the characteristic features of patent claim 1.

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According to the invention, the profile corpus of the spacer profile is formed by an elastically-plastically deformable material with low heat conductivity and at least the contact web is firmly materially connected with a deformable reinforcement layer.

The profile corpus comprises volumwise the main part of the spacer profile and imparts to the same it cross section profile. It comprises especially the chamber walls, the bridge sections, as well as the contact webs.

Elastically-plastically deformable materials designates materials wherein after the bending process elastic restoring forces become active, which is typically the case of plastic materials, whereby one part of the bending occurs through a plastic, irreversible deformation.

Plastically deformable materials comprise such materials wherein after deformation practically no elastic restoring forces act, such as is typical for metals bent beyond their apparent yielding point.

The term materially connected means that the profile corpus

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and the plastically deformable layer are permanently connected to each other, for instance through coextrusion of the profile corpus with the plastically deformable layer, or by separately laminating the plastically deformable layer on it, optionally by means of a bonding agent, or similar techniques.

Surprisingly it has been found that already by reinforcing the only the contact webs of the spacer profile made of elastically-plastically deformable material with a plastically deformable reinforcement layer, a good cold bendability of the profile can be achieved. The so-formed sandwich composite produces a high bending resistance moment with the characteristics of the plastic materials and the profile contour. This however results in higher bending forces, but insures only minimal resilience in the bent state, as well as high corner rigidity and makes stiff, and easy to handle spacer frames. The elastic restoring force of the profile corpus material can therefore act only minimally.

The layer thickness of the reinforcement layer depends on the properties of the actually used materials of the profile corpus and of the reinforcement layer which have to be selected so that, after a bending process, the desired bent is

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substantially maintained, which means that after a bending by 90° the resilience amounts in any case only to a few degrees, maximum 10°. The reinforcement layer does not have to be a compact layer, but can have for instance netlike perforations.

Preferably the profile corpus has at least one U-shaped cross section area open towards the outside, whose flanks are formed by a contact web and the neighboring side wall of the chamber and whose base is formed by the bridge sections connecting the same. Outside means in this case the side of the profile corpus facing away for the space between the panes in assembled state.

Further the flanks of the U-shaped cross section area advantageously have a height which is at least three times and further preferably at least 5 times the width of the base.

In a particularly preferred embodiment of the invention the reinforcement layer is set on the contact surface of the contact web. The contact surface is the surface of the contact web facing the pane inside in the mounted state.

In further embodiment the reinforcement layer is set on the

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chamber-side surface of the contact web opposite to the contact surface.

It is thereby self-understood that in each embodiment the reinforcement layer extends normally at least over the most part of the height of the contact web, as well as over its entire length.

Preferably the profile corpus is permanently connected with a reinforcement layer extending substantially over its entire width and length.

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The invention is based on the finding that, in this case, the reinforcement layer contributes to heat conduction from one pane to the other. However, as a result of the contour of the material with low heat conductivity of the profile corpus indicated by the invention, the path of high heat conductivity created by the reinforcement layer is considerably lengthened by comparison with the conventional profiles, so that the heat insulating properties of an insulating window unit equipped with the spacer profile is considerably improved in the area of the peripheral connection due to the invention.

Preferably, especially when the profile corpus material does not offer sufficient diffusion tightness, the reinforcement layer is made to be diffusion tight, at least in the area of the chamber walls and the bridge section, but normally over its entire surface.

Advantageously the reinforcement layer is arranged on the outside of the profile corpus, or close to the same at least partially embedded in the profile corpus. Due to the geometric configuration of the reinforcement layer determined by the profile corpus, an arc-preserving bending resistance moment results, which contributes to the cold pliability without disturbing deformations.

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The bending resistance moment can be increased particularly by arranging the reinforcement layer on the chamber-side surface of the contact web on the outside of the bridge section connected with the contact web, as well as on the outside of the chamber side wall adjacent to the contact web, whereby the reinforcement layer has to be diffusion tight at least in the area of the bridge section and the chamber side wall, when additional steps for diffusion tightness are to be eliminated.

It is particularly preferred when the reinforcement layer extends continuously from the contact surface of the contact web over its chamber-side surface, the outside of the bridge section connected with the contact web, the outside of the adjacent side wall of the chamber, as well as the outside of the outer chamber wall, whereby in this case the reinforcement layer has to be diffusion tight at least in the area of the bridge section and side wall of the chamber. Due to the meandering path of the reinforcement layer in this particularly preferred embodiment, a high arc-preserving bending resistance moment is created. This however has stronger bending forces as a consequence, but in the bent state insures a particularly low resilience and a high degree of corner stiffness. Therefore practically the elastic restoring force of the elastically-plastically deformable materials can not become active.

The spacer profile is easy to manufacture, for instance through an extrusion process. After the application of the reinforcement layer, the profile can be made by cold bending. For this purpose conventional bending equipment without significant modifications can be used. A fixing of the contact webs during bending, as in the prior art, is not necessary within the framework of the invention. After the bending process, the contact webs do not show any disturbing deformations.

Advantageously the chamber is arranged centrally in the spacer profile, whereby on both sides of the chamber at least one contact web is provided. This symmetric design makes a positive contribution to the compensation of relative motions of the panes.

The cross section of the chamber can be substantially polygonal, particularly rectangular or trapezoidal. It is also possible to have corner-free, for instance oval configurations of the chamber cross section. It is self-understood that the concept "chamber" includes, besides closed hollow spaces, also trough-like profile shapes.

According to an advantageous embodiment, in the spacer

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profile, the bridge section is secured in one corner area of the chamber for the connection of at least one contact web. Thereby it is particularly advantageous for the bending behavior and the heat insulation when the bridge section is fastened on a corner close to the space between the panes. However it is also conceivable to arrange the bridge section for the connection of at least one contact web in the middle area of a chamber side wall, which in the mounted state faces the panes of the window unit.

Depending on the individual configuration, it can be equally advantageous to select the height of the contact web bigger, smaller or substantially equal with the height of the adjoining side of the chamber. In order to insure a large contact surface on the pane, it can be advantageous to allow the contact webs to project as much as possible beyond the chamber. Thereby it will also be advantageous to arrange the contact webs parallelly to the a side wall of the chamber. Shorter contact webs improve the contact between the mechanically stabilizing sealing means to be applied externally and the panes.

It is however also possible to arrange the contact webs at a positive or negative angle to one side wall of the chamber, which

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can range for instance between -45° to +45°, in relation to the longitudinal median axis of the chamber cross section. This can improve the spring action of the spacer profile, as necessary.

Also the contact webs can have at least one contact rib. Such a contact rib will normally run orthogonally with respect to the contact web, so that in the mounted state a clear space is defined between the contact web and the inside of the pane.

As materials for the reinforcement layer, which has a heat conduction value $\lambda < 50$ W/(m·K), metals with poor heat conductivity such as mainly tin plate or stainless steel, have proven to be suitable, whereby these materials can be for instance in the form of foils permanently applied to the profile corpus of the spacer profile by means of a bonding agent or laminated onto the same. Thereby tin plate is a sheet iron with a tin surface coating, suitable stainless steel types are for instance 4301 or 4310 according to the German steel standards.

It has proven to be advantageous when, with regard to the strength of the bond between the reinforcement layer and the profile corpus, a peeling value (force/adhesion width) of ≥ 4 N/mm at a 180° peeling test exists in the finished product.

The gas and vapor barrier required for the diffusion tightness of the reinforcement layer, in combination with the mechanical behavior sought according to the invention can be achieved when the reinforcement layer using tin plate has a thickness of less than 0.2 mm, preferably 0.13 mm the most. If stainless steel is used, it is possible to have even lesser layer thicknesses, namely less than 0.1 mm, preferably 0.05 mm the most. Thereby the minimal layer thickness has to be selected so that the required stiffness of the spacer profile is reached and the diffusion tightness is maintained also after bending, particularly in the bent areas. For the indicated materials a minimal layer thickness of 0.02 mm is required.

Depending on the manner in which the spacer profile is finally integrated in the insulating window unit, it can be advantageous to provide the reinforcement layer on its exposed side sensitive to mechanical and chemical influences at least partially with a protective layer. This can for instance consist of a lacquer or plastic material. It is however also possible to provide the reinforcement layer with a thin layer of the heat-insulating material, respectively the material with poor heat conductivity of the spacer profile and to embed the layer in this material at least in certain areas.

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It is preferable when the path of high heat conductivity formed by the reinforcement layer from one pane to the other is minimum 1.2 times, preferably more than 1.5 times, preferably more than 2 times, and furthermore preferable up to 4 times the width of the space between the panes.

With regard to the resilience with simultaneous material savings, the spacer profile can be optimized when the clear width between a contact web and the adjacent side wall of the chamber amounts to more than 0.5 mm. Such a minimal distance improves also the bending behavior of the spacer profile and facilitates the insertion of mechanically stabilizing sealing means.

Generally the chamber, bridge section and contact webs are made substantially with the same wall thickness. When it is intended to keep the chamber volume for receiving hygroscopic material as large as possible, then it is possible to reduce the wall thickness of all or only some walls of the chamber.

Suitable heat-insulating materials for the spacer profile have been proven to be polypropylene, polyethylene terephthalate, polyamide or polycarbonate. The plastic material can contain the usual fillers, additives, dyes, agents for UV-protection, etc.

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From a spacer profile according to the invention it is simple to produce spacer frames made in one piece for insulating window units, which have to be closed only by one connector. Namely it is possible by using commercially available bending tools to bend the spacer profile into corners, which even in this corner areas are characterized by planar surfaces of the contact webs on the side facing the pane inside in the mounted state. The chamber deformation occurring during bending will be

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are absorbed by the space between the chamber side walls and the neighboring contact web. The good pliability of the contact webs, as well as of the spacer profile according to the invention, can be probably explained by the fact that the permanent material bond between the elastically-plastically deformable, heat-insulating material, particularly of synthetic material, and the plastically deformable reinforcement layer, particularly of metal, insures a good balance of forces even during cold bending. However it could still be advantageous to slightly warm the bending point, so that relaxation processes are accelerated. The connector is designed either as a corner connector or, connects as a straight connector the cold-bent spacer profile in a connection area outside the corners, for instance in the middle of a pane edge.

Furthermore the invention comprises an insulating window unit with at least two opposite panes and a spacer frame consisting of a spacer profile as described above, whereby the spacer frame with the panes define an intermediate pane space, wherein the contact webs are bonded substantially over their entire length and height with the inner pane side facing them and wherein the clear space between contact webs and chamber, as well as at least the connection area to the neighboring inner pane side are filled with a mechanically stabilizing sealing material.

According to an advantageous embodiment, in the insulating window unit the mechanically stabilizing sealing material basically fills up entirely the free space to the outer peripheral margin of the window unit. Commercially available insulating glass adhesives based on polysulfide, polyurethane or silicon have proven themselves to be suitable sealing materials. As a diffusion-tight adhesive material for bonding the contact webs with inner pane side for instance a butyl sealing material on a polyisobutylene basis is suitable.

In the following the invention will be further explained with reference to the drawing. It shows:

Figure 1 a first embodiment of a spacer profile in cross section;

Figure 2 a second embodiment of the spacer profile in cross section;

Figure 3 a third embodiment of the spacer profile in cross section;

Figure 4 a fourth embodiment of the spacer profile in cross section;

Figure 5 a fifth embodiment of the spacer profile in cross section;

Figure 6 a sixth embodiment of the spacer profile in cross section;

Figure 7	a detail view of a spacer profile in contact with a pane of an insulating window unit;
Figure 8	a further detail view of a spacer profile in contact with a pane of an insulating window unit;
Figure 9	seventh embodiment of a spacer profile in cross section;
Figure 10	an eighth embodiment of a spacer profile in cross section;
Figure 11	a ninth embodiment of a spacer profile in cross section;
Figure 12	a tenth embodiment of a spacer profile in cross section;
Figure 13	an eleventh embodiment of a spacer profile in cross section;
Figure 14	a spacer profile in the mounted state in an insulating window unit;
Figure 15	a mounting variant for a spacer profile in an insulating window unit;
Figure 16	a spacer profile according to the state of the art in cross section; and
Figure 17	a peripheral bond of an insulating window unit with the spacer profile of Figure 16.

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Figures 1 to 6 and 9 to 13 show cross section views of spacer profiles. Normally this cross section does not change over the entire length of a spacer profile, except for the tolerances defined by the manufacturing techniques.

In figure 1 a first embodiment of a spacer profile according to the present invention is shown in a cross-sectional view. A chamber 10 with a substantially rectangular cross section is filled with a hygroscopic material not shown in the drawing, for instance a silica gel or molecular sieve, which through slits or perforations 50 which are formed in a wall 12 of the chamber 10, can absorb moisture from the space between the panes. To the corner areas of the wall 12 bridge segments 32 and 34 are connected which continue with the contact webs 30 and 36. These contact webs 30, respectively 36, have a height which is smaller than the height of the neighboring side walls 14, respectively 16 of the chamber, and extend parallelly to the same. In this embodiment of the spacer profile, all walls, bridge sections and contact webs have approximately the same thickness. The contact webs 30, 36 are a permanently bonded sandwich compound made of the elastically-plastically deformable profile corpus material and of a therein embedded plastically deformable reinforcement layer 40. The bending behavior in the area of the contact webs 30, 36 is already considerably improved due to the arrangement of the reinforcement layer 40, particularly a deformation of the contact webs 30, 36 is avoided during bending. In this variant the material of the profile corpus has to be diffusion-tight. Alternately a not represented diffusion-tight layer has to be provided, which extends substantially over the entire width and length of the profile.

The variant represented in Figure 2 has a profile corpus corresponding to Figure 1. The plastically deformable reinforcement layer 40 is diffusion-tight and provided on the outer side of the profile spacer which in the mounted state faces towards the margin of the insulating window unit. They extend substantially from the contact surface of the first contact web 30 around the same over its chamber-side surface towards the bridge section 32, then around the chamber 10 up to the bridge section 34 and around the contact web 36. The usual mounting manner for such a spacer profile would be so that the wall 12 would face the space between the panes, so that the same would be kept free of moisture by the hygroscopic material inside chamber 10. Due to the fact that the reinforcement layer 40 covers the contact surface of the contact webs 30, 36 a better adhesion capability with the adhesive used later for bonding the spacer profile with the insulating window unit is achieved. Besides the bending behavior in the area of the contact webs is improved

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due to the basically all-around permanently bonded sandwich compound. The effective heat-conductive path from the closest point to the pane on the side of the first pane to the closest point on the side of the second pane with the mounted spacer profile, i.e. the segments of the reinforcement layer 40 on the contact surfaces of the contact webs 30, 36 do not contribute significantly to the heat-conductive path.

Another variant for the formation of the reinforcement layer 40 is shown in Figure 3. In this variant the reinforcement layer 40 ends before each of the contact surfaces of the contact webs 30, 36. Further the wall 12 of the chamber 10 from Figure 1 is practically completely replaced by a porous layer 52, through which the moisture from the space between the panes can enter the chamber 10 and be absorbed by the hygroscopic material.

In the embodiment of Figure 4, the contact webs 30 and 36 are prolonged, so that they project beyond the outside of chamber 10, which has a trapezoidal cross section. This results in a further prolonged effective heat-conductive path through the reinforcement layer 40. The trapezoidal configuration of the cross section of chamber 10 increases the clear space between chamber 10 and the contact webs 30, respectively 36, wherein later during the assembly of the insulating window unit additional sealing material can be introduced. On the surface 12 of the chamber 10 facing the space between the panes in the mounted state, a decorative layer 54 is applied, which extends over the bridge sections 32 and 34. Instead of the decorative layer 54, also a layer reflecting heat radiation can be provided. Perforations for access to the inside of chamber 10 are not shown in the drawing.

In the embodiment according to Figure 5 the height of the contact webs 30, 36 is selected so that it is basically equal to the height of the respectively neighboring side wall 14, 16 of the chamber 10. By selecting the dimensions of the clear width y between the contact webs 30, 36 and the respectively neighboring side wall 14, 16 of chamber 10, it is possible to determine the spring behavior of the spacer profile, i.e. the elastic behavior with respect to the bending deformation or position changes of the panes of the insulating window unit in the mounted state. Thereby the contact webs 30, 36 can for instance be deformed until they lie against the neighboring chamber wall 14, 16. The reinforcement layer 40 runs around the exposed sides of the contact webs 30, respectively, i.e., covers their contact surfaces and their chamber-side surfaces, but then, after the transition point at the bridge sections 32, respectively 34, it is embedded in the material of the walls 14, 18, 16 of chamber

10. Here an optimal protection of the reinforcement layer is achieved at least in the area of chamber 10.

The elasticity of the contact webs 30, 36 can also be set when the same, such as in the embodiment example of Figure 6, do not run parallelly to the neighboring chamber walls 14, 16, but under a certain angle α different from zero with respect to the neighboring wall 14, 16 of chamber 10. Thereby the contact webs 30, 36 can also be angled, in order to insure a good contact to the pane inside. This design offers here also the possibility to extend the reinforcement layer 40. The angle α equals here approximately - 30° respectively + 30° with respect to the longitudinal median axis L of the cross section of chamber 10.

With correspondingly prolonged bridge section, the contact webs can also be arranged at an angle towards the chamber, as shown in the detail view in Figure 7. Thereby in the mounted state exists a line contact from the contact web 30 to the inner side of a pane 102. Besides the contact web 30 forms an angle β which differs from zero with the pane 102. In this embodiment under circumstances the effective path for heat conduction of the diffusion-tight layer 40 is shortened, when the same can not be drawn over the entire contact surface of the contact web 30 facing the pane 102.

This drawback is avoided by the embodiment according to Figure 8, in that at the end of the contact web 30 closest to the bridge section a contact rib 38 is provided. the contact rib 38 lies against the inside of pane 102, the reinforcement layer 40 ends under the contact rib 38. With the contact rib 38 it is possible to set a defined distance between the contact web 30 and the pane 102, thereby setting a defined (minimal) thickness of the intermediate adhesive layer (not shown) between the contact web 30 and the pane 12, this way preventing the adhesive from being pushed out towards the space between the panes.

In Figure 9 a seventh embodiment of the spacer profile is represented, wherein the bridge sections 32, 34 are basically arranged on a transverse median axis of the chamber cross section and the corresponding contact webs 30, 36 extend beyond the side walls 14. 16 of chamber 10.

A "double-T variant" of the embodiment example of Figure 9 is represented in Figure 10. Here the bridge sections 32,34 are again arranged centrally on a side wall 14, respectively 16 of chamber 10, the contact webs 30, respectively 36 extending symmetrically thereto.

The embodiment example of Figure 11 corresponds to the one of Figure 2, whereby the chamber wall 12 of Figure 2 is completely omitted, therefore the chamber 10 being designed as a trough. The hygroscopic material is embedded in a polymer matrix 60, which is held in the chamber 10 by an adhesion. In the modified embodiment of Figure 11 represented in Figure 12, the reinforcement layer 40 runs from the contact surfaces of the contact webs 30, 36, over the bridge sections 32, 34 inside the chamber 10, thereby surrounding the hygroscopic material in the polymer matrix 60, which in the mounted state is still open towards the space between the panes.

In the embodiment example according to Figure 13, the walls 14, 16 and 18 of chamber 10 are made with a slimmer wall thickness than the bridge sections 32, 34, respectively the contact webs 30, 36 and the wall 12. This way more hygroscopic material can be lodged in the chamber 10. When selecting the wall thickness it has to be considered that external forces acting on the panes of the insulating window unit have to be absorbed by the spacer profile, so that the same must have a sufficient buckling resistance (rigidity) against this load over the intermediate pane space.

The spacer profile of the invention can be bent to form a frame and assembled with fittingly cut panes into an insulating window unit. Figures 14 and 15 show assembly variants.

In the variant according to Figure 14 the spacer profile 100 is in contact with one side of the chamber essentially with the outer edges of panes 102, 104. In order to protect the sensitive reinforcement layer 40, the latter is provided on the outside with a protection layer 110 which extends at least so far as to protect the area not covered by adhesives 106, respectively sealing material 108. The spacer profile 100 is affixed at first on the inside of the pane 102, 104 by means of a butyl adhesive 106. The remaining space is afterwards filled with mechanically stabilizing sealing material 108.

The variant according to Figure 15 offers the possibility of higher mechanical stability and also of improved protection of the reinforcement layer 40 against external influences, in that the spacer profile 100 is offset further towards the pane inside. The mechanically stabilizing sealing material is thereby extended on the pane outer edge at least up to the neighboring pane inside (simply hatched areas of 108 of Figure 15). It is further preferred to fill completely the clear space between the pane insides and the outside of the spacer profile with mechanically stabilizing sealing material (double-hatched area 108 in Figure 15).

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Example 1

As a plastically-elastically deformable, heat-insulating material for the profile corpus according to the embodiment of Figure 2, polypropylene Novolen 1040K with a wall thickness of 1 mm was used, whereby as a reinforcement layer a tin-plate foil (technical name: andralyt E2, 8/2, 8T57) with a thickness of 0.125 mm was used. The foil was laminated onto the profile corpus.

The chemical composition of this tin plate is: carbon 0.070 %, manganese 0.400 %, silicon 0.018 %, aluminum 0.045 %, phosphorus 0.020 %, nitrogen 0.007 %, the balance being iron. On the sheet iron a tin layer with a weight/surface ratio of 2.8 g/m^2 was applied, which corresponds to a thickness of 0.38 μm.

The finished spacer profile had a width of 15.5 mm including the contact webs and a height of 6.5 mm. The clear width between chamber and contact web, respectively including the tin-plate foil amounted to 4.6 mm. On the one side facing the plastic material the tin-plate foil was provided with a 50μm-layer of bonding agent on a basis of polypropylene. The chamber was filled with a conventional drying agent (molecular sieve phonosorb 555 produced by the firm Grace). Towards the space between the panes a two rows of perforations were provided in the chamber wall.

The spacer profile was cut into 6 m long profile rods and then further processed on conventional bending devices. With the aid of an automatic bending machine produced by F.X. BAYER of the type VE spacer frames cut to customized specification were produced, whereby four corners were bent and the connection of the end pieces was performed with a straight connector.

The spacer frame was connected in the usual manner with two correspondingly large float-glass panes to form an insulating window unit. One of the panes was provided with a heat-protective layer with an emittance of 0.1. The insulating window units were filled in a gas-filling press with argon with a content of more than 90 % by volume.

The peripheral sealing was performed according to Figure 15, whereby also the outside of the spacer (particularly the outer wall 18 of the chamber 10, Figure 2) was covered. As adhesive 106 a butyl sealing material on a polyisobutylene basis was used (width between glass 102 and neighboring contact web: 0.25 mm, height: 4 mm). The remaining clear spaces were filled with a polysulfide adhesive 108, whereby the outer wall coverage of the spacer was 3 mm.

Example 2

A spacer profile was produced corresponding to Example 1, whereby however as reinforcement layer a stainless steel foil (type Krupp Verdol Aluchrom I SE) with a thickens of 0.05 mm was used.

The chemical composition of this stainless steel is: chrome 19 - 21 %, carbon maximum 0.03 %, manganese maximum 0.50 %, silicon maximum 0.60 %, aluminum 4.7 - 5.5 %, the balance being iron.

The characteristic values of the materials used in Examples 1 and 2 are comprised in the following Table 1:

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Table 1

	tinplate 0.125 μm w/ a 50 μm bonding agent coating andralyt E2, 8/2, 8T57	stainless steel 0.05 μm Krupp Werdol Aluchrom I SE	polypropylene Novolen 1040K
E-Module	200 kN/mm^2	210 kN/mm^2	1.9 kN/mm^2
tenacity	350 N/mm^2	650 N/mm^2	38 N/mm^2
elasticity limit	280 N/mm^2	580 N/mm^2	38 N/mm^2
breaking elongation	15 %	12 %	500 %
thermal conduction coefficient transverse to rolling direction	35 $W/m \cdot K$	13.6 $W/m \cdot K$	0.15 $W/m \cdot K$
extensibility	0.2 %	0.2 %	7 %

Example 3

An insulating glass pane unit was produced with a conventional metallic spacer according to Figure 16 and a peripheral seal according to Figure 17.

The box-like hollow profile consisted of aluminum with a wall thickness of 0.38 mm (manufacturer: e.g. the firm Erbslöh). The profile has a width of 15.5 mm and a height of 6.5 mm. The spacer profile was bonded with the panes with an isobutylene sealing material at the height of the contact surfaces with the panes 102, 104, whereby the adhesive were used according to Example 1. The remaining gap was filled with a polysulfide adhesive 108, the covering of the outer wall thereby amounting to 3 mm.

The heat transport in the area of the peripheral bond was determined for he insulating window units described in Examples 1 to 3 with the assistance of heat flow simulation calculations. With the commercially available software program "WINISO 1.3" of the firm Sommer Informatik GmbH two-dimensional heat fields were calculated. From the representation of the isotherms calculated this way the below-indicated glass surface temperature in the area of the peripheral bond were established. They are a measure for the quality of the heat insulation. Higher temperatures in the peripheral area improve the k-value and therewith the heat barrier of the window and reduce the formation of condensate.

Besides values for which manufacturer specification are available, for this calculations also heat-conduction indications according to DIN 4108 Part 4, respectively according to prEN 30 077 were also included. The data is presented in the following Table 2.

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Table 2

Name of Material	Heat conductivity (W/m·K)
glass	1.0
aluminum	220
stainless steel	15
tin plate	35*
polypropylene	0.22
polysulfide	0.19
butyl	0.24
molecular sieve	0.13
argon	0.016

* Manufacturer indication

The calculations were performed with the measurement and geometries according to the individual examples, whereby as it was assumed that the external temperature was 0°C and the internal temperature was 20°C.

The surface temperatures in the area of the peripheral bond on the warm side, respectively 0 mm, 6 mm and 12 mm starting from the glass edge are indicated in Table 3.

Table 3

Spacer	polypropylene + stainless steel	stainless steel +tin plate	aluminum
Surface temp. (°C) on warm side			
0 mm from glass edge	12.3	10.9	8.2
6 mm from glass edge	12.7	11.1	8.3
12 mm from glass edge	13.5	12.5	9.8

The results make clear the improved heat insulation of the spacer profile according to the present invention over the conventional aluminum spacer profiles. The variant polypropylene with stainless steel foil is thereby particularly suited in cases where a high degree of heat insulating capability is required, while the variant polypropylene with tin plate offers pliability advantages.

Insulating window units according to Example 1 were subjected to tests according to insulation glass standards prEN 1279 Part 2 and Part 3. The requirements regarding long-term behavior, vapor and gas tightness were fully met.

The features of the invention disclosed in the preceding description, in the drawing as well as in the claims can be essential to the invention, individually as well as in combination.

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List of Reference Numerals

10	chamber
12	wall facing the space between panes
14	side wall of the chamber
16	side wall of the chamber
18	outer wall of the chamber
30	contact web
32	bridge section
34	bridge section
36	contact web
38	contact rib
40	reinforcement layer
50	perforations
52	porous area
54	decorative layer
60	polymer matrix
100	spacer profile
102	pane
104	pane
106	adhesive
108	sealing material

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Patent Claims

1. Spacer profile for a spacer frame to be mounted in the space between panes forming an insulating window unit, with a chamber (10) for receiving hygroscopic material and with at least one contact web (30, 36) for lying against the inside of a pane on at least one side of the chamber (10), which is connected with the chamber (10) via a bridge section (32, 34), whereby the profile corpus has at least one outwardly open area with a U-shaped cross section, whose flanks are formed by the contact web (30, 36) and the adjacent side wall (14, 16) of the chamber (10) and its base is formed by the bridge section connecting the same, characterized in that the profile corpus of the spacer profile consists of an elastically-plastically deformable material with a heat conduction value of λ < 0.3 W/(mK), that the flanks of the area with a U-shaped cross section has a height which is at least twice the width of the base, and that at least the contact web (30, 36) is permanently materially connected with a deformable reinforcement layer (40) made of a metal with a heat conduction value of λ < 50 W/(Mk).

2. Spacer profile according to claim 1, characterized in that the flanks of the U-shaped cross-sectional area have a height

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which is at least three times, and further preferably at least 5 times the width of the base.

3. Spacer profile according to one of the preceding claims, characterized in that the reinforcement layer (40) is arranged on the contact surface of the contact web (30, 36).

4. Spacer profile according to one of the preceding claims, characterized in that the reinforcement layer (40) is arranged on the chamber-side surface of the contact web (30, 36).

5. Spacer profile according to one of the preceding claims, characterized in that the profile corpus is permanently materially connected with a reinforcement layer (40) extending substantially over its entire width and length.

6. Spacer profile according to one of the preceding claims, characterized in that the reinforcement layer (40) is diffusion-tight at least in the area of the walls (14, 16, 18) of the chamber (10) and of the bridge sections (32, 34).

7. Spacer profile according to one of the preceding claims, characterized in that the reinforcement layer (40) is arranged on

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the outside of the profile corpus or at least partially embedded close to the surface of the same.

8. Spacer profile according to one of claims 1 or 2, characterized in that the reinforcement layer (40) is arranged on the chamber-side surface of the contact web (30, 36), on the outside of the bridge section (32, 34) connected with the contact web (30, 36), as well as on the outside of the side wall (14, 16) of the chamber (10) adjacent to the contact web (30, 36), and that the reinforcement layer (40) is diffusion-tight at least in the area of the bridge section (32, 34) and the side wall (14, 16) of the chamber (10).

9. Spacer profile according to claim 1 or 2, characterized in that the reinforcement layer (40) extends continuously from the contact surface of the contact web (30, 36) over its chamber-side surface, the outer side of the bridge section (32, 34) connected with the contact web (30, 36), the outer side of the neighboring side wall (14, 16) of the chamber (10), as well the outer side of the outer wall (18) of the chamber (10), and that the reinforcement layer (40) is diffusion-tight at least in the area of the bridge section (32, 34) and the side wall (14, 16) of the chamber (10).

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10. Spacer profile according to one of the preceding claims, characterized in that the chamber (10) is centrally arranged and that on both sides of the chamber (10) at least one contact web (30, 36) is provided.

11. Spacer profile according to one of the preceding claims, characterized in that the chamber (10) has a substantially polygonal cross section, particularly rectangular or trapezoidal.

12. Spacer profile according to one of the preceding claims, characterized in that the bridge section (32, 34) for the connection of at least one contact web (30, 36) is fixed in a corner area of the chamber (10), preferably in a corner area arranged close to the space between the panes.

13. Spacer profile according to one of the preceding claims, characterized in that the height of the contact web (30, 36) is smaller or substantially equal with the height of the adjacent side wall of the chamber (10).

14. Spacer profile according to one of the preceding claims, characterized in that the contact web (30, 36) projects beyond the wall(12) facing towards the space between the panes of the

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insulating window unit, or towards the outer wall (18) of the chamber (10) opposite thereto.

15. Spacer profile according to one of the preceding claims, characterized in that the contact web (30, 36) is arranged parallelly to one side wall of the chamber (10).

16. Spacer profile according to one of the preceding claims, characterized in that the reinforcement layer (40) consists of tin plate or stainless steel.

17. Spacer profile according to claim 16, characterized in that the reinforcement layer (40) has a thickness of at least 0.02 mm.

18. Spacer profile according to claim 16 or 17, characterized in that the reinforcement layer (40) of tin plate has a thickness of at least 0.2 mm, preferably 0.13 mm at the most.

19. Spacer profile according to claim 16 or 17, characterized in that the reinforcement layer (40) of stainless steel has a thickness of less than 0.1 mm, preferably 0.05 mm at the most.

20. Spacer profile according to one of the preceding claims

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characterized in that the reinforcement layer (40) is provided at least partially on its outside with a protective layer (110).

21. Spacer profile according to one of the preceding claims, characterized in that the path of higher heat conductivity from one pane to the other, formed by the reinforcement layer (40), equals at least 1.5 times, preferably more than 2 times, and further preferably up to 4 times the width of the space between the panes.

22. Spacer profile according to one of the preceding claims, characterized in that the clear width between the contact web (30, 36) and the neighboring wall of the chamber (10) equals at least 0.5 mm.

23. Spacer profile according to one of the preceding claims, characterized in that the chamber (10), the bridge section (32, 34) and the contact web (30, 36) have substantially the same wall thickness.

24. Spacer profile according to one of claims 1 to 22, characterized in that at least one of the walls (12, 14, 16, 18) of the chamber (10) have a reduced wall thickness with respect to

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the bridge section (32, 34) and the contact web (30, 36).

25. Spacer profile according to one of the preceding claims, characterized in that the profile corpus is made of polypropylene, polyethylene terephthalate, polyamide or polycarbonate.

26. Insulating window unit with at least two panes facing each other at a distance and with a spacer frame made of a spacer profile according to one of claims 1 to 27, which together with the panes defines an intermediate pane space, characterized in that the contact webs (30, 36) are glued to the inner pane side facing them over substantially their entire length and height by means of a diffusion-tight adhesive (106) and that the clear space between the contact webs (30, 36) and the chamber (10), as well as at least the connection area to the neighboring inner side of the pane are filled with a mechanically stabilizing sealing material (108).

27. Insulating window unit according to claim 26, characterized in that the mechanically stabilizing sealing material (108) basically fills the free space to the peripheral margins of the insulating window unit completely.

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28. Insulating window unit according to claim 26 or 27, characterized in that the mechanically stabilizing sealing material (10) is a sealing agent on a polysulfide, polyurethane or silicon basis.

29. Insulating window unit according to claim 27 or 28, characterized in that the contact webs (30, 36) are glued together with the inner side of the panes by means of a butyl sealing material on a basis of polyisobutylene.

Fig. 1

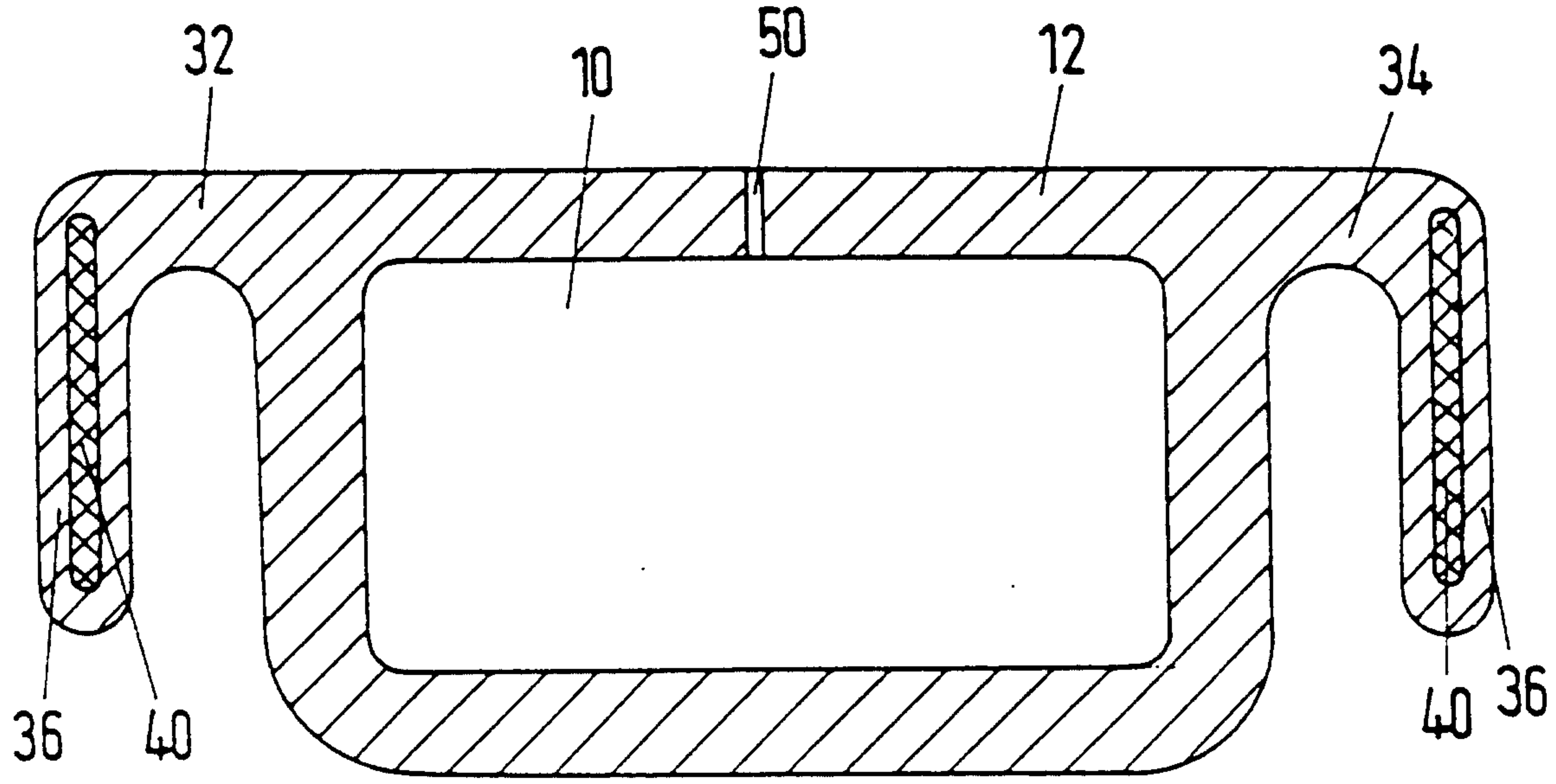

Fig. 2

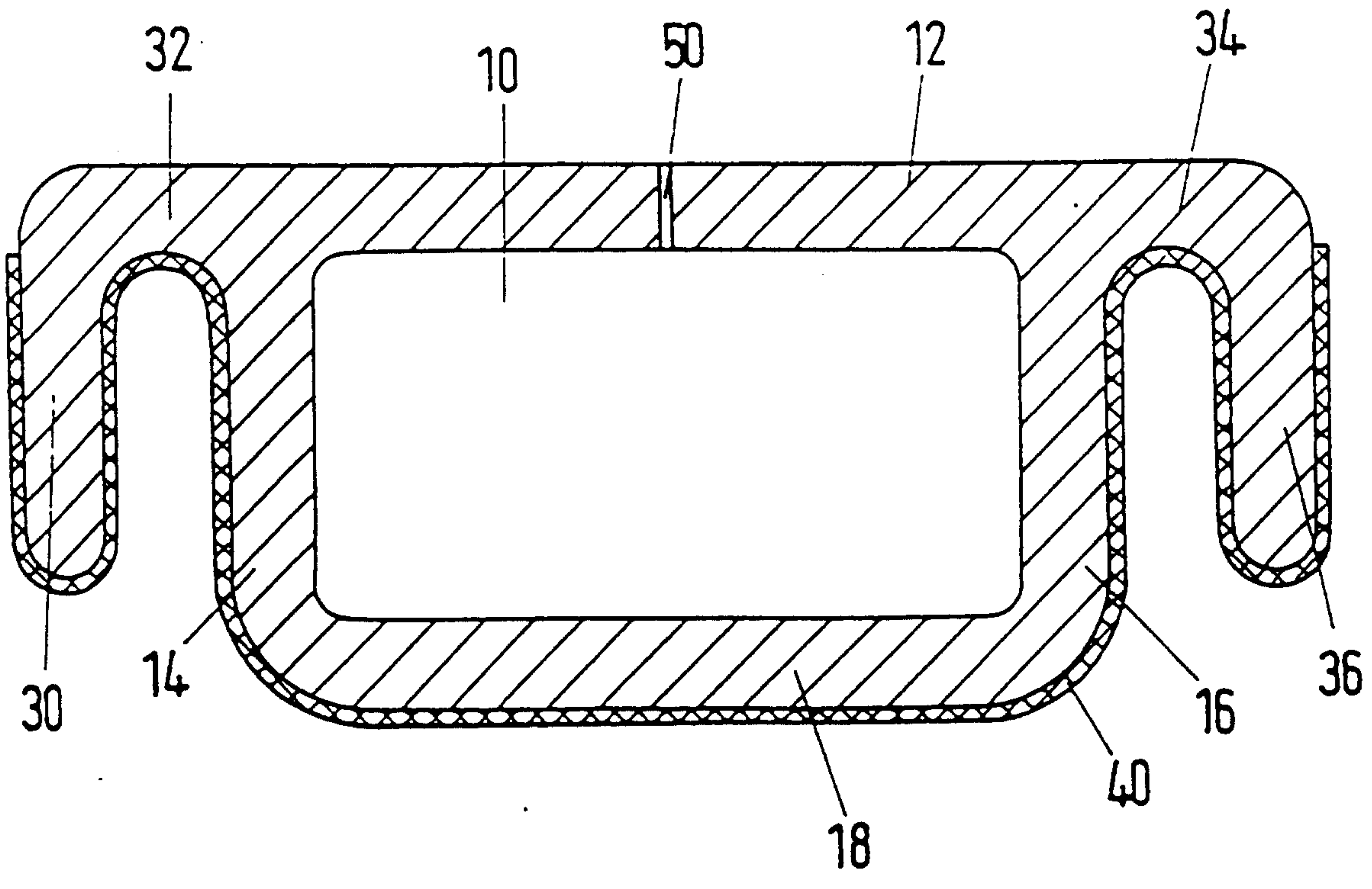

Fig. 3

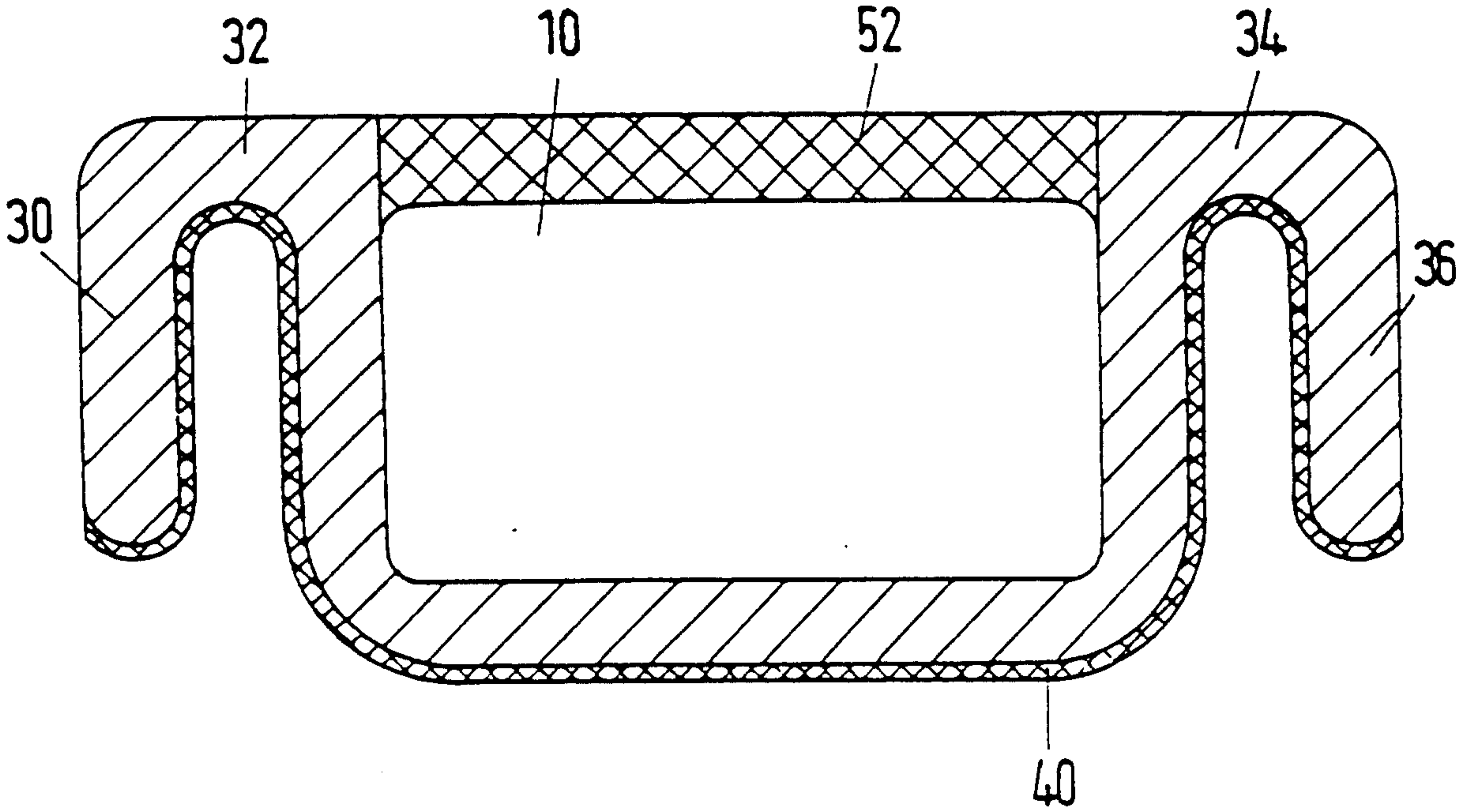

Fig. 4

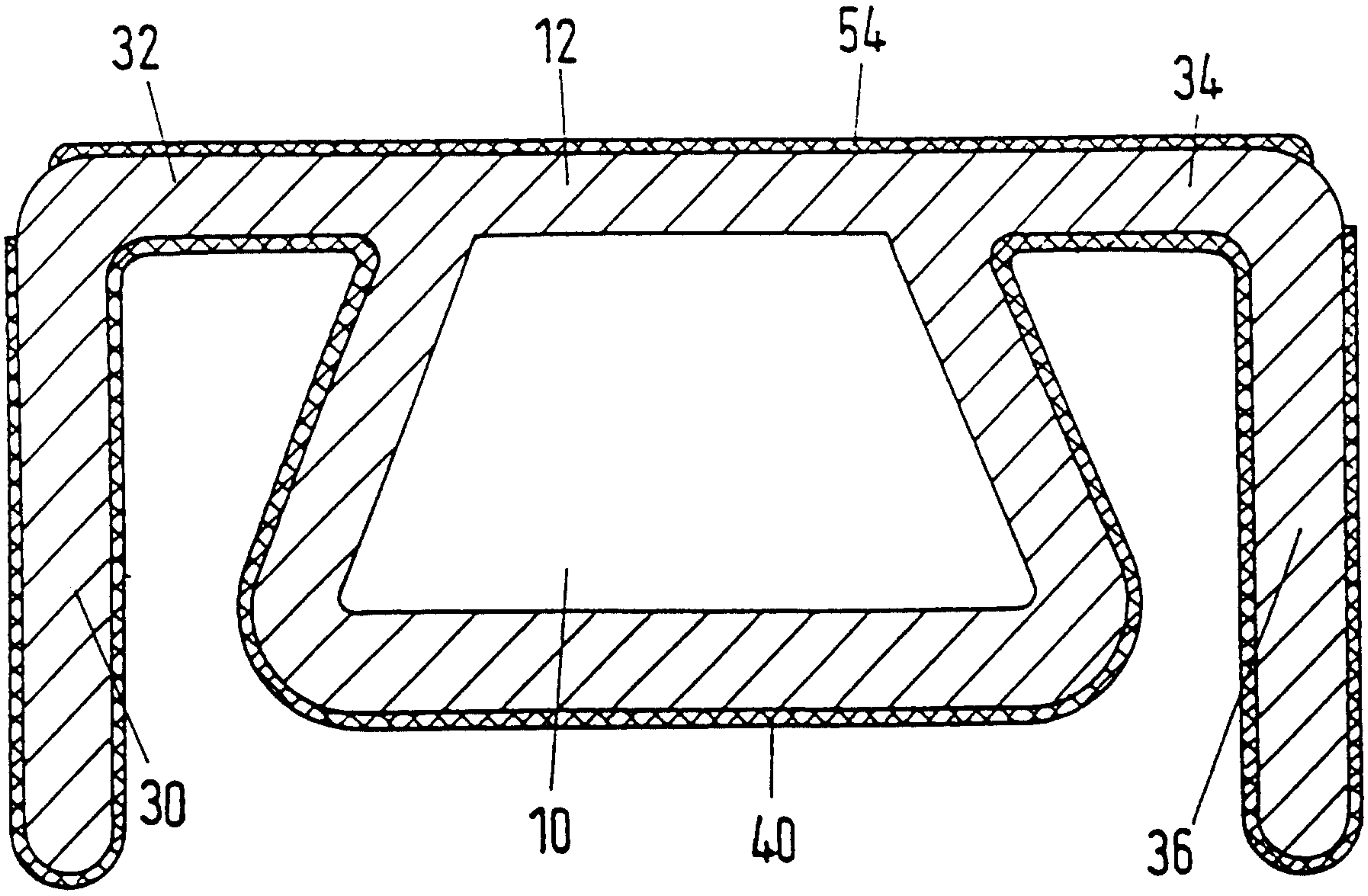

Fig.5

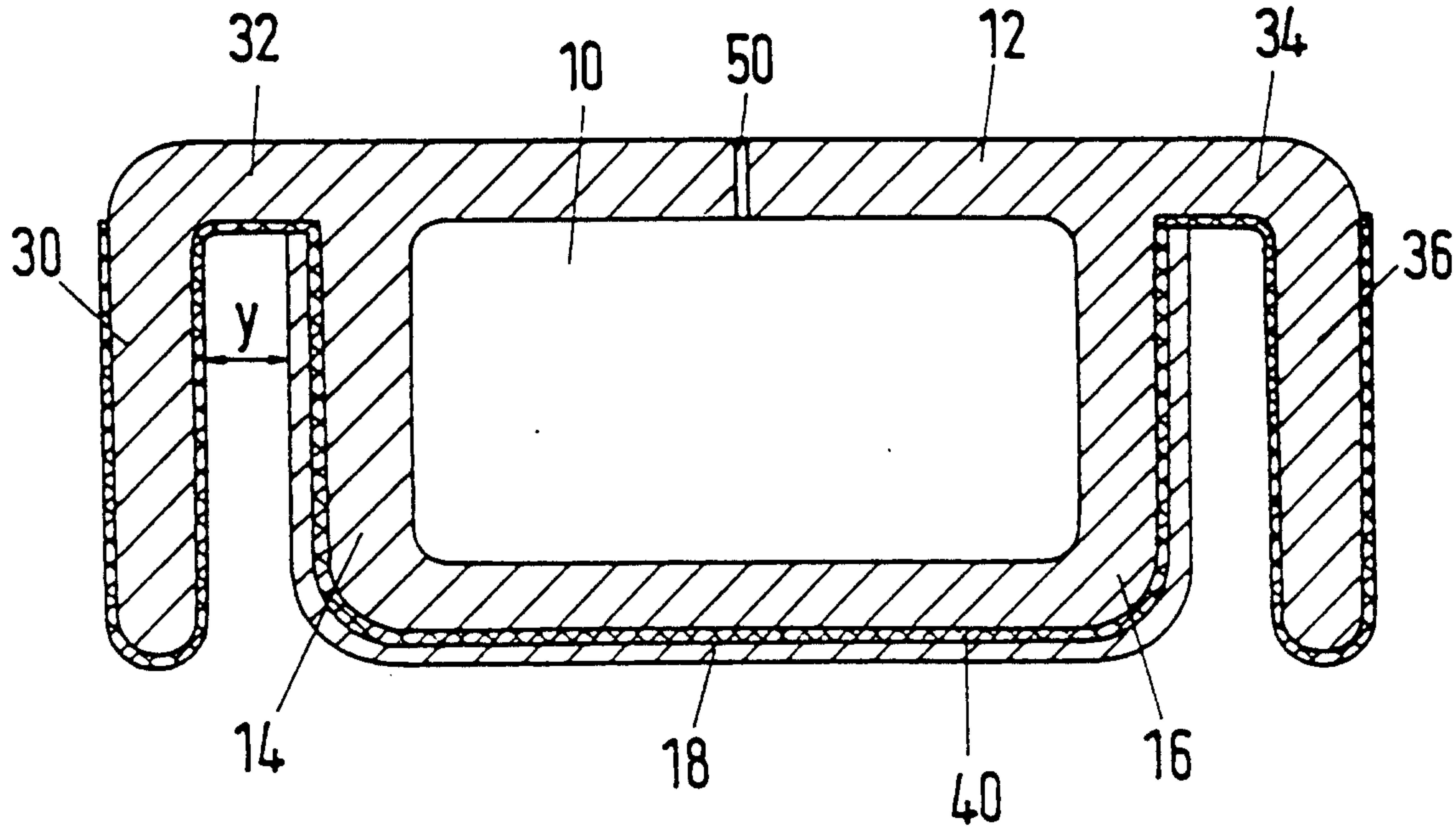

Fig.6

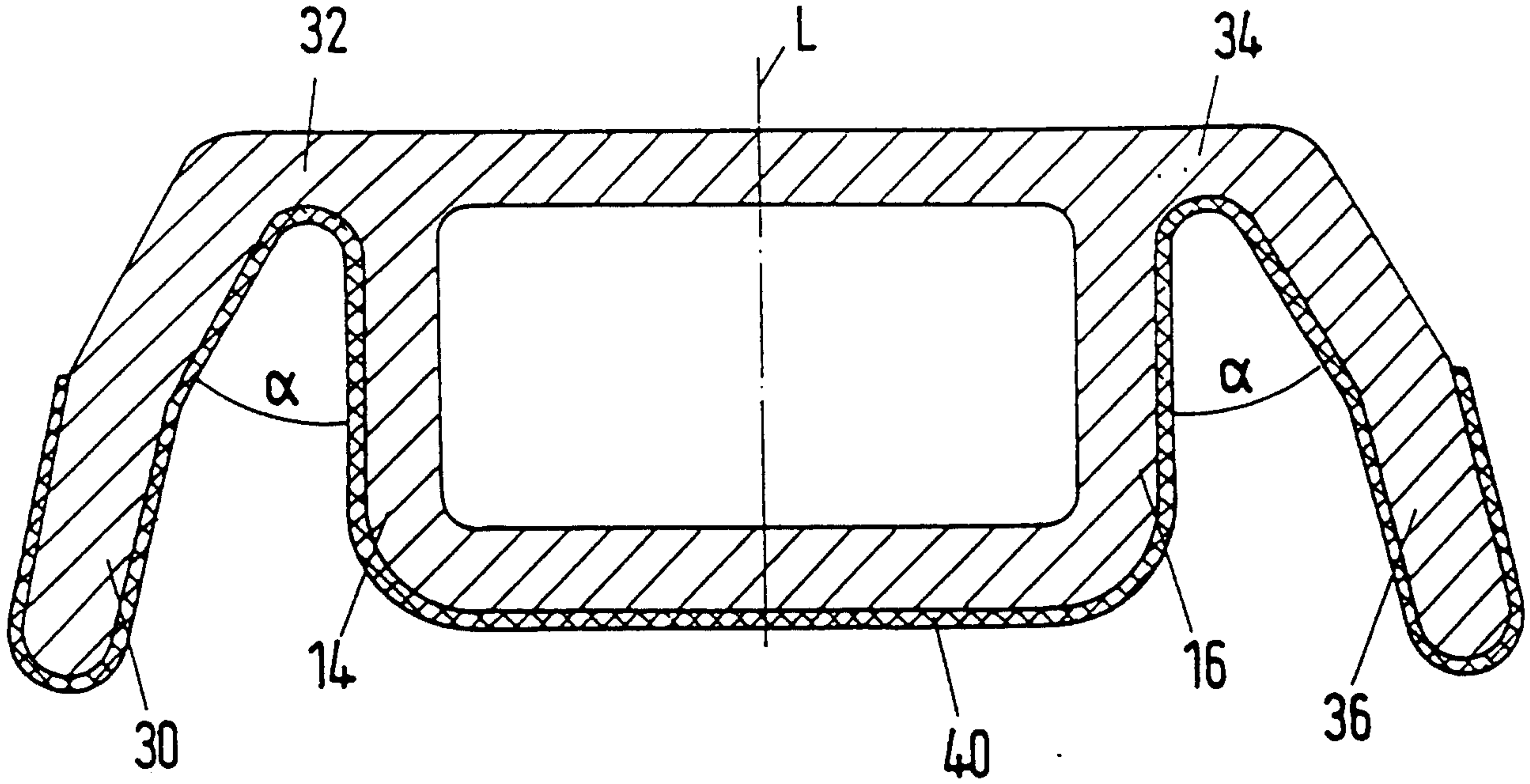

Fig.7

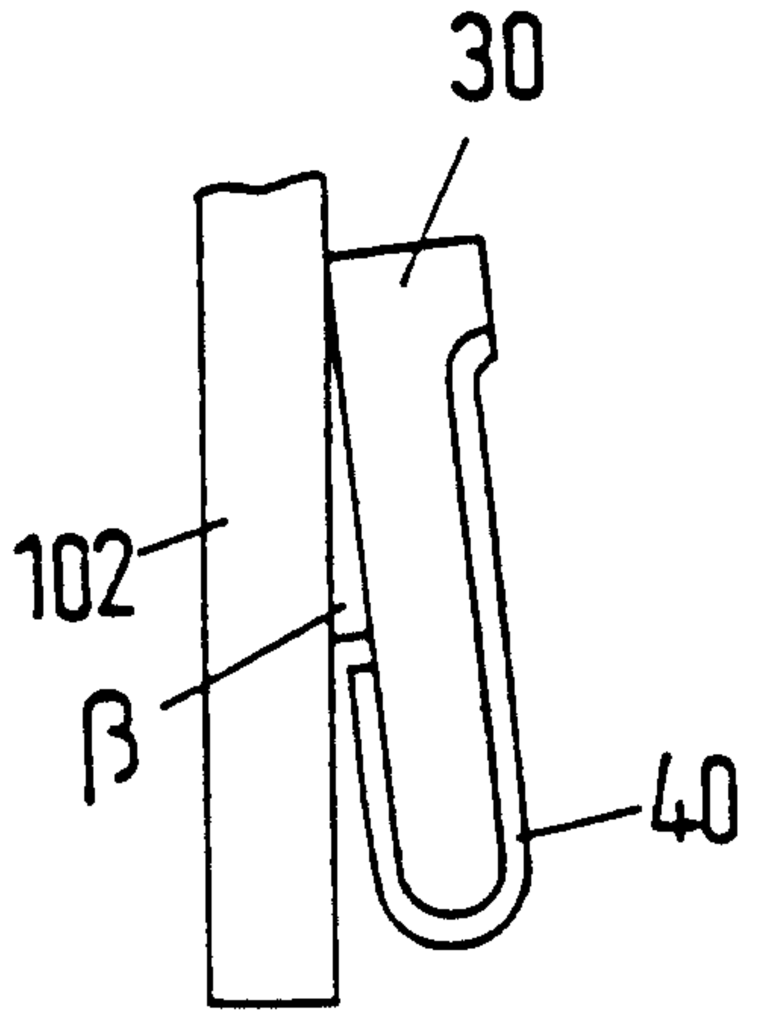

Fig.8

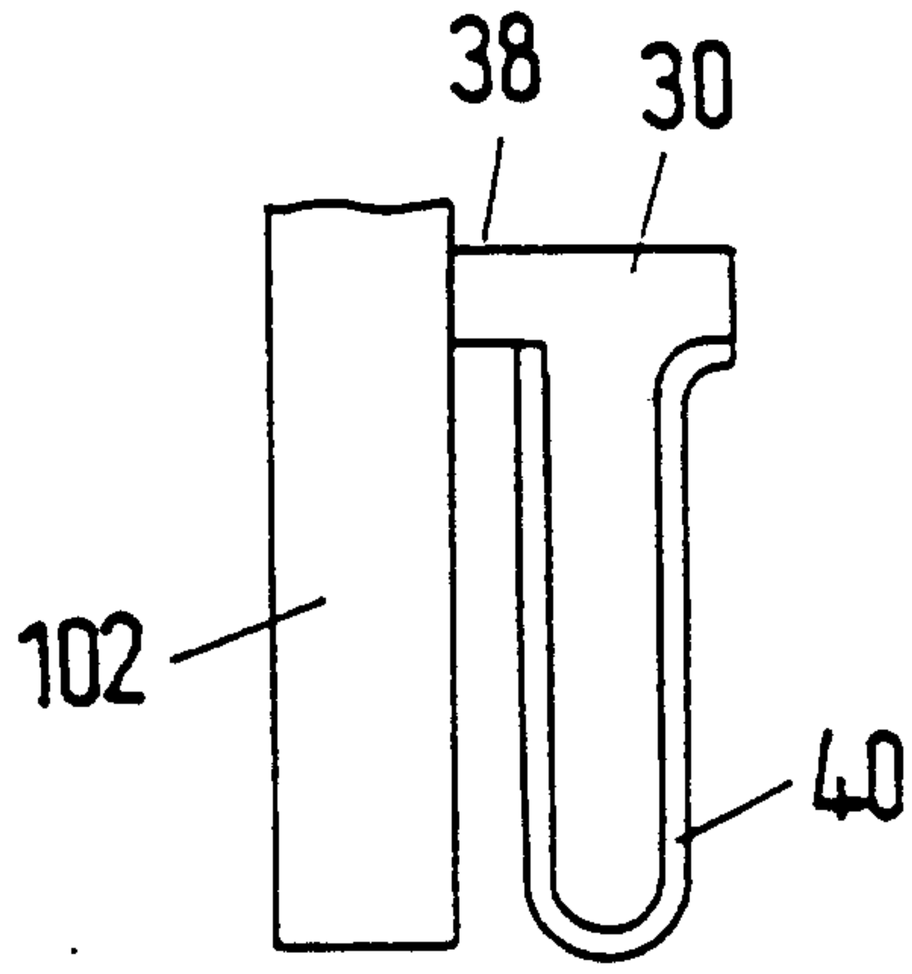

Fig.9

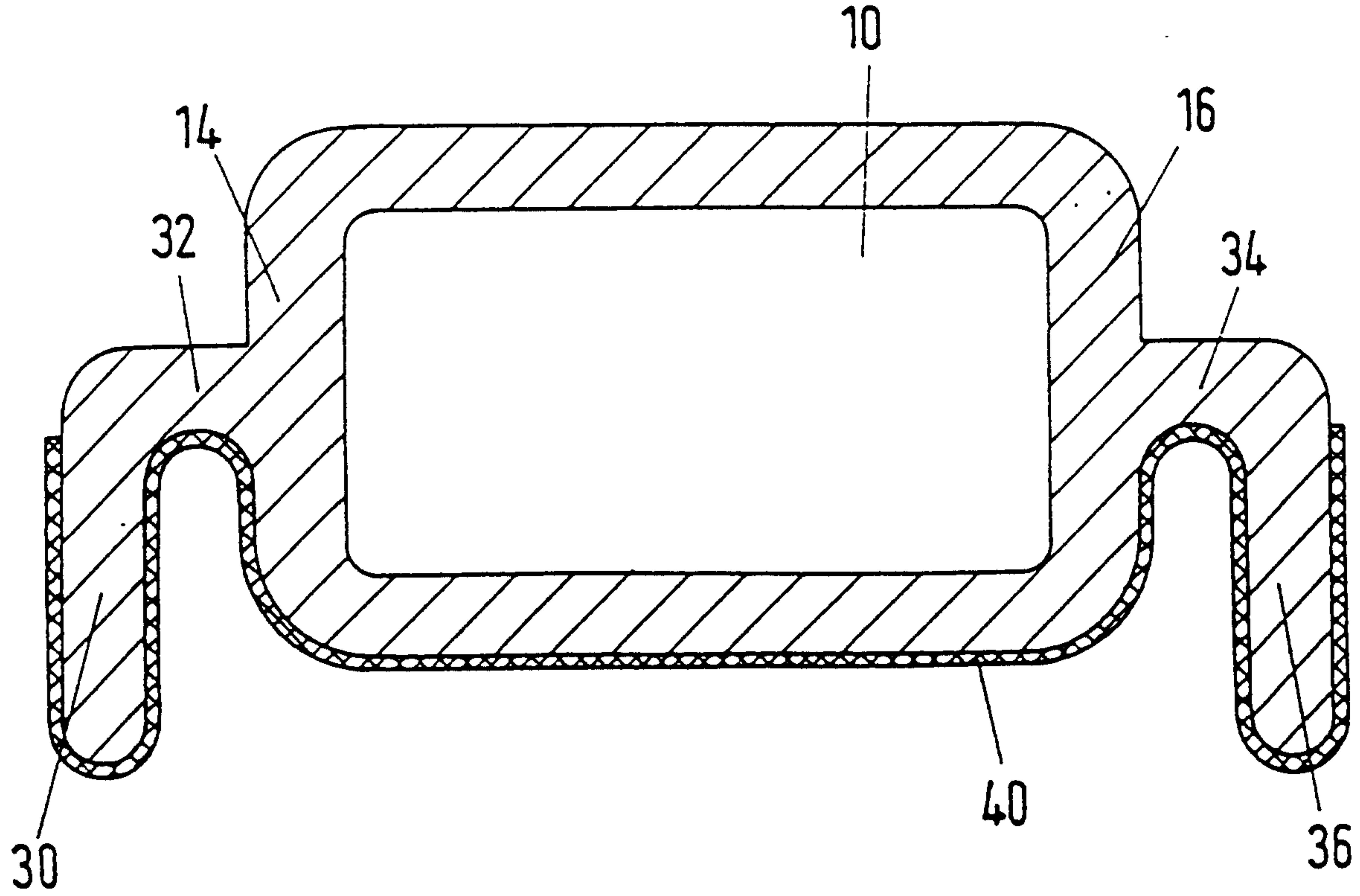

Fig. 10

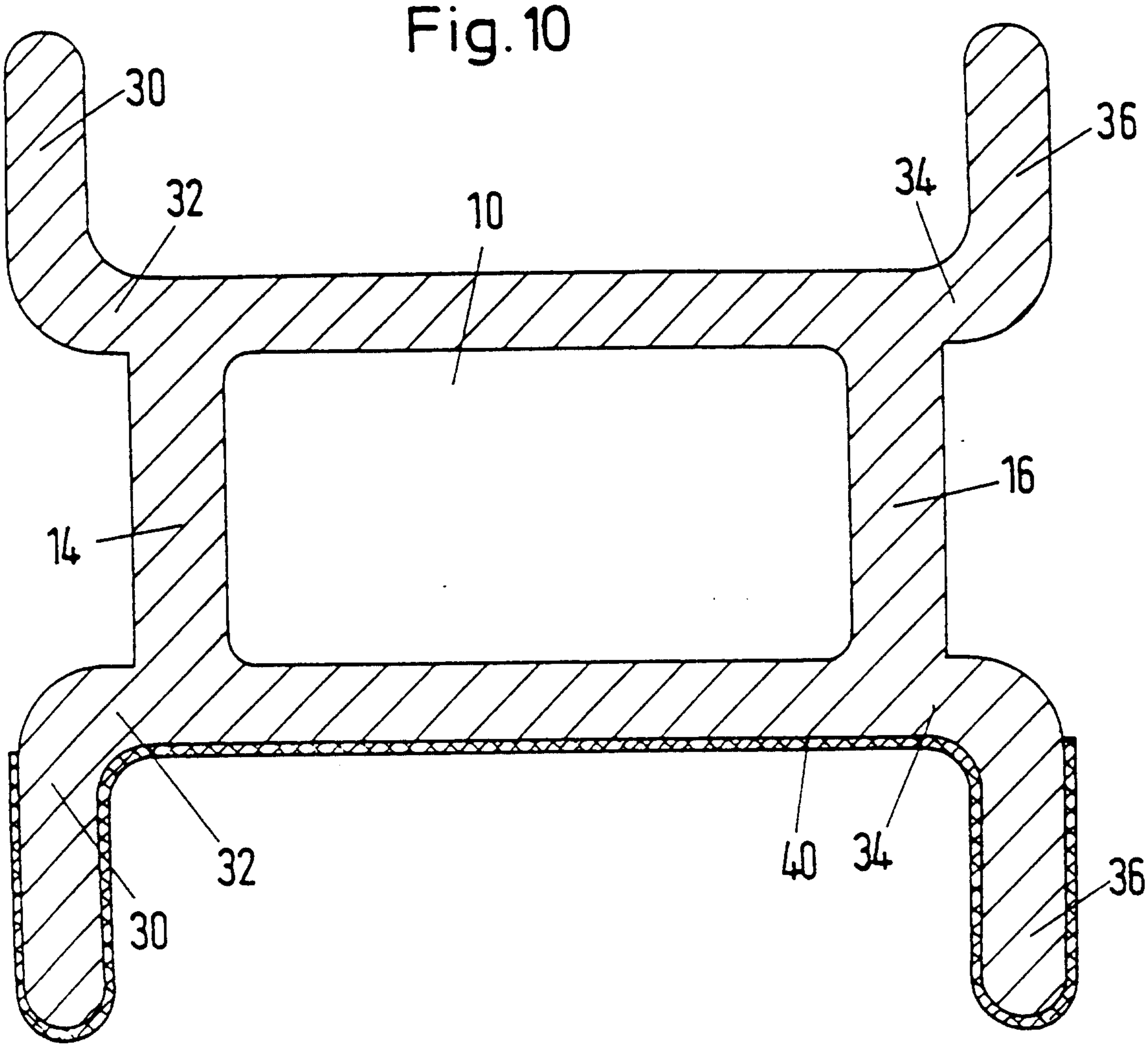

Fig.11

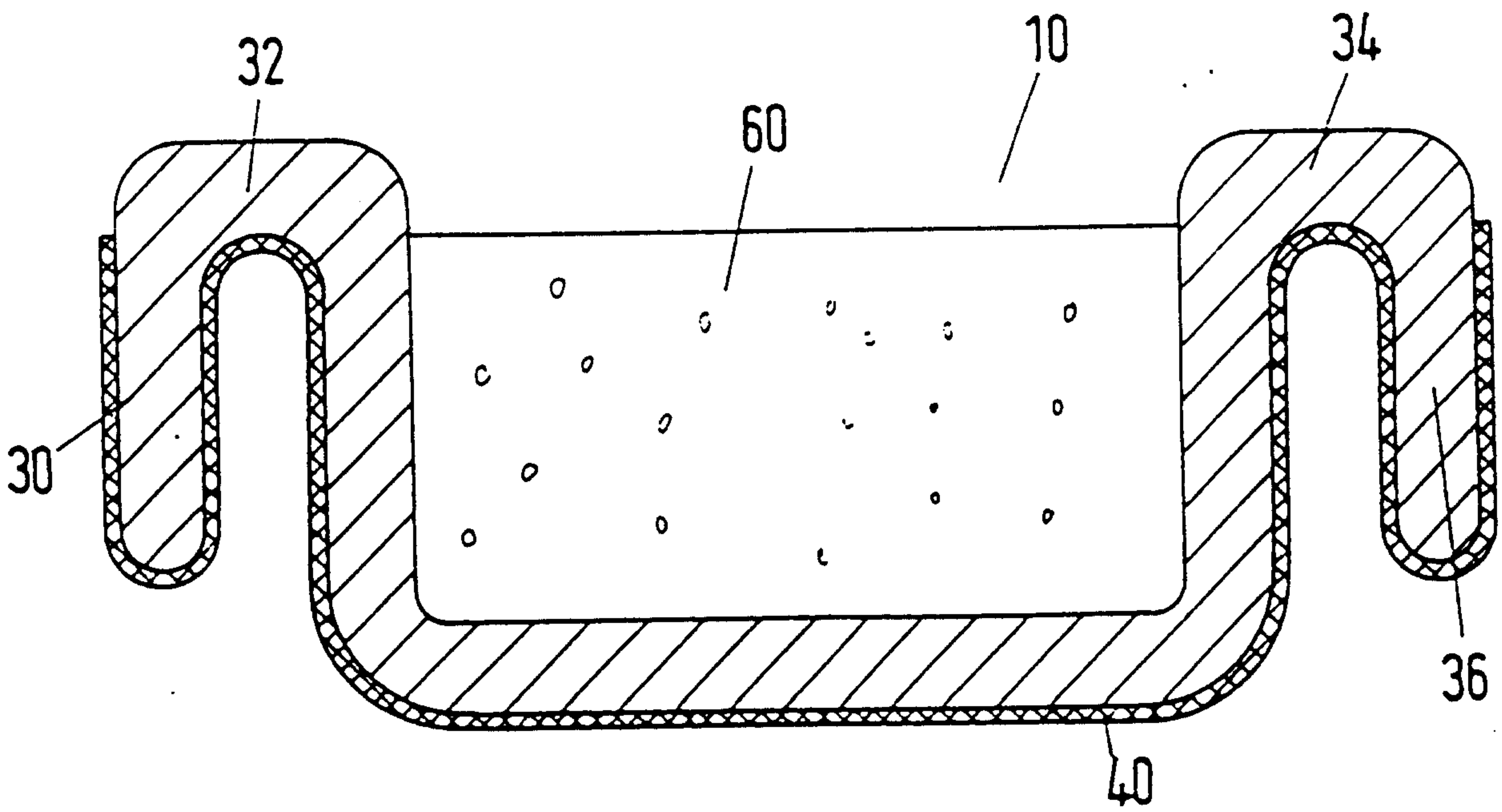

Fig. 12

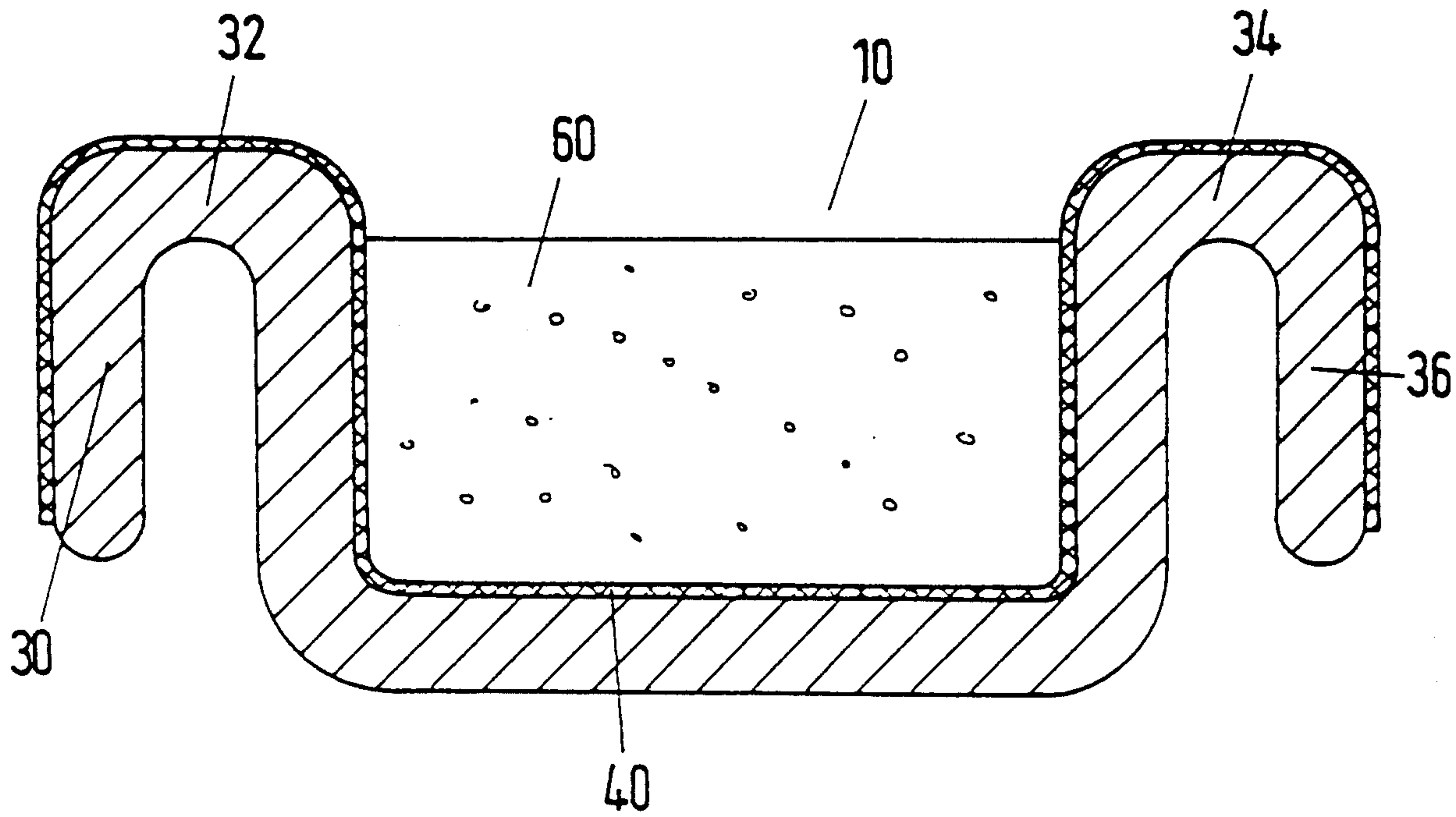

Fig. 13

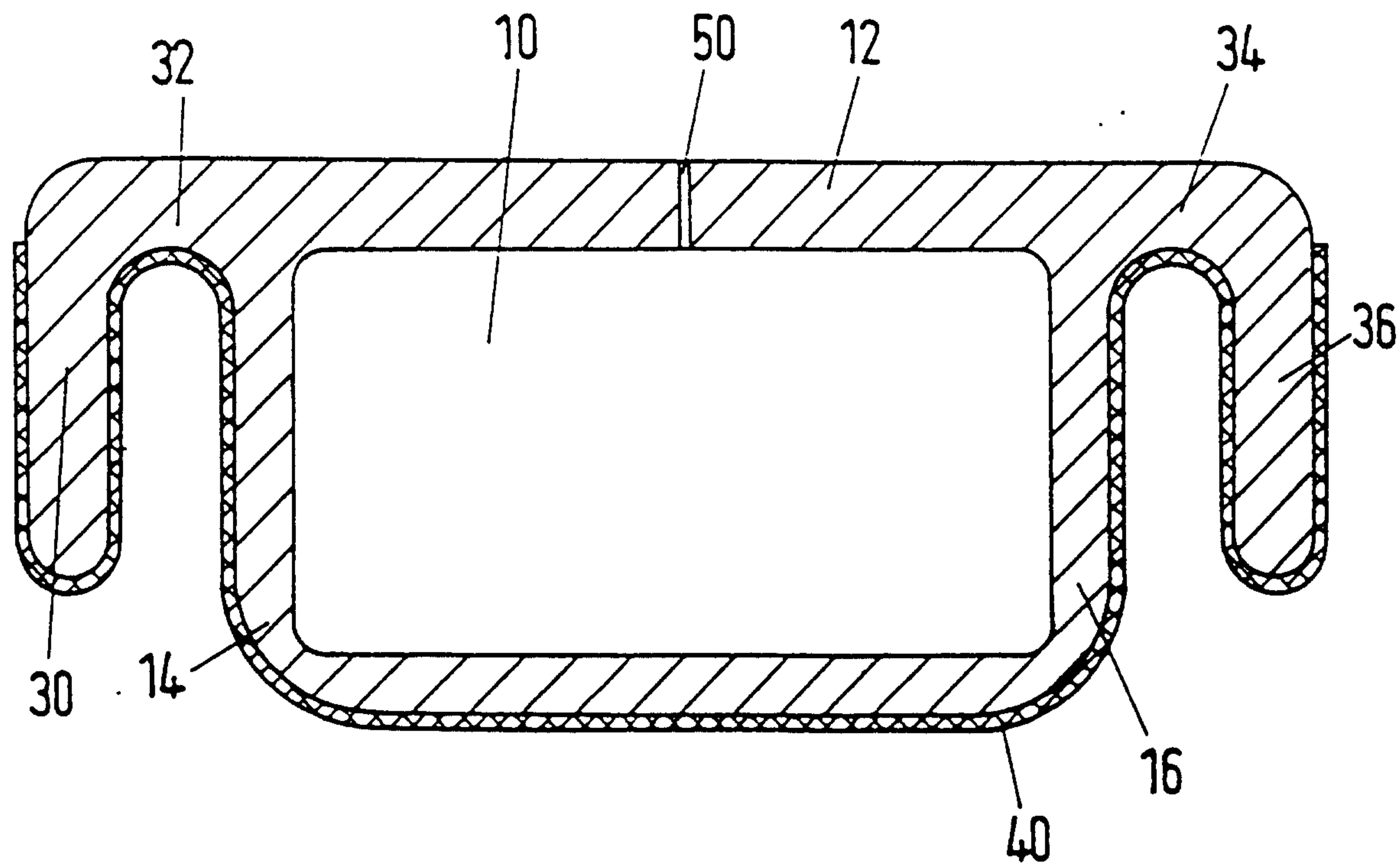

Fig.14

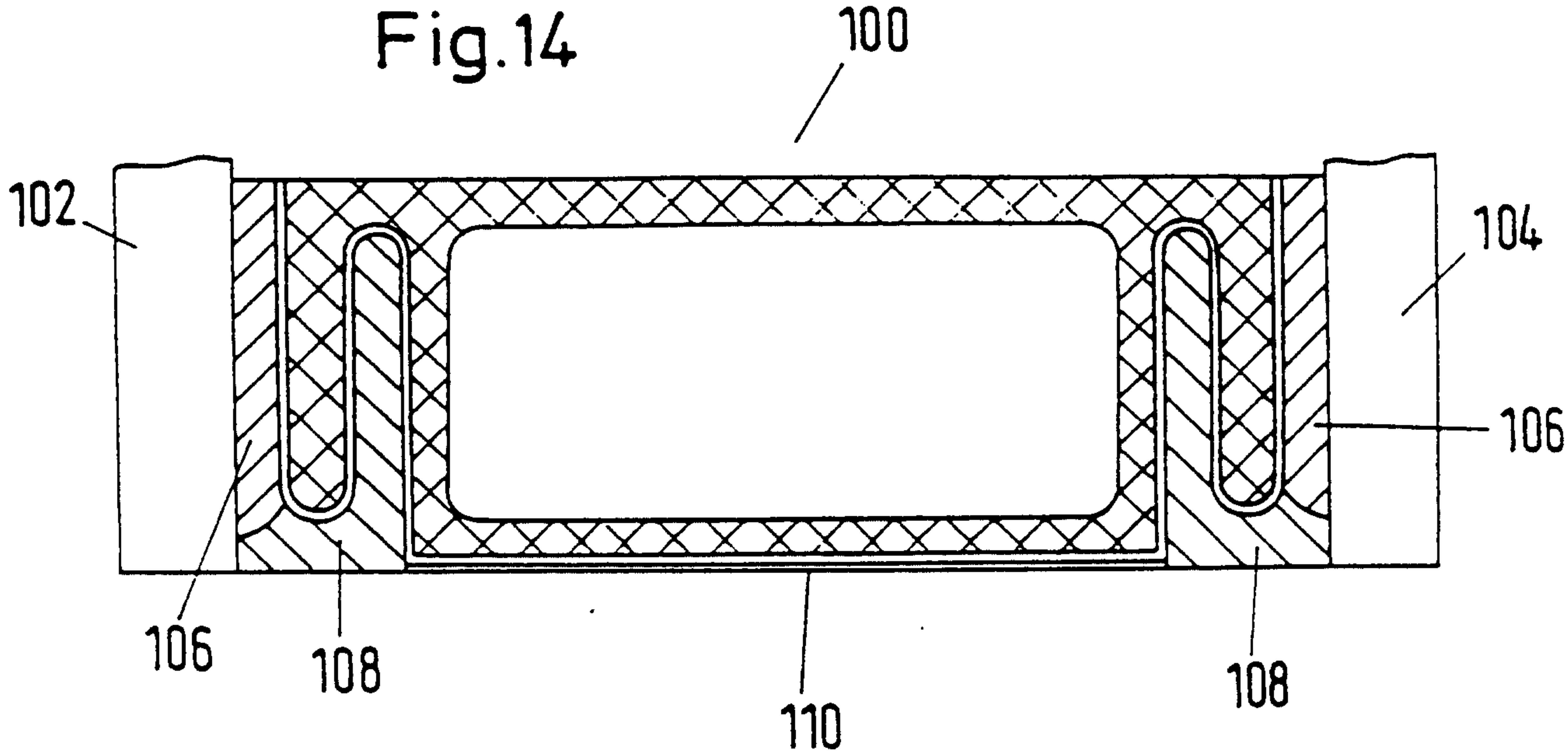

Fig.15

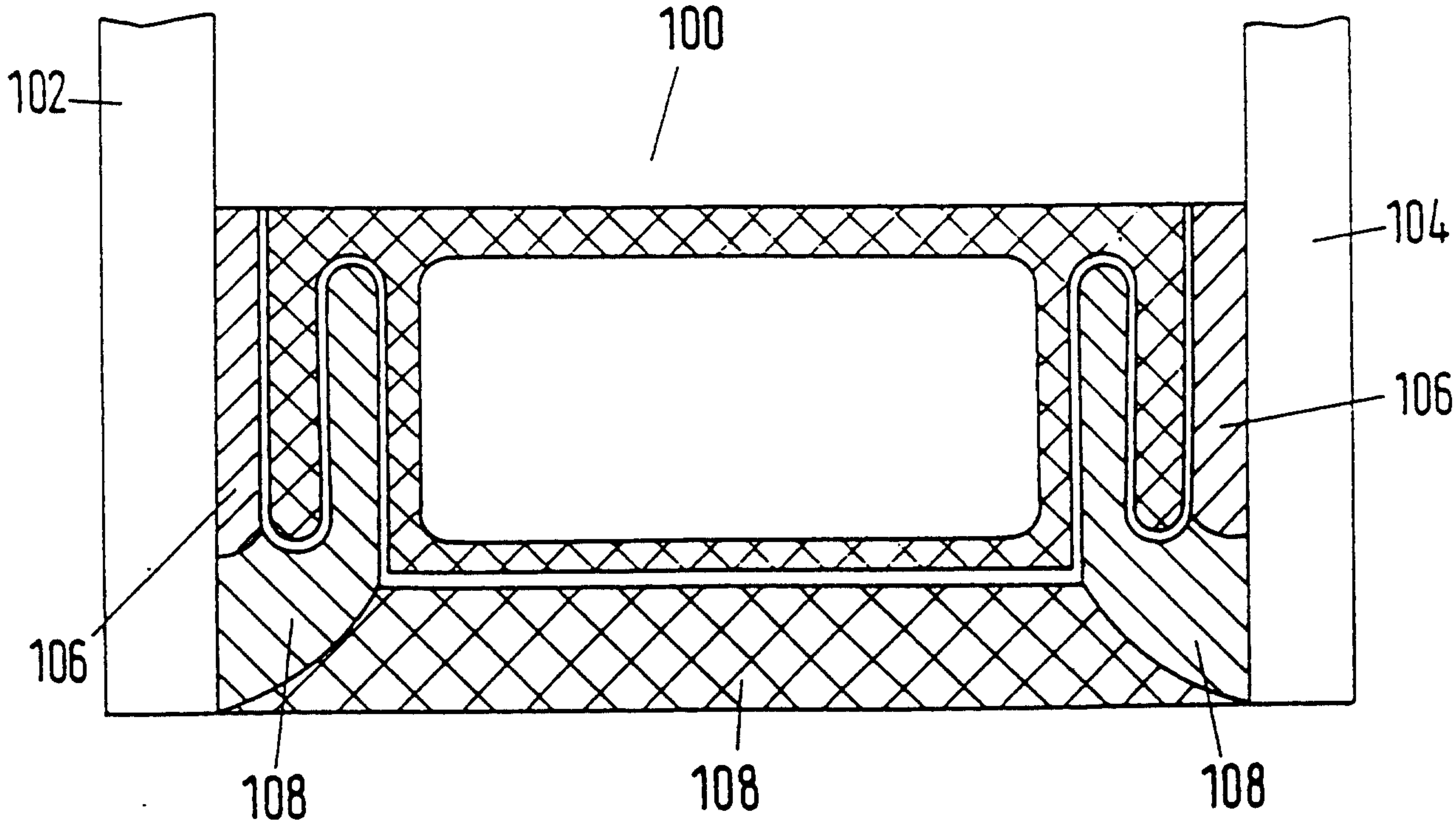

Fig. 16

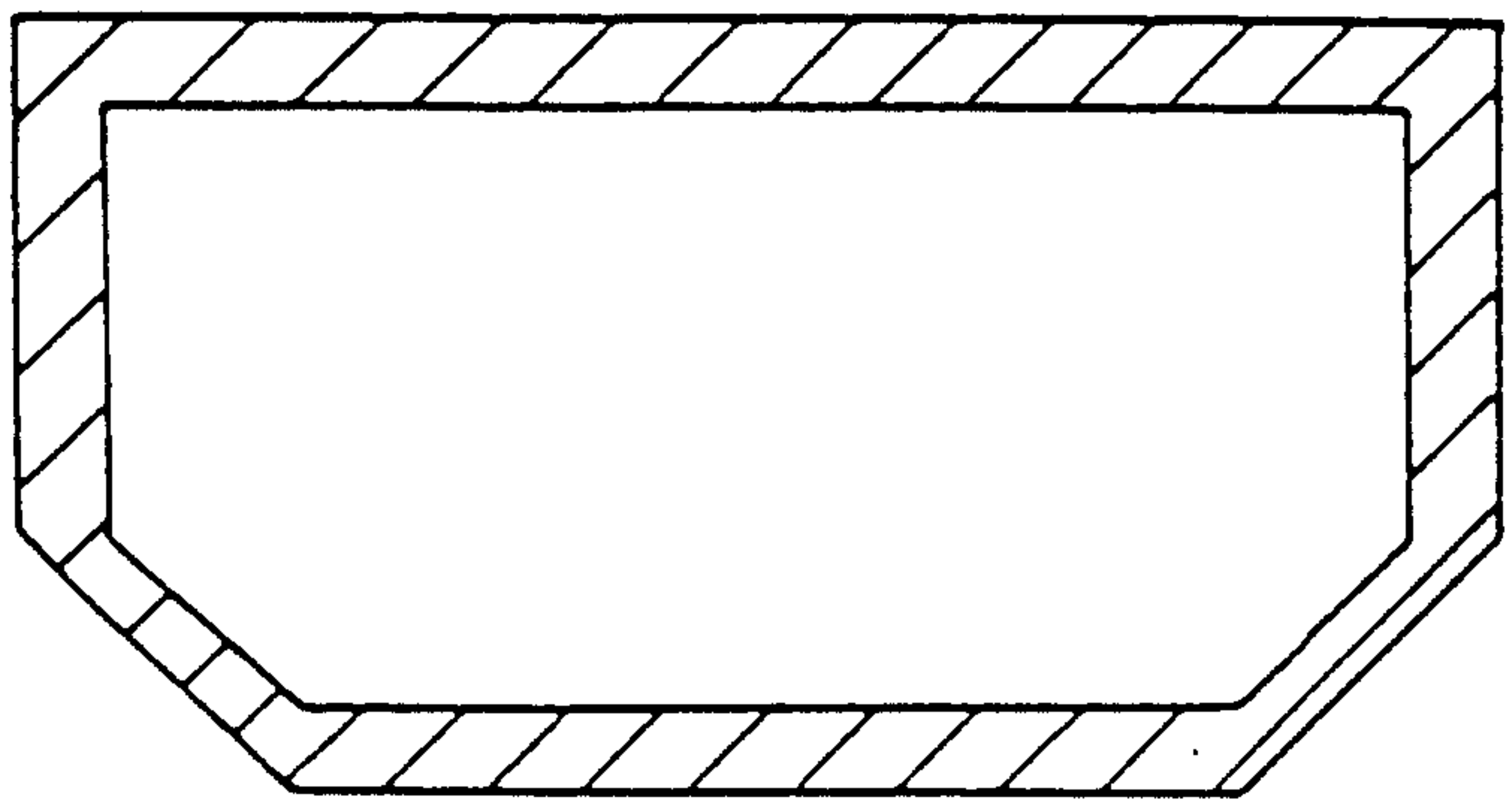

Fig. 17