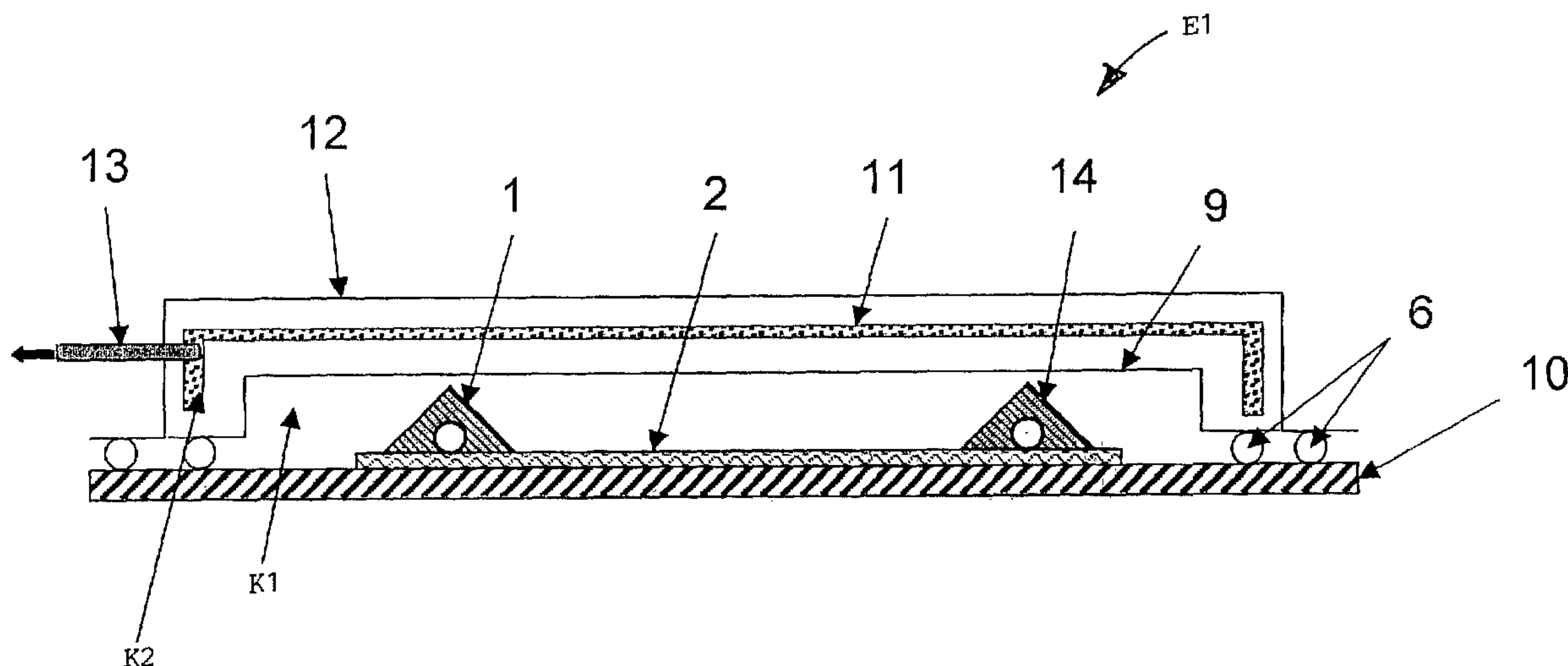




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(54) Titre : DISPOSITIF DE DEGAZAGE DE MATIERE MATRICE POUR LA FABRICATION DE PIECES EN MATIERE RENFORCEE PAR DES FIBRES
(54) Title: DEGASSING DEVICE FOR DEGASSING MATRIX MATERIAL IN ORDER TO PRODUCE FIBRE-REINFORCED COMPONENTS



(57) Abrégé/Abstract:

The invention relates to a degassing device for degassing matrix material in order to produce fibre-reinforced components, comprising a support-device (10), a distributing fabric (2), an injection device (1), an outlet device (14), a matrix material impermeable blocking layer (9) which is sealed by means of a seal (6) arranged opposite the support device (10) and which forms a first chamber (K1) extending around the injection device to the degassing device (E1). The invention also relates to a degassing device (E2) for degassing matrix-material in order to produce fibre-reinforced components, comprising a first connection (A1) for guiding the matrix material which is to be degassed to the degassing device, a second connection (A2) for guiding the degassed fluid out of said device, and a third connection (A3) for applying low pressure to the inside of said device, an internal body (41), a resin impermeable and air impermeable film (42) and an external housing (44).

Abstract

Degassing device for degassing matrix material in the manufacture of fiber-composite components with a support device (10), a distribution fabric (2), a gate device (1), a discharge device (14), a matrix-material-impermeable barrier layer (9), which is sealed with respect to the support device (10) by means of a seal (6) and thus forms a first chamber K1 of the degassing device (E1) located around the gate device, as well as a degassing device (E2) for degassing matrix material in the manufacture of fiber-composite components with a first connection (A1), for conducting the matrix material to be degassed into the degassing device, a second connection (A2) for conducting the degassed fluid out of the same, and a third connection (A3) for applying negative pressure to the interior of the same, an inner body (41), a resin-impermeable and air-permeable film (42), and an outer housing (44).

Degassing Device for Degassing Matrix Material for Producing Fiber-Composite Components

The invention relates to a degassing device for degassing matrix material provided for the manufacture of fiber-composite components.

In the manufacture of fiber-composite components, hereinafter also referred to as FC components, using resin injection methods, the formation of pores in the FC component being produced may come about as a result of gas bubbles, dissolved gases and other volatile constituents contained in the matrix material. As a result, the quality of the FC components is reduced, which can cause the FC components to be unusable.

From German patent DE 100 13 409 C1 is a device and a process for manufacturing fiber-reinforced plastic components from dry fiber-composite semifinished products using an injection method for injecting matrix material with a gas-permeable and matrix-material-impermeable membrane, which is arranged around the semifinished product on at least one side and forms a first space and into which matrix material can be introduced, having a flow promoter arranged on a surface of the semifinished product, having a second space, sealed with respect to a tool, adjacent to the first space, which is delimited from the surroundings by means of a gas-impermeable and matrix-material-impermeable film, wherein when air is removed from the second space by suction, matrix material is drawn from the reservoir into the evacuated first space and the flow promoter causes distribution of the matrix material over the surface of the semifinished product facing it and penetration thereof vertically into the semifinished product.

In this process, the matrix material is distributed by means of a flow promoter over the fiber-composite semifinished product, and from there penetrates

the semifinished product. The flow promoter is delimited on one side by the gas-permeable and matrix-material-impermeable membrane. During transport of the matrix material in the thin flow promoter, degassing of the matrix material takes place. The degassing takes place through the membrane adjoining the flow promoter into the evacuated second chamber. For efficacious degassing, it is necessary for the matrix material to first be able to travel an adequately long distance through the flow promoter before it enters the semifinished product.

In the frequently used gate arrangements for introducing the matrix material into the flow promoter, such film degassing does not occur directly beneath the gates, and occurs only incompletely in the areas directly adjacent thereto. Accordingly, the probability is greater beneath the gates and in the areas adjacent thereto that pore formation will take place there.

Another disadvantage of this process resides in that the use of two chambers requires greater expenditure of auxiliary materials for the membrane as compared to the single-chamber principle likewise known in fiber composite technology.

In addition, degassing of the matrix material can take place according to a method known from the general prior art wherein the matrix material is remelted into a thin layer (film) in an evacuated space. In general, the thinner the matrix material layer to be degassed, the more effective such a degassing process is. This process for degassing the matrix material, which is also called film degassing, has the following disadvantages, for example:

- The additional degassing step is unfavorable with regard to costs and additional inputs.

- The matrix material must be heated for the degassing step. This causes aging processes to occur.
- The matrix material can again absorb volatile constituents, such as water vapor from the air, prior to later processing to produce fiber-composite components.
- The matrix material can react with auxiliary materials during the course of the injection process, with the formation of gas. Thus, reactions with low-cost, flexible silicone profiles for gates have been observed.

It is the object of the invention to provide methods and devices for the manufacture of FC components in which or with which advantageous degassing of matrix material occurs during the manufacture of FC components.

This object is attained with the features of the independent claims. Additional embodiments are given in the subordinate claims related thereto.

The invention may be utilized in combination with the device and/or the method from German patent DE 100 13 409 C1 or with other devices or methods from the prior art in which resin or matrix material is introduced into a structure with fiber-composite semifinished products for infiltration into the same. The devices in accordance with the invention are provided in order to degas the supplied resin or matrix material.

The invention is explained below on the basis of the attached figures, which show:

Figure 1 an embodiment of the degassing device in accordance with the invention, which works together with a single-chamber or dual-chamber injection structure,

Figure 2 another embodiment of the degassing device in accordance with the invention, which likewise works together with a single-chamber or dual-chamber injection structure,

Figure 3 a cross-section along line A-A through the embodiment from Figure 2.

In accordance with the invention, a degassing device for the matrix material used in the manufacture of FC components is provided that is arranged separately from the FC manufacturing device. The matrix material, which generally is a fluid, is thus degassed in a degassing device that is separate from the FC manufacturing device (Figures 1 to 3).

In this context, material referred to as textile fabric is understood to be a dry or pretreated fiber-composite fabric or fiber-composite nonwoven fabric from which a fiber-composite component can be manufactured after resin infiltration and aftertreatment in an autoclave.

An exemplary embodiment of the degassing device in accordance with the invention for a degassing of the matrix material or resin in advance of an injection process for fiber-composite component manufacture is shown in Fig. 1. The injection process may be a single-chamber or multi-chamber process. A multi-chamber process is described in the patent DE 100 13 409 C1. A single-chamber process is described in European patent application EP 1 136 238 A2, for example.

Advance degassing is especially necessary in a single-chamber process, since integrated degassing is not possible because of the lack of a second chamber.

This degassing device in accordance with the invention is placed in advance of the actual injection device in such a manner that the matrix material must flow through the degassing device on the way from the supply to the injection device. The principle of operation of the advance degassing device is based on the fact that the matrix material passes through a dual-chamber system in such a way that the gas bubbles, dissolved gases, and other volatile constituents contained can be drawn off during the process.

Fig. 1 shows a first embodiment of the degassing device E1 in accordance with the invention. It comprises a support device 10, which may also be a mold; a spacer or a distribution fabric 2, which may also be a flow promoter; a gate runner or a gate device 1 and a discharge device 14, which both may be pipe openings and also integrated in the support device 10; a matrix-material-impermeable layer or barrier layer 9, which is sealed with respect to the support device 10 by means of a seal or a sealing strip 6, and thus forms a first chamber K1 of the degassing device E1 located around the gate device.

Such a barrier layer 9 can be realized with a PTFE film, an adhesive, and/or a backing fabric, or in the form of a sandwich construction made from these materials. The matrix-material-impermeable layer or barrier layer 9 may take the form of a film or panel. The barrier layer 9 is designed gas-permeable.

Located above the barrier layer 9 is a venting fabric or exhaust fabric 11, which is formed in accordance with the prior art. Viewed in relation to the support device 10, a film 12 is arranged over the barrier layer 9 and the venting fabric 11, which film is sealed with respect to the support device 10 by means of a seal 6. In

this way the film 12 and the barrier layer 9 together forms a second chamber K2 of the degassing device. The degassing device E1 is evacuated by means of a vacuum connection 13, which communicates with the second chamber K2.

The degassing process proceeds as follows: the matrix material enters the degassing device E1 through the gate device 1. From there, the matrix material flows into the distribution fabric or the spacer 2. While the matrix material flows through this spacer 2, the gas bubbles, dissolved gases and other volatile constituents contained in the matrix material are drawn off through the semi-permeable film 9 when negative pressure is applied by means of the vacuum connection 13. Thereafter the degassed matrix material flows through the discharge device 14 to the structure with the fiber-composite semifinished product, which is to say to the actual injection process.

Another exemplary embodiment of the degassing device in accordance with the invention is shown in Figure 2 and 3.

The device has a first connection A1, with which the fluid or matrix material to be degassed is conducted into the degassing device, a second connection A2 for conducting the degassed fluid out of the degassing device, and a third connection A3 for applying negative pressure or vacuum to the interior of the degassing device.

The degassing device E2 shown in Figures 2 and 3 has an inner body 41. The latter preferably is equipped with grooves N on its surface. Viewed in the longitudinal direction L, they may more particularly be elongated or spiral in design. The design of the grooves N depends on the desired dwell time of the matrix material.

The degassing device E2 further has a resin-impermeable and air-permeable film 42. This permits a degassing process after the application of negative pressure by means of the vacuum connection A3. It separates a first space R1 surrounding the film 42 from a second space R2 located in the interior of the film 42.

The first space R1 is surrounded by an absorption device or intermediate layer 43. This is attached to the film 42 in order to serve as a carrier for it. It can be made of a gas-permeable ceramic or a perforated plate. Its function is oriented toward the exchange of the gas of the matrix material due to negative pressure.

The degassing device E2 further has an outer container or a housing 44. The size of the outer housing 44 depends on the quantity of resin to be degassed.

The body or the housing 41 and 44, respectively, may have any – even irregular – shapes. These may also be flexible in design. The shape or the material is determined by the application. In particular, they may have a cylindrical form.

Shown in Figure 3 is a cross-section of the degassing device E2. The first space R1 is formed by the outer container 44 and the film 42. This space is evacuated by means of the vacuum connection 42, causing the undegassed fluid (matrix material) to flow through the opening A1 into the degassing device. As a result of the application of negative pressure, a negative pressure differential exists between the first space R1 and the second space R2, where the negative pressure in the first space R1 is greater than the negative pressure in the second space R2.

The mode of operation of the degassing device E2 is as follows. The first space R1 is evacuated by means of the vacuum connection 13 and the device is brought between an injection pipe (matrix pipe). The undegassed fluid (matrix

Claims

1. Degassing device (E1) for degassing of matrix material provided for the manufacture of fiber-composite components
 - with a gate device (1), in each case arranged on a support device (10), for conducting the matrix material to be degassed into the degassing device, and a discharge device (14), a distribution fabric (2),
 - with a matrix-material-impermeable and gas-permeable layer (9), which is sealed with respect to the support device (10) by means of a seal (6) to form a first chamber (K1) surrounding the gate device (1) and the discharge device (14), in which is placed a venting fabric (11),
 - with a film (12) surrounding the layer (9) and sealed with respect to the support device (10) to form a second chamber (K2),
 - with a vacuum connection (13) that communicates with the second chamber (K2) for degassing the matrix material in the degassing device (E1).
2. Degassing device (E1) for degassing of matrix material provided for the manufacture of fiber-composite components, characterized in that the gate device (1) and/or the discharge device (14) are integrated in the support device 10.
3. Degassing device (E1) for degassing of matrix material provided for the manufacture of fiber-composite components, characterized in that the barrier layer (9) is a film or panel.
4. Degassing device (E1) for degassing of matrix material provided for the manufacture of fiber-composite components, characterized in that the layer (9) is realized with a PTFE film, an adhesive, and/or a backing fabric, or in the form of a sandwich construction made from these materials.

5. Degassing device (E2) for degassing of matrix material provided for the manufacture of fiber-composite components
 - with an inner body (41), with an outer container (44) surrounding this and a matrix-material-impermeable and gas-permeable film (42) arranged between them to form a first space (R1) between the film (42) and the inner body (42) and a second space (R2) between the film (42) and the outer container (44), wherein the film (42) is held by an intermediate layer (43),
 - with a first connection (A1) for conducting the matrix material to be degassed into the first space (R1), a connection (A2) for conducting the degassed matrix material out of the same, and a connection (A3) for applying negative pressure to the first space (R1).
6. Degassing device (E2) for degassing of matrix material provided for the manufacture of fiber-composite components according to claim 5, characterized in that the surface of the inner body (41) is equipped with grooves.
7. Degassing device (E2) for degassing of matrix material provided for the manufacture of fiber-composite components according to claim 6, characterized in that the grooves on the surface of the inner body (41) run in an elongated or spiral direction, viewed in its longitudinal direction.
8. Degassing device (E2) for degassing of matrix material provided for the manufacture of fiber-composite components according to one of claims 5 to 7, characterized in that the intermediate layer (43) is made of a gas-permeable ceramic.

9. Degassing device (E2) for degassing of matrix material provided for the manufacture of fiber-composite components according to one of claims 5 to 7, characterized in that the intermediate layer (43) is made of a perforated plate.

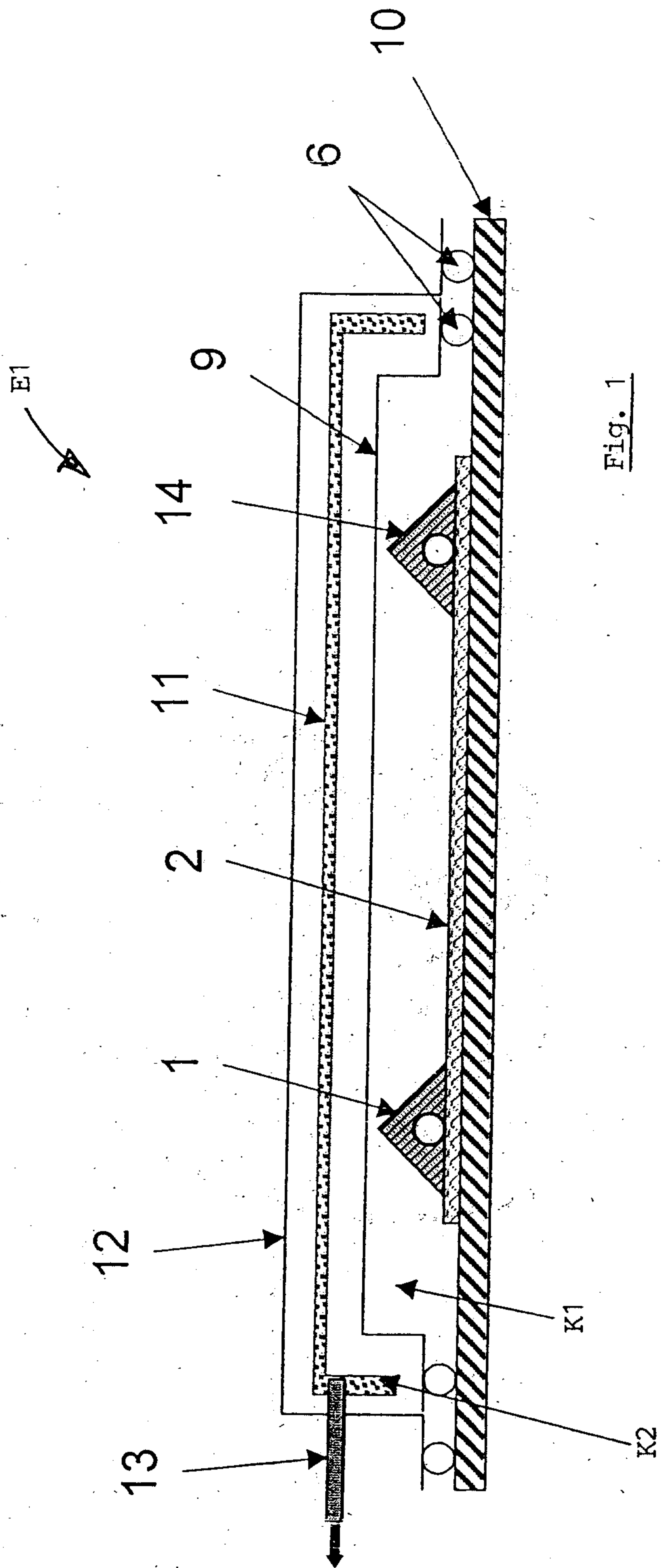


Fig. 1

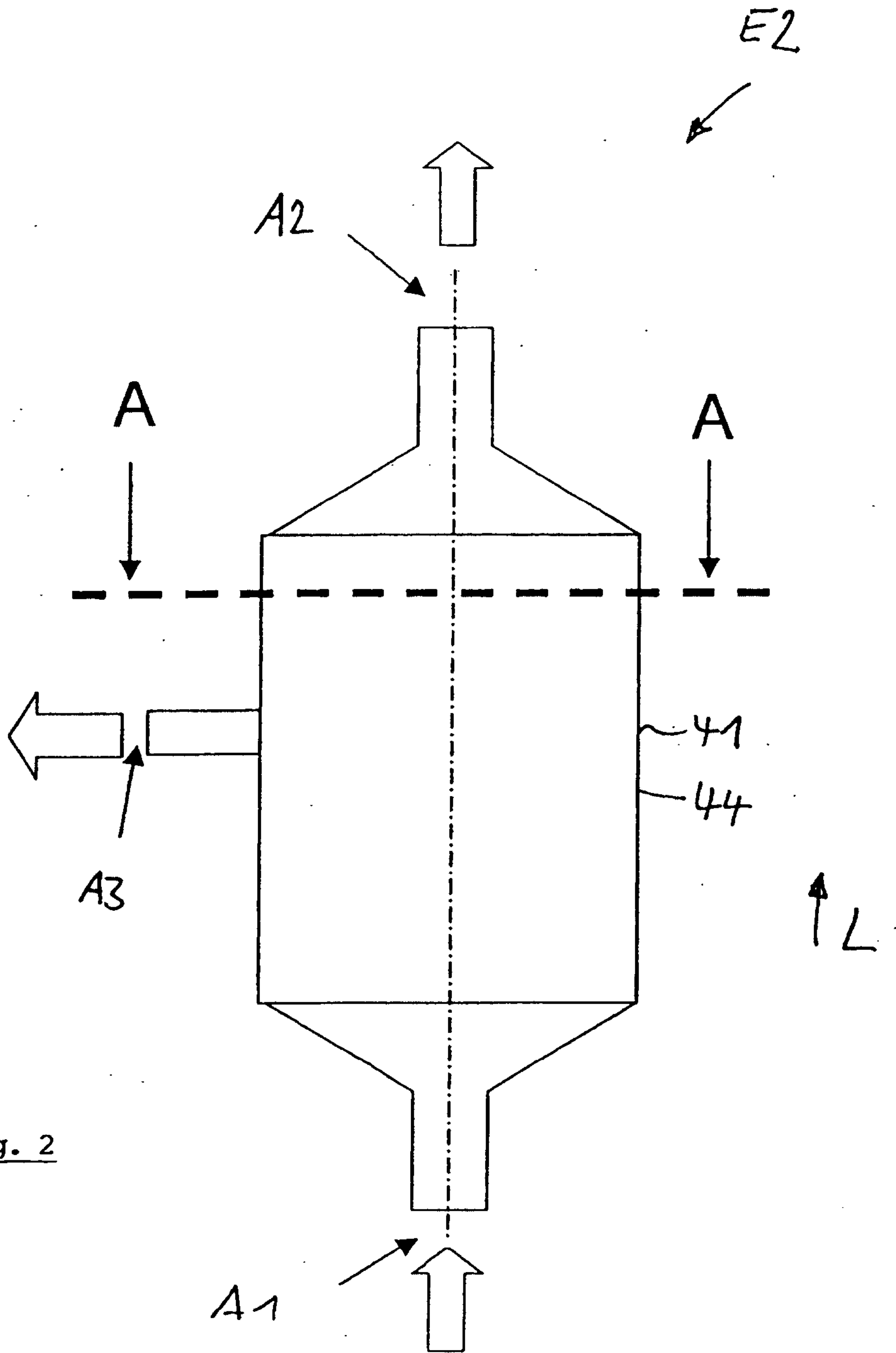


Fig. 2

AMENDED SHEET

Cross-section A-A:

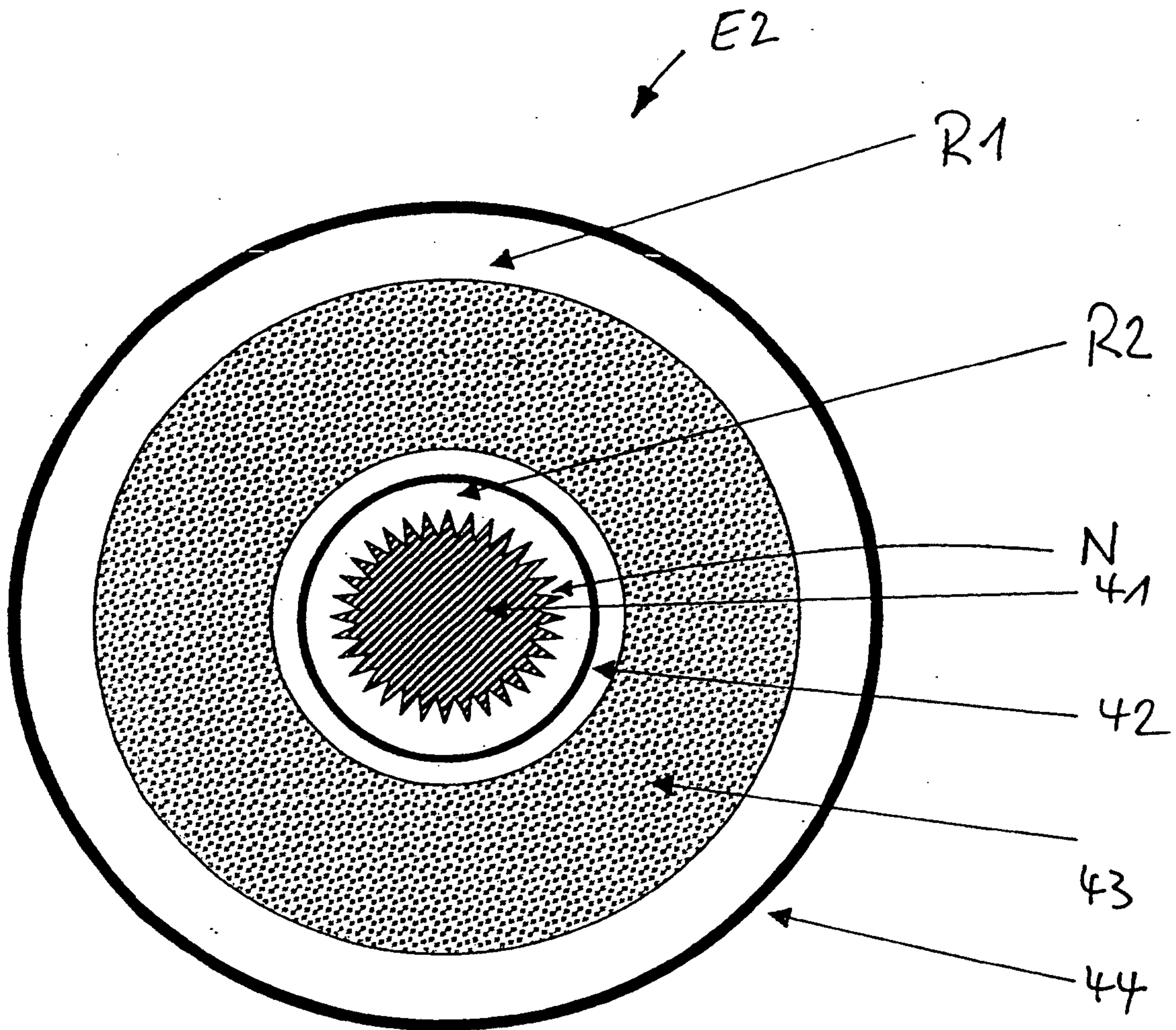


Fig. 3

**AMENDED
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