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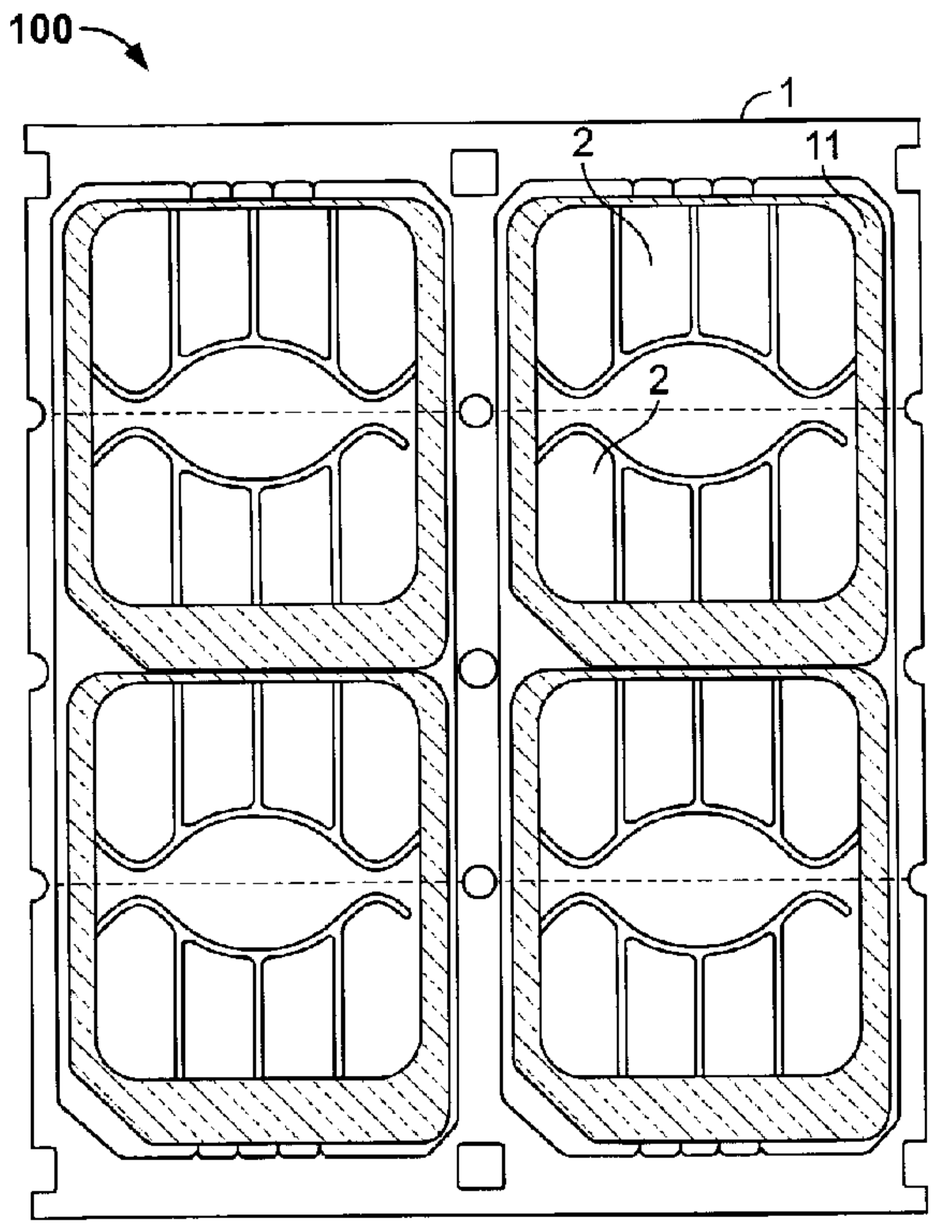
(54) Title: SMART CARD BODY, SMART CARD AND MANUFACTURING PROCESS FOR SAME



(57) Abrégé/Abstract:
The present invention relates to a smart card body, a smart card and a manufacturing process for same, and in particular to smart cards used for subscriber identity modules (SIM) cards. To improve a process for the manufacture of a smart card body and a process for the assembly of a smart card in such a manner that a simple and adaptable process can be achieved for the manufacture of a smart card, a process for the manufacture of a smart card body (10) for incorporating a semiconductor chip is described, wherein the process comprises the formation of a lead frame in a conductive layer (1), wherein the lead frame has first contacts (2) on a first surface and can be connected to the semiconductor chip on a second surface opposite the first surface, and the formation of a electrically insulating casing layer (11) on the second surface of the smart card body, wherein the casing layer (11) has a recess (12) for incorporating the semiconductor chip.

Abstract

The present invention relates to a smart card body, a smart card and a manufacturing process for same, and in particular to smart cards used for subscriber identity modules (SIM) cards. To improve a process for the manufacture of a smart card body and a process for the assembly of a smart card in such a manner that a simple and adaptable process can be achieved for the manufacture of a smart card, a process for the manufacture of a smart card body (10) for incorporating a semiconductor chip is described, wherein the process comprises the formation of a lead frame in a conductive layer (1), wherein the lead frame has first contacts (2) on a first surface and can be connected to the semiconductor chip on a second surface opposite the first surface, and the formation of a electrically insulating casing layer (11) on the second surface of the smart card body, wherein the casing layer (11) has a recess (12) for incorporating the semiconductor chip.

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Smart Card Body, Smart Card and Manufacturing Process for Same

The present invention relates to a smart card body, a smart card and a manufacturing process for same, and in particular to smart cards used for subscriber identity modules (SIM) cards.

According to a conventional manufacturing process for a smart card, a smart card body and a chip card module are manufactured separately. The chip card module is normally embedded in the smart card body before the smart card body provided with the chip card module is cut out.

US 6,288,904 shows a chip card module that is incorporated in a smart card body. A chip is positioned on a circuit carrier and connected to contacts on the opposite site of the circuit carrier by means of wire bonds. The chip is enclosed in a frame which is surrounded with a filling to protect the chip and the wire bonds from mechanical stress.

From US 5,147,982 an encapsulation process for a semiconductor chip in a micromodule is known, wherein the micromodule can then be incorporated in a card. A pre-punched metallic layer is formed, a pre-perforated plastic layer is applied to the metallic layer and a semiconductor chip is positioned on the surface of the metallic layer in a perforation of the plastic layer. A protective ring, which surrounds the chip, is filled with protective material, for example a silicone resin.

In the case of the known manufacturing processes, the chip card modules and smart card bodies are manufactured separately and the chip card module manufactured separately has to be incorporated in a smart card body to produce a smart card, something that results in a complicated manufacturing process.

The European patent application EP 1 554 754 describes a manufacturing process for a data carrier, in particular for a GSM plug body, wherein a data carrier is manufactured on a carrier strip. The data carrier has a data carrier body, which is

provided with an electronic component, and the carrier strip has a large number of carrier elements. The manufacturing process comprises injection moulding around the carrier elements of the carrier strip to produce a large number of data carrier bodies, and connection of the electronic components to the data carrier bodies to produce a large number of data carriers.

In this manufacturing process for data carriers, the large number of data carriers are manufactured with the electronic component incorporated in the data carrier body and the data carriers are manufactured on a single carrier strip so that it is possible to reduce the manufacturing costs. This manufacturing process for a data carrier is however not flexible enough as the data carrier is manufactured with the electronic component.

There is therefore a need for a flexible and simple manufacturing process for a smart card body and an assembly process for a smart card which are compatible with a roll-to-roll process.

Some aspects of the present disclosure seek to improve a process for the manufacture of a smart card body and a process for the assembly of a smart card in such a manner that a simple and adaptable process can be achieved for the manufacture of a smart card.

According to an aspect of the present invention, there is provided a process for the manufacture of a smart card body for incorporating a semiconductor chip, the process comprising the steps of: forming a lead frame in a conductive layer, wherein the lead frame has a first contact on a first surface and can be connected to the semiconductor chip on a second surface opposite the first surface, and forming an electrically insulating casing layer on the second surface of the smart card body, wherein the casing layer has a recess for incorporating the semiconductor chip, wherein at least a portion of the casing layer extends in a direction toward the second surface from a position substantially coplanar with the first surface.

According to another aspect of the present invention, there is provided a process for the assembly of a smart card, the process comprising the steps of: fitting a semiconductor chip in a recess in a casing layer of a smart card body manufactured according to the process described above, and closing the recess in the casing layer of the smart card body.

According to another aspect of the present invention, there is provided a smart card body for incorporating a semiconductor chip, the smart card body comprising: a conductive layer, which is structured in such a manner that it forms a lead frame that has first contacts on a first surface and can be connected to the semiconductor chip on a second surface opposite the first surface, wherein the smart card body has on its second surface an electrically insulating casing layer with a recess for incorporating a semiconductor chip, wherein at least a portion of the casing layer extends in a direction toward the second surface from a position substantially coplanar with the first surface.

According to another aspect of the present invention, there is provided a carrier strip comprising a plurality of smart card bodies described above, wherein the plurality of smart card bodies are detachable from the carrier strip.

According to another aspect of the present invention, there is provided a smart card comprising a semiconductor chip, which is affixed in the recess in the casing layer of the smart card body described above, and a surface layer to close the recess in the casing layer of the smart card body.

According to some embodiments, a process for the manufacture of a smart card body for incorporating a semiconductor chip is described, wherein the process comprises the formation of a lead frame in a conductive layer, wherein the lead frame has on a first surface first contacts for connection to an external component, such as a mobile telephone or similar item, and can be connected to the semiconductor chip on a second surface opposite the first surface. According to some embodiments, the process comprises the formation of a casing layer made of insulating material, for example injection-moulded material, on the second

surface of the smart card body, wherein the casing layer has a recess for incorporating the semiconductor chip.

The process thus manufactures a smart card body which is adapted to incorporate a semiconductor chip. Incorporation of the semiconductor chip does not take place until the assembly of a smart card, which comprises a smart card body and a semiconductor chip incorporated therein. According to some embodiments, a process is thus described wherein a smart card body, which does not yet contain a semiconductor chip, is manufactured. This has the advantage that the manufacture of a smart card can take place in a particularly flexible manner.

The possibility of not only manufacturing a smart card body but also performing the assembly of a smart card by means of a roll-to-roll process also makes the manufacture of a smart card particularly simple. A roll of smart card bodies can be simply supplied to a smart card manufacturer, who then only needs to install the semiconductor chips and close the smart card bodies provided with the semiconductor chips as the final process steps. In addition, the personalization of a smart card can be carried out by the smart card manufacturer using a roll-to-roll-process by laminating a personalized strip onto the smart card bodies provided with the semiconductor chips.

The manufacture of a smart card is also particularly simplified because the smart card manufacturer no longer has to carry out the steps involving detachment of the smart card module and embedding of the smart card module in the smart card body as necessary in the conventional manufacturing processes. According to some embodiments, the smart card body is manufactured by means of a roll-to-roll-process so that only the semiconductor chip needs to be installed and the smart card body closed to produce a smart card. The smart card manufacturer can also make use of his existing roll-to-roll processes.

In addition, the smart card body according to some embodiments can also be incorporated in another larger smart card body. This is particularly advantageous when the smart card body is manufactured according to the 3FF smart card format, which represents a smart card format with reduced dimensions in comparison with the 1FF and 2FF smart card

formats. A 3FF smart card body can thus be incorporated in another 1FF or 2FF smart card body, something that offers a smart card manufacturer even greater flexibility in smart card manufacturing.

It is particularly advantageous when the step involving the formation of a lead frame comprises the punching-out of the conductive layer, preferably consisting of copper, and the metallization, preferably by electroplating, of the punched-out conductive layer. A roll of copper can thus be punched out and metallized using a roll-to-roll process to produce a lead frame in a simple and low-cost manner.

When the second surface of the conductive layer is provided with second contacts, preferably made of gold, wherein the second contacts are used for contacting of the semiconductor chip to be incorporated, the semiconductor chip to be incorporated can easily be electrically connected to the lead frame.

When the casing layer is formed from an insulating injection-moulded material, wherein a pre-punched dielectric layer is laminated onto the second surface of the conductive layer, and plastics material is injection-moulded around the laminated conductive layer, it is possible to manufacture the casing layer in a simple and low-cost manner. In addition, this has the advantage that only one surface layer needs to be arranged on the casing layer in a subsequent process step once a semiconductor chip has been incorporated in the recess of the casing layer to produce a smart card. The process for the assembly of a smart card is thus simplified.

It is particularly advantageous to manufacture a large number of smart card bodies on a carrier strip, wherein the large number of smart card bodies can be detached from the carrier strip. The process for the manufacture of a smart card body is thus compatible with a roll-to-roll process, something that provides for a simple and low-cost manufacturing process. The large number of smart card bodies is manufactured on a roll and can be supplied to a smart card manufacturer, who then only has to fit a semiconductor chip in the smart card body and close the smart card body to produce a smart card.

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According one aspect, a process for the assembly of a smart card is described, wherein the process comprises the fitting of a semiconductor chip in the recess of the casing layer of the manufactured smart card body and closing of the recess in the casing layer of the smart card body.

A smart card is thus manufactured in a simple and low-cost manner. In addition, the process for the assembly of a smart card offers a smart-card manufacturer the advantage that the manufacture of a smart card can be carried out more quickly, above all when the smart cards are manufactured by means of a roll-to-roll process. As the smart card bodies are supplied on a roll ready for use, it is only necessary to fit the semiconductor chip in the smart card body and to close the smart card body in order to manufacture the smart card. The surface layer of the smart card body can also be personalized, for example provided with labeling.

It is particularly advantageous when closing of the recess in the casing layer of the smart card body comprises the lamination of a strip over the recess. It is thus possible to close the smart card bodies in a simple, fast and low-cost manner.

Examples of embodiments of the invention are explained in greater detail below by means of the designs shown in the attached drawings. Similar or corresponding details of the smart card body according to the various embodiments are provided with the same reference signs in the figures. The following are shown:

Fig. 1 a top view of a first side of a carrier strip, which is at a first step of the manufacturing process for a smart card body according to an embodiment of the present invention;

Fig. 2 a top view of a first side of a carrier strip, which is at a second step of the manufacturing process for a smart card body according to an embodiment of the present invention;

Fig. 3 a top view of a first side of a carrier strip, which is at a third step of the manufacturing process for a smart card body according to an embodiment of the present invention;

Fig. 4 a top view of a second side of the carrier strip shown in Fig. 3;

Fig. 5 a sectional view through the carrier strip shown in Fig. 4 along the section line A-A;

Fig. 6 an enlarged view of the section shown in Fig. 5.

Figs. 1, 2 and 3 show a top view of a first surface of a carrier strip. Fig. 4 shows a top view of a second surface opposite the first surface. Figs. 1, 2 and 3 and Fig. 4 thus show top views of the two sides of the smart card body according to an embodiment of the invention.

As can be seen from Fig. 1, a large number of smart card bodies 10 are manufactured on a carrier strip 100. The carrier strip 100 is formed by a conductive layer 1, which preferably consists of copper sheeting. Other conductive materials are however also possible, for example aluminum. The carrier strip 100 preferably consists of a roll of

the conductive layer 1 so that the large number of smart card bodies 10 can be manufactured by means of a roll-to-roll process.

The process for the manufacture of a smart card body 10 for incorporating a semiconductor chip is explained with the help of Figs. 1, 2 and 3.

First of all the conductive layer 1 is punched out, and a lead frame formed in the conductive layer 1. On a first surface of the conductive layer 1, which is shown in Fig. 1, the lead frame has first contacts 2, and the conductive layer 1 is punched out along the roll by a punching tool (shown in Fig. 1 by the black punch-outs). As can be seen from Figs. 1, 2 and 3, two smart card bodies 10 are manufactured within a single width of the conductive roll. It is of course also possible to select a different number of smart card bodies within the width of the roll.

Once the conductive layer 1 has been punched out and the lead frame formed, the contacts 2 arranged on the first surface are metallized. The first contacts 2 are preferably coated with nickel and nickel-phosphorus using an electroplating process. Other metallization processes for the punched-out conductive layer 1 are however also possible, for example sputtering, vapor-deposit or such methods. The second surface of the conductive layer 1 (not shown in Figs. 1, 2 and 3) is provided with second contacts 13, which are preferably made of gold. These second contacts 13 are used to connect the semiconductor chip to be incorporated with the first contacts 2 of the lead frame. The semiconductor chip is preferably connected to the second contacts 13 via wire bonds.

A pre-punched dielectric layer (not shown in Figs. 1, 2 and 3) is then laminated onto the second surface of the conductive layer 1. The dielectric layer is pre-punched in such a manner that the second contacts 13 correspond to the punch-outs of the dielectric layer.

The dielectric layer is then activated by means of a laser treatment, wherein said laser treatment increases the roughness of the surface of the dielectric layer. This process

step is necessary to ensure that the injection-moulded plastics material applied in a subsequent process step adheres to the surface of the dielectric layer.

As can be seen from Fig. 2, punching dies punch out the carrier strip 100 (shown by the black punch-outs), thus creating the form of the smart card body 10.

According to an advantageous embodiment of the present invention two smart card bodies 10 are manufactured within a single width of the roll and a punching tool punches out the first half of each of two first smart card bodies while a second punching tool punches out the second half of each of two second smart card bodies, as can be seen from Fig. 2. Movement along the roll thus allows the two halves of two smart card bodies to be punched out within one width of the roll and the form of the smart card body to be created.

As can be seen from Fig. 3, a casing layer 11 is then formed from insulating injection-moulded material on the second surface of the smart card body. Here plastic material is injection-moulded around the laminated conductive layer 1. The injection-moulded casing layer 11 thus forms an edge on all sides of the smart card body 10 both around the first and the second contacts 2, 13, and the smart card body 10 so formed preferably corresponds to the format of a 3FF smart card.

Fig. 4 shows a top view of the second surface of the smart card body 10 and Fig. 5 shows a section through the carrier strip 100 along the section line A-A shown in Fig. 4. Fig. 6 shows an enlarged view of detail VI of the section shown in Fig. 5.

As can be seen from Fig. 4, the casing layer 11 has a recess 12 for incorporating a semiconductor chip. The second contacts 13 are arranged on the conductive layer 1 and the dielectric layer 14 laminated to the conductive layer 1 is pre-punched in such a manner that the second contacts 13 are accessible for contacting to a semiconductor chip to be incorporated.

As can be seen from Figs. 5 and 6, the combined height of the casing layer 11 and the surface layer (not shown in the figures), which is laminated onto the casing layer 11 in a subsequent process step for the assembly of a smart card, corresponds to the thickness of a smart card according to the 3FF format. The height of the casing layer 11 preferably has a value H of 0.7 millimeters, while the thickness of the laminated surface layer has a value of 0.1 millimeters. As can be seen from Fig. 6, the height H of the casing layer 11 encompasses the distance between the first surface of the injection-moulded material arranged level with the first surface of the conductive layer 1 and the second surface of the injection-moulded material, to which the surface layer is laminated.

The assembly of a smart card is explained in greater detail below.

A semiconductor chip is fitted in the recess 12 of the casing layer 11 of the smart card body 10. The semiconductor chip is preferably glued to the dielectric layer 14. Alternatively, the semiconductor chip can also be directly affixed to the conductive layer 1. The recess 12 provided with the semiconductor chip in the casing layer 11 of the smart card body 10 is then closed. A strip is preferably laminated onto the recess 12 in the casing layer 11.

According to an advantageous embodiment of the present invention a large number of smart card bodies 10 are manufactured on a carrier strip 100 by means of a roll-to-roll process. This simplifies the manufacturing process of a smart card as a carrier strip can be supplied to a smart card manufacturer, who then only needs to carry out the process steps involving installation of a semiconductor chip and closing of the casing layer 11. As the large number of smart card bodies 10 can be detached from the carrier strip 100, the smart cards only need to be separated after assembly.

The process for the manufacture of a smart card body according to the present invention allows the manufacture of Subscriber Identity Module (SIM) cards to be made more flexible and simple. Smart card bodies 10 can be manufactured on a carrier strip 100

by means of a roll-to-roll process and such a carrier strip 100 can be subsequently supplied to a smart card manufacturer, who then only needs to install a semiconductor chip and close the smart card body to produce a smart card.

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CLAIMS:

1. A process for the manufacture of a smart card body for incorporating a semiconductor chip, the process comprising the steps of:

forming a lead frame in a conductive layer, wherein the lead frame has a first contact on a first surface and can be connected to the semiconductor chip on a second surface opposite the first surface, and

forming an electrically insulating casing layer on the second surface of the smart card body, wherein the casing layer has a recess for incorporating the semiconductor chip,

wherein at least a portion of the casing layer extends in a direction toward the second surface from a position substantially coplanar with the first surface.

2. The process according to claim 1, wherein the step of forming a lead frame comprises punching-out the conductive layer and metallizing the punched-out conductive layer.

3. The process according to claim 2, wherein the step of metallizing comprises electroplating the punched-out conductive layer.

4. The process according to any one of claims 1 to 3, further comprising providing the second surface of the conductive layer with second contacts for contacting the semiconductor chip to be incorporated.

5. The process according to claim 4, wherein the second contacts comprise gold.

6. The process according to any one of claims 1 to 5, further comprising laminating a pre-punched dielectric layer onto the second surface of the conductive layer.

7. The process according to claim 6, wherein the step of forming the casing layer comprises injection-moulding plastics material around the laminated conductive layer.

8. The process according to any one of claims 1 to 7, wherein a plurality of smart card bodies are manufactured on a carrier strip and are detachable from the carrier strip.

9. The process of any one of claims 1 to 8, wherein the conductive layer comprises copper.

10. A process for the assembly of a smart card, the process comprising the steps of:

fitting a semiconductor chip in a recess in a casing layer of a smart card body manufactured according to the process of any one of claims 1 to 9, and

closing the recess in the casing layer of the smart card body.

11. The process according to claim 10, wherein the step of closing comprises laminating of a strip onto the recess in the casing layer of the smart card body.

12. A smart card body for incorporating a semiconductor chip, the smart card body comprising:

a conductive layer, which is structured in such a manner that it forms a lead frame that has first contacts on a first surface and can be connected to the semiconductor chip on a second surface opposite the first surface,

wherein the smart card body has on its second surface an electrically insulating casing layer with a recess for incorporating a semiconductor chip,

wherein at least a portion of the casing layer extends in a direction toward the second surface from a position substantially coplanar with the first surface.

13. The smart card body according to claim 12, wherein the conductive layer is punched out.

14. The smart card body according to claim 12 or 13, wherein the second surface of the conductive layer is provided with a second contact for contacting the semiconductor chip to be incorporated.

15. The smart card body according to claim 14, wherein the second contact comprises gold.

16. The smart card body according to any one of claims 12 to 15, wherein the second surface of the conductive layer is provided with a pre-punched dielectric layer.

17. The smart card body according to claim 16, wherein the casing layer comprises a plastics material.

18. The smart card body according to claim 17, wherein the plastics material is injection molded.

19. The smart card body according to any one of claims 12 to 18, wherein the conductive layer comprises copper.

20. A carrier strip comprising a plurality of smart card bodies according to any one of claims 12 to 19, wherein the plurality of smart card bodies are detachable from the carrier strip.

21. A smart card comprising a semiconductor chip, which is affixed in the recess in the casing layer of the smart card body according to any one of claims 12 to 19, and a surface layer to close the recess in the casing layer of the smart card body.

22. The smart card according to claim 21, wherein the surface layer comprises a laminate.

23. The smart card according to claim 21 or 22, wherein the smart card comprises a Subscriber Identity Module (SIM) card.

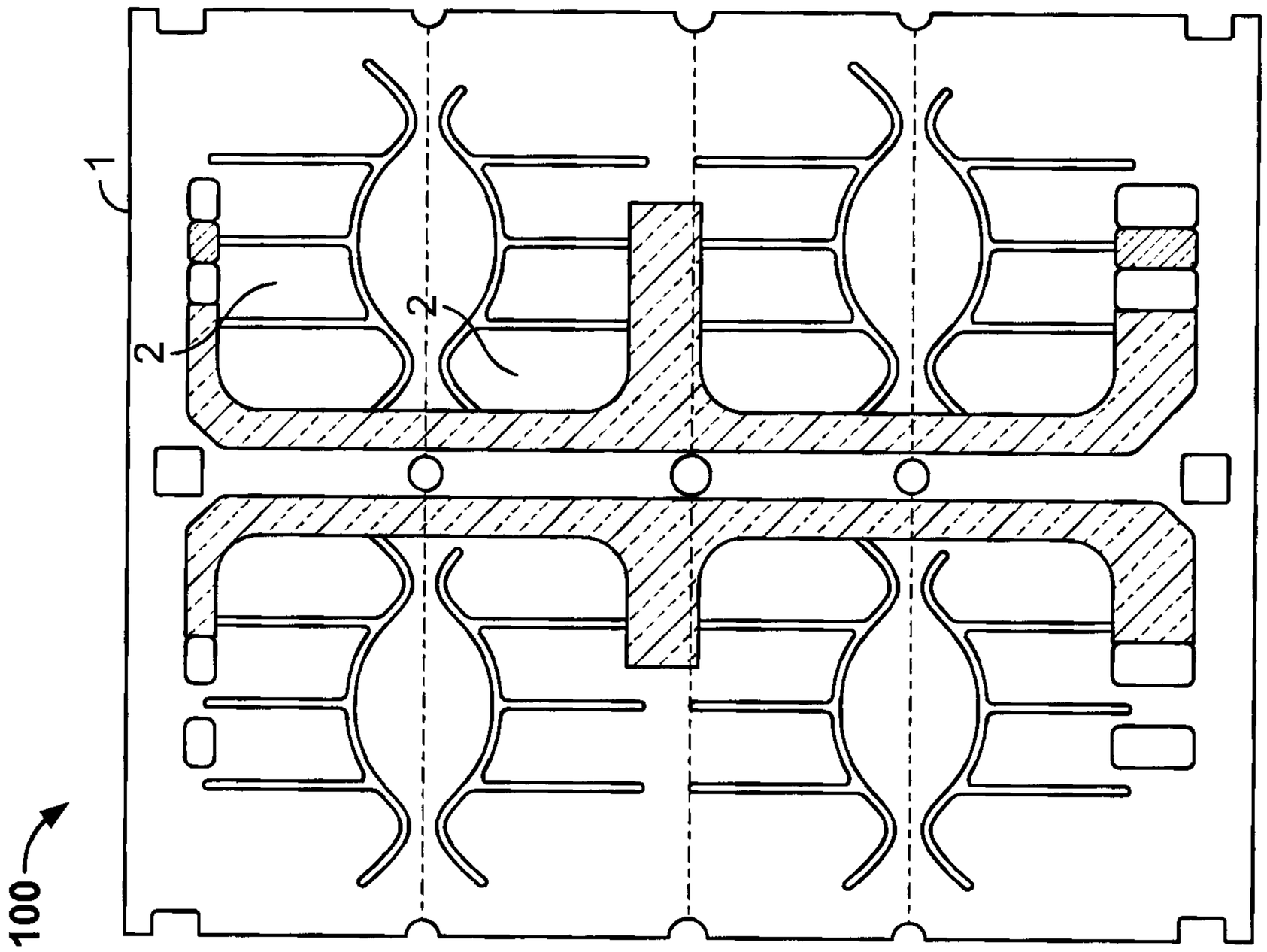


Fig. 2

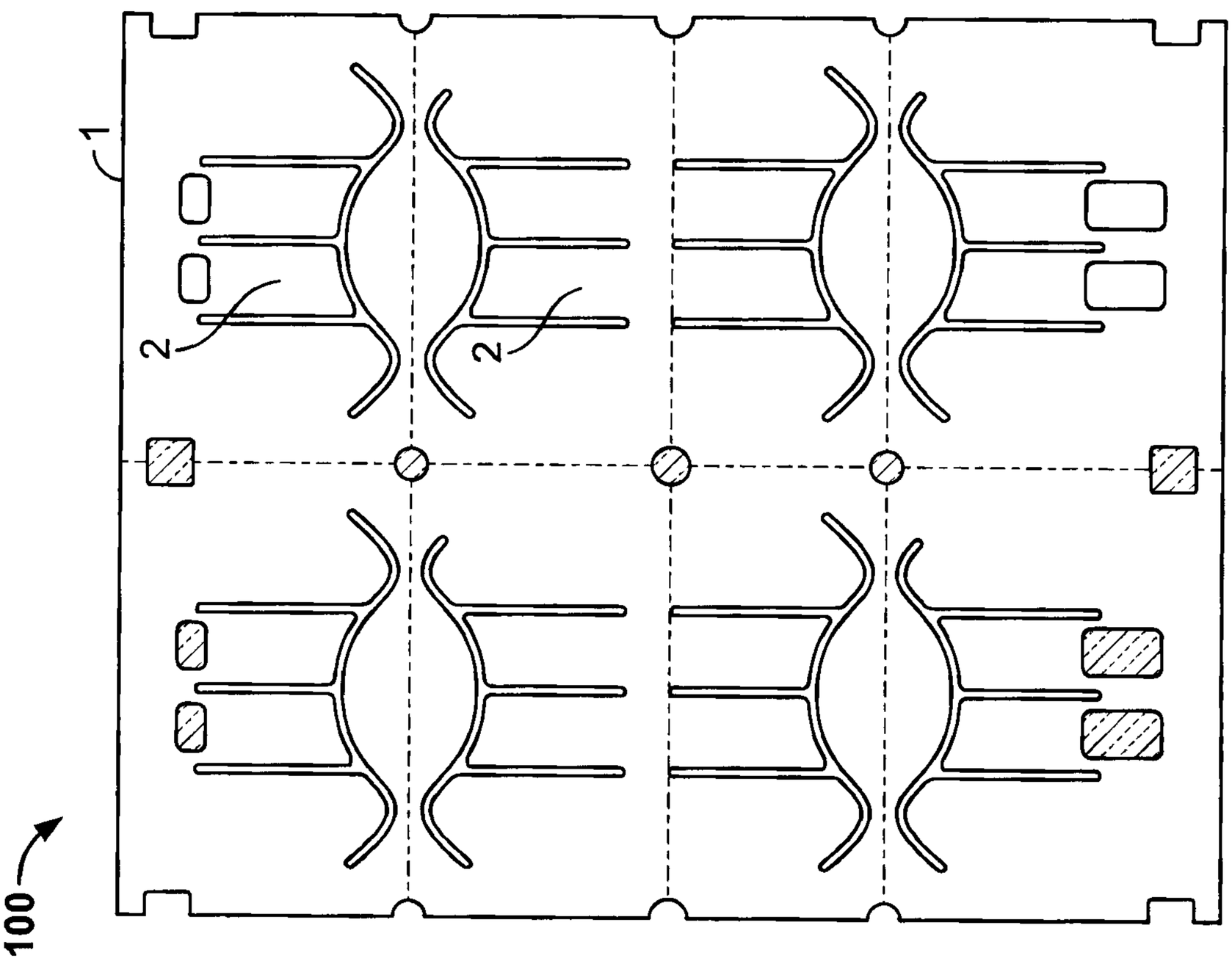


Fig. 1

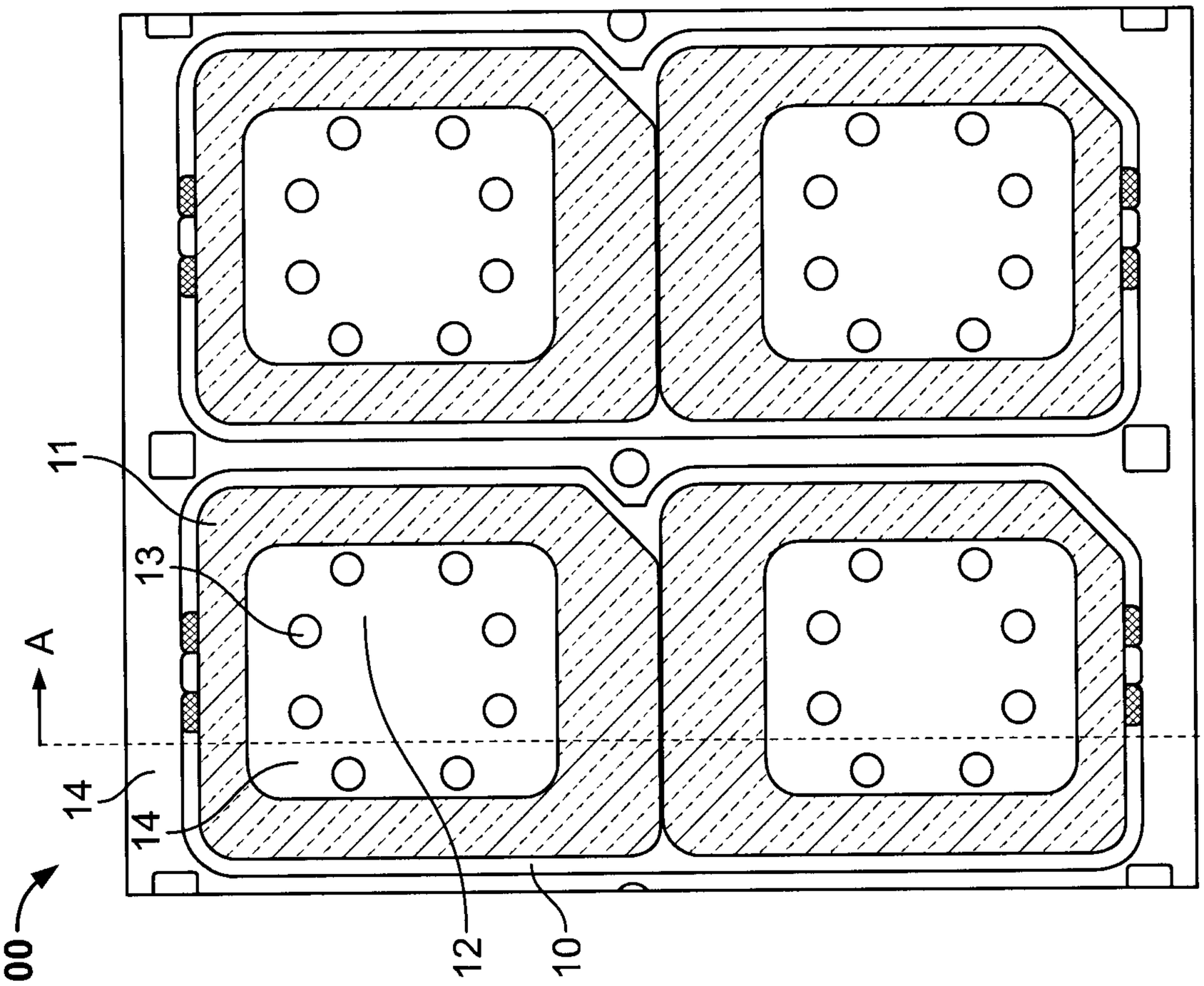


Fig. 4

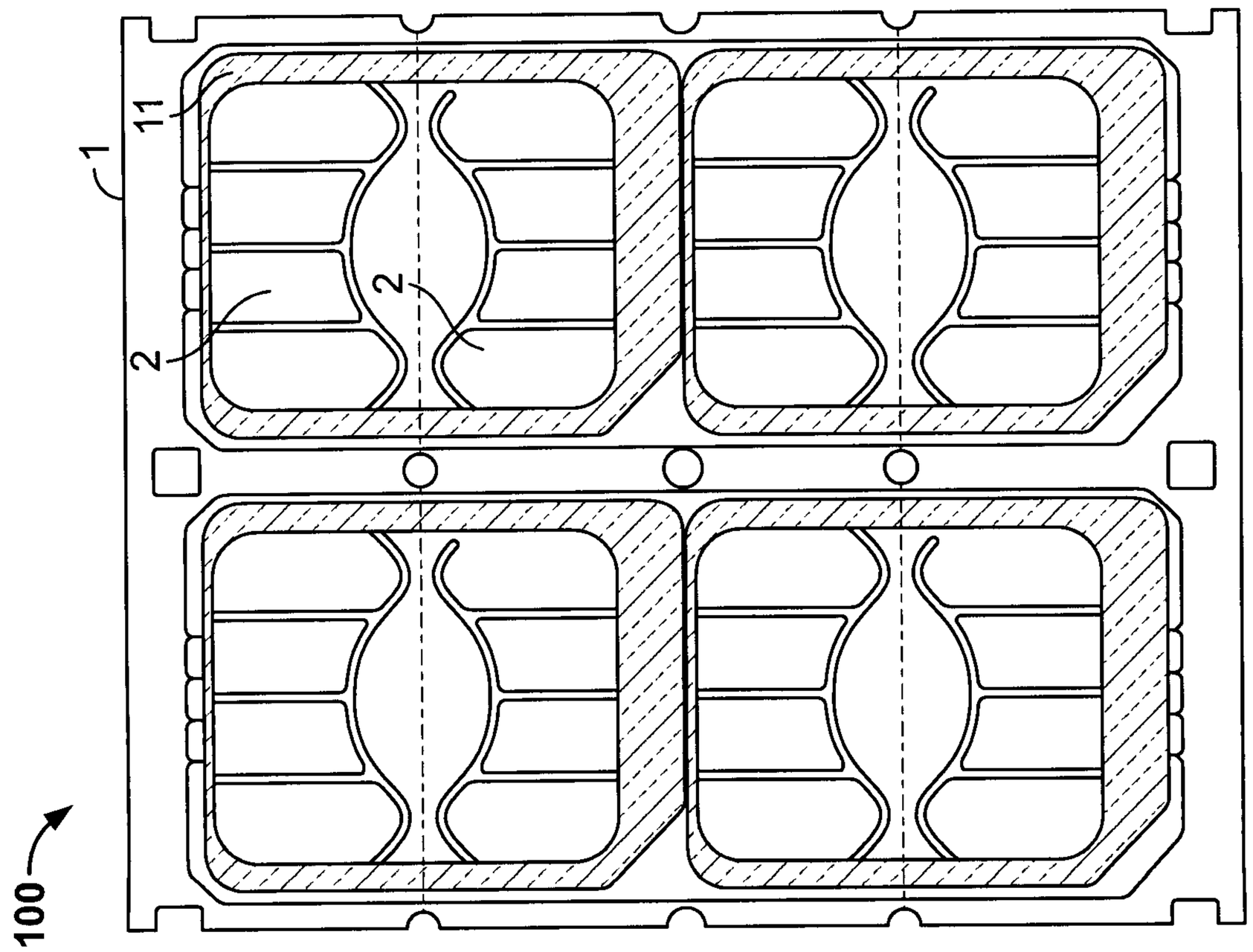


Fig. 3

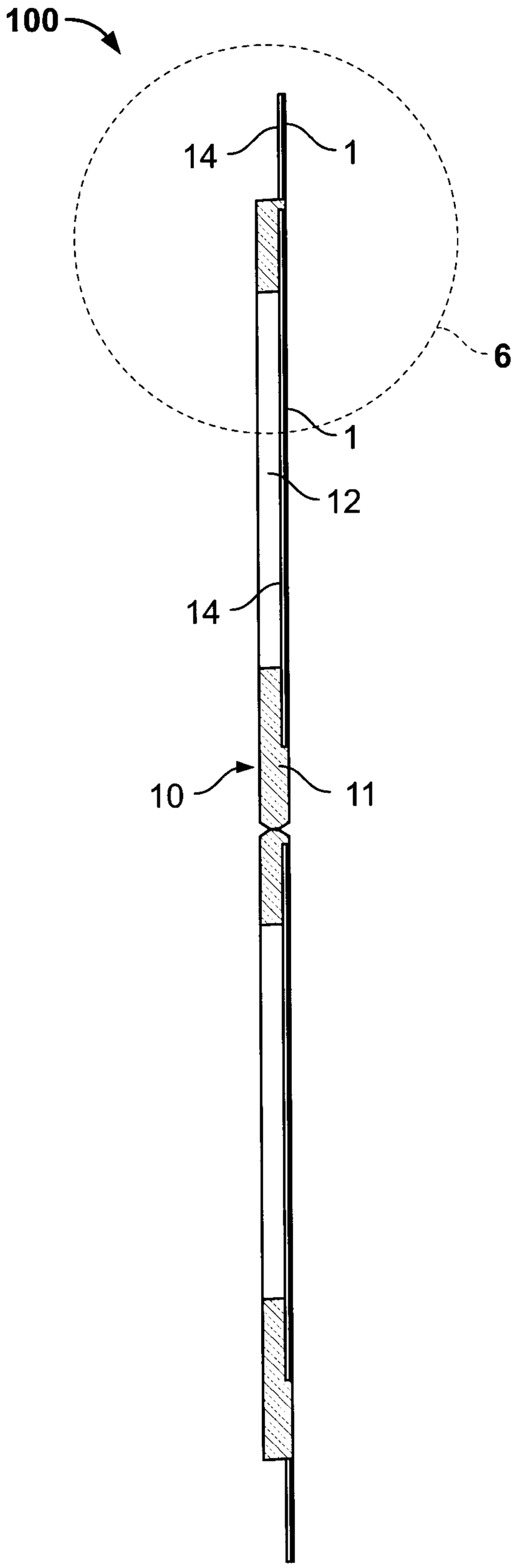


Fig. 5

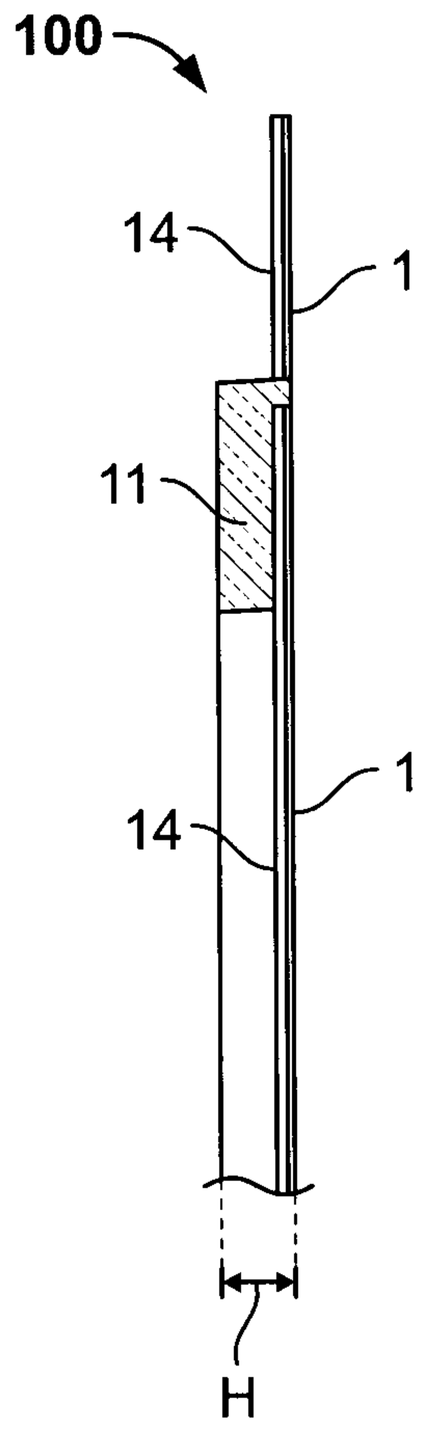
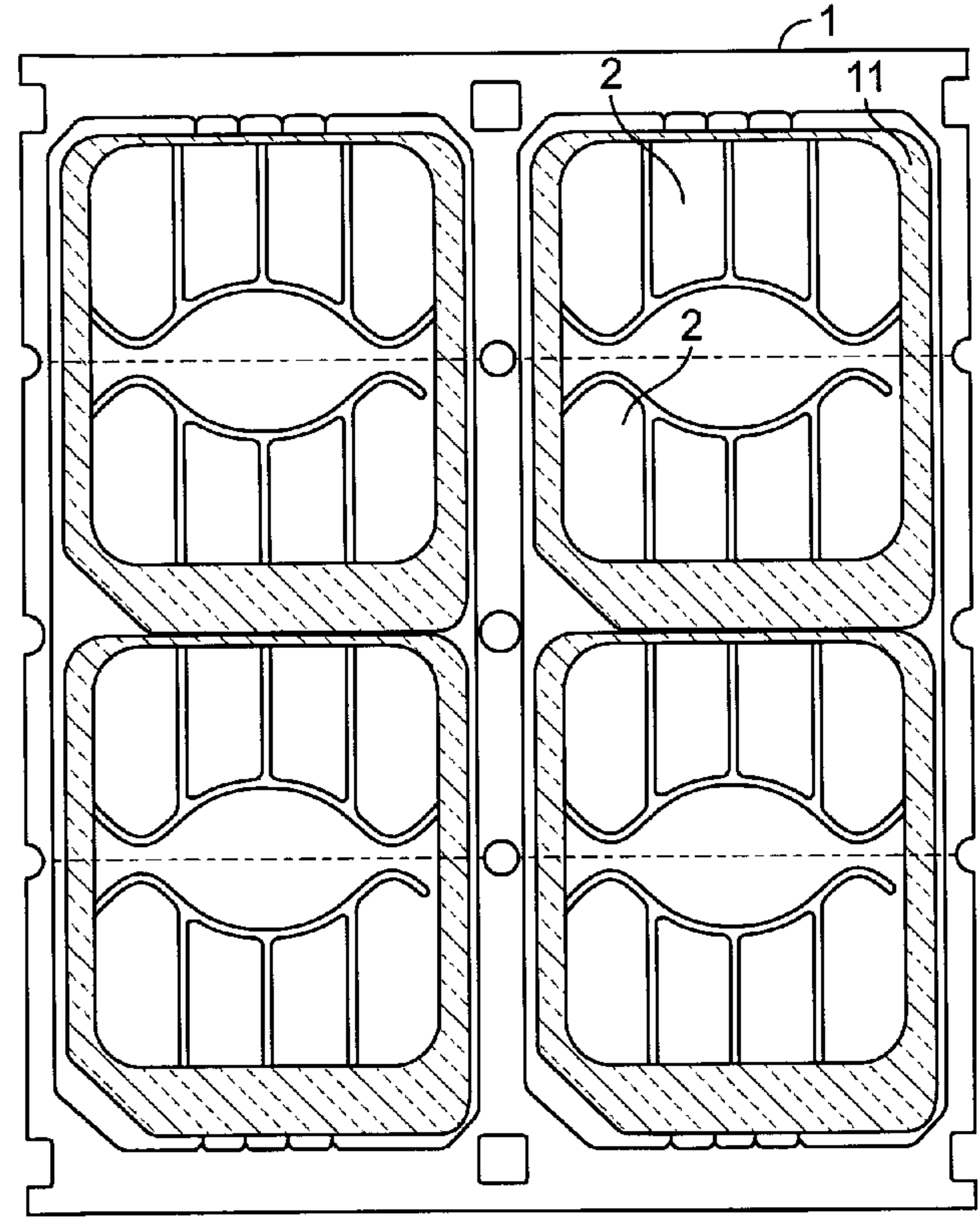


Fig. 6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