METHOD OF MANUFACTURING CARDS COMPRISING AT LEAST ONE ELECTRONIC MODULE, ASSEMBLY PRODUCED DURING THIS METHOD AND INTERMEDIATE PRODUCTS

FIELD OF THE INVENTION

The present invention concerns a method of manufacturing cards that each include an electronic module, in particular, an electronic module comprising an electronic display. The card obtained from the method according to the invention is, for example, a bankcard, in particular, which conforms to the ISO standard. However, the present invention can also apply to electronic cards whose general profile is not rectangular, particularly circular cards. The present invention also concerns assemblies and intermediate products obtained within the scope of the method according to the invention.

BACKGROUND

Electronic cards or integrated circuit cards have considerably developed over the last few years. Initially, electronic cards were formed of a card body including a resistive contact module housed in a recess in the body of the card. Then, contactless cards were made, i.e. cards including a transponder formed of an electronic circuit connected to an antenna. As electronic cards develop, it is sought to integrate other electronic elements for other functions into the cards. By way of example, cards including a switch that can be activated by the user and an electronic display have been disclosed. Such cards generally require relatively large batteries or powering means of the photovoltaic cell type. In order to integrate these various elements in a card, they are generally grouped together in the form

of at least one electronic module, including a support or substrate, on the surface of which various electronic elements are arranged. Figure 1 shows a schematic example of this type of module. Module 2 includes an integrated circuit 4, connected to an electronic display 6, a battery 8 and an activator 10, arranged on a support 12, forming a PCB interconnecting these various elements. In order to limit the thickness of these modules, the battery and/or the display can be arranged at the periphery of support 12 or in recesses therein.

It is not easy to integrate a relatively large electronic module, made up of various elements of variable shape and size, in a card. Further, integrating a digital display, which has to be precisely positioned in the manufactured card, causes an additional problem, which the present invention proposes to overcome.

EP Patent No. 0 570 784 discloses, in one implementation, a method of manufacturing cards including an electronic assembly, in particular, a transponder, which is placed in a main aperture of a positioning frame. According to the implementation disclosed, the transponder and the positioning frame are embedded in a binding agent that can be added in viscous liquid form, particularly a resin. In EP Patent No. 0 570 784, the positioning frame is only used for delimiting an inner zone for the transponder, formed of an integrated circuit and a coil, inside the card. Thus, when pressure is applied to the various elements and the binding agent to form a card, the transponder is held in an inner zone, whereas it is possible for the binding agent, in a non-solid state, to spread out on to form a layer that passes through the manufactured card. Those skilled in the art can find, in this Patent document, a method for integrating a relatively large and complex-shaped electronic module in a compact, flat card. However, the electronic module placed in the main aperture of a positioning frame, as described in that document, will often be moved slightly when the card is being formed. Indeed, this document does not disclose how to maintain the transponder in a precise, determined position inside the aperture of the

positioning frame. Those skilled in the art might certainly think of reducing the dimensions of the main aperture to make them approximately match the dimensions of the electronic module, in particular the external profile of the module. However, manufacturing tolerances must be taken into account, so that it is difficult to envisage too tight a fit. Moreover, depending upon the way in which the modules are manufactured, the positioning of the various elements on the support may also vary slightly. Thus, for example, digital display 6 is arranged on the surface of the PCB or at the periphery thereof in a position that may vary slightly. However, to obtain a high quality card, this digital display must be positioned precisely relative to the external contour of the manufactured card. This is particular important when a transparent aperture, which fits the dimensions of the digital display, is arranged above the digital display to allow the user of the card to read the display.

There is a further problem in addition to this problem of positioning the electronic module relative to the external contour of the card. This problem concerns introducing the electronic module within the card manufacturing installation. It will be noted here that electronic cards are generally manufactured in batches, i.e. several cards are manufactured simultaneously in the form of a plate that includes a plurality of electronic modules. Then, each card is separated from the obtained plate during a cutting step, as is described in EP Patent No. 0 570 784. Within the scope of the embodiments described in the latter disclosure, the transponder remains free in relation to the positioning frame until the card is formed. This requires precautions in the handling of the various elements brought to form the card, to ensure that the transponders remain in the corresponding apertures in the positioning structure until the press is activated.

SUMMARY

The present disclosure thus also proposes to answer this latter problem, in order to simplify the provision of electronic modules, while ensuring that the electronic modules are held in the apertures of a positioning structure and to facilitate assembly of the various elements and materials provided for manufacturing the cards.

Therefore, the present disclosure concerns, firstly, an assembly produced during the manufacture of cards, which each include an electronic module. The card manufacturing process includes the provision of a plate, which has at least one, at least partially through aperture, and at least one electronic module, which is electrically independent of said plate and housed, at least partially, in said at least one aperture, in an installation where a resin is added to at least one side of said electronic module, said plate forming a positioning structure for said electronic module. This assembly includes said plate and said at least one electronic module and is characterized in that, before said assembly is brought to said installation, said plate and said at least one electronic module are assembled in a sufficiently rigid manner for said at least one electronic module to remain in a substantially defined position relative to said plate, firstly until the resin is added, and subsequently during said resin is added.

It should be noted that the resin could be added in various forms and in various states. The term "resin" should be understood in a broad sense, including various known adhesives, PVC and Polyurethane resins or other resins available to those skilled in the art.

In a preferred embodiment, each aperture and/or the electronic module located in said aperture are arranged such that a space remains in the aperture, and open on at least one side of the plate. The card or intermediate product manufacturing process then includes a step where a filling material is introduced into this space remaining in the apertures.

Assembling the plate pierced with apertures and electronic modules in a preliminary step of the card manufacturing method has numerous advantages and answers the aforementioned problem. The fact that a material connection is made between the electronic module and the plate means that the assembly can be handled, in particular, via the plate, in order to implement subsequent steps in the card manufacturing method. The assembly according to the disclosure resolves the problem of holding the electronic modules in the apertures of the plate, when the plate and electronic modules are brought into an installation where a resin is added in accordance with the card or intermediate product manufacturing method of the disclosure.

In the preferred embodiment, wherein a space remains in the apertures of the pierced plate after the assembly according to the disclosure has been assembled, the spaces remaining in the apertures are generally filled with a filling material or a resin by applying pressure, particular using a press or a roller that spreads out the filling material or resin. If no particular precautions are taken, this step may move the electronic modules relative to the frame. The assembly according to the present disclosure resolves this problem in an advantageous manner, by maintaining the modules in a precise position during the entire card manufacturing method; both in the general plane of the plate and along the axis perpendicular to the general plane.

The present disclosure also concerns an intermediate product of the card manufacturing process, which comprises an assembly according to the aforementioned preferred embodiment, and a filling material, which fills at least most of the space remaining in the plate apertures where the electronic modules are situated. The top and bottom surfaces of this intermediate product are preferably more or less flat. In a first variant, the thickness of the intermediate product is approximately the same as said plate, the filling material being essentially provided in the spaces remaining in the plate apertures. In a second variant, the filling material is formed by a

resin, which covers at least one of the top and bottom surfaces of the plate. In this latter case, the intermediate product has improved rigidity, because the resin covers at least one side of the plate and preferably both sides.

If the resin covers both sides of the plate and the electronic modules, the intermediate product can already be used as a card, when the outer surfaces are approximately flat. However, there are several advantages to making the intermediate product according to the disclosure in a card manufacturing method that includes at least one further step of adding resin to both sides of the intermediate product. The present disclosure also concerns this manufacturing method. According to this method of manufacturing at least one card, an intermediate product, as defined above, is made, and then the resin is deposited on at least one of the top and bottom surfaces of the intermediate product. Finally, pressure is applied to the deposited resin, which is then in a non-solid state, to form at least one card that has a flat outer surface, since the resin deposited on the intermediate product fills in any variations in thickness in the intermediate product. The resin deposited on the intermediate product preferably forms a thin layer. The resin can be added in a single step or in several successive steps to further improve flatness.

This method is particularly advantageous for obtaining cards which have a perfectly flat surface and which incorporate a relatively large electronic module that has variations in thickness and is formed of various elements. In fact, when the electronic module is formed of various elements, made of different materials and with different levels of thickness and empty intermediate zones, the filling material or resin added to the remaining space in the plate aperture is distributed in an irregular manner, with variations in thickness. When the filling material or resin hardens, shrinkage, and thus a variation in thickness, may occur in the resin, which then generates a surface with slight hollows or bumps. The surface state of the intermediate product generally does not meet the bankcard standards, but the variations in thickness can be removed, by subsequently depositing

a resin film on both sides of the intermediate product, when the finished cards are formed. The cards then have perfectly flat outer surfaces.

Generally, the disclosure concerns a method of manufacturing at least one intermediate product or at least one card including the following steps:

– making an assembly according to the preferred embodiment of the disclosure described above, said assembly including a plate that has at least one aperture and at least one electronic module arranged, at least partially, in said aperture, said plate and said at least one electronic module being assembled, before a filling material is added to the remaining space in said at least one aperture, in a sufficiently rigid manner to hold said at least one electronic module in said at least one aperture, in a substantially fixed position relative to said plate, prior to and during the following step of:

– adding a filling material and introducing said filling material in a viscous liquid state into said remaining space in said at least one aperture;

– solidifying said filling material.

According to a preferred variant, the method is characterized in that a resin is deposited over at least one of the bottom and top surfaces of said plate, at least on the side where the filling material was introduced into said at least one aperture in said plate. According to a preferred variant, the filling material is identical to the resin and is added simultaneously.

According to a particular feature of the method described above, the resin is spread out using at least one roller or one blade, which moves relative to the plate-electronic module assembly. An intermediate product or card with more or less flat outer surfaces is thus obtained.

In accordance with one aspect, there is provided an assembly produced during the manufacture of cards and including at least an electronic module and a plate, having at least one, at least partially through aperture, said electronic module being electrically independent of said plate and at least partially housed in said at least one aperture, this assembly being intended to be brought in an installation where a resin is added to at least one side of said electronic module, said plate forming a positioning structure for said electronic module, wherein

before said assembly is brought to said installation, said plate and said at least one electronic module are assembled to each other in a sufficiently rigid manner for said at least one electronic module to remain in said at least one aperture in a substantially defined position relative to said plate until it is brought in said installation, and afterwards during said resin is added.

In accordance with another aspect, there is provided an intermediate product produced during the card manufacture, wherein the intermediate product is formed by an assembly as disclosed herein, said assembly including a plate with at least one, at least partially through aperture and at least one electronic module, which is housed at least partially in said at least one aperture, and by a filling resin, which fills at least most of the remaining space of said at least one aperture.

In accordance with another aspect, there is provided a method of manufacturing an intermediate product or at least one card including the following steps:

- making an assembly as disclosed herein;
- adding a filling resin and introducing this filling resin in a viscous liquid state in the remaining spaces of the apertures in the plate of said assembly, and
- solidifying said filling resin.

In accordance with another aspect, there is provided a method of manufacturing at least one card including the following steps:

- making an intermediate product as disclosed herein;
- depositing a resin over at least one of the top and bottom surfaces of said intermediate product, and
- applying pressure on said resin, which is deposited on said intermediate product and which is then in a non-solid state to form at least one card with a flat external surface, said resin compensating for variations in thickness in said intermediate product.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages and particular features of the assembly of the invention, of the method according to the present invention, and intermediate products obtained within the scope of the method, will appear more clearly upon reading the following description of embodiments of said assembly and said intermediate product, in addition to implementations of the intermediate product or card manufacturing method, which are given by way of non-limiting example. The description refers to the illustrative drawings, in which:

- Figure 1, already described, shows schematically an electronic module that can be integrated in a card according to the method of the present invention;

- Figure 2 shows a plate involved in a first embodiment of an assembly in accordance with the present invention;

- Figure 3A shows an electronic module being brought into an aperture of the plate of Figure 2,

- Figure 3B shows a partial cross-section of a first embodiment of an assembly according to the invention,

- Figure 4 is a partial top view of the first embodiment of an assembly according to the invention;

- Figures 5 and 6 show, respectively, and partially, first and second variants of the first embodiment of said assembly,

- Figure 7A is a partial top view of a plate involved in a third variant of the first embodiment of said assembly;

- Figure 7B is a partial top view of said third variant of the first embodiment of said assembly;

- Figure 8 shows partially a fourth variant of said first embodiment of said assembly;

- Figure 9 is a partial top view of a second embodiment of the assembly according to the invention,

- Figure 10 is a partial top view of a variant of said second embodiment of said assembly;

- Figure 11 is a partial top view of a third embodiment of an assembly according to the invention;

- Figure 12 is a partial top view of a fourth embodiment of an assembly according to the invention;

- Figure 13 is a partial cross-section along the line XIII-XIII of Figure 12;

- Figure 14 shows schematically a partial top view of a variant of the fourth embodiment of said assembly;

- Figure 15 is a partial cross-section along the line XV-XV of Figure 14;

- Figure 16 is a partial cross-section of an intermediate product according to the present invention, which is produced in a method of manufacturing cards according to the present invention;

- Figure 17 is a partial cross-section of an alternative embodiment of an intermediate product according to the invention;

- Figure 18 is a partial cross-section of another alternative embodiment of an intermediate product according to the invention;

- Figure 19 is a partial cross-section of a card obtained according to a manufacturing method of the invention from the intermediate product shown in Figure 17;

- Figure 20 shows schematically another implementation of the card manufacturing method of the invention. This method can also being be applied to make an intermediate product according to the present invention;

- Figure 21 is a partial cross-section of a plurality of cards that result from the method described in Figure 20; and

- Figure 22 shows schematically an alternative embodiment of a plurality of cards or intermediate products that also result from the method described in Figure 20.

DETAILED DESCRIPTION

With reference to Figures 2 to 4, we will now describe a first embodiment of an assembly according to the invention, which is produced in a card manufacturing method, also in accordance with the invention. The method of the invention is particularly well suited to manufacturing cards in batches, i.e. manufacturing several cards simultaneously. The assembly 22 shown partially in Figure 4 includes several electronic modules 2 for manufacturing several batches of cards. However, it will be noted that the present invention is not limited to the batch manufacture of cards, but can also, in a particular variant, apply to card-by-card manufacture, i.e. individual card manufacture.

Assembly 22 includes a plate 14 that has at least one, at least partially through aperture 16, and at least one electronic module 2 at least partially housed in said at least one aperture 16. In the example shown in Figure 2, plate 14 has a plurality of through apertures 16 and defines as many frames for electronic modules 2 as there are modules housed in said apertures 16. The plate defines a positioning structure for the electronic modules. According to the invention, projecting portions 18 are arranged at the periphery of each aperture 16. In the variant shown in Figures 2 to 4, two projecting portions 18 are arranged on two opposite sides of aperture 16, substantially along a diagonal of said aperture. It will be noted, however, that there can be any number of projecting parts and they can be arranged anywhere along the periphery of each aperture 16. Preferably, at least two

projecting portions are provided in each aperture 16. These projecting portions form stop members for the electronic modules inserted in the apertures.

Figures 2 and 4 show, in dotted lines 20, the final periphery of each card obtained from the manufacturing method of the invention, in which assembly 22 is involved. In a conventional manner, each card obtained is cut out by means known to those skilled in the art. Figure 3A shows plate 14 in the cross-sectional plane III-III of Figure 2. The thickness or height of projecting portions 18 is less than that of plate 14. Projecting portions 18 are formed before electronic module 2 is brought, in a variety of manners. These portions can be obtained by hot or cold pressing in a press. They can also be obtained using an ultrasound head or a head generating a high frequency electric field. This provides an initial plate 14 of constant thickness, pierced with apertures 16 that have projecting portions. Next, the thickness of the projecting portions is reduced, by a tool or head acting in a localised manner on these projecting portions. This step can be performed quickly and efficiently using one of the aforementioned means. In another variant of plate 14, the thickness of projecting portions 18 is reduced by machining, in particular by using a milling cutter. In another variant, plate 14 is formed of two layers, laminate welded to each other, the bottom layer including projecting portions 18, whereas the top layer has rectangular apertures that match apertures 16 in the projecting portions. Projecting portions 18 can thus be made by any means known to those skilled in the art.

Once plate 14 has been made, one electronic module 2, which is electrically independent of the plate, is inserted into each aperture 16. The electronic module and all the electrical connections thereof, are made beforehand. In the example described here, module 2 includes a substrate 12, which extends into at least some zones at the edge of said module, beyond the electronic elements 4 to 8 which said module carries. The dimensions and shape of substrate 12 are such that it has two

zones 24 which are superposed on the two projecting portions 18, when electronic module 2 is inserted into aperture 16. Thus, substrate 12 abuts against projecting portions 18, as shown in Figure 3B.

According to the invention, electronic modules 2 are assembled to plate 14 in a sufficiently rigid manner, firstly, so that electronic modules 2 remain in apertures 16 during the card manufacturing method according to the invention, and secondly, so that they approximately maintain the initial position defined when projecting portions 18 are assembled. The electronic module can be positioned when it is inserted into aperture 16 relative to a defined reference on plate 14. This positioning of module 2 relative to plate 14 may concern the module as a whole and thus in particular substrate 12, or it may concern one particular element of the module, in particular electronic display 6. This is particularly advantageous, given that display 6 is, by definition, meant to be visible on one surface of the finished card. Precise positioning of the display relative to the contour 20 of the card is important for aesthetic reasons, and also functional reasons, when the display appears through an aperture in a covering layer of the card. When positioning is required relative to the display, means are provided for marking electronic display 6 and then inserting module 2 in such a way that display 6 is in a determined position relative to plate 14, which thus forms a positioning structure.

Electronic module 2 can be secured to projecting portions 18 in various ways. By way of example, provided that the materials forming the two zones 24 of substrate 12 and projecting portions 18 can adhere directly to each other, said zones 24 are simply heat welded to projecting portions 18, using thermodes. Module 2 can also be secured to plate 14 using an ultrasound head or other means known to those skilled in the art. In another variant, an adhesive film is deposited, either on projecting portions 18, or on zones 24, so as to bond them to each other. In other variants, substrate 12 is secured to projecting portions by adding drops of adhesive or a strip of adhesive between the edge of the substrate and the

projecting portions. Any chemical or physical means that assemble module 2 to the projecting portions in a sufficiently rigid manner can be used within the scope of the present invention.

A secure assembly is thus obtained, formed of plate 14 and electronic modules 2, which are housed in apertures 16 of the plate. Two particular, advantageous features of assembly 22 will be noted:

- firstly, the thickness of module 2 is substantially identical to the thickness of plate 14, electronic module 2 being entirely housed in the corresponding aperture 16;
- secondly, a slot 26 remains between module 2 and the edge of aperture 16, with the exception of the zones where projecting portions 18 are located.

The fact that module 2 is housed entirely inside aperture 16, i.e. in the thickness of plate 14, means that the manufacture of relatively thin cards can be better controlled. This means cards that have the smallest possible increase in thickness relative to the thickness of module 2. The presence of a slot 26 reduces manufacturing tolerances for pierced plate 14 and modules 2 and also allows substrate 12 to be positioned slightly differently from one aperture to another, depending upon the position of the electronic display assembled to the substrate. Moreover, as will become clear below, slots 26 can then be filled by a resin, which thus provides an adherent bridge between substrate 12 and the wall of through aperture 16. This ensures, finally, that electronic module 2 and plate 4 are perfectly secured to each other, such that, when the finished card is bent or subjected to other stress, electronic module 2 follows the deformation of plate 14 properly. This prevents the edges of substrate 12 of module 2 marking the external surfaces of the finished card and thus damaging the aesthetic appearance of the card. It will be noted that the material used, in particular for making substrate 12, is selected so that it can withstand a certain amount of elastic deformation and can allow electronic module 2 to

be bent, when the card is subjected to stress, particularly within the scope of tests carried out to ensure compliance with the relevant standards.

A first alternative embodiment is shown in Figure 5, which shows a single aperture 16 of a plate 14, which here has approximately the dimensions of a single card. This simplified diagram, which is also used in Figures 6 and 8, is in no way restrictive, and describes an assembly 30, which is similar to assembly 22 of Figure 4, i.e. for batch manufacturing a plurality of cards.

The variant of Figure 5 differs in that the projecting portions 18A are formed in the four corners of aperture 16. The portions thus define truncated corners in the bottom area of aperture 16. Projecting portions 18A, which project relative to the generally rectangular shape of aperture 16, can be made by the same, aforementioned techniques. The dimensions of module 2 are such that the four corners of substrate 12 are superposed on the four parts 18A. The electronic module is assembled to plate 14 in a similar manner to the previously described variant.

Figure 6 shows a second alternative embodiment of the assembly according to the invention. This alternative is characterized in that it provides a step 34, which forms an intermediate level against which two lateral zones 36 of substrate 12 abut, along two opposite edges of rectangular aperture 16. Steps 34 can be formed in a similar manner to the projecting portions described in the other variants. The electronic module is assembled to plate 14 by welding or bonding, or by any other physical or chemical means available to those skilled in the art.

Figures 7A and 7B show an assembly according to a third variant of the first embodiment. Frame 14 includes a plurality of apertures 16. The peripheral area of each aperture has at least one notch 38 or preferably at least two notches 38. Each notch defines a small circular step. Electronic module 2 has projecting portions 40 at the edge thereof, which are partially superposed on notches 38 when module 2 is inserted in aperture 16. These projecting portions 40 rest on the small circular steps 38. Module 2 is

assembled to plate 14 via zones 40, which are either welded, or bonded in notches 38. In a particular variant, the notches are sized such that projecting zones 40 have to be forcibly pushed into these notches, which secures electronic module 2 to plate 14. However, this latter variant has the drawback of requiring substrate 12 and notches 38 to be machined very precisely in the peripheral area of each aperture 16. It will be noted that the first and third variants can be combined, with projecting portions 18 then being superposed on projecting zones 40.

The various variants of the first embodiment of an assembly according to the invention, which have been described up until now, are characterized in that distinct zones on the edge of the electronic module, in particular on the substrate, are superposed on corresponding peripheral areas of the plate aperture, which houses said electronic module. The thickness of these peripheral areas is preferably smaller than that of the pierced plate. According to the invention, said edge zone and said peripheral area, which is superposed thereon, are assembled to each other so that the electronic module is secured in the plate aperture. The edge zone of the electronic module can directly abut against the corresponding peripheral area or be connected thereto via a resin film. Material connections are thus created between the electronic module and the pierced plate by means of specific zones on the edge of the electronic module, located opposite corresponding peripheral zones of the aperture, in which the electronic module is arranged.

Figure 8 shows a fourth, particular variant of the first embodiment of an assembly of the invention. Assembly 44 is formed by a frame 14 that includes at least one aperture 16, which is separated into two secondary apertures by a crossbeam 46 whose thickness is less than that of plate 14. One could say that aperture 16 has two secondary apertures or equally that there are two apertures separated by a relatively narrow crossbeam. Electronic module 2 is arranged so that there are no electronic elements in a central area of substrate 12, which is superposed on crossbeam 46 once

module 2 has been inserted in aperture 16. Module 2 is assembled to plate 14 via horizontal member 46, to which module 2 is, for example, welded or bonded. Other assembling means could be provided by those skilled in the art.

In all of the variants of the first embodiment of an assembly according to the invention that have been described, the thickness of the areas of plate 14 that are peripheral to apertures 16 is preferably smaller than the thickness of the plate in general. It will be noted that other variants with a plate of constant thickness could be envisaged. In such case, substrate 12 is located above plate 14, with the electronic elements in aperture 16.

Figure 9 shows a second embodiment of an assembly 50 according to the invention. The references that were described above will not be described again in detail here. This embodiment is characterized in that electronic module 2 is assembled to plate 14 via portions of adhesive strip 52, in particular two portions. In this embodiment, electronic module 2 is entirely contained within the corresponding aperture 16 and has no parts superposed on plate 14. The adhesive strip portions 52 define material connections between each electronic module and the pierced plate. These portions 52 can be arranged on either side of electronic module 2. In the example of Figure 9, these portions 52 form a bridge between substrate 12 of module 2 and the peripheral area of aperture 16. These portions are arranged on the opposite side to the electronic elements carried by substrate 12. This example is in no way restrictive.

This second embodiment is characterized generally by the arrangement of strips formed of distinct material elements forming bridges between the edge of the electronic modules and the corresponding peripheral areas of the apertures housing the electronic modules. An "adhesive strip portion" means generally a strip portion with a surface that adheres both the plate 14 and to substrate 12. The adherence must be sufficient to hold the electronic module in the corresponding aperture 16

during transport and handling of assembly 50, and also during the steps of the card manufacturing method, in which this assembly 50 is produced as a constituent element in the batch of simultaneously manufactured cards.

Figure 10 shows an advantageous variant of the second embodiment of an assembly 56. The material connection or bridge between the electronic module and the peripheral area of aperture 16 in plate 14 is achieved here via self-adhesive discs 58. The peripheral area of each aperture has notches 60 defining two small intermediate steps. The parts of self-adhesive discs 58 superposed on plate 14 are arranged inside these notches 60 in order to avoid creating any excessive thickness relative to frame 14. The depth of notches 60 can be relatively small, at least equal to the thickness of disc 58, or, conversely, their depth can be relatively large but less than the thickness of frame 14. The references that have already been described are not all described again here.

Figure 11 shows a third embodiment of an assembly according to the invention. This assembly 62 also includes a pierced plate 14 and electronic modules 2 arranged in apertures 16. These modules 2 are assembled to plate 14 here by heat-reactivatable adhesive wires 64. These heat-reactivatable adhesive wires 64 pass through plate 14 and, in particular, apertures 16. Each heat-reactivatable adhesive wire 64 is arranged to adhere to plate 14 and to the modules 2 through which it passes. In the example shown in Figure 11, each electronic module 2 is held in the corresponding aperture 16 by two wires 64 arranged in proximity to two opposite edges of the module. The heat-reactivatable adhesive wire 64 can be a wire made of synthetic or natural material, or covered with adhesive. In another variant, the wire itself is formed by a solid resin, which can be made to adhere by applying heat or ultra-violet light. Of course, in another variant, an adhesive strip that passes through apertures 16 can form wire 64. In another variant, the heat-reactivatable adhesive wires could pass grooves made in plate 14 between two adjacent apertures 16, to prevent the wires causing excessive thickness relative to plate 14.

Heat-reactivatable adhesive wires 64 can be added before or after the electronic modules, depending upon the arrangement anticipated. Likewise, the heat-reactivatable adhesive wires can be provided on the side of substrate 12 opposite the electronic elements carried by the substrate, as shown in Figure 11, or located elsewhere, relative to substrate 12, on the same side as the electronic elements. The heat-reactivatable adhesive wire can adhere either to substrate 12 or to some of the electronic elements above which it is arranged. Those skilled in the art will understand that the possible variants are numerous. The assembly method here comprises an element that adheres to the electronic module and to plate 14 and passes through spaces 16 from a peripheral area to another peripheral area of each aperture 16. Figure 11 shows the heat-reactivatable adhesive wires parallel to one edge of rectangular apertures 16, but the wires could very well be arranged obliquely, particularly along a diagonal direction of said apertures 16.

Figures 12 to 15 show two variants of a fourth embodiment of an assembly according to the invention. The references that have already been described previously will not be described again here in detail. This fourth embodiment differs in that electronic modules 2 are assembled to plate 14 by introducing a resin in slot 26 between module 2 and the corresponding aperture 16. In the variant shown in Figures 12 and 13, the adhesive is introduced, for example by using a syringe, into slot 26 so that a small strip of adhesive 70 forms an adherent bridge between the lateral wall 17 of aperture 16 and the edge of substrate 12 of the electronic module. This strip of adhesive can be added once the electronic module has been placed in the corresponding aperture in the plate or before the module is brought. In this latter case, a strip of adhesive is applied against lateral wall 17 of aperture 16. The strip of adhesive can be added in a viscous liquid state or in a paste like state, or even in a solid state and then made soft or viscous by applying heat. Strip 70 can be formed by any resin that adheres sufficiently well to frame 14 and the electronic module, in particular to the substrate 12 thereof, to hold the electronic module in the

corresponding aperture and thus enable assembly 68 to be handled, without the electronic modules coming out of their respective apertures. The material connection made beforehand between the electronic module and plate 14 is important for holding the electronic module in a given position during the initial handling operations and also during the various steps of the method according to the invention, which will be described below.

The variant of Figures 12 and 13 is characterized in that the strip of resin 70 defines a small bridge in slot 26, i.e. between the edge of substrate 12 and the lateral surface 17 of plate 14. This obviously does not mean that resin strip 70 cannot also extend partly over one or other of the top or bottom surfaces of substrate 12 and also over the top surface of plate 14. However, it will be noted that, preferably, the resin for securing the module is entirely inside aperture 16 and does not therefore cause any excessive thickness relative to the plate.

The variant shown in Figures 14 and 15 differs in that the assembly 72 includes drops of resin for securing electronic elements 2 to plate 14. These drops 74 are preferably added to the side of substrate 12 where the electronic elements are arranged. The drops of resin 72 form a joint essentially between the lateral wall 17 of aperture 16 and the top surface of substrate 12. This does not, however, mean that drop 74 flows into slot 26. The two variants of this fourth embodiment of an assembly according to the invention are thus relatively close to each other. In this fourth embodiment, a resin is applied locally to create a bridge or joint between the electronic module and the peripheral area of the corresponding aperture. This bridge or join is preferably located inside aperture 16 so that it does not cause any excessive thickness relative to the thickness of frame 14, which is approximately equal to the maximum thickness of electronic module 2.

It will be noted that the resin can be applied over several distinct edge zones of module 2. In Figures 12 and 14, the resin is only deposited in two diametrically opposite zones. Evidently, more zones could be provided,

in particular, four zones approximately at the four corners of aperture 16. It will also be noted that the distinct zones can be relatively short as shown in Figures 12 and 14, or extend over a longer distance, for example, along the two small sides of rectangular aperture 16.

In all of the embodiments of the assembly according to the invention described above, the electronic module can have various configurations. This electronic module can have electronic elements on both sides of substrate 12 so that the substrate 12 is located in the median area of the corresponding aperture. Some elements can also be arranged in apertures in substrate 12 or at the periphery thereof, to prevent their respective thickness being added. In this latter case, it is also possible for an electronic element to pass through the substrate and come out of both sides of the substrate. Preferably, the thickness of plate 14 is approximately identical to the thickness of the electronic module; but this is not a compulsory requirement. Some elements, in particular an electronic display, have a greater thickness than that of plate 14. Finally, it will be noted that various embodiments and/or various variants could be combined with each other.

Two main variants of an intermediate product produced during the card manufacturing method according to the invention will be described below with reference to Figures 16 and 17.

The intermediate product 80 shown in Figure 16 is formed by an assembly according to the invention, said assembly including a pierced plate 14 and electronic modules housed in corresponding apertures 16. Substrate 12 of module 2 rests abutting against projecting parts arranged at the periphery of apertures 16, as described with reference to the first embodiment of an assembly according to the invention. Initially, electronic modules 2 and pierced plate 14 are assembled to each other by an adherent film provided between the projecting parts of plate 14 and substrates 12 of the electronic modules. In another variant, modules 2 are secured to plate 14 by adding drops of resin or strips of resin, in particular in the slot remaining between substrate 12 and wall 84. It will be noted in

Figures 16 and 17 that the example chosen for the assembly according to the invention is given by way of non-limiting illustration. In fact, any assembly according to the invention can form an intermediate product by adding a filling material 82 in the space remaining in apertures 16. In the variant of Figure 16, the filling material 82 approximately fills each aperture 16, without, however, covering the top and bottom surfaces of plate 14, or the surfaces of electronic display 6 that have the same thickness as plate 14. Filling material 82 fills at least most of the space remaining in apertures 16. This filling material is added in viscous liquid form and inserted in the apertures by various means available to those skilled in the art, in particular by casting pouring or any other technique known to those skilled in the art. It will be noted, in particular, that it is possible to envisage introducing filling material 82 by an injection technique, by pressing the mould cover on plate 14, the cover mastering the top surface of electronic display 6 during injection. One variant can be envisaged wherein electronic display 6 is also covered by the filling material, which is then transparent. Once again, the examples given are in no way restrictive. In the variant of Figure 16, the filling material is added entirely through the top surface of frame 14, i.e. on the opposite side of substrate 12 to electronic module 2.

Filling material 82 can be formed by various suitable materials, which preferably have some elasticity once they have solidified. Preferably filling material 82 has a good adherence with the lateral walls of openings 16. In particular, a synthetic or natural resin forms material 82. By way of example, material 82 can be a polyurethane resin or a PVC resin. Material 82 could also be formed by an adhesive that hardens at ambient temperature or reacts, for example, to ultraviolet light (UV). In another variant that could be envisaged, material 82 could be formed by a gel or silicon-based material.

The intermediate product 86 shown in Figure 17 differs from that of Figure 16 in that filling material 82 is formed by a resin that covers at least the top surface 88 of plate 14, i.e. the surface on the side of which resin 82

was introduced. In the example of Figure 17, resin 82 also covers bottom surface 89 of plate 14 and module 2, in particular, substrate 12. In another variant, plate 14 and the electronic modules are placed on a work surface or a worksheet as in the case of Figure 16, and the resin is only introduced slowly, from above, into the space remaining in apertures 16. In such case, only top surface 88 of plate 14 and the top surface of display 6 will be covered. If electronic display 6 is covered by resin 82, this resin 82 will obviously be sufficiently transparent to allow the display to be read. As in the example of Figure 16, electronic circuit 4 is covered by resin 82.

Once the resin has been added and distributed in apertures 16, a step is provided for solidifying the resin to form the intermediate product. In the example of Figure 17, the assembly according to the invention is embedded in resin 82. However, in the example of Figure 16, resin 82 does not define a through layer, but it is localised essentially in apertures 16 of plate 14. In Figures 16 and 17, the top surface of the solidified resin is slightly rippled, i.e. it has slight variations in thickness. This does not mean that the resin was only added by a casting technique, but it can indicate that, when the resin or filling material solidified, the material may have shrunk in a non-homogenous manner, given the presence of relatively bulky electronic elements, formed of various materials. Thus, the non-flat surface of intermediate product 86 can also result from a method wherein the resin is spread using a roller or blade, and even in the case where the resin is injected or spread in a press with flat surfaces. The intermediate product 86 can already be used to form a card or electronic token once it has been cut out, but its surface state can be improved within the scope of a method according to the invention, which will be described below.

Figure 18 shows an alternative embodiment of the intermediate product. This variant is characterized in that two worksheets are also provided on either side of the assembly according to the invention, i.e. covering the top and bottom surfaces of the resin layer. These worksheets 104 and 106 thus have poor adherence to resin 82 and facilitate the

manufacture of the intermediate product. In fact, the resin is not then placed in contact with the surfaces of the manufacturing installation for the intermediate products according to the invention. The worksheets are removed once the resin has solidified. In another variant, a thin plastic film is provided on each side of the resin, which adheres securely to the resin. This film remains in the cards manufactured in accordance with the method described below.

With reference to Figure 19, we will describe below a method of manufacturing at least one card according to the invention. The steps in this method include:

- making an intermediate product according to the invention, for example intermediate product 80 of Figure 16, or intermediate product 86 of Figure 17;
- depositing a resin over at least one of the top and bottom surfaces of the intermediate product;
- applying pressure on the resin deposited on the intermediate product to spread the resin out and make said bottom and/or said top surface of the intermediate product level, said resin then being in a non-solid state and preferably viscous liquid, to compensate for any variations in thickness in the intermediate product.

Figure 19 shows a plurality of cards that are batch manufactured in accordance with the method described below. After intermediate product 86 was made, two resin layers 92 have been added on either side of intermediate product 86, in addition to two external solid layers 94 and 96. Using a press, pressure is applied against external layers 94 and 96 so as to form a plurality of cards 90. The references that have already been cited will not be described again here in detail. If the intermediate product includes two external plastic films, the resin is then deposited above and the films are covered with resin on both sides.

It will be noted that there are various possible variants as regards the addition of resin 92 on either side of intermediate product 86. A first main

variant consists in adding the resin in a viscous liquid state, either before or simultaneously with the addition of external layers 94, 96. The card according to the invention can be formed for example in a press with flat surfaces in which the various elements are placed, or using press rollers known to those skilled in the art. Resin 92 can be identical to the filling material or resin 82, used to form the intermediate product. However, a different resin that is suited to application in thin layers could very well be selected for layers 92. Moreover, a resin 92 that is particularly stable and has no significant shrink during solidification, will preferably be selected.

As is clear from Figure 19, intermediate product 86 has a slightly rippled top surface. Resin 92 is distributed when pressure is applied so as to fill in the ripples in the intermediate product, to form a card, or a plurality of cards 90, whose external layers 94 and 96 have a perfectly flat surface. Manufacturing by adding the resin or filling material in two steps results in cards that have a given thickness and thus overcomes the flatness problems encountered in the manufacture of cards that have relatively large electronic modules or elements inside, in particular electronic elements whose thickness is variable, which cause variable resin thickness inside the card. The resin can be added to the intermediate product and pressure can be applied above in several successive steps. Thus, during the first application of resin, two worksheets are preferably used, and then removed once resin layers 92 have solidified. A second resin layer can then be added above to further improve the flatness of the card. As already mentioned, a multi-layered structure with thin plastic films between two depositions of thin resin layers, could also be provided.

According to a second main variant, the resin layers 92 are added in the form of solid resin sheets, which are then at least partially melted prior to or simultaneously with the application of pressure to form the finished cards. The resin sheets are thus sufficiently soft and easily deformed for the resin to be able to spread and fill the surface unevenness of the intermediate product 86, in order to form a high quality flat card. Heat can

be applied by various means and, in particular, via the actual press. Finally, resin 92 can also be solidified in various ways, depending upon the features of the resin. The resin can solidify at ambient temperature, or by other means known to those skilled in the art, particularly by a chemical reaction or polymerisation with thermosetting materials.

It will be noted that the finished card 90 can include several external layers and transparent protective layers, for example, to protect any printing performed on layer 94 or 96. Generally, any intermediate product and any card obtained within the scope of the present invention, can then be laminated with a variable number of plastic layers, without using any additional resin. An intermediate layer that has been laminated with external layers in this way can form finished cards after the cutting operation.

With reference to Figures 20 to 22, we will describe another implementation of the card or intermediate product manufacturing method according to the invention. In this implementation, one may take any assembly according to the invention, formed of a pierced plate 14 and electronic modules, in particular a display 6 and an electronic circuit 4 mounted on a substrate 12. As in Figures 16 and 17, the electronic display is arranged in an aperture of substrate 12 or at the periphery thereof. It is secured to the substrate by connecting pins or other connecting or securing means. This assembly according to the invention is provided with a resin 98, in a viscous liquid state, between two solid layers 94 and 96, respectively 104 and 106 in an installation provided with press rollers 100 and 102, between which the various elements are continuously introduced. Rollers 100 and 102 preferably rotate freely and the assembly formed of the electronic modules and the pierced plate, and the external layers, are pulled. This implementation is not restrictive, but has the advantage of allowing the assembly according to the invention and the external layers in contact with press rollers 100 and 102 to move forward in an identical way. Resin 98 is preferably added to bottom layer 94, or respectively top layer 104 and over the assembly according to the invention. This is in no way

restrictive and any other way of adding the resin that allows the electronic assembly to be properly embedded or coated could be used by those skilled in the art. The installation supports have been shown entirely schematically and do not form any particular feature of the method of the invention.

It will be noted that press rollers 100 and 102, and the arrangement thereof in the card manufacturing installation, have been shown schematically. It is possible to provide several pairs of press rollers arranged one after the other or other similar means of pressure, for example a continuous press fitted with a conveyor belt. These pairs of rollers can have different diameters and the distance between the rollers of one pair can also be different. In particular, the distance between the press rollers could decrease in the direction of movement of the elements that pass through the press rollers. Thus, the thickness gradually decreases between external layers 94 and 96, or 104 and 106 respectively. This enables the resin 98 to be better distributed to obtain improved flatness for the manufactured cards.

Means other than press rollers could be provided, for example blades for spreading out the resin and distributing it in the remaining spaces in the apertures in the pierced plate and on either side of the assembly of the invention.

Figure 21 shows a batch of cards obtained by the method described above. Cards 108 thus include an electronic module connected to a pierced plate 14 and coated with resin 98. These cards include two external solid layers 94 and 96, which have approximately flat surfaces. These layers 94 and 96 adhere properly to resin 98, so that they form part of the finished cards. In a known manner, each card is cut out of the batch of simultaneously manufactured cards using a cutting tool or by means known to those skilled in the art, particularly using a jet fluid.

Figure 22 shows an intermediate product or a batch of cards 110 obtained by the manufacturing method described with reference to

Figure 20. Here, solid layers 104 and 106 form worksheets that do not adhere well to resin 98 so that these sheets 104 and 106 are removed once resin 98 has solidified. An intermediate product, or batch of cards is thus obtained, whose body is formed by resin 98, the external surfaces of the resin then defining the external surfaces of the product obtained. According to various variants, other external layers can be subsequently added, by laminating either side of the intermediate product 110. Likewise, the cards 108 shown in Figure 21 can also receive other external layers, in particular a printing layer and a final transparent protective layer. The cards can be individually cut before or after these additional layers are added.

In another implementation of the method described here, the intermediate product or cards can be formed in a press that has flat surfaces. All of the elements are added between these surfaces before any pressure is exerted to form the intermediate products or approximately flat cards. It will be noted that it is possible, firstly, to use press rollers and then to place the product obtained in a press with a flat surface until the resin solidifies. It will be noted finally, that resin 98 is preferably added in a viscous liquid state. However, in a variant, it is possible to add the resin or any other filling material in a solid state and then to melt it so that it can then fill the remaining spaces in the apertures in pierced plate 14 and thus form compact and substantially full cards, i.e. cards that have a relatively low level of residual air.

CLAIMS

1. Assembly produced during the manufacture of cards and including at least an electronic module and a plate, having at least one, at least partially through aperture, said electronic module being electrically independent of said plate and at least partially housed in said at least one aperture, this assembly being intended to be brought in an installation where a resin is added to at least one side of said electronic module, said plate forming a positioning structure for said electronic module, wherein before said assembly is brought to said installation, said plate and said at least one electronic module are assembled to each other in a sufficiently rigid manner for said at least one electronic module to remain in said at least one aperture in a substantially defined position relative to said plate until it is brought in said installation, and afterwards during said resin is added.

2. Assembly according to claim 1, wherein each aperture and/or the electronic module located in said aperture are arranged so that a space remains in the aperture, open on at least one side of said plate.

3. Assembly according to claim 1 or 2, wherein at the periphery of each aperture, said plate has at least one projecting portion, which has a smaller thickness than that of said plate and is superposed on an edge zone of said electronic module, which is arranged in said aperture, said zone being secured to said projecting portion in order to secure the electronic module to the plate.

4. Assembly according to claim 1 or 2, wherein each electronic module has at least one projecting zone, which is superposed on a peripheral area of the corresponding aperture

in said plate, said projecting zone being bound to said peripheral area to secure the electronic module to the plate.

5. Assembly according to claim 4, wherein said peripheral area is defined by a notch, which is made at the periphery of each aperture, and which defines an intermediate step whose thickness is less than that of the plate.

6. Assembly according to claim 1, wherein each aperture is separated into two secondary apertures by a cross-beam of said plate, which is superposed on the electronic module arranged in the aperture, said cross-beam being secured to the electronic module to fix said electronic module to the plate.

7. Assembly according to claim 6, wherein the thickness of said cross-beam is less than that of said plate.

8. Assembly according to claim 1, wherein each electronic module is assembled to said plate by adhesive fasteners.

9. Assembly according to claim 8, wherein said adhesive fasteners are formed by pieces of an adhesive strip or adhesive discs.

10. Assembly according to claim 9, wherein said adhesive fasteners are secured to said plate in notches provided at the periphery of each aperture.

11. Assembly according to claim 8, wherein said adhesive fasteners are formed by wires or thermoadhesive strips, which pass through the apertures provided in said plate and connect the electronic modules arranged in said apertures to said plate.

12. Assembly according to claim 1, wherein each electronic module arranged in an aperture in said plate is

connected to said plate via drops of resin or strips of resin, which define material bridges between the electronic module and said plate.

13. Assembly according to claim 1 or 2, wherein a slot is provided between the electronic module and the corresponding aperture, which houses the electronic module, said slot being interrupted by the means for securing the electronic module to said plate.

14. Assembly according to claim 1 or 2, wherein each electronic module has a substrate that carries electronic elements, the electronic module being assembled to said plate via said substrate.

15. Intermediate product produced during the card manufacture, wherein the intermediate product is formed by an assembly according to claim 2, said assembly including a plate with at least one, at least partially through aperture and at least one electronic module, which is housed at least partially in said at least one aperture, and by a filling resin, which fills at least most of the remaining space of said at least one aperture.

16. Intermediate product according to claim 15, wherein the intermediate product includes a covering resin that covers at least one of the top and bottom surfaces of said plate.

17. Intermediate product according to claim 16, wherein said filling resin and said covering resin are formed by a same substance.

18. Intermediate product according to claim 16 or 17wherein at least one solid layer covers said resin, said solid layer forming a worksheet that does not adhere well to said resin and that will be removed during said card manufacture, such that said worksheet is not included in the finished cards.

19. Method of manufacturing an intermediate product or at least one card including the following steps:

- making an assembly according to claim 2;

- adding a filling resin and introducing this filling resin in a viscous liquid state in the remaining spaces of the apertures in the plate of said assembly, and

- solidifying said filling resin.

20. Method according to claim 19, wherein a covering resin is deposited over at least one of the top and bottom layers of said plate.

21. Method according to claim 20, wherein said filling resin and said covering resin are formed by a same substance and are added simultaneously.

22. Method according to claim 20, wherein at least one solid layer is added onto said covering resin to form a top layer and/or a bottom layer.

23. Method according to claim 22, wherein said top layer, respectively said bottom layer, is a worksheet that does not adhere well to said covering resin, said worksheet being subsequently removed.

24. Method according to claim 22, wherein said top layer, respectively said bottom layer, forms one layer of the manufactured cards, said solid layer adhering securely to said covering resin.

25. Method according to claim 19, wherein said filling resin is spread out using at least one roller or a blade, which moves relative to said assembly, such that, after hardening, the filling resin fully fills said remaining spaces of said apertures.

26. Method according to any of claim 20 or 21, wherein said filling resin and said covering resin are spread out using at least one roller or a blade, which moves relative to said assembly, such

that, after hardening, the covering resin has an approximately flat external surface

27. Method of manufacturing at least one card including the following steps:

- making an intermediate product in accordance with claim 15 or 16;
- depositing a resin over at least one of the top and bottom surfaces of said intermediate product, and
- applying pressure on said resin, which is deposited on said intermediate product and which is then in a non-solid state to form at least one card with a flat external surface, said resin compensating for variations in thickness in said intermediate product.

28. Method according to claim 27, wherein the operations of depositing resin, applying pressure to said resin in a non-solid state and solidifying said resin are carried out at least twice in succession.

29. Method according to claim 27 or 28, wherein said resin is added in a viscous liquid state.

30. Method according to claim 27 or 28, wherein said deposited resin is covered by at least one worksheet that does not adhere well to said resin, said at least one worksheet being removed after the resin has solidified.

31. Method according to claim 27 or 28, wherein there is a final step of adding at least one solid external layer onto said resin, said solid layer adhering securely to said resin.