Laminate, in particular in the form of cards, and a process for the production thereof

The invention concerns laminates, in particular in the form of cards, for example identity cards, credit cards or the like, which include at least two films which are fixedly connected together and between which security elements and optionally identification elements are arranged, wherein at least one of the films is semi- or completely transparent so that the security and optionally identification elements are visible through said transparent film, and wherein moreover at least one security element is formed by a three-dimensional structure which has an optical diffraction effect and which is produced by a correspondingly structured surface of a lacquer or polymer layer, said surface being provided with a coating which improves the recognisability of the structure.

The invention further concerns a process for the production of a laminate comprising at least two films of which at least one is semi- or completely transparent and between which are arranged security elements and optionally identification elements having a structure with an optical diffraction effect, wherein the security and/or identification elements are applied to a first film and then the second film is laminated in position over its entire surface area under the action of heat and pressure.

Laminates of the above-indicated kind as are known for example from WO 95/09084 are very frequently used for the production of cards, for example identity cards, credit cards, driving licences in card form etc. Corresponding laminates can also be used for example as an identification page in passports or otherwise as a constituent part of a document which is to be suitably safeguarded. In that respect certain demands are made on such cards or laminates. On the one hand the period of use of the card should be on average between 5 and 30 years. The cards should further enjoy a high level of mechanical stability as well as a high level of resistance to scratching, abrasion wear and chemicals. In addition it should

be possible to provide for reliably safeguarding the cards to prevent forgery and manipulation. Finally it is frequently necessary, in regard to cards or laminates of that kind, also to be able to implement the possibility of personalisation, either during card manufacture or subsequently to the card manufacturing process, by means of the processes which are usual for such personalisation, for example by printing on or applying labelling to the cards by means of laser processes.

At any event, in comparison with such documents or the like which have a base layer on which then the security or identification elements are arranged, laminates in which security or identification elements are disposed between two layers have in that respect the advantage that, by virtue of the security and identification elements being enclosed between the two cover layers, the security and identification elements are substantially safeguarded in relation to chemicals, abrasion wear and direct forgery.

Now, hitherto the production of corresponding laminates involved a procedure such that the security or identification elements were generally applied in a printing or transfer process to a first film which was then covered over its entire surface area with a lacquer layer or which had a second film applied thereto by being laminated thereover, in which case the film materials were generally different (see for example WO 95/09084).

That procedure also has a number of shortcomings. Thus on the one hand the procedure is such that structures which are diffractive or have an optical diffraction effect, in the case of cards comprising a laminate, are generally only embossed into a lacquer layer which is applied to the first film, in which respect that lacquer layer, by virtue of its small thickness and the fact that the structure having the optical diffraction effect is exposed, could already be easily damaged or soiled during the production procedure. When then a second film is applied to the first film by lamination, there is the risk that the structure with the optical diffraction effect is damaged or altered in such a way as to cause problems, during the laminating procedure, as a result of excessively high temperature or excessively high

pressure or a shearing effect. Therefore, in order to avoid that, to protect the temperature-sensitive lacquer layers with the structures having the optical diffraction effect in the rolling laminating procedure for applying the further cover layer, only very short periods of action (of less than 1 second) are used with effective material temperatures in the range of only 60 to 160°C.

That procedure also suffers from serious disadvantages, in which respect the most serious shortcoming is that such low temperatures in conjunction with a comparatively short period of action are only sufficient to sufficiently firmly connect the two films of the laminates to each other when the procedure involves using films which have a correspondingly low melting point and which are thus susceptible to damage. A further disadvantage with the known procedure is that quite specific substances must be used for the security or identification elements which are arranged in the interior of the laminate, which substances provide a very good join to the materials of the two films and which in addition in themselves also have a sufficient level of strength, because it is only in that way that it is possible to prevent the two films of the laminate which enclose the security and identification elements between them from being intentionally or unintentionally separated from each other. In order to prevent such unintentional separation which would permit a forgery to be effected, for example by replacing a photograph or other identification element present between the films, it is also necessary to ensure that the materials between the films cannot be softened for example by a fusing procedure. This means however that quite considerable limitations are involved, in regard to the materials which can be used for the security and identification elements.

In order to make it more difficult for the two films to be separated from each other, it is already known from WO 95/09084 for the security elements to be provided only in a region-wise manner, in which case the films which enclose the security elements between them are in directly mutually adjoining relationship, between the security elements. So that the

films securely adhere to each other, WO 95/09084 proposes a quite specific material combination. More specifically, one of the films is to be a PVC film while the other film is formed by an amorphous copolyester. That film combination also suffers from disadvantages, in particular the disadvantage that the frequently desired strength and resistance to temperature cannot be achieved. The optical properties in PVC films or films of amorphous copolyesters also frequently leave something to be desired.

Therefore the object of the invention, for corresponding laminates, is to propose a novel construction which on the one hand affords substantial freedom in regard to the nature and chemical composition of the security and identification elements disposed between the films, but nonetheless ensures that on the one hand the films adhere to each other reliably and in such a way that they cannot be separated in normal circumstances so that the security and identification elements are reliably protected in the interior of the laminate and forgery is almost completely excluded. On the other hand the laminate should have particular good optical and mechanical properties. Furthermore the invention seeks to propose a process which permits the production of corresponding laminates in a particularly advantageous manner.

Now, in accordance with the invention, to attain that object, it is proposed that a laminate of the kind set forth in the opening part of this specification is designed as set forth in the classifying portion of claim 1.

Therefore in accordance with the invention, for holding together the films which generally form the cover layers of the laminate or the card, only those films are responsible for that purpose, which means that materials which adhere comparatively poorly to the films can also be used as security or identification elements. Nonetheless, the arrangement according to the invention provides a reliable safeguard against the films being separated from each other, and thus affords a safeguard against interventions at the security or identification elements. It is proposed for the first time in accordance with the invention that films of polycarbonate (PR) and thus a material with good mechanical and optical properties is used as cover

layers, wherein security or identification elements of such materials which normally have relatively poor adhesion on polycarbonate films can be enclosed between the PC films. Thus for example lacquers which can be applied in a printing process or deformable lacquer or polymer layers for applying structures having an optical-diffraction effect can be used for the security or identification elements. Astonishingly it has been found that, in spite of the laminating procedure, the structures having an optical-diffraction effect, which are present between the films, are maintained if only those structures are embossed into a suitable lacquer or polymer, more specifically even when comparatively high temperatures act over a relatively long period of time for the purposes of laminating the two films together. In addition the adhesion between the PC films can be specifically reduced by security elements or the like of suitable material in order thus to produce virtually "desired-rupture locations" in the event of attempts being made to manipulate or forge the article.

An essential feature of the laminate according to the invention is to be found in the presence of the fine graphic elements or alphanumeric characters which in a continuous surface region of the laminate form the security and optionally identification elements. As those elements have a maximum line width or point size of less than 5 mm, preferably dimensions of between 0.1 and 3.0 mm, in one direction, this ensures that the foils cannot be displaced relative to each other when the card or the like is bent, as is the case for example specifically in the card in accordance with WO 95/09084, as that could certainly make it easier for the two foils to be separated from each other. In addition there is no risk that for example structures which have an optical-diffraction effect on the security elements or the like are altered or damaged as a consequence of mutual displacement of the films.

In order to ensure that the films enclosing the security and optionally identification elements adhere sufficiently firmly to each other, it is sufficient if, in a proportion of at least 25% of the total surface area of the laminate, the two films are directly adjacent to each other, that is to say

they are directly fused to each other in the laminate production procedure. In such a situation it is not possible to separate the films from each other without inflicting damage and without taking particular measures.

In order however to provide that, even after corresponding mechanical actions or the like, the security and optionally identification elements formed by the fine elements or alphanumeric characters are satisfactorily recognisable and are not damaged, it is proposed in accordance with the invention that, in the continuous surface region which has the fine elements or alphanumeric characters, the films enclosing the security and optionally identification elements are directly adjacent to each other, that is to say are fused to each other in the finished laminate, in a proportion of from 65 to 95% of the surface area of the surface region.

If, as is provided in accordance with the invention, when the laminate is in the form of a card, a region along the card edge of a width of at least 3 mm and preferably 3 to 10 mm is free from security or identification elements, this affords the advantage that the card edge has a region therealong, in which the two PC films are connected over their full surface area, whereby on the one hand forcible separation of the films is made still more difficult while on the other hand reliably ensuring that moisture, chemicals or the like cannot penetrate into the space between the two films by way of a location which lacks sealing integrity.

The coating which improves recognisability of the structure having an optical-diffraction effect, which forms at least one security element, can be formed in a per se usual manner by a metalisation. For example a very thin metal layer, preferably an aluminium layer, can be applied by vapour deposition over the entire surface area or in region-wise manner to the structures having the optical-diffraction effect. It is particularly advantageous however if in accordance with the invention the reflection-enhancing coating of the structure having an optical-diffraction effect, which forms a security element, is formed by a transparent material which, in comparison with the material adjoining the coating and disposed in front thereof in the direction of view, has a markedly different refractive index, in

which respect advantageously the difference between the refractive index of the transparent coating and that of the adjoining material is at least 0.3 and preferably at least 0.5. The use of a transparent coating material for the structure having the optical-diffraction effect affords the advantage that any elements which are present in the direction of view behind the structure having the optical-diffraction effect and the corresponding coating are visible. That is particularly desirable if both cover films of the laminate are also transparent because then the laminate can be used for example for coating a substrate containing any items of information, for example details relating to the person of a user. It will be appreciated that all not all structures having an optical-diffraction effect have to be coated with a transparent, reflection-increasing material. On the contrary it is also possible for only certain structures having an optical-diffraction effect to be provided with a transparent coating, but in the case of other structures the usual coating in the form of a metalisation can be employed. In particular the usual dielectric layers which can be applied by vapour deposition, for example TiO_2 or ZnS fall to be considered as the transparent coating.

It may further desirable for at least one lacquer or polymer layer to be arranged between the recognisability-improving coating of the three-dimensional structure of the at least one security element and each film, that is to say, it may be desirable for the three-dimensional structure to be placed in such a way that it is enclosed on both sides by a layer of that nature. In this design configuration, even when using comparatively high pressure when the two films are being laminated together, this arrangement guarantees with a very high degree of certainty that the three-dimensional structure of the security element or elements is not altered.

While the state of the art provides that the security or identification elements are mostly applied to one of the films directly by printing or another lacquer application procedure, it is preferred in accordance with the invention that at least one of the security and/or identification elements is formed by the decorative layer of a (per se known) transfer film, in

particular a hot stamping film. The use of corresponding hot stamping films affords quite a number of advantages. In particular, this affords a high degree of variability in regard to the different security or identification elements. In addition when using hot stamping films a structure having an optical-diffraction effect is usually enclosed in any case between two lacquer or polymer layers so that, particular when the lacquer of the hot stamping foil is fully hardened or has reacted to a totally set condition, variations in shape as a result of the effect of pressure in the laminating procedure are no longer to be feared. Hot stamping films can further be applied to a film in the most widely varying geometrical configurations, in which respect both security elements and also identification elements can be formed in dependence on the nature and the construction of the hot stamping films used. It would also be possible to use hot stamping films which could include a magnetic layer as a further security measure or for example also fluorescent colours. Finally an essential advantage in the use of hot stamping films is that – depending on the construction and configuration of the decorative layer of the hot stamping film – it is also possible to produce the very fine patternings which are essential for the invention as security or identification elements, in which case then it is nonetheless possible to achieve very good stability for the laminate by virtue of the films being connected in the intermediate spaces which are left free by the decorative layer of the hot stamping film.

It is further provided in accordance with the invention that at least one security and/or identification element in the form of a single-layer or multi-layer, label-like surface element is provided outside the continuous surface region which has the fine elements. Label-like elements of that kind enjoy the advantage that they are easy to transfer and represent particularly striking markings in the laminate.

In order – at least during manufacture – to improve the adhesion of the security and/or identification elements to at least the one film, it can be advantageous in accordance with the invention if at least one of the security and/or identification elements has an adhesive layer at a surface,

in which case an adhesive layer of that kind can naturally also be provided on both surfaces. An adhesive layer of that kind is generally present in any case in relation to commercially available hot stamping or laminating films and also in relation to label-like elements. Even if that adhesive layer does not adhere or does not adhere firmly to the material of the film, this is of no relevance in the present case, as in fact the connection between the two films is effected primarily by way of the regions in which the films directly adjoin each other.

In accordance with a development of the invention it can be desirable if at least one of the films is provided with an adhesive application in register relationship with the security and/or identification elements, whereby the adhesion within the laminate can be improved. An adhesive application in register relationship however can also have the purpose of assisting with correct embossing of the decorative layer of a hot stamping film insofar as the decorative layer remains adhering to the film only in the region of the previous adhesive application, in the embossing procedure.

It is further possible for at least one of the films of the laminate to be provided at its free surface with a coating covering all of its surface area or part thereof. The function of such a coating on the one hand can be to eliminate surface roughnesses of the cover layer. The coating however may also be for example applied printing, a signature area, a magnetic strip, a protective layer or the like. It is also possible for the finished laminate to be personalised for example by way of suitable printing processes. It is also possible to envisage the application of further protective layers, in particular after coating one or both free surfaces of the laminate.

The invention is further concerned with a process for the production of a laminate of the configuration discussed hereinbefore, wherein the security and/or identification elements are applied to a first film and then the second film is applied thereto by lamination over the entire surface area under the action of heat and pressure. In accordance with the invention it is provided that such a process is to be carried in such a way that

polycarbonate films are used as the films, that there is applied to the first film security elements which include at least two hardened or dry transparent lacquer or polymer layers and a transparent coating for improving the recognisability of a structure, and optionally identification elements, in a transfer or laminating process, wherein the security and/or identification elements cover at most 65% of the total surface area of the laminate, that then the second film is applied, and that then the layer arrangement formed is subjected to a heat treatment such that the two films are fused together in their mutually adjacent regions in which there are no security or identification elements.

The process according to the invention has the advantage that it can be used in practice without problems, wherein a secure bond can be guaranteed between the two films by suitable control of the supply of heat when joining the two films. As a result of the presence of the lacquer or polymer layers which possibly enclose between them a structure having an optical-diffraction effect as well as a coating for improving recognisability, the procedure reliably provides, in spite of a possibly long heat treatment, that the structure having the optical-diffraction effect is not damaged or altered when the two films are laminated to each other. That operating procedure also has the advantage that the apparatus expenditure is comparatively low.

By virtue of the use of polycarbonate films the hot pressing operation is desirably effected for a period of from 1 to 60 minutes, preferably for a period of from 10 to 50 minutes, at a temperature of 170 to 210°C. Laminates of polycarbonate films which are connected together at such high temperatures are distinguished by a particularly high level of mechanical and thermal stability and thereby achieve a service life which is much greater than the hitherto usual life.

Finally it is also in accordance with the invention that, in the process, prior to application of the security and/or identification elements, at least the first film is provided with a primer or adhesive application in region-wise manner, preferably in the register relationship with at least certain ones of

those elements. The use of a pre-printed primer or adhesive, which is known per se from the application of optically variable security elements to substrates, in particular in the form of stamping films, has in particular the advantage that in that way it is possible for the surface of the corresponding film to be made particularly smooth so that the action of the structure having the optical-diffraction effect is also not adversely affected by unevenness or roughness of the cover layer surface. That is particularly important for the reason that usually the security or identification elements are arranged on the rough surface of the PC film as the rough surface of those films is usually in the interior of the laminate. Furthermore, as will be appreciated, such a primer or adhesive can also serve to improve the adhesion between the surface of the foil on the one hand and the corresponding security and/or identification element on the other hand.

Further features, details and advantages of the invention will be apparent from the description hereinafter with reference to the drawing in which:

Figure 1 shows by way of example an identification card comprising a laminate according to the invention,

Figure 2 shows a view in section through the card taken along line II-II in Figure 1,

Figure 3 is a view in section on an enlarged scale of the region of the card identified by the arrow III in Figure 2,

Figures 4 to 6 show different arrangements and combinations of films and parts of the security and identification elements in cross-section and highly diagrammatic form, while moreover the views are not true to scale, in particular in regard to the thickness of the individual layers,

Figure 7 is a view similar to Figure 1 showing a second embodiment of an identification card or the like,

Figure 8 is a view in section taken along line VIII-VIII in Figure 7, and

Figure 9 is a view in section taken along IX-IX in Figure 7, wherein Figures 8 and 9, similarly to Figures 4 to 6, are not true to scale.

As Figures 2 and 3 clearly show, the identification card illustrated in Figures 1 to 3 includes a lower film 1 and an upper film 2, wherein both films are polycarbonate films.

At least one of the films of the laminate, in the present case at least the upper film 2, must be transparent in order to ensure that the elements which are present between the two films 1, 2, in the present case a security printing 3, a security element 4 having a structure with an optical-diffraction effect, a picture 5 of the identity card holder and a script area or panel 6 with the name of the identity card holder and a script area or panel 7 with a registration serial number can be recognised.

The security element 4 which in the present case represents the applicants' company logo comprises a plurality of components, namely an outer ring 8 which is formed for example by a flat and thus reflective surface, a semicircular region 9 which is equipped with a first diffraction structure, a triangular region 10 which has a second structure which has an optical-diffraction effect and which differs from the structure of the region 9, and the for example transparent remaining region 11 between the ring 8 and the regions 9 and 10.

The security element 4 of the illustrated embodiment involves a label-like element formed by the decorative layer of a hot stamping film, wherein the basic structure of the security element 4 can be seen from Figure 3. The security element 4 as shown in Figure 3 includes a lacquer or polymer layer 12 which is transparent and in which the structures of the regions 9 and 10, which have an optical-diffraction effect, are replicated upon production of the security element 4. The transparent lacquer or polymer layer 12 which usually serves as a protective layer for a corresponding security element upon being applied to a free surface is provided in the regions 8, 9 and 10 with a coating 13 which improves the recognisability of the structure. The coating 13 can be for example a metal layer, for example an aluminium layer applied by vapour deposition under vacuum. It is however also possible for the coating 13 to be in the form of a transparent dielectric layer, for example TiO_2 or ZnS, insofar only as it is

guaranteed that the coating 13 has a refractive index which is sufficiently different from the refractive index of the lacquer or polymer layer 12 and the lacquer or polymer layer 14 which adjoins the coating 13 on the opposite side. Combinations of (partially) demetalised and dielectric layers are also possible. Further details relating to the lacquer or polymer layers 12 and 14 are described in connection with the description relating to Figures 4 to 6.

Finally the security element 4 also has an adhesive layer 15 by means of which the security element 4 is fixed on the lower film 1.

As a result of the differing structure of the regions 8, 9, 10 and 11 the viewer, in dependence on the respective viewing angle and the angle of incidence of the light, receives different optical effects which in per se known manner serve to make forgery more difficult or impossible.

In Figure 3 the structures of the regions 9 and 10 are diagrammatically illustrated in the form of wave-shaped or rectangular grid regions. In actual fact the structures of the individual regions can be substantially more complicated. Here there are a multiplicity of options which are correspondingly familiar to the man skilled in the art.

The security printing 3 may also involve one of the usual forms of printing which is applied directly to the lower film 1, for example security printing as is used in the production of banknotes. It would however also be readily possible for the security printing 3 not to be provided directly on the film 1 but for the security printing 3 to be applied either by means of a special hot stamping film or for the security printing 3 and the structures 8, 9 and 10 having an optical-diffraction effect to be combined to form a common security element, either in the form of a corresponding detachable layer of a transfer film, in particular a hot stamping film, or in the form of a label-like element.

As Figure 1 shows the security printing 3 comprises a plurality of individual lines 30 which in the present case extend diagonally, wherein the lines 30 of the security printing 3 cover a continuous surface region 31. The lines 30 forming the security printing are of a relatively thin line width

and are of such a configuration and arrangement that the two films 1 and 2 respectively directly adjoin each other between the lines 30, as is indicated in the region 3 in Figure 2. Instead of the lines 30 of the security printing 3 it would also be possible to provide other elements, for example structures having an optical-diffraction effect, in which case however those fine elements must be of such an arrangement and configuration that the maximum line width or point size of the elements in a direction is below 5.0 mm, preferably between 0.1 and 3 mm. In addition the security or identification elements are to cover not more than 50% of the total surface area of the continuous surface region 31. In the case of the card shown in Figure 1 it would be possible for example to provide lines of a line width of about 0.3 mm which are arranged at a mutual spacing of about 1 mm.

In regard to the picture 5 the procedure for example can be such that a corresponding picture is glued onto the film 1 by means of a suitable adhesive. It would however also be possible to provide on the film 1 a material which can be suitably varied photochemically or by high-energy radiation, for example laser engraving, and for the picture 5 then to be directly recorded on the inner surface of the lower film 1. The image could also be printed on, for example by means of thermoprinting.

In regard to the script areas 6 and 7, there are also various possible ways of applying the script. It is for example possible for the script in the areas 6 and 7 to be directly printed onto the lower film 1 or to be applied in a conventional thermotransfer process. In regard to the script in the areas 6 and 7 however it would also be possible for the card to be of such a configuration that the script is produced by modifying the surface of the lower film 1 of the card. Both in regard to the name in the script area 6 and also the picture 5, consideration is to be given in particular to processes which permit the production of the picture 5 and the application of the name 6 only after the card or the laminate is basically finished, that is to say for example production thereof by means of laser radiation which passes through the transparent upper film 2 without damage but which is correspondingly absorbed by the substances present in the lower film 1 and

consequently results in a modification to the lower film 1, which is triggered off by heating.

If the script is applied by printing in the areas 6 and/or 7 or is applied by a thermotransfer process, for example by means of suitable films, care should also be taken to ensure that the line width of the script is in the preferred range, that is to say smaller than 5 mm and preferably the line width is between 0.1 and 3.0 mm. In addition the total surface area covered by the script characters in the script areas 6 and 7 should be less than 50% of the total surface area of the script areas, so that the two films 1 and 2 directly adjoin each other in a suitably large surface region and consequently can also be directly connected together.

Finally Figure 3 also shows that an additional coating 17 can be provided in region-wise manner at the free underside 16 of the lower film 1 which is not transparent in the illustrated embodiment, which coating in that respect may involve for example a magnetic strip, a signature panel and so forth.

Now, in manufacture of the card as shown in Figure 1, the procedure is such that at any event the security printing 3 and the security element 4, possibly as multiple items, is applied in the usual manner to the lower film 1, either in the form of the individual card or in the form of a larger sheet which is subsequently cut up to form cards. In addition the picture 5 and the labelling in the areas 6 and/or 7 can be applied simultaneously with or subsequently to the application of the security elements 3 and 4 to the corresponding surface of the lower film 1.

Then, the upper film 2 is applied over the lower film 1 with at least the security elements 3 and 4 and then the two cover layers 1 and 2 are connected in such a way that the films 1 and 2 fuse together in the free regions, that is to say in the regions where there are neither security elements 3 and 4 nor a picture 5 or texts 6, 7. In order here to guarantee that the upper film 2 is reliably bonded to the lower film 1, it is necessary to ensure that at least 25% of the total surface area of the laminate or each card is free from security elements 3, 4 or identification elements 5, 6, 7.

It will be appreciated in that respect that free regions are also deemed to include for example the regions between the individual lines of the security printing 3 or the individual letters of the script areas 6, 7. In the continuous surface region 31 of the security printing 3 and the script areas 6, 7 which can also be viewed as continuous surface regions, the films 1, 2 are directly adjacent to each other in a proportion of surface area which corresponds to 65 to 95% of the surface area of the respective continuous surface regions 6, 7 and 31 respectively.

It is highly desirable if the security and identification elements 3 to 11 respectively are disposed between the films 1, 2 in such a way that, along the edge 28 of the card, a region 29 indicated by the broken line in Figure 1 remains free of security and identification elements 3 to 11. The width b of the region 29 should be at least 3 mm and preferably from 3 to 10 mm. This "free" region 29 has the advantage that in that way the two films 1, 2 are reliably connected together along the card edge 28 so that moisture, chemicals or the like cannot penetrate into the intermediate space between the films 1, 2.

The upper film 2 is laid on the lower film 1. Thereafter, a sufficiently high heating effect must be implemented during a sufficiently long period of time in order to reliably guarantee that the two films 1, 2 are suitably fused to each other in the boundary region thereof. It has been found in this respect that, when using a polycarbonate for the two films 1 and 2, pressing times of 5 to 60 minutes at temperatures in the range of 170 to 210°C have given very good results. In spite of those high temperatures the structures with optical-diffraction effect in the regions 9 and 10 which are enclosed between the lacquer or polymer layers 12 and 14 are not damaged or destroyed. It was also possible to provide that the transparency of the upper film 2 was not adversely impaired or was impaired only to an immaterial degree.

A card produced in the above-indicated manner and formed by a laminate is substantially safe from forgery. It is guaranteed in particular that the two films 1, 2 cannot become separated from each other without

resulting in damage which at any event can be detected. What is crucial in particular in that respect is that the fusion of the two films 1 and 2 in the free regions means that there those layers actually cannot be separated from each other. Separation could at most occur where security or identification elements are present. In this case also however it is to be reckoned that the security or identification elements also have relatively good adhesion to both films, as a consequence of the conditions applied when connecting the two films 1, 2 together, so that these elements are also damaged in the attempt to separate the two films.

The free surface 18 of the upper film 2 is shown as being relatively uneven in Figures 2 and 3. In actual fact the free surface 18 of the film 2 will be substantially flat, as a result of the temperatures and pressures used in the laminating operation.

Figures 4 to 6 diagrammatically show some examples of sequences of layers, as can be used in accordance with the invention.

In all cases, there is a lower film 1 which comprises polycarbonate, in which respect film thicknesses of about 50 to 200 μm are used in practice.

To improve the adhesion of corresponding security elements 19, 19a, 19b on the lower film 1 it may be desirable for a suitable primer or adhesive 20 to be first applied by printing to the lower film 1 in the regions where later the security elements 19, 19a, 19b are to adhere, in which respect it is also possible to provide a corresponding application of adhesive 20a, by printing, on the upper film 2, as shown in Figure 5. The adhesive 20, 20a may involve for example a hot sealing adhesive of known kind, but also a pressure-sensitive cold adhesive.

In the embodiments shown in Figures 4 to 6 the security elements 19, 19a, 19b are of a different construction, in which case the embodiment of Figure 4 differs from those shown in Figures 5 and 6 in that the laminate of Figure 4 has a plurality of security elements 19 or portions of a security element, which form fine elements of alphanumeric characters. The security elements 19 shown in Figure 4 are desirably arranged within a continuous surface region, as will be described in greater detail with

reference to Figure 7, and are of a maximum width s, s' (in one direction) of less than 5 mm. Preferably the width s, s' is between 0.1 and 3.0 mm. The security elements 19 can be of any dimensions, in the direction transversely to the direction which is decisive in regard to the width s, s'. It is only necessary to ensure, within the respective continuous surface region, that a proportion of 65 to 95% of the surface area of the surface region is free from security elements 19 so that in that respect the PC films 1, 2 are directly adjacent to each other and can fuse directly to each other.

The security elements 19 shown in Figure 4 involve the decorative layers of hot stamping films which are known per se for these purposes.

In the present case the security elements 19 include two protective lacquer layers 21, 22. The inner protective lacquer layer 22 is adjoined by a replication lacquer layer 23. Embossed into the replication lacquer layer 23 is a structure having an optical-diffraction effect, which is provided with a coating 24 for improving its recognisability. The coating 24 which for example has a reflection-enhancing effect can be for example a metal layer applied by vapour deposition, preferably however the layer of a suitable, also transparent dielectric, for example TiO_2 or partially demetalised regions, in which respect it is essential that there are suitable differences in refractive index of at least 0.3 and preferably 0.5 between the coating 24 and the layers which precede it in the viewing direction. As the last layer, the decorative layer of the hot stamping film shown in Figure 4 has a thermoplastic hot melt adhesive layer 25. It would however also be possible, instead of that hot melt adhesive layer 25, to provide a corresponding lacquer or polymer layer if, as shown in Figure 4, the lower film 1 already carries a suitable adhesive 20.

The various layers of the security element 19 are generally applied over a large area to a carrier film which is not shown here and which would be envisaged as being on the side of the security elements 19, which is remote from the adhesive 25. Application of the security elements to the lower film 1 is then effected in such a way that the hot stamping film with the adhesive layer 25 or a corresponding lacquer layer is laid on the

corresponding side of the lower film 1 and pressed thereagainst under the action of heat and pressure by means of a tool which is designed according to the desired security element pattern, in particular a ram. When the carrier film is pulled off the regions of the decorative layer of the hot stamping film which are to form the security elements 19 and correspond to the raised regions of the ram or the like adhere to the regions 20 of the lower film 1, which are provided with adhesive. In the intermediate spaces, the decorative layer is pulled off together with the carrier film. In that way it is possible to produce very fine graphic configurations for the security elements 19.

After the security elements 19 have been applied to the lower film 1 of polycarbonate, the upper PC film 2 is then laid thereon and pressed thereagainst. The upper film 2 is also advantageously of a thickness of about 50 to 200 μm. In that respect the view in Figure 4 arouses the wrong impression, more specifically because the thickness of the hot melt adhesive 20 on the lower film 1 is only about 2 to 5 μm, while that of the security elements in total is only about 3 to 10 μm. Consequently, no problems are involved in causing the upper film 2 to come to bear against the lower film 1 in the intermediate spaces between the security elements 19, in order in that way to reliably produce the appropriate connection therebetween.

The embodiment of Figure 5 has a security element 19a which is of a label-like configuration. In order here also additionally to improve the adhesion of the upper film 2, the upper film 2 is also provided with a hot melt adhesive coating in the region of the security element 19a, in which case the adhesive layers 20, 20a may be substantially of a thickness of 2 to 5 μm.

The film from which the security element 19a is for example stamped out or cut out is substantially the same as the hot stamping film forming the security elements 19. A difference however is that there is additionally provided a carrier layer 26, for example a polyester layer, which however only facilitates handling and which can certainly also be omitted, as is the

case with the security element 4 of the card shown in Figure 1. If the layer 26 is present, the element 19a is of a substantially larger thickness than the security elements 19. The thickness of the security element 19a can be for example from 20 to 60 μm.

It should also be mentioned in regard to the embodiment of Figure 5 that therein the coating 24 of the structure is not provided over the entire surface area but, for example in the form of a given fine pattern, only over part of the surface area, or in the form of a combination of various media which for example increase reflection. Processes for the production of coatings on partial surface areas in that way are generally known.

Finally Figure 6 also shows an embodiment which is intended for specific uses and in which the security element 19b is formed by a sticker which differs from the security element 19a shown in Figure 5 in that an adhesive 27 is additionally present on the free surface of the carrier 26, for example a polyester film. The security element 19b shown in Figure 6 can be for example of a thickness of 50 to 80 μm.

By virtue of the presence of adhesive at both surfaces of the sticker 19b, it is in principle possible to forego providing the corresponding surfaces of the films 1, 2 with an adhesive, prior to the application of the security element 19b. That moreover also applies in principle to the adhesives 20, 20a in Figures 4 and 5 as security is primarily attained by virtue of the fact that the films 1, 2 are directly fused together in the free regions between the security elements 19, 19a, 19b. It is however necessary to ensure that at least in a proportion of 25% of the total surface area of the laminate, the PC films 1, 2 bear directly against each other and are fused to each other.

In general, in regard to manufacture of the laminate in accordance with the invention, it can also be noted that, under certain circumstances, it may be desirable for either the finished laminate or the individual surface materials which form the cover layer, to be provided at the side which is outward in use, entirely or partly, with a coating which can be used for example as a signature panel. Surface printing can also additionally be

provided, either in the form of an additional security element or in order to personalise a card produced from the laminate, that is to say to apply to the card information about the card owner.

Figures 7 to 9 show a further embodiment of a laminate in accordance with the invention, concerning a card which in comparison with the embodiment of Figures 1 to 3 has an additional layer, namely a carrier 100. The carrier 100 can be individualised in respect of the user, wherein for that purpose the carrier 100, for example a corresponding piece of cardboard or a plastic card, carries on its surface 132 which is covered in use, elements which are matched to the respective user, for example a photograph 105 and a script area 106 bearing the name of the user.

The carrier 100 of the card shown in Figures 7 to 9 is then covered with a laminate which in principle corresponds to the laminate of Figures 1 to 3 and which is generally identified by reference 133.

The laminate 133 also comprises two films 101 and 102 of polycarbonate. Provided between those films is a security element 104 composed on the one hand of the security printing 103 and on the other hand various regions having an optical-diffraction effect, wherein the security printing 103 jointly with the security element 104 having the optical-diffraction effect forms an overall security element 131. In regard to configuration and arrangement of the overall security element 131, reference may be made to the corresponding description of the printing region 3 and the security element 4 and the arrangement thereof between the films 1 and 2, in connection with Figures 1 to 3.

In addition the card shown in Figure 7 has a script area 107 which is occupied for example by a serial number. That serial number 107 can be formed for example by printing on the film 101 before the films 101 and 102 are laminated together.

The particularity of the card shown in Figures 7 to 9 in relation to the card shown in Figures 1 to 3 is now that the photograph 105 and the name 106 of the card owner are not arranged between the two films 101, 102 but between the carrier 100 and the film 101.

Now, as an additional security measure, the laminate 133 which covers the name area 106 and the photograph 105 is provided in the continuous surface region indicated by the dash-dotted line 134, outside the overall security element 131 and the script area 107, with an additional safeguard in the form of relatively fine graphic elements 119 and 119' provided between the films 101 and 102.

In the illustrated diagrammatic embodiment of Figures 7 to 9 the graphic elements are provided in the form of wider lines 119 and narrower lines 119', wherein, for reasons of the films 101 and 102 suitably firmly adhering to each other, it is necessary to ensure that on the one hand the line width or point size of the graphics elements 119, 119' is less than 5 mm in one direction, particularly advantageous dimensions being between 0.1 and 3 mm. On the other hand it is necessary to ensure that, in the surface region 135, (Figure 7) indicated by the dash-dotted line 134 a surface area proportion of at least 50% is not covered by the fine graphics elements 119, 119'. It is desirable if the graphics elements 119, 119' only cover a proportion of 5 to 35% of the continuous surface region 135 so that, in the remainder of that surface region, that is to say, approximately 65 to 95%, the films 101 and 102 bear directly against each other and can be directly connected to each other by fusing.

In the illustrated embodiment the graphics elements 119, 119' are formed by diffraction structures which are formed similarly to the security elements 19, 19a, 19b in Figures 4 to 6.

The graphics elements 119, 119' for example comprise two lacquer layers 112, 114 which enclose between them a corresponding structure having an optical-diffraction effect. That structure is provided with a coating 113 which improves the recognisability thereof, for example which increases reflection, in order to make it clearly visible.

As in the embodiment of Figure 7 the graphics elements 119, 119' cover over both the name area 106 and also the picture 105, the elements 119, 119' are such that they are transparent. That is achieved by the coating 113 comprising a dielectric material, for example vapour-deposited

TiO_2, as has already been described in principle above in connection with the embodiment of Figures 1 to 3.

The card shown in Figure 7 moreover is of such a nature that an edge region 129 is free from any security elements or the like so that in that edge region 129 the films 101 and 102 are suitably firmly connected together and the penetration of moisture or the like between the films 101 and 102 is reliably prevented.

In manufacture of the card shown in Figure 7, on the one hand in a first step in the process the carrier 100 is provided with the photograph 105 and possibly the name of the owner in the script area 106. In that respect therefore the carrier 100 is respectively adapted to the owner of the identity card or the like.

For protection purposes, the carrier 100 with the picture 105 and the name 106 is then covered over with the laminate 133 which is already prepared, as it can be of the same configuration for all identity cards or the like. It will be noted that it is certainly possible for the laminate 133 also to be individualised at least in the sense that the serial number in the script area 107 changes from one laminate to another, which is easily possible with the described construction of the laminate, as the number in the script area 107 is applied by printing for example before the films 101 and 102 are laminated together and consequently it can easily be varied.

In regard to the configuration of the security and identification elements the laminate according to the invention has the great advantage that there is substantial freedom here because the invention provides that very fine structures are also used as the security or identification elements. Astonishingly it has been found that, in the case of a laminate according to the invention, the two films are connected together even when there are only comparatively small spacings, that is to say for example fine lines, points of small diameter etc., between the enclosed elements. In spite of the use of comparatively high temperatures for laminating the polycarbonate films together, it is possible to use security elements in the form of hot stamping films which employ the lacquers which are usual for

that purpose, that is to say security elements in which, as a consequence of the properties of the lacquer layers used, it was previously assumed that the application thereof could be implemented only at effective material temperatures in the range of between 60 and 160°C and with very short periods of action thereon.

CLAIMS

1. A laminate, in particular in the form of cards, for example identity cards, credit cards or the like, including at least two films (1, 2; 101, 102) which are fixedly connected together and between which security elements (3, 4, 19, 19a, 19b; 103, 104, 119, 119') and optionally identification elements (5, 6, 7; 105, 106,107) are arranged, wherein at least one of the films (2, 102) is semi- or completely transparent so that the security and optionally identification elements (3 to 7, 19, 19a, 19b; 103 to 107, 119, 119') are visible through said transparent film (2, 102), and wherein moreover at least one security element (19, 19a, 19b; 119, 119') is formed by a three-dimensional structure which has an optical diffraction effect and which is produced by a correspondingly structured surface of a lacquer or polymer layer (12, 14; 112, 114), said surface being provided with a coating (13, 24; 113) which improves the recognisability of the structure, characterised in that the security and optionally identification elements (3 to 7, 19, 19a, 19b; 103 to 107, 119, 119') are formed by at least one ink or lacquer layer (12, 14; 112, 114) and in at least one continuous surface region (31; 135) of the laminate by fine graphic elements (30; 119, 119') or alphanumeric characters of a maximum line width or point size (s, s') of less than 5.0 mm in one direction, which are arranged in such a way that in a proportion of at least 50% of the total surface area of the continuous surface region (31; 135) the films (1, 2; 101, 102) which enclose the security and optionally identification elements are directly adjacent to each other, and that said adjacent films (1, 2; 101, 102) comprise polycarbonate (PC) of substantially identical composition and are fused together in the region of their contact surfaces.

2. A laminate according to claim 1 characterised in that the lines (30; 119, 119') forming the security and optionally identification elements are of a line width (s, s') of between 0.1 and 3.0 mm.

3. A laminate according to claim 1 or claim 2 characterised in that the films (1, 2; 101, 102) enclosing the security and optionally identification elements (3 to 7, 19, 19a, 19b; 103 to 107, 119, 119') are directly adjacent to each other in a proportion of at least 25% of the total surface area of the laminate.

4. A laminate according to one of the preceding claims characterised in that the films (1, 2; 101, 102) enclosing the security and optionally identification elements (3 to 7, 19, 19a, 19b; 103 to 107, 119, 119') in the continuous surface region (31; 135) having the fine elements (30; 119, 199') or alphanumeric characters (6, 7; 107) are directly adjacent to each other in a proportion of 65 to 95% of the surface area of the surface region (31; 135).

5. A laminate according to one of the preceding claims characterised in that in the case of a card-shaped configuration along the card edge a region (29; 129) of at least 3 mm and preferably 3 to 10 mm in width (b) is free from security or identification elements (3 to 7, 19, 19a, 19b; 103 to 107, 119, 119').

6. A laminate according to one of the preceding claims characterised in that the coating (13; 113), for improving recognisability of the structure, of the structure having an optical-diffraction effect forming at least one security element (19; 119, 119') is formed by a transparent material which has a markedly different refractive index in relation to the material which adjoins the coating and which is in front of same in the viewing direction.

7. A laminate according to claim 6 characterised in that the difference between the refractive index of the coating (13; 113) and that of the adjoining material is at least 0.3 and preferably at least 0.5.

8. A laminate according to one of the preceding claims characterised in that at least one lacquer or polymer layer (12, 14; 112, 114) is arranged between the coating (13; 113) of the three-dimensional structure of the at least one security element (19; 119, 119') and each film (1, 2; 101, 102).

9. A laminate according to one of the preceding claims characterised in that at least one of the security and/or identification elements (4, 19; 104) is formed by the decorative layer of a transfer film, in particular a hot stamping film.

10. A laminate according to one of the preceding claims characterised in that at least one security and/or identification element (131) in the form of a single-layer or multi-layer label-like surface element is provided outside the continuous surface region (31; 135) having the fine elements (30; 119, 199').

11. A laminate according to claim 9 or claim 10 characterised in that at least one of the security and/or identification elements (4, 19;19a, 19b) has an adhesive layer (15, 25, 27) at a surface.

12. A laminate according to one of the preceding claims characterised in that at least one of the films (1, 2) is provided with an adhesive application (20, 20a) in register relationship with the security and/or identification elements (19, 19a).

13. A laminate according to one of the preceding claims characterised in that at least one of the films (1) is provided at its free surface (16) over its entire surface area or part of its surface area with a coating, for example with printing thereon, a signature area, a magnetic strip (17), a protective layer or the like.

14. A process for the production of a laminate (133) comprising at least two films (1, 2; 101, 102) of which at least one (2; 101, 102) is semi- or completely transparent and between which are arranged security elements (4, 19, 19a, 19b; 104, 119, 119') and optionally identification elements (5, 6, 7; 107), said elements having a structure (9, 10, 23) having an optical-diffraction effect, according to one of the preceding claims, wherein the security and/or identification elements (3 to 7, 19; 103, 104, 107, 119, 119') are applied to a first film (1; 101) and then the second film (2; 102) is applied by lamination over the entire surface area under the action of heat and pressure, characterised in that polycarbonate films are used as the films, that security elements (4, 19; 104, 119, 119') which include at least two hardened or dry transparent lacquer or polymer layers (12, 14; 112, 114) and a transparent coating (13; 113) for improving the recognisability of a structure, and optionally identification elements (5, 7; 107) are applied to the first film (1; 101) in a transfer or lamination process, wherein the security and/or identification elements cover at most 65% of the total surface area of the laminate, that then the second film (2; 102) is applied and that then the layer arrangement (133) formed is subjected to such a heat treatment that the two films (1, 2; 101, 102) fuse together in their mutually adjacent regions in which there are no security or identification elements.

15. A process according to claim 14 characterised in that the hot pressing operation is effected for a period of 1 to 60 minutes, preferably for a period of 10 to 50 minutes, at a temperature of 170 to 210°C.

16. A process according to one of claims 14 and 15 characterised in that at least the first film (1) is provided with a primer or adhesive application (20, 20a) prior to application of the security and/or identification elements (3 to 7, 19, 19a; 103, 104, 107, 119, 119') in region-wise manner, preferably in register relationship with at least given ones of said elements.