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Patent Application

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"Process and apparatus for producing a laminate"

The invention relates to a process for producing a laminate containing a metal foil strip and a plastic film strip, in which the two strips respectively exhibit stamping structures which are repeated at regular intervals in the longitudinal direction of the strips and are disposed at contiguous points in the laminate, a pre-stamped strip and the second strip being continuously joined together from respectively one end. The invention further relates to an apparatus for producing a laminate exhibiting a metal foil strip and a plastic film strip and having stamping structures which are repeated at regular intervals, which apparatus exhibits a feeding and guiding device for the laminate, a joining apparatus for the fixed connection of the two strips and feeding and guiding devices for the merging and joining together of the two strips.

From WO-92/15118 it is known to bring two strips, which exhibit stamping markings, one on top of the other in such a way that the stamping markings of the one strip are disposed at the same point on the laminate as the stamping markings of the second strip. To this end, the position of the stamping markings is monitored and any mismatch between the stamping markings is equalized by the size of this mismatch being measured and, according to this size, the two strips, prior to being joined together, being subjected to a different temperature in

order, by virtue of the different expansion of the two strips thereby provoked, to equalize the mismatch. In addition, the one strip can be subjected to a tensile stress, so that the expansion of this strip thereby produced helps to equalize the mismatch. A process of this type requires a high level of equipment complexity in order to realize the different temperature bombardment of the two strips and to guarantee that the necessary temperature alterations can be effected in a very short time to enable that segment of the laminate which exhibits this mismatch to be kept as small as possible. The control circuit required for such an adjustment by means of temperature alterations or tensile stresses is very complicated and generally non-reactive. Furthermore, it is problematical to connect two foils/films fixedly together under such starting conditions, since, after the tensile force has dropped away or after the temperatures of the two strips in this laminate have been matched, thermomechanical stresses would probably arise between the two strips, which might result in the laminate becoming deformed or the two strips becoming detached from each other.

In addition, the so-called TAB-process (Tape Automatic Bonding) is known. A plastic strip is herein used as a pre-stamped carrier film, onto which a metal foil is applied. The metal structure is then produced by chemical etching.

Derived from the above-described prior art, the object of the present invention consists in defining a

process by which a stamped plastic film tape can be laminated together with a stamped metal foil tape such that, with the least possible complexity, the mismatch between the structures of the two tapes is kept as low as possible. The object of the present invention further consists in defining an apparatus for carrying out this process.

According to the invention, the object for the process characterized in the introduction is achieved by the fact that, after the strips have been merged, the position of position markings of the stamping structures, bearing against the second strip, of the pre-stamped strip are successively scanned and, once a predetermined position of the position markings has been reached, a stamping structure is introduced into that region of the second strip situated in front of the site of the merging, at a distance from the predetermined position corresponding to an integral multiple of the interval at which the stamping structures are repeated in the pre-stamped strip. It is generally expedient for the pre-stamped strip to be made of metal and for the second strip to be made of plastic. It is also however conceivable to pre-stamp the plastic strip. In this process, the position of each stamping structure in the metal strip is determined and this position transferred, in a type of copying operation, to the plastic strip, the stamping of the plastic strip being effected at such an interval that the stamping structures of the two strips, after the strips have been joined together, are disposed at the

same point on the laminate. The mismatch between the structures of the metal strip and of the plastic strip is then simply determined by tolerances in the distance between the scanning point and the site of the stamping of the plastic film. This distance can be reduced to just a few multiples of the interval at which the stamping structures of the metal strip are repeated. As a result of this and by precise pinpointing of the site of the stamping of the plastic strip, the accuracy of the position of the stamping structures in the plastic strip can be increased virtually at will. In this process, only the start of the plastic strip, namely on the section between the first position marking and the site of the stamping, exhibits no stamping structure, so that it is only necessary to discard that part-piece of the finished laminate which corresponds to this first piece.

Advantageously the plastic strip is provided, prior to the merging of the strips, at least partially with markings, namely in its initial region over a length corresponding to the distance between the scanning point and the site of the stamping, the position of which markings corresponds to the position of the position markings of the metal strip. This can be achieved, for example, by virtue of this first part-piece of the plastic strip, in the same stamping device in which the structure of the metal strip is stamped, being provided with the markings also used for the metal strip, which markings are utilized as position markings, i.e. as those markings which are scanned as the strips are brought

together. As a result of the scanning of mutually corresponding position markings of both strips which is thus possible, a mismatch can already be identified during the scanning operation, which mismatch can be equalized by altering the site of the stamping of the plastic film.

Expediently, the strips are bonded together following the scanning, since the two strips exhibiting different thermal expansion coefficients are thereby heated only after the scanning operation (the bonding generally being expediently effected under heat influence). This prevents the two strips, in the region of the scanning or between the scanning and the site of the stamping of the plastic strip, from being variously expanded and hence prevents inaccuracies arising as the two strips are joined together. It is expedient in this case to affix the strips, in a first step, by means of individual small-area bonding points and subsequently, in a second step, to bond them over a large area. The foil/film strips are thereby fixed together, in their position relative to each other, under purely punctiform heating and are only subsequently, in the second bonding step, heated over a large area, so that any varying expansion of the two strips during heating does not lead to warping or to a relative change of position of the stamping markings.

The accuracy of the joining together of the two strips can be further enhanced by the fact that after the strips have been merged, the stamping structures of the strips are visually monitored, and by the fact that, when

a predetermined deviation of the position of the stamping structures of the plastic strip from the position of the stamping structures of the metal strip is exceeded, the distance between the scanned predetermined position and the site of the stamping of the plastic strip, which site is characterized by a stamping tool, is corrected. This correction can be effected manually by an operator or via an automatic control system, by the stamping tool being adjusted in the corresponding direction by the amount of the mismatch. In this case, corrections both in the direction of running of the strips and perpendicular thereto can be carried out.

It is expedient for circular position markings of the stamping structures of the metal strip to be scanned and compared with the position of circular stampings introduced into the plastic strip prior to the merging of the strips, the arrangement of which circular stampings on the plastic strip corresponds to the arrangement of the circular position markings of the stamping structures on the metal strip. The scanning can in this case expediently be effected by means of a spike. The scanning and comparison of circular structures is substantially simpler and yields clearer results than is possible in the scanning of other shapes. In principle, however, other shapes such as rectangles or triangles are also possible as position markings. The shape of the spike is in this case advantageously matched to the shape of the position markings.

The object of the invention is achieved, for the

apparatus characterized in the introduction, by the fact that behind the site of the merging of the two strips there is disposed a scanning apparatus for detecting the position of the stamping structure of the pre-stamped strip, and by the fact that this scanning apparatus is coupled with a trip device of a stamping tool disposed in front of the site of the merging of the two strips, the distance of the scanning apparatus from the stamping tool corresponding to an integral multiple of the interval at which the stamping structures of the pre-stamped strip are repeated. The position of the stamping structure in the second strip is in this case determined by the position of the stamping structure in the pre-stamped strip, thereby ensuring a mismatch-free contiguity within the laminate. Any mismatch of the two strips can be identified early and corrected by adjustment of the stamping tool.

It is expedient for the scanning apparatus to contain a feeding device, thereby enabling the scanning operation to be coupled with the feed.

It is advantageous in this case if between the site of the merging of the two strips and the scanning apparatus there is disposed a monitor for the visual inspection of the stamping structures. The monitor can contain a device for the metrological detection of deviations between the position of the stamping structures of the metal strip and of the plastic strip and, whenever a defined tolerance limit is exceeded, can trip an adjusting mechanism of the stamping tool for

readjusting the position of the stamping tool, so that the deviation detected on the monitor can be compensated. To this end, it is expedient for the stamping tool to exhibit an adjusting device, which allows an adjustment of the stamping tool in the direction of running of the strips and/or transversely thereto (x and y-directions), and for the monitor to be connected to the adjusting device of the stamping tool. It is also possible to compensate the deviation measured on the monitor by a manually effected adjustment of the position of the stamping tool.

It is advantageous for the scanning apparatus to contain a spike as a scanning element. By means of such a spike, it is possible, in a relatively easy manner, to detect the position of the stamping structures.

It is likewise possible of course, and should be expressly covered by the invention, for the stamping structures to be introduced into the strips not by using a conventional stamping tool, but in a different fashion, for example by means of a laser beam.

The invention is explained in greater detail below with reference to an illustrative embodiment and a drawing, in which:

Figure 1 shows the apparatus according to the invention, including the strip guide, in diagrammatic representation,

Figure 2 shows the merging of the strips.

The metal strip 1 and plastic strip 2 are fed, for the production of the laminate 3, separately to the

apparatus according to the invention (Figure 1). The metal strip is located on a supply roller 4. It is already pre-stamped, i.e. it already contains the stamping structure 5 assigned to it, including the circular position marking 6 assigned to each individual stamping structure 5. Via a feed roller 7 and a guide roller 8, the metal strip 1 is fed, past a monitor 9, to the scanning apparatus 10. The scanning apparatus 10 serves simultaneously as a feeding device. The plastic strip 2 is likewise located on a supply roller 4. The start of the plastic strip 2 is provided, at an interval corresponding to the distance between the scanning apparatus 10 and the stamping tool 11, with circular position markings 6, the position of which on the plastic strip 2 corresponds to the position of the circular position markings 6 on the metal strip 1. These circular position markings 6 of the plastic strip 2 are produced using the same stamping apparatus (not represented in the drawing) in which the stamping structures 5 have been introduced into the metal strip 1. This stamping in the plastic strip 2 is carried out, however, only for the purpose of introducing the circular position markings 6. Further stamping structures have not been introduced in this case.

The plastic strip 2 is fed via guide rollers 8, past the stamping tool 11 and the monitor 9, likewise to the scanning apparatus 10, by which the feed, too, is effected. The protective film 12, which was originally present on the plastic strip 2, is wound onto a disposal roller 13 prior to the passage of the plastic strip 2

through the stamping tool 11.

The plastic strip 2 and metal strip 1, as the two strips are introduced into the scanning apparatus 10, are disposed such that their position markings 6 are located one on top of the other. Using the monitor 9, the position of the two strips is inspected and any mismatch between the two strips identified, thereby enabling the arrangement of the stamping tool 11, where necessary, to be readjusted. The stamping tool 11 is disposed distanced from the scanning apparatus 10 by an integral multiple of the interval at which the stamping structures 5 on the metal strip 1 are repeated. The scanning apparatus 10 contains a spike (for reasons of clarity not represented in the drawing) as the scanning element. Determinant of the distance between the scanning apparatus 10 and the stamping tool 11 is the distance between the spike and the stamping element of the stamping tool 11 which stamps the circular position markings 6 in the plastic strip 2. In the example represented, the stamping structures 5 of the strips are repeated at an interval of around 57 mm. The distance between the scanning apparatus 10 and the stamping tool 11 consequently corresponds to an integral multiple of this distance apart. A roughly 8-12 fold interval has proved to be favorable. As a result of the scanning of the strips in the scanning apparatus 10 and the inspection of the mismatch in the monitor 9, it is possible to limit to a minimum the mismatch which is actually produced, since this mismatch remains essentially only dependent upon any inaccuracy present in the

arrangement of the stamping tool 11. Since the section between the monitor 9 and the stamping tool 11 can be kept very small (the monitor 9 is disposed between the stamping tool 11 and the scanning apparatus 10), the inaccuracies can be very quickly identified and either manually corrected, following inspection of the mismatch in the monitor 9, or it is also possible to couple the monitor 9, in a control circuit, with the stamping tool 11 and to implement automatically any readjustment necessary to the stamping tool 11. With such an arrangement it is possible to reduce the mismatch between the individual stamping structures 5 of the two strips to less than 50 μm .

Since the supply rollers 4 and the stamping tool 11, the monitor 9 and the scanning apparatus 10 can all be disposed in an air-conditioned room, inaccuracies caused by temperature fluctuations are able to be prevented.

During the process, the position of position markings 6 in the metal strip 1 is therefore identified and, in accordance with this position, the position of the stamping in the plastic strip 2 defined.

In Figure 2, the merging of the two strips is represented. The representation of the start of the laminate, which is not covered with stamping structures 5 in the plastic strip 2, has been omitted in this case. The stamping structures 5 of the two strips are laid against each other during the operation and the mismatch between the two is minimized by means of the position

markings 6, as described above.

Following the passage of the strips through the scanning apparatus 10, the strips are fed, by means of the feeding device of the scanning apparatus 10, to the joining apparatus 14, in which the two strips are affixed for about 1 to 2 seconds at around 170°C. The strips are guided in this case by guide pins (not represented in the drawing), which engage in the circular position markings 6 of the strips. By virtue of this guidance by means of the guide pins, the guidance being expediently effected by at least two guide pins, the strips are prevented from becoming misaligned as they are joined together. The strips which are affixed in the joining apparatus 14 are fed via guide rollers 8, in a loose loop 15, to the laminating apparatus 16, in which the two strips are tightly bonded together for about 30 seconds at around 180°C to form a laminate 3. Both bonding operations run in a clocked manner, the guidance of the strips in a loose loop 15 between the joining apparatus 14 and the laminating apparatus 16 compensates the different clock times. Emerging from the laminating apparatus 16, the laminate 3 is fed by a feed unit 17 to the end roller 18. Prior to further processing of the laminate 3, for example into IC-card-modules, only the first part of the laminate 3 has to be cut off at an interval corresponding to the distance between the scanning apparatus 10 and the stamping tool 11 and discarded. This length amounts, in the chosen example, to around 0.5 m and, with possible lengths of the laminate 3 ranging from 100 to 200 m, is

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virtually negligibly small.



Patent Claims

1. A process for producing a laminate containing a metal foil strip and a plastic film strip, in which the two strips respectively exhibit stamping structures which are repeated at regular intervals in the longitudinal direction of the strip and are disposed at contiguous points in the laminate, a pre-stamped strip and the second strip being continuously joined together from respectively one end, wherein, after the strips have been merged, the position of position markings (6) of the stamping structures (5), bearing against the second strip (2), of the pre-stamped strip (1) are successively scanned and, once a predetermined position of the position markings (6) has been reached, a stamping structure (5) is introduced into that region of the second strip (2) situated in front of the site of the merging, at a distance from the predetermined position corresponding to an integral multiple of the interval at which the stamping structures (5) are repeated in the pre-stamped strip (1).

2. The process as claimed in claim 1, wherein the pre-stamped strip (1) is made of metal and the second strip (2) is made of plastic.



3. The process as claimed in claim 2, wherein the plastic strip (2), prior to the joining together, is provided at least partially with position markings (6), the position of which corresponds to the position of the position markings (6) of the metal strip (1).

4. The process as claimed in claim 3, wherein the position markings (6) of the plastic strip (2) are stamped.

5. The process as claimed in one of claims 1 to 4, wherein the strips are bonded together following the scanning.

6. The process as claimed in claim 5, wherein the strips, following the scanning, are affixed, in a first step, by means of a plurality of small-area bonding points and, in a second step, are bonded together over a large area.

7. The process as claimed in one of claims 2 to 6, wherein, after the strips have been merged, the position of the stamping structures (5) of the strips is visually monitored, and wherein, when a predetermined deviation of the position of the stamping structures (5) of the plastic strip (2) from the position of the stamping structures (5) of the metal strip (1) is exceeded, the distance between the scanned predetermined position and the stamping tool (11) for the plastic strip (2) is corrected.

8. The process as claimed in one of claims 1 to 7, wherein circular position markings (6) of the stamping structures (5) of the metal strip (1) are scanned and



compared with the position of circular stampings introduced into the plastic strip (2) prior to the merging of the strips, the arrangement of which circular stampings on the plastic strip (2) corresponds to the arrangement of the circular position markings (6) of the stamping structures (5) on the metal strip (1).

9. The process as claimed in claim 8, wherein the scanning is effected by means of a spike.

10. The process as claimed in claim 9, wherein the shape of the spike is matched to the shape of the position markings (6).

11. An apparatus for producing a laminate exhibiting a metal foil strip and a plastic film strip and having stamping structures which are repeated at regular intervals, which apparatus exhibits a feeding and guiding device for the laminate, a joining apparatus for the fixed connection of the two strips and feeding and guiding devices for the merging and joining together of the two strips, wherein behind the site of the merging of the two strips there is disposed a scanning apparatus (10) for detecting the position of the stamping structure (5) of a pre-stamped strip (1), and wherein this scanning apparatus (10) is coupled with a trip device of a stamping tool (11) disposed in front of the site of the merging of the two strips, the distance of the scanning apparatus (10) from the stamping tool (11) corresponding to an integral multiple of the interval at which the stamping structures (5) of the pre-stamped strip (1) are repeated.



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12. The apparatus as claimed in claim 11, wherein the scanning apparatus (10) exhibits a feeding device.

13. The apparatus as claimed in claim 11 or 12, wherein between the site of the merging of the two strips and the scanning apparatus (10) there is disposed a monitor (9) for the visual inspection of the stamping structures (5).

14. The apparatus as claimed in claim 13, wherein the monitor (9) exhibits a device for the metrological detection of deviations between the position of the stamping structures (5) of the metal strip (1) and of the plastic strip (2).

15. The apparatus as claimed in one of claims 11 to 14, wherein the stamping tool (11) exhibits an adjusting device.

16. The apparatus as claimed in claim 15, wherein the stamping tool (11) is adjustable in the x and y-directions.

17. The apparatus as claimed in one of claims 14 to 16, wherein the monitor (9) is connected to the adjusting device of the stamping tool (11).

18. The apparatus as claimed in one of claims 11 to 17, wherein the scanning apparatus (10) contains a spike as a scanning element.