



FIXING DEVICE FOR A LAMINATED WALL ELEMENT

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The invention relates to a fixing device for a laminated wall element which must be fixed without a frame to a subconstruction, for example made of metal. In particular, it relates to a fixing device for a wall element consisting of a laminated plate formed from several sheets, the sheet on the wall side of which has through openings, for example bores, in which are provided fixing elements which press against the rear face, facing the laminate, of the sheet on the building side.

Such a fixing device may be used not only for laminated plates consisting of glass sheets with layers of adhesive, but also for mixed glass/plastic laminates or laminated plates made from multilayer plastic. Furthermore, the fixing device may also be used for plates consisting of other laminated materials, such as stone, ceramic, etc. All these applications are implicitly included in the description of the present invention without necessarily being mentioned specifically, and are implicitly included, inter alia, in the terms "wall element" and/or "laminated plate". Applications using laminated glass panes are however of particular importance.

For the purpose of clarification, it should also be noted that "on the wall side" or "on the building side" must always refer to the side of the sheet of the laminated plate facing the subconstruction, for example a building wall in the outer and/or inner region, whereas "on the outer side" or "outer side" means the free side or sheet on the side away from the subconstruction.

Various embodiments of this type of fixing device are known for laminated glass panes. For example, document

EP-A2-0 277 535 describes a fixing device in which the bores in the glass sheet on the building side have, on the side oriented toward the adhesive sheet, a frustoconical-shaped recess of the undercut bore type.

5 A fixing bolt, having the shape of a screw with a conical head, is inserted by positive engagement, with intercalation of a plastic socket, into this bore, the circular surface of the conical head resting flush with the flat surface of the glass sheet on the building
10 side.

Document EP-B1-0 340 089 discloses a fixing device of the aforementioned type for laminated glass panes, in which the fixing elements placed in the bores of the
15 glass sheet on the building side are provided with a disk-shaped retaining piece which presses, on the one hand, on the surface of the glass sheet on the building side in the peripheral zone of the bore, and which, on the other hand, is adhesively bonded to the external
20 glass sheet by means of the intermediate layer of the laminated glass pane.

Document EP-A1-0 799 949 also describes, inter alia, a fixing device of the aforementioned generic type. In
25 this case also, the glass sheet on the building side is provided with reamed bores. A flanged nut, in which a threaded bolt is screwed prior to mounting the wall element, is inserted into these undercut bores.

30 In these known fixing devices, the weight of the outer glass sheet is exclusively supported by the thermoplastic bonding layer of the laminated glass pane. In the case of wall elements having large and heavy outer glass sheets, this may in particular cause
35 long-term problems when the façade plates are strongly heated under the effect of solar radiation and when the thermoplastic bonding layer softens under the effect of the heat.

Document DE-C1-197 51 124 discloses a device for fixing laminated glass plates, in which plates the outer glass sheet is provided, on the side oriented toward the glass sheet on the building side, coaxially with the bores in the glass sheet on the building side, with countersunk blind bores. The fixing elements comprise a countersunk peg with a spacing element, which is anchored in the countersunk blind bore by forced engagement. In this case, the load of the outer glass sheet is no longer supported by the thermoplastic bonding layer, but by the spacer element penetrating the blind bore. However, the spacer element exerts considerable radial and axial forces on the periphery of the hole of the countersunk bore, which easily leads to chipping or cracking of the glass.

The object of the invention is to develop a fixing device for wall elements made of laminated material, which is in particular improved with regard to supporting the load of outer sheets.

This objective is achieved by the characteristics of claim 1. Secondary claims 2 to 23 indicate advantageous improvements to this objective, whereas claims 24 et seq relate to wall elements equipped with such fixing devices and to the resulting walls.

Starting from a fixing device of the aforementioned generic type, the fixing device according to the invention for a laminated plate is therefore differentiated by the fact that an outer sheet of the laminated plate is provided with recesses which are aligned axially over the openings or holes in the sheet on the wall side, and open towards them, and that the end portions of the fixing elements penetrate into the recesses and that on each occasion at least the hollow space formed between the wall of the recess and the end portion of the fixing element is filled with a cured filler. The fixing elements thus pass through the

entire sheet on the wall side, but only partly penetrate the outer sheet.

As a result, the load of the outer sheet is mainly supported by the fixing elements without forces of undesirable intensity being exerted due to the arrangement of the fixing elements on the (glass) sheets incorporated in the laminate.

This device may naturally also be used for laminated plates having more than two sheets. In all the configurations, the recesses are obviously in the outermost individual sheet, whereas the sheets which are closest to the subconstruction have through openings, which are axially flush, for passage of the fixing element.

The recesses may have internal dimensions or diameters which are equal or similar to those of the openings with which they are associated. However, they may also have internal dimensions or diameters which are greater than those of the associated openings. In particular, it is preferred for the recesses to be completely filled with the filler up to one face facing the bottom of the recess inside the laminate. This face may be formed by a portion of the surface of the sheet on the building side which is in the laminate or else by the walls of a countersunk hole inside the recess. To this end, the axial forces are also absorbed by the fixing element.

The openings passing through the sheet on the wall side may be made in the form of circular bores, rectangular or oblong slots, or with yet other cross sections. The recesses may also be made as circular blind holes, rectangular or oblong grooves or with other appropriate shapes and cross sections (for example frustonical, dovetail) corresponding to the associated openings, but

they never completely pass through the respective sheet.

5 The recesses are preferably cylindrical blind holes, rectangular grooves or the like, but they may also have a slightly conical countersunk cross sectional shape, since such slightly countersunk cross sections are easy to manufacture in some circumstances, in particular in glass sheets. In this case also, the largest internal
10 dimensioning or diameter is inside the recess, the recess on the surface of the outer sheet having to have at least the same internal diameter as the associated through opening in the sheet on the building side.

15 As a result, free cross sections or hollow spaces are formed inside the laminated plate, which are countersunk if need be, which receive the fixing element and which may be filled with the filler. At the same time, the outer (visible) face of the outer sheet of the wall
20 element remains free of perforations.

In general, it is endeavored to fill the openings and the recesses in the sheets beforehand with the fixing elements which must be inserted therein, until there
25 are only relatively small slots or free spaces remaining, which are finally filled with the filler. If the openings and the recesses are circular, fixing elements with a round or polygonal perimeter, for example bolts or trunnions, will therefore be used. If
30 the associated openings and recesses are oblong, the fixing elements will also have an oblong shape, for example fillets, ribs, fins or the like. In this case, their longitudinal dimension will preferably be oriented transverse to the gravitational force, in
35 order to decrease the surface load.

By filling the recess with the filler which cures, an ideal bond is obtained between the end portion of the fixing element and the recess, in which no force peak

is applied to the inner surface of the hole, even in the case of a high weight load, through the outer sheet. In contrast, the wall of the inner surface of the hole is uniformly stressed, but however remains
5 free from additional radial or axial stress forces. In this way, the load of the outer sheet in the region of the recesses is safely supported without risk of damage to the sheet; the adhesive layer of the laminate is essentially free from stresses.

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The fixing elements must first of all be inserted into the openings provided for this purpose after putting the laminated plates in place, as the filler can then be poured. This also has the advantage, compared with
15 the known generic solutions, that the sequence for producing laminated plates is not subject to any disturbing influence, for example due to projecting metal parts.

20 In an appropriate improvement of the invention, the hollow space between the wall of the recess and the end portion of the fixing element is filled with filler up to the face facing the bottom of the recess, on the sheet on the building side. In this way, the fixing
25 element is supported particularly uniformly and efficiently against the back of the sheet on the building side, such that the fixing element may also take considerable axial forces. Furthermore, it is advantageous, but not absolutely necessary, also to
30 fill the hollow space remaining between the fixing element and the through opening with the filler, so as to guarantee, also in this zone, that the load of the peripheral surface is transferred from the opening to the fixing element.

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The ability to load the fixing device in the axial direction may be further increased, in an improvement of the invention, by connecting in a lasting manner at least the end portion of the fixing element to the

filler. Such a lasting connection is advantageously produced by providing, at least on the peripheral surface of the end portion of the fixing element, one or more notches for anchoring with the filler. On
5 filling the hollow space with the filler which is initially still flowing, the latter also penetrates the notches. Once set, the filler is anchored therein by positive engagement with the fixing element.

10 In an advantageous embodiment, the fixing element is provided with an axial through bore, through which the filler can be poured from the outside into the recess. According to an improvement, at least one radial opening communicating with the axial bore, for example
15 a transverse bore or slot, is provided close to or on the end of the fixing element to be introduced into the recess. The filler itself may escape from the recess in the radial direction through the axial bore, although the free end of the fixing element is almost in contact
20 with the bottom of the recess and the outlet from the axial bore is very narrow.

In a preferred embodiment, the fixing device has a depth stop connected to the fixing element, which depth
25 stop presses against the surface of the laminated plate and defines the depth for inserting the fixing element. It may be fixedly (as one part) or adjustably connected to the fixing element. It may, for example, be made in the form of a plate or a peripheral flat rib or in the
30 form of individually protruding projections. An adhesively bonded connection may also be provided between the depth stop and the surface of the laminated plate facing it, it being possible for this connection to support larger axial forces via the fixing element.

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Above all, if the outer sheet consists of a transparent material, for example glass, the fixing point or the poured filler are preferably covered so that they cannot be seen from the outside. For this purpose, it

is also possible to use insertion parts resting on the bottom of the recess, such as disks or covers, opaque coatings or the like.

5 Advantageous configurations and improvements of the invention result from the following description of various exemplary embodiments with laminated glass panes, illustrated by the drawings.

10 The drawings show, each time in section,

- figure 1, a fixing device with solid fixing bolt having an external thread;

- figure 2, a fixing device with a fixing bolt having an external thread and with an axial through

15 bore;

- figure 3, an embodiment with a fixing bolt having an internal thread;

- figure 4, an embodiment with a fixing bolt having an internal thread and an axial through bore; and

20 - figure 5, a fixing device with a closing threaded socket flush with the surface of the plate, acting as a fixing element.

The exemplary embodiments described hereinbelow, which
25 are not limited to the materials described for the plates, illustrate on each occasion fixings for laminated glass panes consisting of two sheets of glass and/or plastic. However, it is understood that these panes may also consist of laminates of three plastic
30 and/or glass sheets, or more. Furthermore, in the exemplary embodiments, the openings are made and described in the form of bores and the recesses in the form of blind holes.

35 In the examples below, a laminated glass pane forming the wall element consists of a glass sheet 1 on the building side, an outer glass sheet 2 and a thermo-plastic adhesive layer 3 mutually connecting the two glass sheets 1 and 2, preferably consisting of

polyvinyl butyral. One of the two glass sheets 1, 2 or possibly also both glass sheets may be provided with a transparent or even opaque surface coating not illustrated here, for example a coating reflecting heat radiation. The glass sheet 1 on the building side preferably consists of prestressed glass, especially cured or tempered by a chemical or heat treatment, preferably by a heat treatment. It has cylindrical bores 4 which are made before the prestressing process. Blind holes 5, axially aligned as accurately as possible with these bores 4, are made in the outer glass sheet 2. Their diameter is, for example, greater by a few millimeters than the diameter of the bores 4. The thermoplastic adhesive layer 3 is recessed in a circular manner in the region of the bores, concentrically therewith, the diameter of these recesses corresponding to the diameter of the blind holes 5. Because of the difference in diameter between the blind holes 5 and the bores 4, there is therefore a circular annular area on the side, facing the laminate, of the face of the sheet 1 on the building side. On this point, all the embodiments described have the same features, such that these common features will not be returned to in the remainder of the description.

For reasons of simplification, the subconstruction to which the laminated panes are fixed is not illustrated. Provision can be made for a suitable connection with the subconstruction for each individual fixing point formed by a fixing element. In another embodiment, several fixing elements, which are placed relatively close to each other or else in the peripheral zones of the laminated plates pressed against each other, may be assembled by means of a plate or another construction in order to form a group and to be fixed together to the subconstruction.

In the embodiment illustrated in figure 1, the fixing element is a cylindrical bolt 7 which comes out of the

glass sheet 1 on the building side and which is provided with an external thread 8 on its projecting portion. The latter may be connected to a subconstruction in the corresponding known manner. The
5 other end of the bolt 7 is provided with a peripheral notch 9.

To fix the bolt 7 to the laminated glass pane, with the laminated glass pane in the flat position, the flowing
10 filler 10 is first of all poured through the bore 4 into the blind hole 5, in a quantity such that the blind hole 5 is virtually filled. A suitable flowing filler or sealant is, for example, the commercially available "HILTI HIT HY 50" product. This product does
15 not adhere to the glass and has neutral behavior with regard to the adhesive layer 3 with which it is in contact. After curing or setting, the filler has inelastic behavior.

20 After the filler 10 has been poured into the blind hole 5, the bolt 7 is inserted into the bore 4 and is also pushed a few millimeters into the filler 10, which then also flows into the notch 9. Naturally, air removal means are provided to allow the air displaced by the
25 filler 10 on insertion of the bolt 7 to escape. So that the bolt 7 is centrally inserted, a centering ring 11, whose external diameter approximately corresponds to the internal diameter of the bore 4, is placed on its shaft. In this way, this centering ring also transmits
30 loads from the sheet 1 to the fixing element. Furthermore, a plate 13 acting as a depth stop, preferably provided with an adhesive layer 12, is placed on the bolt 7, the position of the plate being determined by a nut 14 and the plate being adhesively
35 bonded by the adhesive layer 12 to the glass sheet 1. A nonadhesive intermediate elastic layer could also be used instead of the adhesive layer. The insertion depth of the bolt 7 is advantageously predetermined by

adjustment of the plate 13 along the shaft of the bolt by means of the nut 14.

In a variant (not illustrated), the bolt and the plate
5 could also be made as one piece, so as to provide an accurate insertion depth of the bolt into the laminated plate and into the filler. However, this assumes strict compliance of the dimensions in the case of the available depth of the recess.

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After the filler 10 has cured, the latter presses on the circular annular face 15 of the glass sheet 1 surrounding the bore 4 inside the laminate, such that the suction forces exerted in the mounted state on the
15 laminated glass plate are thus taken up - and possibly by adhesive bonding with the plate 13 - and transferred by the filler 10 or the nut 14 into the bolt 7 and the subconstruction retaining the latter.

20 In the embodiment illustrated in figure 2, the bolt 16 is provided with an axial through bore 17. In addition, a cover 18, for example made of chrome-plated brass, is placed in the blind hole 5, and presses closely against the wall of the blind hole 5. The bolt 16 and the
25 filler 10 are covered on the outside by the cover 18. In this embodiment, during mounting, the bolt 16 provided with the plate 13 is firstly inserted into the bore 4 up to the final position desired. In this position, the bolt 16 with the plate 13 are fixed by
30 means of the adhesive layer 12 or in another suitable way with a predefined insertion depth. Next, the flowing filler 10 is poured through the bore 17 into the hollow space between the bolt 16, the cover 18 and the internal surface of the hole of the bore 4, and
35 this space is also completely filled in the region of the bore 4. The filler is also injected under pressure as required. Naturally, means for removing air must also be provided in this case along the annular slot between the bolt 16 and the peripheral surface of the

bore 4 and through the adhesive layer 12 and/or the plate 13. After the filler 10 is cured, the wall element for mounting on the subconstruction is ready for use, the external thread of the bolt 16 having again to be connected thereto.

The embodiment of the fixing device according to the invention, illustrated in figure 3, is comparable to the example described in figure 1 with regard to the arrangement of the bolt 20. In this case, a cover 18 is however again placed in the blind hole 5. The bolt 20 is provided, on the one hand, with an external thread 8 for the purpose of positioning the plate 13 using the nut 14 and, on the other hand, an internal thread 21 for fixing the wall element to the subconstruction.

The additional embodiment illustrated in figure 4 comprises a fixing bolt 23 which is again provided, at its portion projecting above the glass sheet on the building side, with an external thread 8 for positioning the plate 13, and an internal thread 21 for inserting another screwable bolt (not illustrated), for fixing the wall element to the subconstruction. In addition, the bolt 23 is provided, in its portion penetrating inside the laminated glass pane, with an axial through bore 24. The latter serves in its turn for filling with filler 10 in the same way as described in the example illustrated in figure 2. In this case, instead of a cover, only a disk 25 is placed on the bottom of the blind hole 5, the latter having the same function as the cover 18 in the examples described above. The filler could also be covered optically by means of an opaque coating on the bottom and possibly also the internal walls of the blind hole at the location of the cover 18 or of the disk 25.

Another variant of the fixing device according to the invention is illustrated in figure 5. In this case, the fixing element 27 is a hollow cylindrical body with an

internal thread 28. In its portion penetrating the blind hole 5 or the metal cover 18, the fixing element 27 is again provided with a notch 9 for anchoring in the filler 10. The outer front face of the fixing
5 element 27 ends flush with a surface 29 of the glass sheet 1. The fixing element 27 is inserted into the laminated glass sheet and filling with the filler is carried out in the manner already described. In this instance, the positioning and centering of the fixing
10 element while the filler 10 is poured and cured may be facilitated by the fact that a fixing device is temporarily screwed into the internal thread 28, which device presses on the surface of the glass sheet 1 and is subsequently removed after the filler 10 is cured.

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Finally, it should be noted that when using oblong openings, recesses and fixing elements, the results will be no different from the illustrations described here, in the fixing device shown in lateral section.

CLAIMS

1. A fixing device for a wall element consisting of a laminated plate, in particular a laminated glass pane, the sheet on the building side in which has through openings, with fixing elements provided in these openings, which press against the rear face, facing the laminate, of the sheet on the building side, **characterized in that** the sheet on the external side (2) is provided with recesses (5) which are aligned axially over the openings (4) in the sheet (1) on the building side, and open toward the latter, in that the end portions of the fixing elements (7, 16, 20, 23, 27) penetrate into the recesses (5), and that on each occasion at least the hollow space formed between the wall of the recess (5) and the end portion of the fixing element (7, 16, 20, 23, 27) is filled with a cured filler (10).
2. The fixing device as claimed in claim 1, **characterized in that** the recesses (5) having an internal diameter larger than the openings (4) are completely filled with the filler (10) up to a face (15) facing the bottom of the recess (5) inside the laminate, this face being formed on the actual surface of the sheet (1) on the building side located in the laminate, or as a countersunk hole inside the recess.
3. The fixing device as claimed in claim 1 or 2, **characterized in that** the opening, recess and fixing element are made with an oblong shape and lengths matched to each other.
4. The fixing device as claimed in claim 1 or 2, **characterized in that** the opening is a round bore (4) and the recess is a cylindrical blind hole (5) of larger diameter than the bore, and in that the hollow space between the wall of the blind hole (5) and the

end portion of the fixing element (7, 16, 20, 23, 27) is filled with the filler (10) up to an annular surface (15) facing the blind hole (5) of the sheet on the building side (1).

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5. The fixing device as claimed in any one of the preceding claims, **characterized in that** a support element (centering ring 11) is provided in a hollow space between the peripheral surface of the opening (4) passing through the sheet (1) on the building side and the fixing element (7, 16, 20, 23, 27), in order to align the fixing element inside the opening.

6. The fixing device as claimed in any one of the preceding claims, **characterized in that** a hollow space between the peripheral surface of the opening (4) passing through the sheet (1) on the building side and the fixing element (7, 16, 20, 23, 27) is also at least partially filled with the cured filler (10).

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7. The fixing device as claimed in any one of the preceding claims, **characterized in that** the end portion of the fixing element (7, 16, 20, 23, 27) is connected to the filler (10) in a lasting manner, in particular by positive engagement, in the axial direction.

8. The fixing device as claimed in claim 7, **characterized in that** the end portion of the fixing element (7, 16, 20, 23, 27) is provided, on its peripheral surface, with one or more notches (9) for anchoring with the filler (10).

9. The fixing device as claimed in any one of the preceding claims, **characterized in that** the fixing element (16, 23) has an axial through bore (17, 24).

10. The fixing device as claimed in claim 9, **characterized in that** at least one radial opening

communicating with the axial bore is provided in the end portion of the fixing element.

11. The fixing device as claimed in any one of the preceding claims, **characterized in that** the fixing element (7, 16, 20, 23) is a bolt projecting above the glass sheet (1) on the building side and provided with an external thread (8).

12. The fixing device as claimed in any one of the preceding claims, **characterized in that** the fixing element (20, 23) is a bolt projecting above the glass sheet (1) on the building side and provided with an internal thread (21).

13. The fixing device as claimed in any one of the preceding claims, **characterized in that** a depth stop connected to the fixing element (7, 16, 20, 23) is provided on each occasion, in particular a plate (13) surrounding the latter, which abuts against the surface of the laminated plate on the building side.

14. The fixing device as claimed in claim 13, **characterized in that** the plate (13) for predefining the insertion depth of the fixing element (7, 16, 20, 23) is connected in an adjustable manner (nut 14) therewith.

15. The fixing device as claimed in claim 13, **characterized in that** the plate for predefining the insertion depth of the fixing element is fixedly connected thereto and in particular is made as one piece therewith.

16. The fixing device as claimed in any one of the preceding claims 13 to 15, **characterized in that** the plate (13) is adhesively bonded to the surface of the laminated plate facing it.

17. The fixing device according to any one of claims 1 to 10, **characterized in that** the fixing element (27) is provided with an internal thread (28) and finishes approximately flush with the surface (29) of the glass sheet (1) on the building side.

18. The fixing device as claimed in any one of the preceding claims, **characterized in that** a covering (18, 25) is placed on each occasion in the recesses (5) of the sheet on the outer side, at least covering their bottom, in the form of a nontransparent material.

19. The fixing device as claimed in claim 18, **characterized in that** the coverings are formed by an opaque coating covering the bottom, and possibly also the walls of the recess.

20. The fixing device as claimed in claim 18 or 19, **characterized in that** the coverings are formed by fitted covers (18) or disks (25).

21. The fixing device as claimed in any one of the preceding claims, **characterized in that** the filler (10) is an inelastic filler which does not adhere to the glass.

22. The fixing device as claimed in any one of the preceding claims, **characterized in that** an adhesive layer (3) connecting the two sheets (1, 2) of the laminated plate to each other is provided in the region of the fixing elements (7, 16, 20, 23, 27) with holes, whose internal diameter corresponds at least to the width of the openings (4) passing through the sheet (1) on the building side.

23. The fixing device as claimed in any one of the preceding claims, **characterized in that** an adhesive layer (3) connecting the two sheets (1, 2) of the laminated plate together is provided in the region of

the fixing elements (7, 16, 20, 23, 27) with holes whose internal diameter corresponds to the width of the recesses (5) in the glass sheet (2) on the outer side.

5 24. A wall element consisting of a laminated pane, in particular of a laminated glass pane consisting of at least two sheets of glass, **characterized in that** at least one fixing device according to any one of the preceding claims is provided.

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25. The wall element as claimed in claim 24, **characterized in that** at least one of the sheets forming the laminated pane is a sheet of prestressed glass.

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26. The wall element as claimed in claim 24 or 25, **characterized in that** at least one of the glass sheets (1, 2) forming the laminated pane is provided with a surface coating.

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27. The wall element or group of wall elements as claimed in any one of claims 24 to 26, **characterized in that** several very close fixing elements placed in one or more wall elements pressing against each other are
25 assembled by means of a connection member in order to form a group, which is fixed at the same time to a subconstruction.

28. A wall consisting of wall elements fixed to a
30 subconstruction, comprising wall elements as claimed in any one of claims 24 to 26.