

Attachment device for panes, particularly panes of  
glass

The present invention relates to an attachment  
5 device for panes, particularly panes of glass,  
comprising retainers arranged between each pane of  
glass and a support structure with a view to  
transferring the loads from panes to the support  
structure, which retainers comprise means for  
10 compensating for the dimensional variations or  
differences, deformations and displacements between the  
pane and the support structure.

In the glass-construction industry, there are,  
in general, many known elements for retaining or  
15 attaching at isolated points which support glazing, for  
example in a façade cladding, only over a small area.  
They make it possible to produce largely transparent  
constructions requiring little in the way of optical  
materials.

20 There are in existence systems which support  
glazing in pairs at its edge and which pass through the  
joints between panes. Other retainers pass through holes  
made in the glazing.

Various loadings assume importance in glass  
25 constructions for reasons of safety. On the one hand,  
there are the external loadings (the weight of the  
glass itself, wind, precipitation, shocks, etc.). On  
the other hand, there are stresses exerted by  
constraints (impeded or prevented deformations, or  
30 compensation movements, resulting from temperature  
variations, tolerances in the support structure and  
fitting errors, for example). It is known that glass is  
extremely fragile and, unlike ductile materials (metals  
or plastics for example) can tolerate only extremely  
35 small amounts of elastic deformation and no plastic  
deformation at all.

In theory, the glass therefore must experience  
minimum mechanical stressing when loads exerted on it  
are transferred to the support structure or framework.

The matter of determining which of the effects described themselves produce stresses in the glass depends on the static system, that is to say, in particular, on the way in which the panes of glass are mounted.

Unfavourable static systems demand greater thicknesses of glass with a higher self-weight and therefore a stronger support structure. If the mounting is statically indeterminate then the panes will experience stresses both from the external loading and from pressures. By contrast, if the panes are mounted in a statically determinate manner, only the external loadings will be exerted, whereas the pressure loadings will be compensated for in the system or will even not occur. The tensions in the glass resulting from the external loadings are also lower when the mounting is statically determinate than when the panes are more firmly attached.

Known retaining systems using isolated points already make it possible to fulfil these requirements satisfactorily. Spherical or ball joints permit torsion between the glass and the support structure. However, the isolated point supports with spherical joints do not yet in themselves constitute a truly statically determinate manner of mounting a pane of glass. This result can be achieved only by means of additional freedoms in translation.

There are also in existence retainers at isolated points with spherical and sliding joints. In a retainer disclosed by document DE-44 00 979 C2, a lower spherical bushing is attached to the support structure. Its normal axis is perpendicular to the surface of the pane of glass that is to be attached. A compensation piece is placed on this spherical bushing so that it can pivot like a sphere, but without there being any degree of freedom in translation with respect to the normal axis. A support piece is held on the compensation piece in such a way that it can move perpendicularly to the said normal axis, that is to say

parallel to the pane of glass that is to be attached, in all directions within a limited field. However, its adjustable and almost clearance-free axial guidance allows pivoting movements only with interaction with the compensation piece. On the support piece, the pane of glass is clamped onto a thin elastic insert using a screw which passes through a hole in the surface of the glass.

Document DE-43 40 511 A1 describes a stress-free attachment device for panes of glass, in which device each retainer comprises a universal joint on the pane side. In some embodiments with a free bearing, a hinge joint arranged spatially some distance from the universal joint is provided on the support structure side. It may be replaced by a slideway for compensating for tension by sliding, the practical configuration of which slideway is not, however, described in greater depth.

Document DE-44 45 724 A1 describes an attachment device for panes, the retainers of which have a universal joint essentially on one side. Some axial distance from this joint, depending on the embodiment, there may be another spherical joint or hinge joint. The particular features relating to compensation for stresses by translation or sliding are not disclosed.

The invention now intends to produce an attachment device of the type described in the introduction, advantageously without a universal joint, in which, according to the characterizing part of Claim 1, degrees of freedom in rotation in compensation means of the retainers are embodied solely by uni-axis pivoting joints.

The characteristics of the dependent claims relate to advantageous developments of the invention.

According to these advantageous developments, the retainers further comprise compensation means with degrees of freedom in translation so as to allow relative displacements, at least over limited

distances, between the pane and the support structure, these displacements being due, for example, to thermal expansion.

According to one development of the invention, uni-axis hinge joints may be produced in a particularly simple way so as to allow sliding which in itself is restricted in the direction of the axis of the hinge. Such an embodiment, if need be, then allows the pivoting and sliding movements to be transferred locally or strung together. Hinge joints can be produced in the form of bushes and pins or from pairing two cylindrical surfaces, one convex and one concave, with one another for sliding, there being appropriate safeguards against lifting included.

A retainer in the form of a free bearing preferably comprises two hinge pins which extend at right angles to each other in projection. In this instance they may form an intersection or may lie some distance from one another.

It is also possible to separate the two degrees of freedom - "pivoting" and "sliding" - in the spatial and functional plane, for example by arranging the base of one hinge on a support so that it can be displaced flat or along an axis on a support.

In another advantageous embodiment, a retainer may also have a degree of freedom in rotation with respect to its longitudinal axis intersecting the pane.

Other features and advantages of the invention emerge from the drawings of the embodiments and from their detailed description hereafter.

In the drawings:

Fig. 1 shows a simplified perspective skeleton diagram of an attachment device for a pane, arranged at each of the four corners of which there is a retainer according to the invention;

Fig. 2 is a view of all the essential components of a retainer of the attachment device in the bottom of Fig. 1;

Fig. 3 is a diagram in perspective of a retainer;

Figs 4a and 4b show two views, at 90° from each other, of an alternative form of a component of the retainer, and

Fig. 5 illustrates a modified support piece of a retainer so as to clarify an alternative way in which the degrees of freedom in translation and in rotation can be strung together.

According to Fig. 1, a rectangular pane 1, particularly a pane of glass, is fitted with four retainers 2, 3, 4 and 5 which are illustrated only diagrammatically. The pane is, for example, suspended vertically from the façade of a building. The figure shows the rear of the pane from the support structure, indicated by the reference 6. The retainers 2 to 5 extend between the support structure 6 and the pane 1. Their longitudinal axes extend essentially at right angles to the plane of the pane.

Four axes 7, 8, 9 and 10 depicted in chain line extend some distance from the four edges of the pane 1 and parallel to these edges. In the mounted position illustrated, the axes 7 and 9 extend horizontally and the axes 8 and 10 vertically, each being parallel to the adjacent edge of the pane. The points of intersection of the four axes 7 to 10 define the position of each of the retainers 2 to 5, the longitudinal axis of each retainer intersecting one of the said points of intersection. The symmetrical layout illustrated here of the retainers on the surface of the pane is not, however, absolutely essential, and panes of absolutely any shape may of course be attached in this way.

Essentially, each retainer 2 to 5 is connected to the pane 1 by a hinge joint 11. The axis of pivoting of the hinge joints 11 extend horizontally in the direction of the axes 7 and 9. On the support structure side, the retainers 2 to 5 are generally also fitted with hinge joints 12. The axes 13 of pivoting of these

hinge joints extend at right angles to the axes of the hinge joints 11. They therefore extend parallel to the axes 8 and 10, that is to say parallel to the line of action of the static weight.

5           In theory, it would be possible to switch the orientatation of the hinge joints so that the joints 11 allow movement about a vertical axis of pivoting and so that the joints 12 allow movement about a horizontal axis. In this way, the static weight of the pane 1  
10 could, however, already produce a local bending force, which is something that can only occur in the case of the axis geometry illustrated if forces are exerted in the lateral horizontal direction.

15           In theory, each of the hinge joints 11 and 12 studied can not only rotate about its axis of pivoting and thus constitute a compensation means with a degree of freedom in rotation, but can also slide in the direction of the axis in a limited field. The skeleton diagram of Fig. 1 does not depict any limit on the  
20 degrees of freedom except for modifications purely in terms of translation of the distance between the pane 1 and the support structure. The intersecting axes of pivoting protect the pane 1 from any bending moment when normal forces are applied in all directions, and  
25 the longitudinal displacements are absorbed by sliding along the axes of pivoting. For each pane, there will, however, be a stationary point defined and this will determine the overall position of the pane on the support structure.

30           It should be strongly emphasized that the transverse offset between the axes of pivoting of the joints 11 and 12 is not essential. It is also possible to use so-called intersecting joints in which the two hinge axes intersect one another, so long as they allow  
35 at least partial relative displacements.

          Some embodiments of the hinge joints will be described hereafter. In this respect, various possibilities are also described for reducing the degrees of freedom, something which is essential for

transferring the stresses from the pane 1 to the support structure 6 in a statically determinate way.

As shown in Fig. 2, a retainer 2 extends between the suspended pane 1, on the right, and the support structure 6, shown on the left. A support piece 14 is connected to the pane 1 by a screw 15 which passes through a hole in the pane 1. According to the customary technique, elastic inserts 16 are arranged between the pane 1 and the support piece 14 or the screw 15. The support piece 14 forms a pivot bearing 17, the axis of which extends parallel to/along one of the horizontal axes 7 or 9 shown in Fig. 1, and which is produced in the form of a cylindrically rounded bottom of an open slot on one side.

An anchoring piece 18 is attached to the support structure 6 by a screw 19 with the insertion of an adapter washer 20. The anchoring piece 18 also forms a pivot bearing 21, the axis of which corresponds to one of the vertical axes 13 mentioned in Fig. 1.

The support piece 14 and the anchoring piece 18 can be produced simply in the form of round discs in which the necessary recesses are made.

A connecting piece 22 connects the two pivot bearings 17 and 21. It comprises a connecting bar 23 which is along the longitudinal axis of the retainer 2. Its length essentially determines the spacing between the pane 1 and the support structure 6. There are cylindrical hinge pins 24, 25 at the two ends of the connecting bar 23. Their longitudinal axes extend, a certain distance from one another, at right angles to one another. Overall, the connecting piece 22 therefore is the shape of a double T, the two transverse arms (the hinge pins 24 and 25) of which are orientated at  $90^\circ$  to one another with respect to the longitudinal axis of the upright of the T (the connecting bar 23) but lie in mutually parallel planes. This piece may be manufactured from simple part-worked products, for example round steel bar stock of sufficient thickness,

or may be cast in a die. Of course, use may also be made of high strength plastics.

The hinge pin 24 is in the pivot bearing 17. Therein, it can pivot in both directions, at least to a certain extent. These two components form one of the hinge joints 11 of horizontal pivot axis, sketched out in Fig. 1.

The hinge pin 25, for its part, can pivot inside the pivot bearing 21 and therewith forms one of the hinge joints 12 of vertical axis 13 of pivoting which are illustrated in Fig. 1.

It can also be seen in Fig. 2 that the pivot bearing 17 comprises a recess 26 which is transverse to its axis of pivoting, and which the connecting bar 23 enters with clearance in all directions. What this means is that the hinge pins 24 can both pivot and slide in the longitudinal direction inside the pivot bearing 17 and can do so in both directions starting from the central position illustrated, until the connecting bar 23 comes laterally up against one of the walls of the recess 26.

The pivot bearing 21 arranged facing the pivot bearing 17 with an  $90^\circ$  offset, is produced in the same way. The recess 26 cannot be seen in the view illustrated.

Friction between the hinge pins and the pivot bearings must naturally remain as low as possible. This result can be achieved by high-level surface treatment of these components, by appropriate combinations of materials and/or by lubrication. For example, the anchoring piece and the support piece may be made of a metal sinter endowed with good sliding properties. Depending on the anticipating loadings, use may also be made of pieces made of high strength plastics.

The connecting bar 23, and therefore the distance or transverse separation between the hinge pins 24 and 25 must be as short as possible so that the longitudinal displacements by sliding are not unnecessarily impeded by jamming movements.

When assembling the hinge joints 11 and 12, the hinge pins 24 and 25 may simply be inserted transversely into their pivot bearings which are open on a respective side, until they reach the ends of these bearings. At the same time, the connecting bar 23 passes through the respective recess 26 which is transverse with respect to its longitudinal axis.

This embodiment in which the pivot bearings are open on one side is particularly suited to connecting pieces which are prefabricated as one or more parts.

A safety piece 27 is fixed into the anchoring piece 18 illustrated in Fig. 2. This safety piece is preferably attached removably by means of a screw 28 and closes the open side of the pivot bearing 21. It assures the hinge pins 25 in the manner of a bearing cap in the pivot bearing 21. It should be remembered at this point that this bearing is open on one side in a horizontal direction in the preferred mode of mounting.

On the side of the pane 1 where the pivot bearing 17 is open on one side vertically downwards in the preferred mode of mounting, it is not essential to provide a safety piece of this kind. It may also be enough to suspend the pane, according to Fig. 1, from the four prepared retainers 2 to 5 because its weight keeps it safely in the end of the pivot bearing 17.

When attaching the pane to the support structure, it is possible, for example, to follow the following procedure: first of all, the anchoring pieces 18 are attached to the support structure 6 in such a way that the openings of the pivot bearings 21 face the side and so that their axes extend vertically. The openings of the pivot bearings that are situated at the same height will preferably be orientated so that they face each other. Next, the hinge pins 25 are installed and, if need be, fixed by means of the safety pieces 28. In the case of the embodiment depicted in Fig. 1, four connecting bars 23 then extend horizontally from the anchoring pieces 18. At their free ends, four hinge pins 24 are orientated

uniformly with their axes horizontal. The support pieces 14 previously attached to the pane can then simply be suspended in these until all the hinge pins 24 rest on the end of the pivot bearing 17. The pane 1  
5 can now be removed only by lifting it.

In a diagram in perspective, Fig. 3 once again illustrates the overall configuration of a retainer with hinge joints 11 and 12. The direction of view is the same as in Fig. 1. For reasons of simplicity, the  
10 screws on the support piece 14 and on the anchoring piece 18 have been omitted. The broadly similar embodiment of the latter two components, and the configuration of the recesses 26 provided, are illustrated here. In particular, the radial mobility in  
15 all directions of the connecting bar 23 in the recess 26 of the support piece 14 can be seen. The hinge pins 24 can pivot in the pivot bearing 17 in one direction and in the other and can slide both sides.

Figs 4a and 4b depict, in two views, one from  
20 the side (4a) and the other from above (4b), an alternative form of a support piece 14 or of an anchoring piece 18. The pivot bearing 17/21 has the form of a cylindrical through hole. In place of the recess 26 there is an oblong hole 26'. In a free  
25 bearing, this again is aimed at allowing the connecting bar 23 radial mobility in all directions. In the direction of its longitudinal axis, this bar must in general have the smallest possible amount of clearance so as to assemble the pane and the support structure  
30 rigidly in terms of tension and compression. The alternative form depicted in Figs 4a and 4b is suitable only for connecting pieces to be assembled from several parts. The hinge pins 24/25 must first of all be introduced into the said through hole. Next, the  
35 connecting bar 23 is inserted into the oblong hole 26'. Using an appropriate screw 29, merely sketched in the side view, this bar is connected to the hinge pins. If the two ends of the connecting bar have screw threads of opposite hand, this bar can be screwed into the two

hinge pins (in the support piece and in the anchoring piece) simultaneously while the retainer is still laterally accessible.

If necessary, it is also possible to combine  
5 the two illustrated embodiments of the pivot bearings, that is to say to provide, at one end of the connecting bar, fixed hinge pins as in Fig. 2 and, at the other end, an assembly screw of the type described earlier.

If the lateral displacement of hinge pins in  
10 the pivot bearing is to be subordinate to determining the corresponding degree of freedom, then a number of possibilities present themselves. The recess 26 or the oblong hole 26' which corresponds to it in the direction of the hinge axis can simply be made with a  
15 width that merely corresponds to the thickness of the connecting bar so that this connecting bar fixes the associated hinge pins in the longitudinal direction.

Another possibility consists in providing blocking which acts on the end faces of the pins. To  
20 this end, screws may, for example, be screwed right into the pivot bearings or into the through holes, the end faces of the pins coming up against the end faces or points of the screws.

Likewise, it is also possible, if necessary, to  
25 prevent the pin from rotating in the pivot bearing by clamping, by additional attachment pieces or by adopting suitable dimensions for the recess 26 or the oblong hole 26' which corresponds to it.

If, for example, there is a desire to produce a  
30 fixed point, it is possible, as described earlier, on the one hand, to produce the recess 26 without transverse clearance depending on the dimensions of the diameter of the connecting bar and, on the other hand, to close off its open side after it has been introduced  
35 by fitting a safety piece similar to the safety piece illustrated in Fig. 2.

By comparison with a direct fixed connection between the connecting piece 22 and the support piece 14 and/or the anchoring piece 18, these measures have

the advantage that the components broadly speaking comply with the standards, even at the fixed point.

Another embodiment, not depicted, consists in inverting the method of mounting the hinge joints already described, in a way which is kinetically equivalent. At the location of a pivot bearing formed on the support piece and/or the anchoring piece are two pins extending, while projecting, along the same axis in a radial direction. An appropriate connecting piece comprises, at its end, a forked bearing housing the support piece or the anchoring piece, and the two branches of which are mounted, with pivoting, on the said pin and can be displaced in the longitudinal direction to a certain extent if necessary.

In another conceivable alternative embodiment, the hinge pin (which is vertical in the mounted position) is displaced towards the sides of the support structure in the connecting piece. This yields an additional reduction in the separation between the two uni-axis joints.

Fig. 5 partially depicts another alternative form of a retainer, which constitutes another possibility for stringing together one or two degrees of freedom in uni-axis rotation with one or two degrees of freedom in translation.

This embodiment is described with a modified support piece 14' which is made of several parts with a support cup 30 comprising an edge 31 and a sliding surface 32 surrounded by this edge, and a pivot bearing 33 which can be displaced over this surface and comprises a projecting collar 34.

The support cup 30 is fixed to a pane 1 in a way which is not depicted in greater detail. A cover disc 35, which is preferably removable, is attached to its edge 32. This disc overlaps the collar 34 and protects the pivot bearing 33 from lifting off the sliding surface 32. In a way similar to the embodiments described earlier, a connecting piece 22 pivoting about

an axis, and which therefore has a degree of freedom in rotation, is arranged in the pivot bearing 33.

The pivot bearing 33 can move away from the central position depicted in hatching until its collar  
5 34 bears against the edge 31. One or two degrees of freedom in translation may be allowed in the sliding surface. The dimensions of the collar and of the edge, or of the sliding surface may be mutually determined to create a limitation. If necessary, the collar may thus  
10 be produced in such a way that it can move only in one direction in a straight line in one direction and in the other by virtue of the edge which loosely traps the two sides.

If the sliding surface 32 and its counterpart  
15 sliding surface of the pivot bearing are produced with a cylindrical curvature and the pivot bearing can be moved only in the direction of the axis of the cylinder, then a degree of freedom in translation and a degree of freedom in rotation can also be combined in  
20 the same way as in the embodiments illustrated in Figs 2 to 4. The connecting piece 22 can then be attached to the pivot bearing 33.

Depending on the configurations of the edge and of the collar, the body of the pivot bearing 33 on the  
25 sliding surface 32 may also rotate on an axis about a normal to the sliding surface (plane) or about the longitudinal axis of the connecting piece 22, which means that an additional degree of freedom in rotation can thus be permitted or prevented.

30 Incidentally, this degree of freedom in rotation can also be provided, if need be, actually within the connecting piece, because this piece resists tension and compression but has properties allowing torsion.

## CLAIMS

1. Attachment devices for panes (1) particularly panes of glass, comprising retainers (2 to 5) arranged between each pane and a support structure (6) with a view to transferring the loads from the panes to the support structure (6), which retainers comprise means for compensating for the dimensional variations, deformations and displacements between the pane and the support structure, characterized in that the degrees of freedom in rotation of the compensation means consist only of uni-axis pivoting joints (11, 12).
2. Attachment device according to Claim 1, characterized in that the retainers (2 to 5) further comprise compensation means which have degrees of freedom in translation and allow relative displacements, at least by limited distances, between the pane (1) and the support structure (6).
3. Attachment device according to Claim 1 or 2, characterized in that one degree of freedom in translation consists of the limited mobility of a uni-axis joint (11, 12) along its axis (13) of pivoting.
4. Attachment device according to Claim 3, characterized in that a hinge pin (24, 25) of the uni-axis joint (11, 12) can move along its axis (7, 9, 13) of pivoting with respect to the bearing (14, 17) in which it pivots.
5. Attachment device according to any one of the preceding claims, characterized in that two uni-axis joints (11, 12) are provided on a retainer (2), their axes (7, 9; 13) of pivoting lying in mutually parallel planes and being at 90° to one another with respect to the longitudinal axis of the retainer.
6. Attachment device according to any one of the preceding claims, characterized in that a retainer (2 to 5) comprises a support piece (14) that can be connected to the pane (1) and an anchoring piece (18) that can be connected to the support structure (6), each of which pieces comprise a bearing (17, 21) for pivoting of a uni-axis joint.



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7. Attachment device according to Claim 6, characterized in that a connecting piece (22) intended to connect the support piece (14) and the anchoring piece (18) have, at its two ends, bearing means  
5 corresponding to the respective pivot bearings (17, 21).

8. Attachment device according to Claim 7, characterized in that the connecting piece (22) comprises a connecting bar (23) which is connected  
10 rigidly at its two ends to a hinge pin (24, 25), the two hinge pins being at 90° to one another with respect to the longitudinal axis of the connecting bar (23).

9. Attachment device according to Claim 8, characterized in that the pivot bearing (17, 21) is  
15 produced in the form of the rounded cylindrical end of a slot which is open on one side, which has a recess (26) extending transversely to the axis of pivoting and intended to accommodate the connecting bar (23).

10. Attachment device according to Claim 9,  
20 characterized in that the connecting bar has a radial clearance in all directions inside the recess (26).

11. Attachment device according to any one of the preceding claims, characterized in that at least one degree of freedom in translation consists of the  
25 mobility of a uni-axis joint (33) relative to its support (30).

12. Attachment device according to any one of the preceding claims, characterized in that a retainer (2 to 5) has a degree of freedom in rotation with respect  
30 to its longitudinal axis intersecting the pane (1).

13. Attachment device according to Claim 11 or 12, characterized in that a uni-axis pivot bearing (33) is able to move over a sliding surface (32) and is guided and protected against lifting.

35 14. Attachment device according to Claim 13, characterized in that the sliding surface is domed cylindrically and in that the pivot bearing can move in the direction of the axis of the cylinder.



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