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(54) **Munkadarabtartó**

WORKPIECE SUPPORT

The present invention relates to a workpiece support comprising at least two components, which are each made of a carbon-fibre-reinforced carbon (CFC).

Workpiece supports made from CFC are used to support or hold workpieces in high-temperature environments. For example, so called charging racks are used as supports during hardening or sintering of workpieces in industrial furnaces, wherein in the simplest case the workpieces to be heat treated are laid on a support surface of the charging rack. In comparison to workpiece supports made from steel, workpiece supports made from CFC are characterised in particular through higher temperature resistance and better form stability.

The assembling of a workpiece support from a plurality of components is advantageous in terms of production costs and flexibility. In particular, this makes it possible to construct complex frames which correspond to the respective type and quantity of workpieces. The individual components can be connected together, for example, by means of friction-locked connection elements. A workpiece support for parts to be hardened, which is formed from four connected frame-like CFC rails, is disclosed for example in DE 295 12 569 U1.

However, such workpiece supports made from connected CFC components have the problem that the friction-locked connection elements in question, such as guide ribs and grooves, must be produced with relatively high accuracy in order to prevent both undesired loose connection as well as clamping together of the components during connection. This is connected with high production costs. Further, because of the high temperatures and the large temperature differences present during a hardening of sintering process, the friction-locked connection can release and, as a consequence, result in an undesired deformation of the entire workpiece support. In order to prevent such an undesired releasing of two connected components they can be bonded together; this however again results in an increased production effort.

In DE 20 2010 015 436 U1, latched CFC components are assembled into a workpiece support. Therefore one problem addressed by the present invention is that of further developing workpiece supports of the above-mentioned type with simpler means that securely prevent an undesired release of the individual components.

The problem is solved by a workpiece support comprising the features of claim 1.

According to the invention, at least two of the at least two CFC components are latched together. In such a latching, at least two corresponding latching teeth elements engage in one another in a form-fit manner and hold the two CFC components firmly in a defined latching position, it being however possible to overcome the form-fit, at least in one direction, through the application of force. This means that when connecting the components together, and if necessary when disassembling them, the described teeth elements can slide past one another. For such a latching and/or snap connection, the achievement of the latching position is often audibly and/or tactilely perceptible ("clicking in" or "snapping in").

The two CFC components are thus not only connected together and hence connected in a friction-locked manner, but rather because of their latching there is also a form-fit connection, which increases the stability of the entire structure and prevents an undesired loosening or releasing of the individual components. A complex glueing is therefore not required here. Because of the increase in the carrying capacity of the connection due to the form-fit, material can be saved in the design of the components, resulting in a reduction in production costs.

Tight form-fit connections in the form of undercuts or pinning often require a complicated assembly of the components from different directions and in a precisely defined sequence. By contrast, a latching together of two components is particularly quick and simple. In addition, a latching connection requires only comparatively few dimensional accuracy requirements to be specified. It is therefore possible, in particular, to provide kits for workpiece supports, by means of which end customers can construct individual workpiece supports, depending on the respective application, by simple click-together connection of the individual parts.

Preferably, the locking of the at least two CFC components can be released by overcoming a latching resistance. The workpiece support can then be easily disassembled if necessary.

According to one embodiment of the invention, the minimum force to be applied to one of the two CFC components in order to overcome the latching resistance is at least 10 N. A customised latching resistance ensures both sufficiently high security against unintentional release of the latching connection and also enables easy assembly

and disassembly of the workpiece support. If a subsequent dismantling of the workpiece support is not taken into consideration, the latching resistance can also be so large that non-destructive release of the locking is practically impossible.

According to one embodiment of the invention, the workpiece support can also comprise at least three CFC components, each of the at least three CFC components being latched to at least one other of the at least three CFC components. This enables the construction of relatively complex workpiece supports, wherein the individual components are securely held together by the mutual locking. For example, a workpiece support can comprise two CFC components embodied as longitudinal members, arranged parallel to one another, and engaged through at least one CFC component designed as a crossmember, wherein the crossmember is latched at both ends with one of the longitudinal members. In this way, it is possible to construct a grate-like or grid-like workpiece support, which is suitable for supporting a plurality of different workplaces.

In order to enable a simple and reliable support of workpieces, a support surface for a workpiece can be formed on at least one of the least two CFC components, and preferably on each of the two CFC components. If the application so requires however, special attachment elements spanning the workpiece to be supported can also be provided on the CFC components, such as recesses or brackets. For certain applications, it can also be advantageous to provide separate support and retaining elements, for example made from ceramic, which are connected to the CFC components.

A latching projection can be provided on at least one of the at least two latched CFC components, which engages with a latching seat provided in another of the at least two latched CFC components. The latching projection can be any material region which projects with respect to a base surface of the CFC component, such as a flat wall for example. Depending on the application task, such a latching projection can be in the form of a tooth, bulge or lug. The latching projection is preferably designed to be ramp-like, in order to provide an inclined bevel to ease the achievement of latching. In principle, the latching projection can be designed as a separate component. It is preferable, however, that the latching projection is formed directly on the associated CFC component.

The latching projection can project by a distance of between 0.05 mm and 1.5 mm, preferably between 0.1 mm and 0.7 mm and particularly preferably between 0.2

mm and 0.4 mm from the base surface of the associated CFC component. Distances which both ensure a secure latching connection and which also enable easy latching or clicking of one CFC component into the other CFC component have proven particularly advantageous.

According to the invention, both a latching projection and a latching seat are provided on each of the at least two latched CFC components, the latching projections and the latching seats of two latched CFC components mutually engaging in each case. In this way the construction of the workpiece support is simplified. In particular, during assembly, it is not necessary to ensure that a sufficient number of CFC components with latching projections and CFC components with latching seats are available, as a latching seat always exists for each latching projection. In this way it is possible to construct various workpiece supports from a limited set of basic elements, in the sense of a modular system.

A further aspect of the invention is that the at least two CFC components for latching in an insertion direction can be connected, the latching projection and the latching seat of each of the at least two CFC components being arranged one behind the other with respect to the insertion direction. When assembling the CFC components in the insertion direction, the latching projection of one CFC component automatically engages in the latching seat of the other CFC component and vice versa, so that a particularly simple latching is possible.

At least one of the at least two latched CFC components can have a slot for receiving an insertion portion of the relevant other CFC component, the latching projection protruding from the side wall of the slot. The insertion portion can be any region of the relevant CFC component, the width of which matches the width of the slot. The slot is then used on the one hand as a guide for the CFC component to be inserted and also provides the latching projection used for latching.

Respective latching projections can also protrude from two opposing side walls of the slot. In this way the stability of the latching connection can be increased.

According to one concrete embodiment of the invention, the at least two latched CFC components are designed to be planar and each comprise at least one slot, the slots mutually engaging in one another. Such CFC components are relatively easy to produce and are particularly suitable for building grid-like charging racks.

The slot can in particular have a rectangular cross-section. This allows a particularly easy production.

A further embodiment of the invention provides that at least one of the at least two latched CFC components, and preferably each of the at least two latched CFC components, has at least three spaced-apart slots for receiving an insertion portion of another CFC component. This allows the flexibility during construction of an application-specific workpiece support to be further increased.

Two parallel and spaced-apart grooves can be formed in at least one side wall of the slot, between which grooves the latching protrusion, which is in particular plateau-like or bulge-like, extends. Such a design of the latching protrusion has been found to be advantageous in terms of easy latching capability.

The grooves can have a rounded cross-section, wherein the radius of curvature of the rounding is at least 0.1 mm and preferably at least 0.3 mm.

Furthermore, a ramp-like latching protrusion and a groove adjacent thereto can be formed in at least one side wall of the slot. The groove enables easy latching or clicking of the latching protrusion into the associated latching seat.

The at least two CFC components are each preferably made from a carbon-fibre-reinforced carbon, which comprises carbonised and/or graphitised poylacrylonitrile fibres. Particularly good results were achieved with such fibres.

Further, it is also preferred that the at least two CFC components are each assembled from carbon reinforced with continuous carbon fibres, cut carbon fibres and/or stretch-broken fibres.

In terms of the fibre thickness, it is preferred that the at least two CFC components are each assembled from a carbon-fibre-reinforced carbon which comprises carbon fibres having an average diameter of between 5 µm and 10 µm. An average diameter of carbon fibre of approximately 7 µm has proven to be a particularly good value.

In relation to the fibre content of the CFC components, it has proven advantageous if the at least two CFC components are constructed from a carbon-fibre-reinforced carbon which comprises at least 30 vol.%, preferably at least 50 vol.% and particularly preferably at least 70 vol.% carbon fibre.

In order to ensure a safe use of the workpiece support during hardening and sintering, it is preferred that the at least two CFC components can withstand temperatures of at least 1500 °C and preferably of at least 2500 °C.

The workpiece support can be made exclusively of, preferably similar, CFC components. This allows a particularly cost-effective production.

Preferably, the workpiece support has a size (WxLxH) of at least 50 mm x 50 mm x 10 mm, more preferably at least 100 mm x 100 mm x 10 mm and particularly preferably of at least 300 mm x 300 mm x 20 mm, such as for example 1200 mm x 1200 mm x 50 mm. Workpiece supports of this size are usually used as charging racks for hardening or sintering of components.

A further subject matter of the present invention is the use of an above-described workpiece support as a charging rack in a high temperature environment.

In the following, the invention will be further described on the basis of explanatory, but not limiting, examples with reference to the drawings.

Figure 1 is a top view of a CFC component for a workpiece support according to a first embodiment of the invention.

Figure 2 is a magnified partial view of the workpiece support according to figure 1.

Figure 3 is a partial view of a CFC component for a workpiece support according to a second embodiment of the invention.

Figure 4 is a partial view of a CFC component for a workpiece support according to a third embodiment of the invention.

The plate-shaped component 11 illustrated in figure 1 is produced entirely from a carbon-fibre-reinforced carbon (CFC) and is used for constructing a workpiece support such as a charging rack, for example. The carbon fibre reinforced carbon comprises continuous fibres made from carbonised and/or graphitised polyacrylonitrile, which is embedded in a matrix of carbon in a proportion of at least 80 vol.%. The fibres preferably have an average diameter of approximately 7 µm.

As illustrated, the CFC component 11 is designed in the form of a longitudinal rail and has a longitudinal axis L. Four slots 13 with rectangular cross-section are formed in the CFC component 11, spaced apart along the longitudinal axis L. The width B of each slot corresponds to the thickness, not shown in figure 1, of the plate-shaped CFC component 11. Furthermore, the CFC component 11 has four rectangular recesses 15,

which are each arranged adjacent to a slot 13 and have a width corresponding to the which B of the slots 13.

As can be seen, in particular from the magnified illustration according to figure 2, each slot 13 has two opposing side walls 17, wherein two grooves 19 are formed in each of the side walls 17, spaced apart parallel to one another and perpendicular to the longitudinal axis L. Between the two grooves 19 of a side wall 17, there is a gently rounded latching bulge 20 which projects from the surface of the side wall 17 by approximately 0.35 mm.

Using the slots 13, the recesses 15 and the latching bulges 20, two CFC components 11, designed as shown in figure 1, are latched together, as explained in more detail below. Thus the two CFC components 11 to be connected are initially arranged in the known manner such that the longitudinal axes L thereof are perpendicular to each other, and a top-side slot 13 of the first CFC component 11 lies opposite an underside slot 13 of the other CFC component 11. The two CFC components 11 are then brought together in an insertion direction E perpendicular to the two longitudinal axes, the slots 13 mutually engaging in one another. The region of the CSC component 11 adjacent to the side of the slot 13 as viewed in the direction of the longitudinal axis L thus forms an insertion portion 21, which is guided through the slot 13 of the other CFC component 11 and on connection slides past under elastic deformation of the latching bulge 20. As soon as the recesses 15 reach the latching bulges 20, the pretensioned latching bulges 20 latch into the recesses 15, so that the two CFC components 11 are latched together. A release of the CFC components 11 from one another in a direction opposite the insertion direction E is only possible by overcoming a latching resistance with an increased application of force. Through the shape and size of the latching bulges 20, as well as through the material selection, the latching resistance can be relatively exactly matched to an application-related specified value. By using three or more CFC components 11, it is easy to construct frame-like or grid-like workpiece supports in the described manner, in which the narrow sides 23 of the CFC components 11 each form support surfaces 25 for workpieces. Such workpiece supports are suitable in particular as charging racks in hardening or sintering furnaces. Because the associated components 11 are made exclusively from CFC, a sufficient temperature resistance and formed stability is ensured.

The assembling of a workpiece support by latching the CFC components 11 is simple and requires no special knowledge. It can therefore also be carried out by any end customer, while the manufacturer of the workpiece support needs merely to provide a set of CFC components 11 for individual connection as a kit. A particular advantage of the illustrated system is that there are no undercuts which would require different connection directions to be taken into account during assembly, and the following of a specified sequence during assembly. There are also no bondings or separate attachment elements such as studs or pins required, because the stability of the CFC component connection is ensured by the latching.

Figure 3 shows an alternative embodiment of a CFC component 11 according to the invention, where instead of a latching bulge, a latching lug 27 comprising a ramp cross-section 29 and a shoulder 31 is provided. A single groove 19 is associated with the shoulder 31. The ramp section 29 of the latching lug 27 forms an inclined bevel for the insertion portion 21 of the other CFC component 11 and thus facilitates the connecting of the two CFC components 11. The shoulder 31 thus guarantees a greater latching resistance in comparison to the embodiment according to figures 1 and 2.

A further embodiment of the invention is illustrated in figure 4. In order to latch in the recess 15, a latching lug 27 is provided as in the embodiment according to figure 3, wherein however no groove is formed in the side wall 17 of the slot 13. In this case, the shoulder 31 ends instead in a rounding 33. In figure 4, the distance A, by which the latching lug 27 protrudes from the side wall 17, is indicated by a dashed line.

In comparison to a pure friction-lock, the insertion of the CFC components 11 in one another provides locking not only with higher stability, but also with simplified assembly.

Reference sign list:

11	component
13	slot
15	recess/latching seat
17	side wall
19	groove
20	latching bulge/latching projection
21	insertion portion
23	narrow side
25	support surface
27	latching lug/latching projection
29	ramp section
31	shoulder
33	rounding
L	longitudinal axis
B	width
E	insertion direction
A	distance

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MUNKADARABTARTÓ

SZABADALMI IGÉNYPONTOK

1. Munkadarabtartó, amely magában foglal legalább két szerkezetalkotó elemet (11), amelyek rendre szénszál-erősítésű elemi szénből (CFC) vannak előállítva, amely munkadarabtartónál a legalább két CFC szerkezetalkotó elemből (11) legalább kettő egymással össze van reteszelve,

azzal jellemezve, hogy

a legalább két egymással összereteszelt CFC szerkezetalkotó elem (11) mindegyikén ki van alakítva mind egy retesznyúlvány (20, 27), mind egy reteszfészek (15), továbbá rendre két egymással összereteszelt CFC szerkezetalkotó elemnek (11) a retesznyúlványai (20, 27) és reteszfészkei (15) kölcsönösen egymásba vannak akaszkodva.

2. Az 1. igénypont szerinti munkadarabtartó,

azzal jellemezve, hogy

a legalább két CFC szerkezetalkotó elem (11) összereteszelését reteszelő ellenállás legyőzésével oldani lehet.

3. Az 1. vagy 2. igénypont szerinti munkadarabtartó,

azzal jellemezve, hogy

a munkadarabtartó magában foglal legalább három CFC szerkezetalkotó elemet (11), továbbá a legalább három CFC szerkezetalkotó elem (11) mindegyike a legalább három CFC szerkezetalkotó elemnek (11) legalább egy másikával össze van reteszelve.

4. Az előző igénypontok legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a retesznyúlvány (27) rámpaszerűen van kialakítva.

5. Az előző igénypontok legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a retesznyúlvány (20, 27) a hozzá tartozó CFC szerkezetalkotó elem (11) bázisfelületéből (17) 0,05 mm és 1,5 mm közötti, előnyösen 0,1 mm és 0,7 mm közötti és különösen előnyösen 0,2 mm és 0,4 mm közötti távolságra (A) áll ki.

6. Az előző igénypontok legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a legalább két CFC szerkezetalkotó elem (11) összereteszelés végett bedugási irányban (E) egymásba dugható, továbbá a legalább két CFC szerkezetalkotó elem (11) mindegyikének a retesznyúlványa (20, 27) és a reteszfészke (15) bedugási irányban (E) egymás mögött van elhelyezve.

7. Az előző igénypontok legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a legalább két egymással összereteszelt CFC szerkezetalkotó elemnek (11) legalább egyike a rendre másik CFC szerkezetalkotó elem (11) bedugási szakaszának (21) befogadására horonnyal (13) rendelkezik, továbbá a retesznyúlvány (20, 27) a horony (13) oldalfalából (17) áll ki.

8. A 7. igénypont szerinti munkadarabtartó,

azzal jellemezve, hogy

a horony (13) két egymással átellenben lévő oldalfalából (17) vonatkozó retesznyúlványok (20, 27) állnak ki.

9. A 7. vagy 8. igénypont szerinti munkadarabtartó,

azzal jellemezve, hogy

az egymással összereteszelt legalább két CFC szerkezetalkotó elem (11) lapszerűen van kialakítva, és rendre legalább egy horonnyal (13) rendelkezik, továbbá a hornyok (13) kölcsönösen egymásba akaszkodnak.

10. A 7–9. igénypont legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a legalább két egymással összereteszelt CFC szerkezetalkotó elem (11) legalább egyike és előnyösen a legalább két egymással összereteszelt CFC szerkezetalkotó elem (11) mindegyike egy másik CFC szerkezetalkotó elem (11) bedugási szakaszának (21) befogadására legalább három, egymástól távközre lévő horonnyal (13) van ellátva.

11. A 7–10. igénypont legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a horony (13) legalább egyik oldalfalában (17) ki van alakítva két párhuzamos és egymástól távközre lévő vájat (19), amelyek között a főleg platószerű vagy púpszerű retesznyúlvány (20) helyezkedik el.

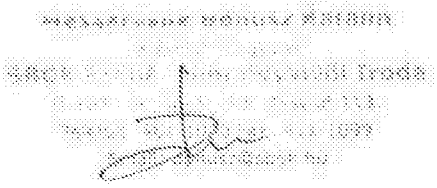
12. A 7–11. igénypont legalább egyike szerinti munkadarabtartó,

azzal jellemezve, hogy

a horony (13) legalább egyik oldalfalában (17) ki van alakítva egy rámpaszerű retesznyúlvány (27) és egy azzal szomszédos vájat (19).

13. Az előző igénypontok egyike szerinti munkadarabtartó berakóállványként való alkalmazása nagy hőmérsékletű környezetben.

A meghatalmazott:



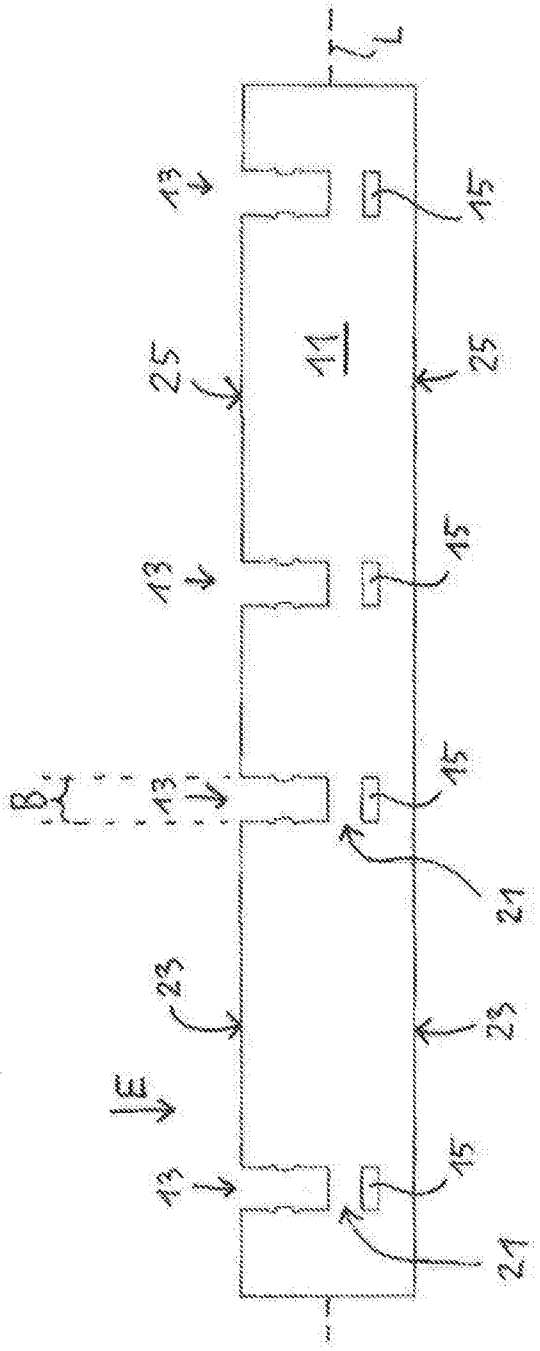


Fig. 1

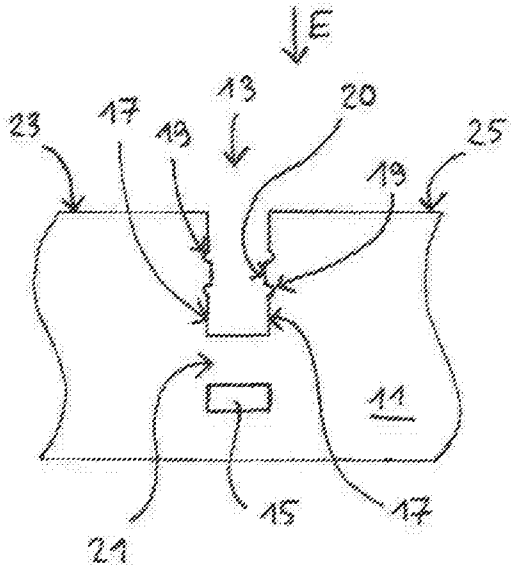


Fig. 2

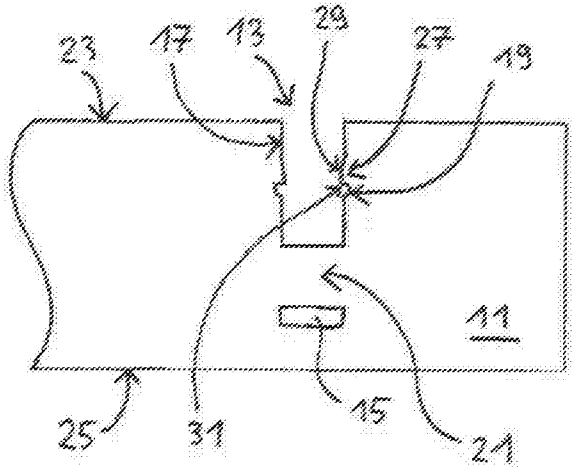


Fig. 3

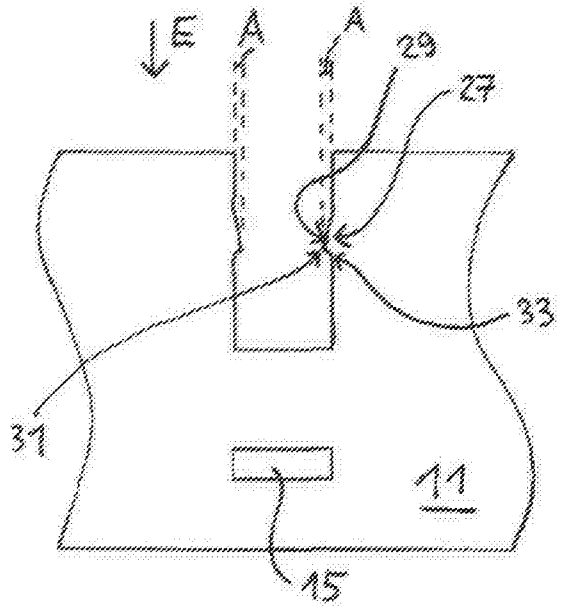


Fig. 4