A joining assembly includes metallic, ceramic, polymeric and/or fiber-reinforced components, which have at least one joining surface with at least one recess and/or raised area with an undercut. The joining assembly also includes a joining element that conforms in size and shape to the recess and/or the raised area of the components to be joined and has at least one flexible rim area. The flexible rim area can be placed in a form-locking and force-locking interconnection with the recesses and/or raised areas of the components to be joined. A method for joining components is also provided.
JOINT ASSEMBLY AND METHOD FOR JOINING COMPONENTS

CROSS-REFERENCE TO RELATED APPLICATION


BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention relates to a joining assembly having a joining element for joining metallic, ceramic, polymeric and/or fiber-reinforced components, which have at least one flat joining surface with at least one recess and/or raised area with an undercut. The invention further relates to a method for joining corresponding components.

[0003] Various joining elements for joining components are known in the prior art, wherein a differentiation is made between reversible and irreversible joining elements. Reversible joining elements are those joining elements distinguished as screw connections, such as screws and nuts or screws and mating threads, or clamp connections such as snap fasteners. Irreversible joining elements include various types of rivets, which undergo an irreversible mechanical deformation in the production of a connection. Snap connectors, used especially to connect molded plastic components, occupy a certain position between those two, in which generally a projecting catch formed onto one joining piece is pressed into and locked in position in an undercut in the other joining piece.

BRIEF SUMMARY OF THE INVENTION

[0004] It is accordingly an object of the invention to provide a joining assembly and a method for joining components, which overcome the hereinafore-mentioned disadvantages of the heretofore-known devices and methods of this general type and which can join generically proposed components.

[0005] With the foregoing and other objects in view there is provided, in accordance with the invention, a joining assembly, comprising components to be joined. The components are formed of at least one of metallic, ceramic, polymeric or fiber-reinforced materials, and the components have at least one joining surface with at least one recess and/or raised area with an undercut. A joining element for joining the components is adapted in shape and size to the at least one recess and/or raised area of the components. The joining element has at least one flexible rim area to be placed in a form-locking and force-locking connection with the at least one recess and/or raised area of the components.

[0006] A form-locking connection is one which connects two elements together due to the shape of the elements themselves, as opposed to a force-locking connection, which locks the elements together by force external to the elements.

[0007] The invention permits a joining of components. The transmission of vibrations between the connected components can be effectively reduced, especially in the case of stresses that cause vibrations in the connected components.

[0008] In accordance with another feature of the invention, the joining element is preferably made of metal, ceramic, polymeric and/or a composite material, with the metal being selected from the group of noble steels, tool steels, case-hardening steels, construction steels, iron-cast alloys, hard metals and nonferrous metals such as aluminium, copper, platinum metals, tantalum and titanium.

[0009] In accordance with a further feature of the invention, if ceramic is used as the joining element, it is selected from the group of hard materials such as sintered alumina, SiC ceramic, silicon nitride ceramic and the hard material/metal/sintered composites (cermets), which are polymers selected from the group of industrial thermoplasts such as polyamide 6 (PA 6), polyamide 6.6 (PA 66), polyoxymethylene (POM) or durores such as epoxide resins (EP), melamine-formalddehyde resins (MF) and unsaturated polyester resins (UP).

[0010] In accordance with an added feature of the invention, when a composite material is used as the joining element, it is selected from the group of glass fiber-reinforced plastics (GFRP), carbon fiber-reinforced plastics (CFRP) and boron fiber-reinforced plastics (BFPR).
BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0019] FIG. 1 is a diagrammatic, plan view of a first embodiment of a joining element according to the invention, in the form of a graphite film bordered by sheet steel;

[0020] FIG. 2 is a cross-sectional view of the joining element of the first embodiment;

[0021] FIG. 3.1 is a cross-sectional view of two components joined by using a second embodiment of the joining element according to the invention, in the form of a wavy or corrugated ring;

[0022] FIG. 3.2 is an enlarged, cross-sectional view of a portion of FIG. 3.1;

[0023] FIG. 4.1 is a cross-sectional view of two components to be joined, with undercut recesses;

[0024] FIG. 4.2 is an enlarged, cross-sectional view of a portion of FIG. 4.1;

[0025] FIG. 5 is a plan view of a component with an undercut recess; and

[0026] FIG. 6 is a plan view of another component, with an undercut recess.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Referring now to the figures of the drawings in detail and first, particularly to FIG. 1 thereof, there is seen a joining element 1a formed of a graphite film 2, which is bordered by sheet steel that forms a flexible rim area or edge region 3.

[0028] FIG. 2 shows a cross-section through the joining element 1a according to FIG. 1.

[0029] FIG. 3.1 shows a joining element 1b formed of a ring element that is wavy or corrugated in a radial direction and is inserted between two components 4, 5. In this case, the component 4 is equipped with a recess 6, the component 5 is equipped with a raised area or elevation 7 and edges of the recess 6 and the raised area 7 are each equipped with a respective undercut 8, 9.

[0030] FIG. 3.2 shows an enlarged representation of a joining area of the components 4, 5. In this case, the joining element 1b engages with its outer peripheral edge into the undercut 8 of the component 4 and with its inner edge into the undercut 9 of the component 5.

[0031] FIG. 4.1 shows a cross-sectional view of two additional components 10, 11 to be joined.

[0032] FIG. 4.2 shows an enlarged partial section of FIG. 4.1. The components 10, 11 to be joined have respective recesses 12, 13. Respective rims 14, 15 of the recesses 12, 13 are equipped with respective undercuts 16, 17.

[0033] FIG. 5 shows a plan view of the component 10 to be joined, which is equipped with two circular recesses 12.

[0034] FIG. 6 shows a plan view of the component 11 to be joined, which is equipped with a substantially rectangular recess 13. It is seen that a transition between straight edges 18, 19 of the rim 15 of the recess 13 follows a curved line 20.

EXAMPLE 1

[0035] Circular disks having a diameter of 50 mm are stamped from a 2 mm thick graphite film 2, which can have an internal sheet metal or fiber reinforcement. An outer rim of the disks is sheathed in a 0.15 mm thick steel sheet, which covers a strip measuring approximately 3 mm in width, and is pressed-in far enough to ensure that a flush surface is created.

[0036] This joining element 1a is placed between two components to be joined, each having circular depressions (recesses) 6 respectively measuring approximately 0.6 mm and 50 mm in diameter, with the edges 14 of the depressions being equipped with an undercut 8 of 45°. The joining element 1a is pressed on a standard press into the depressions 6 of the components to be joined, thereby producing a firm connection that serves to reduce vibrations in the joined components.

EXAMPLE 2

[0037] A joining element 1b, formed of a 0.2 mm sheet ring having an outer diameter of 50 mm and an inner diameter of 25 mm, is equipped with even waves or corrugations that extend in a radial direction. An apparent thickness of the joining element 1b, measured between the wavy or corrugated ridges of the two sides, is approximately 0.5 mm.

[0038] This joining element 1b is placed between two components 4, 5 to be joined, where on one side have a circular depression 6 of approximately 0.4 mm with a diameter of 50 mm. The depression rims 14 are equipped with an undercut 8 of 30°, and on the other side have an approximately 0.4 mm high, circular raised area 7 having a diameter of 25 mm. The rim 19 of the raised area 7 also has an undercut 9 of 30°. The joining element 1b is pressed on a standard press with the components 4, 5 to be joined, thereby producing a firm connection that serves to reduce vibrations in the joined components 4, 5, in which the surfaces of the joined components 4, 5 that face one another after pressing can have a maximum distance of approximately 50-100 μm from one another.

EXAMPLE 3

[0039] A joining element, formed of a 0.2 mm sheet steel ring having an outer diameter of 50 mm, has a U-shaped cross-section that faces the outer rim and an overall thickness of the joining element of approximately 1 mm.

[0040] This joining element is placed between two components to be joined, which have respective circular depressions of approximately 1 mm and 50 mm in diameter, with the depression edges being equipped with an undercut of 30°. The joining element is pressed on a standard press into the depressions in the components to be joined, thereby producing a firm connection that serves to reduce vibrations in the connected parts.

1. A joining assembly, comprising: components to be joined, said components formed of at least one of metallic, ceramic, polymeric or fiber-reinforced materials, and said components having at least one joining surface with at least one of a recess or a raised area with an undercut; and

a joining element for joining said components, said joining element being adapted in shape and size to said at least one of a recess or a raised area of said components, and said joining element having at least one flexible rim area to be placed in a form-locking and force-locking connection with said at least one of a recess or a raised area of said components.

2. The joining assembly according to claim 1, wherein said joining element is formed of at least one of a metal, a polymer, a ceramic or a composite material.

3. The joining assembly according to claim 2, wherein said metal is selected from the group consisting of noble steels, tool steels, case-hardening steels, construction steels, iron-cast alloys, hard metals and nonferrous metals.

4. The joining assembly according to claim 2, wherein said ceramic is a hard material.
5. The joining assembly according to claim 2, wherein said ceramic is a hard material selected from the group consisting of sintered alumina, silicon carbide ceramic, silicon nitride ceramic and hard material/metal/sintered composite materials.

6. The joining assembly according to claim 2, wherein said polymer is selected from the group consisting of industrial thermoplastics and duroplastics.

7. The joining assembly according to claim 2, wherein said composite material is selected from the group consisting of glass fiber-reinforced plastics, carbon fiber-reinforced plastics, and boron fiber-reinforced plastics.

8. The joining assembly according to claim 2, wherein said joining element is formed of a graphite film having a thickness of 0.25 mm to 3 mm, and said rim area of said joining element is bordered by sheet steel.

9. The joining assembly according to claim 1, wherein said joining element has a shape selected from the group consisting of wavy, curved and flat.

10. The joining assembly according to claim 1, wherein said joining element has a thickness of from 0.10 mm to 5 mm.

11. The joining assembly according to claim 1, wherein said joining element has a thickness of from 0.2 mm to 3 mm.

12. The joining assembly according to claim 1, wherein said joining element has a rotationally symmetrical shape.

13. A method for joining components, the method comprising the following steps:

   providing components to be joined, the components formed of at least one of metallic, ceramic or fiber-reinforced materials and having at least one flat joining surface and at least one of a recess or a raised area with an undercut disposed at an angle of from 20° to 60° relative to the components;

   providing a substantially flat joining element adapted in size and shape to the at least one of a recess or a raised area of the components, the joining element having at least one flexible rim area; and

   pressing the rim area and the at least one of a recess or a raised area of the components against one another into a form-locking and force-locking connection.

14. The method according to claim 13, which further comprises carrying out the pressing step by deformation at room temperature in standard presses.

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