HU000032439T2

(19) **HU**

(11) Lajstromszám: **E 032 439**

(13) **T2**

MAGYARORSZÁG
Szellemi Tulajdon Nemzeti Hivatala

EURÓPAI SZABADALOM
SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 09 700040**
(22) A bejelentés napja: **2009. 01. 15.**

(96) Az európai bejelentés bejelentési száma:
EP 20090700040
(97) Az európai bejelentés közzétételi adatai:
EP 2237922 A1 **2009. 05. 28.**
(97) Az európai szabadalom megadásának meghirdetési adatai:
EP 2237922 B1 **2016. 10. 12.**

(51) Int. Cl.: ***B23P 11/02*** *(2006.01)*
F01L 1/047 *(2006.01)*
F02F 7/00 *(2006.01)*
F16H 53/02 *(2006.01)*

(86) A nemzetközi (PCT) bejelentési szám:
PCT/EP 09/000203
(87) A nemzetközi közzétételi szám:
WO 09065970

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(54) **Eljárás és berendezés egy kötés összeszerelésére, ami különösen tartalmaz egy bütykös tengelyt és egy házat**

Description

Method and apparatus for assembling a composite, in particular comprising a camshaft and a housing

The invention relates to an apparatus for assembling an assembly comprising at least one shaft carrying functional elements, in particular a mass-balancing shaft or camshaft and a housing supporting said shaft in undivided bearings, according to the precharacterizing clause of Patent Claim 1. The invention also relates to methods for assembling such an assembly.

DE 23 36 241 A1 discloses a built-up control shaft, the cams and bearings of which are provided on the shaft by joining. Before the joining process, the shaft is cooled and the cams are heated. After the joining and equalizing of the temperature, the cams and the shaft are connected with a force fit. The camshaft can subsequently be assembled in divided bearings.

DE 198 31 772 A1 discloses a cylinder head in which a camshaft is joined within undivided bearings of the cylinder head. For this, the cams are held in a positioned manner within the cylinder head and the shaft is subsequently pushed through the bores in the cylinder head and the cam elements. Arranged on the axial end faces of the cams are contours which engage in contours of the neighboring cam or the bearings and fix the cams on the bearings with respect to one another with a form fit.

The joining of the camshaft in the undivided receptacles of a cylinder head has the advantage that lower friction occurs at the bearing points as a result of the use of smaller bearing diameters. Furthermore, a complete structural unit is created in the joining process.

US 2006/005385 A1 describes a method for manufacturing a built-up camshaft comprising a metallic shaft with shrink-fitted cams. For this purpose, the cams are placed in cam holders, with the aid of which the cams are kept in the desired relative position and angular position in relation to one another, and are heated in these cam holders. From the opposite side of the cam holders, a counterholder is pushed through the cam openings. The shaft is cooled down and moved into the heated cams. The counterholder, which is coupled to the shaft by means of the cooling lance, is thereby pushed back. It is in this way ensured that the shaft axis is aligned highly accurately with respect to the cam axis, so that the cooled shaft does not touch the heated cams.

EP 1 155 770 B1 discloses the assembly of a cylinder head and a camshaft or a mass-balancing shaft and a housing, which takes place by a joining method in undivided receptacles of the cylinder head or of the housing. The mass-balancing weights or the cams are held in a prepositioned manner and, after the shroud has been fitted on, a shaft is pushed through the bores in the shroud and the functional elements, such as cams or a mass-balancing weight. The connection of the elements to the shaft takes place in this case with a force fit, it being possible to use shrink-fitting or hydroforming.

EP 1 155 770 B1 discloses an apparatus for assembling an assembly according to the precharacterizing clause of Claim 1 and a method for assembling such an assembly.

Particularly for camshafts of multi-cylinder engines, the joining method imposes requirements on the structural design of the tool for the positioning of the cams. The prior art describes for this simple bearing surfaces on which the elements are held and aligned. In particular in the case of multi-cylinder

internal combustion engines, a multiplicity of cams have to be held on the shaft and positioned such that they are phase-shifted in relation to one another and, during the joining, held in a positioned manner in relation to one another axially against the joining force and in their phase position. As a result of the different phase position for different cylinders, the cams have different bearing positions on the assembly tool. They may lie against the assembly tool both in the base circle and with the cam tip. In particular when joining within a closed shroud, the engagement of a positioning element that can only take place on one side presents a problem. Since the position of the cams is decisive for the gas exchange during later operation of the camshaft, only small production tolerances are admissible here. Deviations between the cams lead to incorrect control times and to different filling of the cylinders. It is therefore necessary for the cams to be positioned during the joining process in such a way as to prevent them as much as possible from turning.

The object of the invention is therefore to avoid the aforementioned disadvantages and to provide an improved apparatus and an improved method in such a way that a shaft is joined in undivided bearings of a housing, wherein functional elements on the shaft are held in their predetermined phase position during the joining process and deviations with respect to the predetermined phase position during the joining process are minimized.

The object is achieved according to the invention by an apparatus according to Claim 1 and by the methods according to Claims 11 and 12.

Advantageous refinements of the apparatus or of the methods are specified in the subclaims.

According to the invention, the apparatus for assembling an assembly comprising a shaft, formed for example as a camshaft, and a housing supporting said shaft in undivided bearings has positioning devices, which, before the joining, hold the functional elements, formed for example as cams, in a predetermined phase position in the housing in such a way that a shaft can be pushed through the bearings of the housing and openings in the cams. The housing may in this case preferably be a closed shroud of a cylinder head, the cylinder head or a frame structure. The recesses in the positioning device for the cams and the further functional elements have in this case at least one stop, which supports the cam counter to the joining direction of the shaft. A partial contour of the cam contour is provided as a negative profile in the recesses of the positioning device, so that the cams are held in their phase position according to their joining position. For secure abutment of the cams, the respective recess engages around the cam at least over part of the outer contour thereof, so that on the one hand an in-phase abutment of the cam is ensured and at the same time a secure abutment is achieved for the joining process. Preferably, the negative contour engages only halfway around the cam, so that introduction of the cams into the receptacles of the positioning device can be performed with a positioning operation in a direction vertically from above into the receptacles and removal of the positioning device after the joining of the shaft can likewise be performed in a vertical direction of movement. In an alternative refinement, the recesses of the positioning device engage around the cam contour over more than half the circumference thereof, so that, when it is introduced into the receptacle, the cam must be positioned by a vertical and horizontal relative movement in relation to the receptacle. The further engagement of the receptacle is in this case advantageous with regard to the required holding forces during the joining.

If the shaft, which is preferably a camshaft, is fitted not only with cams but also with further functional elements, such as rolling or sliding bearings, rotary sensors, pump drives and sprockets or pulleys for driving them, a negative profile of their outer contour is likewise formed in the recesses of the positioning device for their secure positioning.

In a development according to the invention of the apparatus, the receptacle of the positioning device is configured in such a way that an additional holding force, which can be switched at will, can be produced between cams and any further functional elements there may be and the receptacle. Independently of the way in which the receptacles are formed, an additional holding force is thereby applied, firmly holding the cam and any further functional elements there may be on the receptacle.

In a preferred refinement, the holding force is applied by means of negative pressure. Alternatively, a mechanical holding force or a magnetic holding force is possible.

In the preferred embodiment, application of the holding force by means of negative pressure, the recesses formed as receptacles on a partial region of the contour engaging part of the way around the cam are provided with an opening which is covered over by the surface of the cams or the further functional elements and can be subjected to negative pressure.

In an advantageous embodiment of the invention, a centering pin is provided, pushed through the bearings of the housing and through the openings in line therewith in the cams and the further functional elements. The centering pin thereby positions the cams on the receptacles in the positioning device and exerts a mechanical holding force which holds the cams in the desired phase position on the receptacles. The centering pin has in this case an outside diameter that is made the same as or slightly smaller than the inside diameter of the shaft to be joined.

In an advantageous development, the assembly apparatus has a carriage, which can be moved axially in the apparatus between two end positions. In one position, the cams and the further functional elements, which are held on the carriage by means of the positioning devices, are in engagement with the centering pin. The carriage is thereby displaceable axially along the centering pin. Adjoining the centering pin, a camshaft can be clamped in the same axial position. According to this embodiment of the invention, the carriage is moved from the end position described into a further end position, in which the shaft clamped onto the centering pin in an adjoining manner engages in the bearings in the housing and in the openings in the cams and in the openings of any further functional elements there may be. The joining operation is performed by a carriage movement of the assembly, comprising the housing, cams and any further functional elements there may be, prepositioned on the centering pin. In an alternative embodiment, the assembly is firmly clamped on the assembly apparatus and the centering pin and the adjoining shaft are preferably moved hydraulically or pneumatically.

In an advantageous embodiment, heating up of the cams and of any further functional elements there may be takes place in the assembly apparatus. For this, the latter may include a preferably inductive heating unit, which comprises a unit for heating the cams and any further functional elements there may be, which heats them in the in-phase positioned state on the receptacles of the assembly apparatus. The heating device may in this case be an integral part of the assembly apparatus or be provided as part of the flow in a joining process sequence.

The invention also describes two methods for joining a camshaft in undivided receptacles of a housing carrying the camshaft. They comprise the method steps mentioned in Claims 11 and 12.

In a first method step, the cams and any further functional elements there may be, such as rotary sensors, bearing elements and drive wheels, are introduced into the recesses of the positioning device. These advantageously bear a contour that is equal and opposite to that of the cam and any functional elements there may be in order to ensure an in-phase secure abutment during the joining process. Furthermore, positioning of the carrying bearing the camshafts is performed in a position in which the bearings for the shaft in the housing are axially in line with the openings in the cams and any further functional elements there may be, so that a shaft can be pushed in through the receptacles of the housing and the bores in the camshaft. Heating of the cams and the further functional elements is performed, wherein this may take place in the apparatus itself after placement, or alternatively already preheated cams and any further functional elements there may be are introduced into the receptacles. Cooling of the shaft to be introduced into the housing is also performed before the joining operation. According to the invention, a holding force between the cams and any further functional elements there may be and the receptacle of the positioning device is advantageously applied in order to ensure a secure abutment of the cams and the functional elements in the receptacles of the positioning device.

Before the shaft is introduced through the receptacles in the housing and through the openings in the cams and any further functional elements there may be, a centering pin is introduced in place of the shaft that is later to be joined. This centering pin centers the cams and any further functional elements there may be in their axial position, and consequently produces a mechanical holding force for the cams and any further functional elements there may be in the contours of the receptacles. The shaft is subsequently positioned in axially the same position on the centering pin outside the housing and the joining operation is performed by means of a relative movement between the housing and the centering pin and the shaft adjoining the latter, in which the shaft assumes the position of the centering pin within the housing. The introduction of the centering pin facilitates the joining, since the exactly prepositioned position of the openings of the cams and the receptacles for the shaft in the housing means that there is no longer any need for positioning when the shaft is introduced. Furthermore, the cams are fixed in their position on the receptacles by the centering pin up until the joining operation.

In a refinement of the invention, the assembly method according to the invention is performed in such a way that, after introducing the cams and the further functional elements and positioning the housing, a carriage which is arranged on the assembly apparatus and carries the housing and the positioning devices is made to move axially on the assembly apparatus in relation to the centering pin, so that the centering pin fixedly connected to a supporting structure of the assembly apparatus engages in the bearings in the housing and the openings of the cams and the further functional elements and a shaft is subsequently clamped onto the centering pin in an adjoining manner in axially the same position in relation to the centering pin. By making the carriage move axially along the centering pin and the shaft, the cams and any further functional elements there may be are joined to the shaft in the housing.

In an alternative refinement of the assembly method according to the invention, the positioning device is fixedly arranged on the assembly apparatus and a movement of the centering pin and the shaft is performed. After introducing the cams and any further functional elements there may be and

positioning the housing, the centering pin is introduced into the bearings of the housing and the openings in the cams and the further functional elements there may be by axial movement with respect to the housing. This is followed by clamping of the shaft outside the housing in such a way that it adjoins the centering pin in axially the same position as the latter. For the joining operation, a joint movement of the shaft and the centering pin is performed, wherein the shaft is joined through the bearings in the housing and the opening of the cams and the further functional elements there may be.

According to the invention, heating of the cams and any further functional elements there may be is performed outside the apparatus before they are introduced into the receptacles of the positioning device.

In an alternative refinement of the method, heating of the cams and any further functional elements there may be is performed in the already prepositioned state on the receptacles. The time for the heating up until the actual joining operation can be reduced as a result, so that a great difference in temperature between the shaft and the cams is ensured, which facilitates the joining operation.

According to the invention, an additional holding force for the cams and any further functional elements there may be is produced by the latter being held in the recesses of the positioning device by means of negative pressure before the joining. The negative pressure may in this case be maintained during the joining operation, so that an exact end position of the cams and any further functional elements there may be on the receptacle is ensured.

The previously described apparatus and the associated method may be used advantageously on any desired assemblies of shafts and housings. For instance, mass-balancing shafts which are joined in bearings in housings of mass-balancing transmissions, for example for internal combustion engines, may be used as shafts.

Then, for example, balancing masses are shrink-fitted as functional elements onto the shafts.

Other advantageous refinements can be taken from the description of the exemplary embodiment of the invention that is presented below.

In the drawing:

Figure 1 shows a schematic representation of the view of a typical installation situation of a camshaft of an internal combustion engine,

Figure 2 shows a schematic representation of a housing without an installed camshaft,

Figure 3 shows a schematic representation of a positioning device,

Figure 4 shows a schematic representation of an alternative refinement of a positioning device,

Figure 5 shows a schematic representation of a further alternative refinement of a positioning device,

Figure 6 shows an embodiment of the present invention with a centering pin,

Figure 7 shows a development of the present invention with a basic body which is configured as a carriage,

Figure 8 shows a schematic representation of the interaction of the centering pin and a camshaft,

Figure 9 shows a schematic representation of a method step according to the present invention,

Figure 10 shows a schematic representation of a further method step according to the present invention,

Figure 11 shows a schematic representation of yet a further method step according to the present invention,

Figure 12 shows a schematic representation of yet a further method step according to the present invention and

Figure 13 shows a schematic representation of yet a further method step according to the present invention.

Figure 1 schematically shows the view of a typical installation situation of a shaft formed as a camshaft 1 of an internal combustion engine in a housing 2, which preferably represents the shroud of a cylinder head. Arranged on the camshaft 1 are a number of functional elements formed as cams 1a and possibly further functional elements, such as for example rotary sensors, pump actuating rods, etc.

In Figure 2, the housing 2 is schematically represented without the camshaft 1 in a further view, so that it is clear that the camshaft 1 is supported in the housing 2 in undivided bearings 3. In order to ensure lowest possible frictional losses between the bearings 3 and the camshaft 1, the bearings 3 have comparatively small diameters, so that joining of the camshaft 1 and the cams 1a must be performed within the housing 2.

As represented in Figure 3, according to the invention, a positioning device 4 is provided for assembling the assembly comprising the camshaft 1, the cams 1a and the housing 2 within this housing 2. Before the joining, the positioning device 4 holds the cams 1a and any further functional elements there may be in a predetermined phase position in the housing 2 in such a way that the camshaft 1 can be pushed through the bearings 3 of the housing 2 and openings 1b in the cams 1a and any further functional elements there may be. The positioning devices 4 for the cams 1a have in this case at least one stop 5, which supports the cam 1a counter to the axial joining direction of the camshaft 1. A partial contour of the contour of the respective cam 1a is provided as a negative profile in recesses 4a of the positioning device 4 acting as receptacles for the cams 1a, in such a way that the cams 1a are held in a correct phase position according to their joining position with respect to their relative angular positions to one another. Depending on the number of cylinders of the internal combustion engine that is taken as a basis, a number of positioning devices 4 are provided.

As represented in Figure 3, a cam 1a is placed in a recess 4a of the positioning device 4. For secure abutment of the cams 1a, the respective recess 4a engages around the cam 1a at least over part of the outer contour thereof, so that on the one hand the mentioned rotary in-phase abutment of the cam 1a is ensured and at the same time a secure abutment is achieved for subsequent joining of the camshaft 1 and the cams 1a. As further represented in Figure 3, the negative contour of the cam 1a engages only halfway around it, so that introduction of the cams 1a into the receceses 4a of the positioning device 4 can be performed with a positioning operation in a direction vertically from above into the recesses 4a and removal of the positioning device 4 after the joining of the camshaft 4 can likewise be performed in a vertical direction of movement.

As represented in Figure 4, in an alternative refinement of the invention, the receptacle 4a of the positioning device 4 engages around the contour of the cam 1a over more than half the circumference thereof, so that, when it is introduced into the recess 4a, the respective cam 1a must be positioned by a vertical and horizontal relative movement in relation to the recess 4a.

If the camshaft 1 is fitted not only with cams 1a but also with further functional elements, such as rolling or sliding bearings, rotary sensors, pump drives and sprockets or pulleys for driving them, a negative profile of their outer contour is likewise formed in the recesses 4a of the positioning device 4 for their secure positioning.

Furthermore, the recess 4a of the positioning device 4 is configured according to the invention in such a way that an additional holding force, which can be switched at will, can be produced between cams 1a and any further functional elements there may be and the recess 4a. Independently of the way in which the recess 4a is formed, an additional holding force is thereby applied, firmly holding the cam 1a and any further functional elements there may be on the recess 4a. In a preferred refinement, the holding force is applied by means of negative pressure. Alternatively, a mechanical holding force or a magnetic holding force is possible. In the preferred embodiment, application of the holding force by means of negative pressure, as represented in Figure 5, the recesses 4a on a partial region of the contour engaging part of the way around the cam 1a are provided with an opening 6, which is covered over by the surface of the cams 1a or the further functional elements and can be subjected to negative pressure.

In Figure 6, one embodiment of the present invention is schematically represented in a side view. In particular, a centering pin 7 is provided, pushed through the bearings 3 of the housing 2 and through the openings 1b in line therewith in the cams 1a and the further functional elements. The centering pin 7 thereby positions the cams 1a on the recesses 4a in the positioning device 4 and exerts a mechanical holding force which holds the cams 1a in the desired phase position on the recesses 4a. The centering pin 7 has in this case an outside diameter that is made the same as or slightly smaller than the inside diameter of the camshaft 1 to be joined. Figure 6 shows by way of example the joining of a camshaft 1 of an internal combustion engine with three cylinders. Also provided is a basic body 8, on which the positioning devices 4 are arranged.

According to Figure 7, in an advantageous development of the present invention, the basic body 8 is configured as a carriage, which can be moved axially between two end positions 9 and 10. In the end position 9, the cams 1a and any further functional elements there may be, which are held on the basic body 8 by means of the positioning devices 4, are in engagement with the centering pin 7. The basic body 8 is thereby displaceable axially along the centering pin 7.

As represented in Figure 8, adjoining the centering pin 7, a camshaft 1 can be clamped in the same axial position. According to this embodiment of the invention, the basic body 8 is moved from the end position 9 described into the end position 10, in which the camshaft 1 clamped onto the centering pin 7 in an adjoining manner engages in the bearings 3 in the housing 2 and in the openings 1b in the cams 1a and in the openings of any further functional elements there may be. The joining operation is performed by a carriage movement of the assembly, comprising the housing 2, cams 1a and any further functional elements there may be, prepositioned on the centering pin 7.

According to Figures 9 to 13, also described is a method for joining an assembly comprising a camshaft 1 in undivided bearings 3 of a housing 2 carrying the camshaft 1. It comprises the method steps set out below.

In a first method step according to Figure 9, the cams 1a and any further functional elements there may be, such as rotary sensors, bearing elements and drive wheels, are introduced into the recesses 4a of the positioning device 4.

According to Figure 10, the positioning of the housing 2, in which the camshaft 1 not yet represented in this figure is carried, is also performed. The positioning of the housing 2 is thereby performed in a position in which the bearings 3 for the shaft in the housing 2 are axially in line with the openings 1b in the cams 1a and any further functional elements there may be, so that a camshaft 1 can be pushed in through the bearings 3 of the housing 2 and the openings 1b in the cams 1a. Heating of the cams 1a and any further functional elements there may be is performed, wherein this may take place in the apparatus itself after placement, or alternatively already preheated cams 1a are introduced into the recess 4a. Cooling of the camshaft 1 to be introduced into the housing 2 is also performed before the joining operation. According to the invention, a holding force between the cams 1a and any further functional elements there may be and the recess 4a of the positioning device 4 is advantageously applied in order to ensure a secure abutment of the cams 1a and the functional elements in the rececesses 4a of the positioning device 4.

As shown in Figure 11, before the camshaft 1 is introduced through the bearings 3 in the housing 2 and through the openings 1b in the cams 1a by displacing the basic body 8 in the direction of the end position 9, a centering pin 7 is introduced in place of the camshaft 1 that is later to be joined. This centering pin centers the cams 1a and any further functional elements there may be in their axial position, and consequently produces a mechanical holding force for the cams 1a and any further functional elements there may be in the contours of the recesses 4a.

According to Figure 12, the camshaft 1 is subsequently positioned in axially the same position on the centering pin 7 outside the housing 2.

In a way corresponding to Figure 13, the joining operation is performed by means of a movement of the basic body 8 in the direction of the end position 10, that is to say a relative movement between the housing 2 and the centering pin 7 and the camshaft 1 adjoining the latter, in which the camshaft 1 assumes the position of the centering pin 7 within the housing 2. The introduction of the centering pin 7 facilitates the joining, since the exactly prepositioned position of the openings 1b of the cams 1a and the bearings 3 for the camshaft 1 in the housing 2 means that there is no longer any need for positioning when the camshaft 1 is introduced. Furthermore, the cams 1a are fixed in their position on the recesses 4a by the centering pin 7 up until the joining operation.

ELJÁRÁS ÉS BERENDEZÉS EGY KÖTÉS ÖSSZESZERELÉSÉRE, AMI KÜLÖNÖSEN TARTALMAZ EGY BÜTYKÖS TENGELYT ÉS EGY HÁZAT

SZABADALMI IGÉNYPONTOK

1. Berendezés egy kötés összeszerelésére, ami tartalmaz legalább egy, funkcionális elemeket tartalmazó tengelyt, előnyösen tömegkiegyenlítő tengelyt vagy bütykös tengelyt és egy, ezt osztatlan csapágyakkal (3) ágyazó házat (2), ahol a berendezés tartalmaz helyező szerkezeteket (4) is, amik a behelyezés előtt a funkcionális elemeket úgy tartják meghatározott helyzetben a házban (2), hogy a legalább egy tengely a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b) átfolható, ahol a helyező szerkezet (4) a funkcionális elemek számára kivágásokkal (4a) van ellátva, amiknek ütköző eleme (5) van, ami a funkcionális elemet a tengely bevezetési irányával szemben megtámasztja, **azzal jellemezve,** hogy a helyező szerkezet (4) kivágásai (4a) a funkcionális elemek profiljának egy részprofiljával vannak ellátva negatív profilként úgy, hogy a funkcionális elemek a beillesztési helyzetüknek megfelelő helyzetben vannak megtartva, ahol a kivágások (4a) részprofilja a funkcionális elemeket külső kontúrjuk legalább egy részén körbefogja.
2. Az 1. igénypont szerinti berendezés, **azzal jellemezve,** hogy a részprofil a funkcionális elemeket külső kontúrjuk felénél nagyobb részén körbefogja.
3. Az 1. vagy 2. igénypont szerinti berendezés, **azzal jellemezve,** hogy a kivágások (4a) úgy vannak kialakítva, hogy egy járulékos, szándékosan kapcsolható tartóerő képezhető a funkcionális elemek és a kivágások (4a) között.
4. A 3. igénypont szerinti berendezés, **azzal jellemezve,** hogy a tartóerő mágnesesen előállított erő.
5. A 3. igénypont szerinti berendezés, **azzal jellemezve,** hogy a tartóerő alulnyomással előállított erő.
6. Az 5. igénypont szerinti berendezés, **azzal jellemezve,** hogy a kivágások (4a) a funkcionális elemeket részben körbefogó kontúr egy részén egy nyílással (6) vannak ellátva, amit a funkcionális elemek felülete lefed, és ami alulnyomás alá helyezhető.
7. Az 1 – 6. igénypontok bármelyike szerinti berendezés, **azzal jellemezve,** hogy tartalmaz egy központozó tüskét (7), ami a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b) átfolható, és maximális átmérője azonos a bevezetendő tengely átmérőjével vagy kisebb annál.
8. A 7. igénypont szerinti berendezés, **azzal jellemezve,** hogy van egy olyan alapteste (8), ami axiális irányban elmozdítható, és amin a funkcionális elemek helyező szerkezetei (4) vannak elrendezve, ahol a központozó tüskére (7) csatlakoztatva egy tengely azonos axiális helyzetben a berendezésbe bevezethető és axiálisan kifeszíthető.
9. Az előző igénypontok bármelyike szerinti berendezés, **azzal jellemezve,** hogy tartalmaz egy egységet a funkcionális elemek felmelegítésére, ami azt a helyező szerkezet (4) kivágásain (4a) pozicionált állapotban felmelegíti.
10. A 9. igénypont szerinti berendezés, **azzal jellemezve,** hogy a bütyköket (1a) és adott esetben további funkcionális elemeket felmelegítő egység egy induktív hevítő berendezés, és a helyező szerkezetek (4) hordozzák a bütyköket (1a) és adott esetben további funkcionális elemeket induktívan felmelegítő tekercseket.

11. Eljárás egy olyan kötés összeszerelésére, ami tartalmaz legalább egy, funkcionális elemeket tartalmazó tengelyt, előnyösen tömegkiegyenlítő tengelyt vagy bütykös tengelyt és egy, ezt osztatlan csapágyakkal (3) ágyazó házat (2), egy olyan berendezéssel, ami tartalmaz helyező szerkezeteket (4) is, amely eljárás során

- felmelegítjük a funkcionális elemeket a berendezésen kívül, a helyező szerkezet (4) kivágásaiba (4a) történő bevezetés előtt,
- bevezetjük a funkcionális elemeket a helyező szerkezet (4) kivágásaiba (4a),
- a tengelyt hordozó házat (2) olyan helyzetbe pozícionáljuk, ahol axiális irányban a házban (2) a tengely számára kialakított csapágyak (3) a funkcionális elemek nyílásaival (1b) fedésbe kerülnek oly módon, hogy a tengely a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b) áttolható,
- lehűtjük a házba (2) bevezetendő tengelyt,
- keresztül vezetünk egy központozó tüskét (7) a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b), ahol a központozó tüske (7) maximális átmérője azonos a bevezetendő tengely átmérőjével vagy kisebb annál,
- járulékos tartóerőt fejtünk ki a funkcionális elemek és a helyező szerkezet (4) kivágásai (4a) között,
- átvezetjük a tengelyt a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b),
- ahol egy, az összeszerelő berendezésen elrendezett alaptestet (8), ami a házat (2) és a helyező szerkezeteket (4) tartja, a funkcionális elemek bevezetése és a ház (2) pozícionálása után az összeszerelő berendezésen axiális irányban a központozó tüskéhez (7) képest elmozgatunk, ahol az összeszerelő berendezés egy tartószerkezetével mereven összekötött központozó tüske (7) a ház (2) csapágyaiba (3) és a funkcionális elemek nyílásaiba (1b) benyúlik, és ezt követően egy tengelyt a központozó tüskéhez (7) csatlakoztatva axiálisan ugyanebben az irányban a központozó tüskéhez (7) feszítünk, és az alaptest (2) elmozgatásával a tengelyt a ház (2) funkcionális elemeihez kapcsoljuk.

12. Eljárás egy olyan kötés összeszerelésére, ami tartalmaz legalább egy, funkcionális elemeket tartalmazó tengelyt, előnyösen tömegkiegyenlítő tengelyt vagy bütykös tengelyt és egy, ezt osztatlan csapágyakkal (3) ágyazó házat (2), egy olyan berendezéssel, ami tartalmaz helyező szerkezeteket (4) is, amely eljárás során

- felmelegítjük a funkcionális elemeket a berendezésen kívül, a helyező szerkezet (4) kivágásaiba (4a) történő bevezetés előtt,
- bevezetjük a funkcionális elemeket a helyező szerkezet (4) kivágásaiba (4a),
- a tengelyt hordozó házat (2) olyan helyzetbe pozícionáljuk, ahol axiális irányban a házban (2) a tengely számára kialakított csapágyak (3) a funkcionális elemek nyílásaival (1b) fedésbe kerülnek oly módon, hogy a tengely a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b) áttolható,
- lehűtjük a házba (2) bevezetendő tengelyt,

- keresztül vezetünk egy központozó tüskét (7) a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b), ahol a központozó tüske (7) maximális átmérője azonos a bevezetendő tengely átmérőjével vagy kisebb annál,
- járulékos tartóerőt fejtünk ki a funkcionális elemek és a helyező szerkezet (4) kivágásai (4a) között,
- kifeszítjük a tengelyt a központozó tüskén (7) axiálisan azonos helyzetbe,
- átvezetjük a tengelyt a ház (2) csapágyain (3) és a funkcionális elemek nyílásain (1b), ahol a helyező szerkezet (4) mereven van az összeszerelő berendezésen elrendezve, és miután bevezettük a funkcionális elemeket és pozicionáltuk a házat (2), a központozó tüskét (7) a házhoz (2) történő axiális elmozdítással a ház (2) csapágyaiba (3) és a funkcionális elemek nyílásaiba (1b) bevezetjük, és miután a tengelyt a házon (2) kívül a központozó tüskén (7) kifeszítettük, a tengelyt és a központozó tüskét (7) együttesen elmozdítjuk, ahol a tengelyt a funkcionális elemek nyílásaiba (1b) illesztjük a ház (2) csapágyain (3) keresztül.

13. Az előző igénypontok bármelyike szerinti eljárás, **azzal jellemezve,** hogy a funkcionális elemek számára járulékos tartóerőt biztosítunk oly módon, hogy azokat a beillesztés előtt alulnyomással a funkcionális elemek kivágásaiban (4a) tartjuk.

Fig. 1

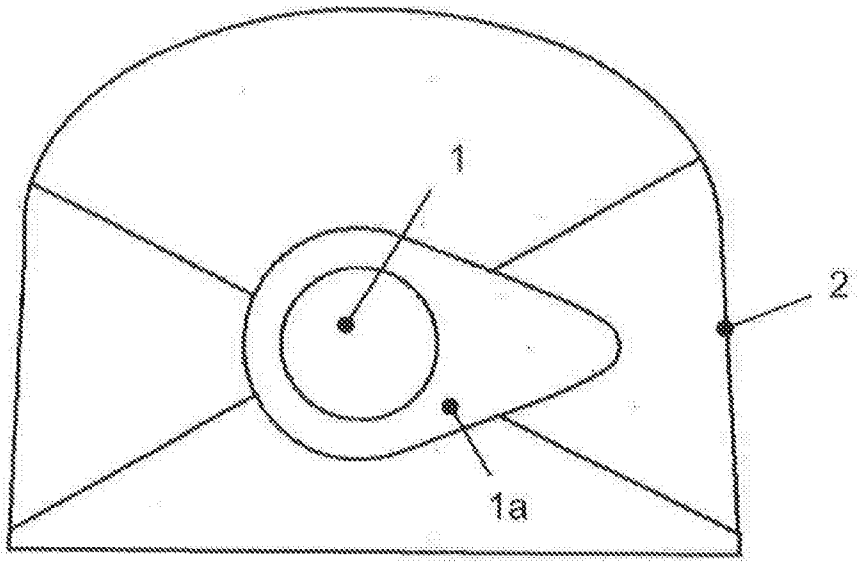

Fig. 2

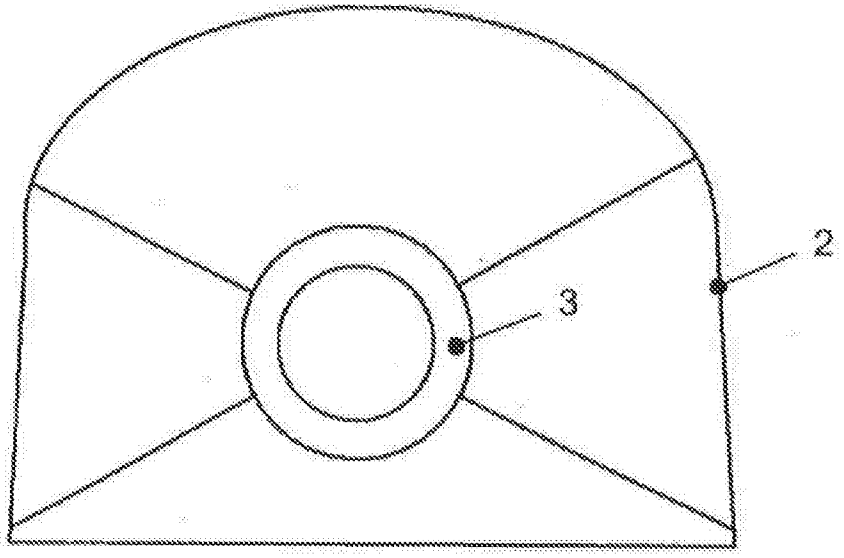

Fig. 3

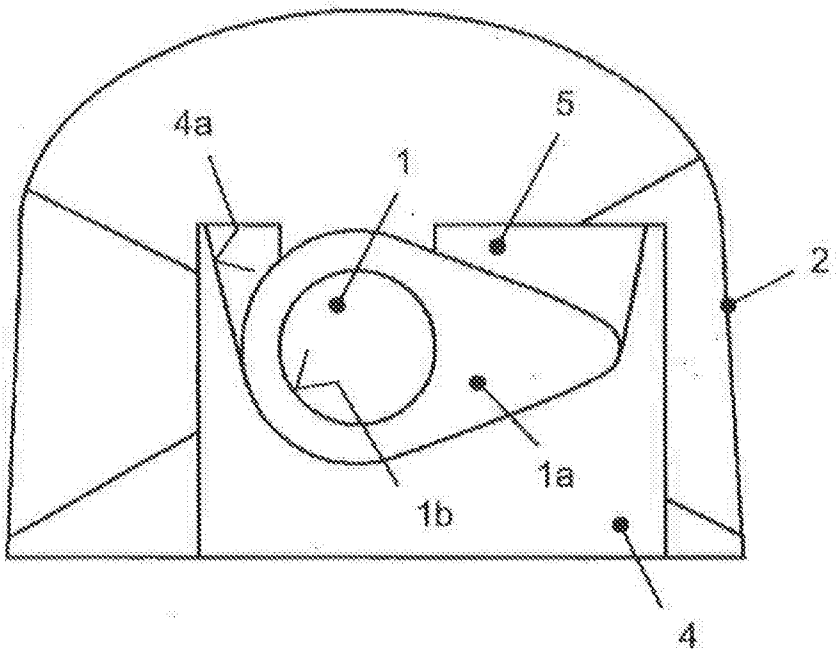

Fig. 4

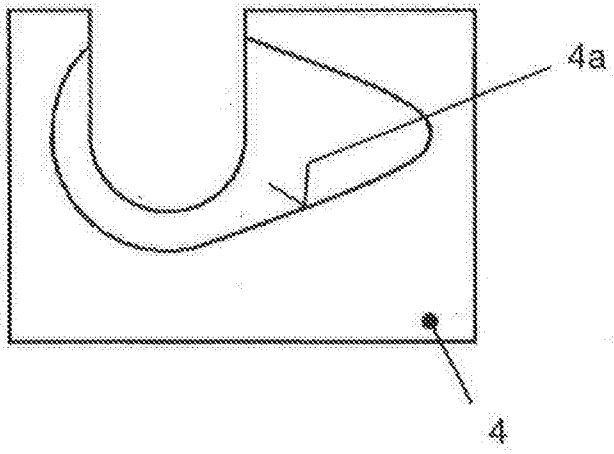

Fig. 5

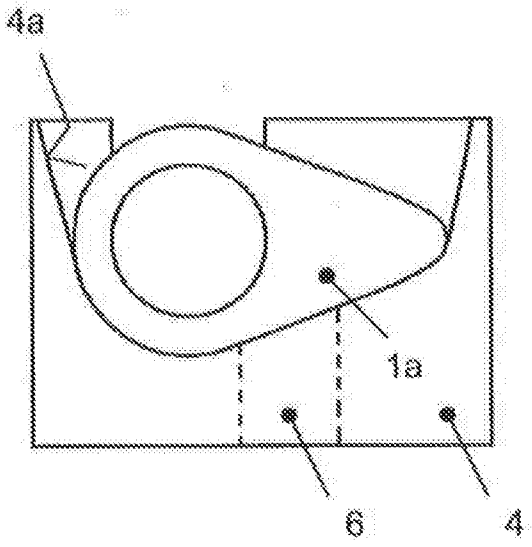

Fig. 6

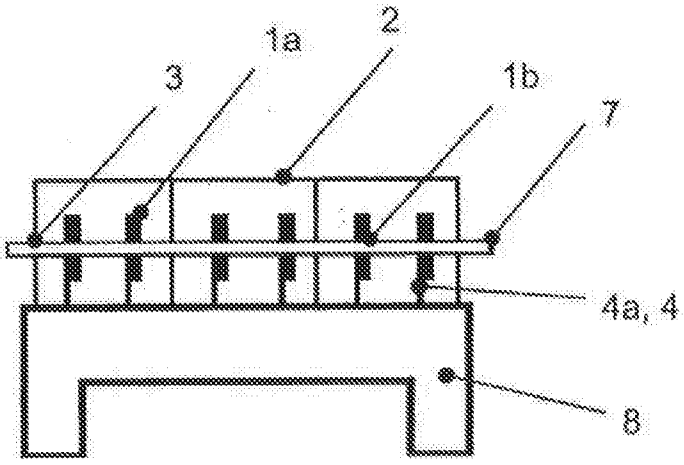

Fig. 7

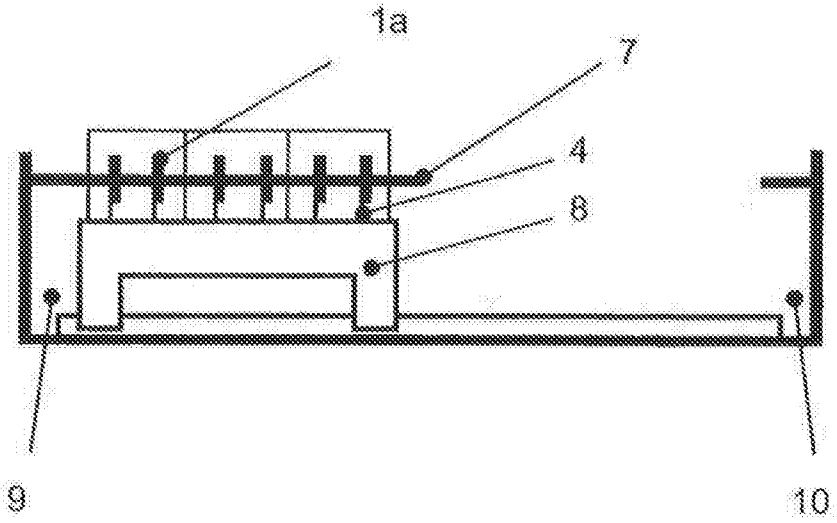

Fig. 8

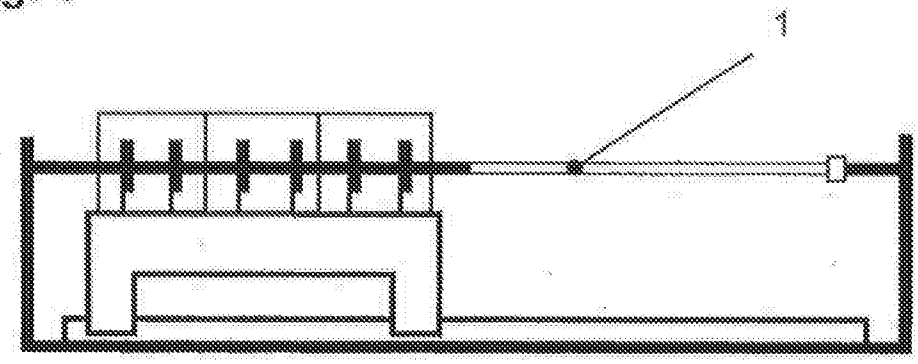

Fig. 9

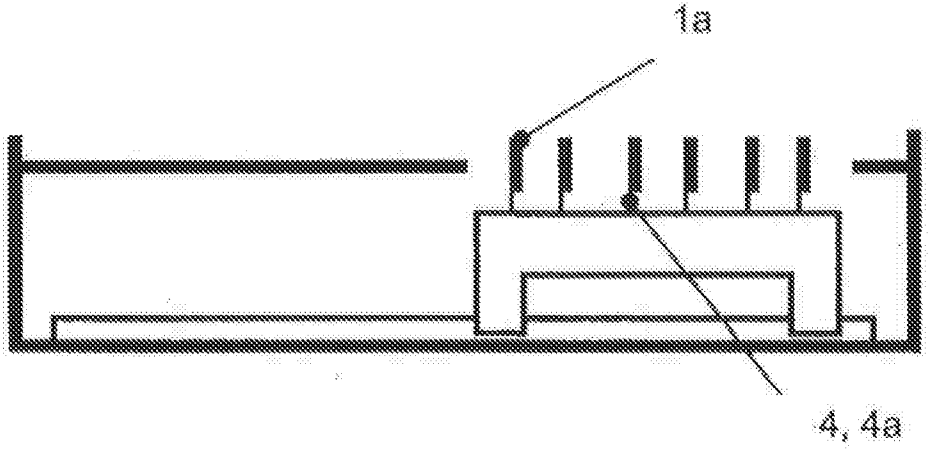

Fig. 10

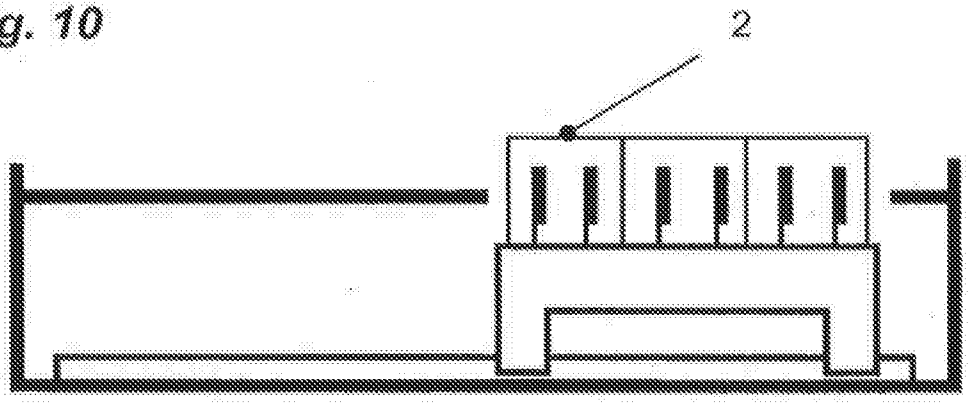

Fig. 11

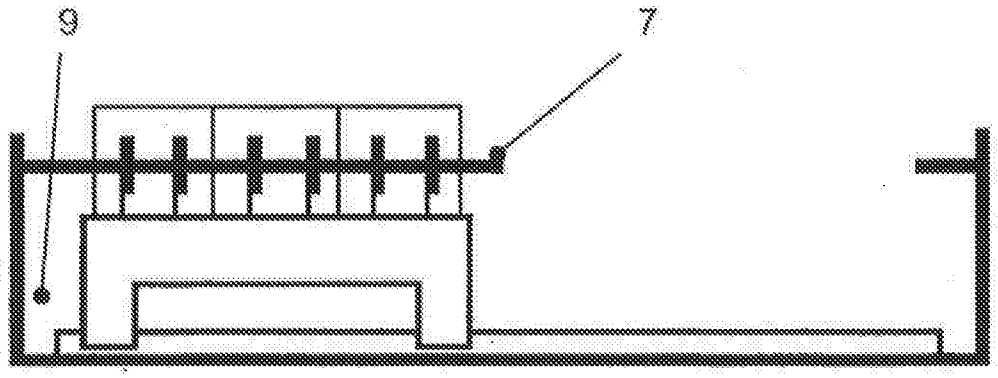

Fig. 12

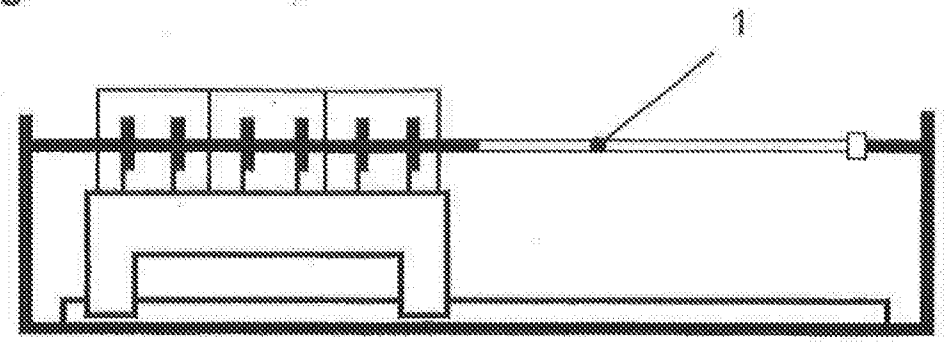

Fig. 13