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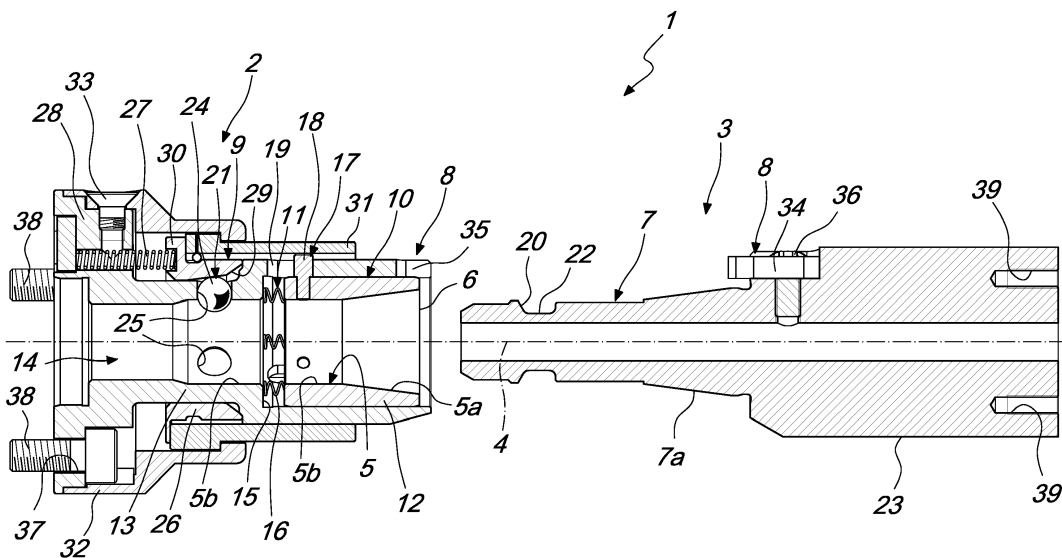
(54) **SPINDLE WITH QUICK COUPLING, PARTICULARLY FOR MACHINES FOR WINDING ELECTRIC COILS**

(57) A spindle with quick coupling, particularly for machines for winding electric coils, comprising:

- a fixed part (2), which extends around a main axis (4) and which can be actuated with a rotary motion about the main axis (4);
- a movable part (3), which can be mated detachably with a main seat (5) defined in the fixed part (2), the main seat (5) extending around the main axis (4) and having an access opening (6), which is defined at an axial end of the fixed part (2) and can be passed through by a shank-like portion (7) of the movable part (3);

- means (8) for connecting in rotation about the main axis (4) the moveable part (3) to the fixed part (2);
- axial locking means (9), which are arranged in the fixed part (2) and can be engaged detachably with the shank-like portion (7) of the moveable part (3) which is inserted into the main seat (5) of the fixed part (2).

The spindle comprises means for eliminating the axial play (10) between the moveable part (3) and the fixed part (2) when the axial locking means (9) are engaged with the shank-like portion (7) of the moveable part (3) inserted into the main seat (5).



*Fig. 4*

## Description

**[0001]** The present invention relates to a spindle with quick coupling, particularly for machines for winding electric coils.

**[0002]** As is known, electric coils are produced by carrying out the winding of a wire, generally made of copper, onto a spool, using special machines called coil winders. The most widespread coil winders are usually provided with a plurality of spindles, generally arranged side-by-side with each other, each one of which supports a corresponding spool onto which the wire is to be wound. Each spindle is actuated with a rotary motion about its own axis so as to rotate the corresponding spool in the direction to which the wire is fed by adapted wire guide elements. The rotation of each spool around the corresponding axis, in combination with the movement of the wire guide parallel to the axis of the spool, causes the winding, in multiple layers, of the wire around the spool.

**[0003]** Each spindle of these machines is generally constituted by a fixed part, which is intended to be fixed to the output shaft of a gearmotor, and by a moveable part which can be coupled, detachably, with the fixed part and which supports a spool-holder on which the spool is fitted around which the wire is to be wound.

**[0004]** More specifically, the fixed part generally is substantially cylindrical, with portions of different diameter that are arranged coaxially to each other, and, internally, a substantially cylindrical main seat is defined coaxially and is intended to receive a shank-like portion, contoured correspondingly, of the moveable part. The fixed part is usually provided with axial locking means that can be engaged, detachably, with the shank-like portion of the moveable part inserted in the main seat of the fixed part. These axial locking means are generally of the quick-connection type so as to allow, at the end of the winding of the corresponding spool, the removal of the moveable part in order to remove the wound spool and the load a new spool to be wound.

**[0005]** In these machines, the need is particularly felt to obtain, as far as possible, an alignment between the various spindles since a different arrangement of one spindle with respect to the others leads to obtaining a winding with a different arrangement of the turns of wire on the corresponding spool relative to the arrangement of the turns of wire on the spools carried by the other spindles and therefore to obtaining, on a same machine, electric coils that have different electrical characteristics from each other.

**[0006]** The perfect alignment of the various spindles is difficult to obtain owing to the inevitable plays between the fixed part and the moveable part of each spindle, in particular of the axial plays.

**[0007]** The reduction of these plays by way of a more accurate mechanical machining of the parts that have to be coupled considerably raises the cost of production of these parts and can be defeated as a result of wear of these parts.

**[0008]** The aim of the present invention is to solve the above mentioned drawback, by providing a spindle with quick coupling, particularly for machines for winding electric coils, which makes it possible to obtain an extremely precise coupling between the moveable part and the fixed part.

**[0009]** Within this aim, an object of the invention is to provide a spindle that, by virtue of the improved precision in the coupling between the moveable part and the fixed part, makes it possible to obtain a precise alignment between the various spindles of a same winding machine.

**[0010]** Another object of the invention is to provide a spindle in which it is possible to obtain a precise coupling between the moveable part and the fixed part without having to execute particularly accurate machining and therefore without considerably increasing the production costs.

**[0011]** A further object of the invention is to provide a spindle in which the coupling between the moveable part and the fixed part is fully satisfactory even after numerous operating cycles.

**[0012]** This aim and these and other objects which will become better apparent hereinafter are achieved by a spindle with quick coupling, particularly for machines for winding electric coils, which comprises:

- a fixed part, which extends around a main axis and can be actuated with a rotary motion about said main axis;
- a movable part, which can be mated detachably with a main seat defined in said fixed part, said main seat extending around said main axis and having an access opening, which is defined at an axial end of said fixed part and can be passed through by a shank-like portion of said moveable part;
- means for connecting, in rotation about said main axis, said moveable part to said fixed part;
- axial locking means, which are arranged in said fixed part and can be engaged detachably with said shank-like portion of the moveable part which is inserted into said main seat of the fixed part;

characterized in that it comprises means for eliminating the axial play between said moveable part and said fixed part with said axial locking means engaged with said shank-like portion of said moveable part inserted into said main seat.

**[0013]** Further characteristics and advantages of the invention will become better apparent from the description of a preferred, but not exclusive, embodiment of the spindle according to the invention, which is illustrated by way of non-limiting example in the accompanying drawings wherein:

Figure 1 is a perspective view of a spindle according to the invention with the moveable part coupled with the fixed part;

Figure 2 is a view of the spindle according to the

invention, seen from an axial end thereof;

Figure 3 is a perspective view of the spindle according to the invention with the moveable part disengaged from the fixed part;

Figure 4 is an axial cross-sectional view of the spindle according to the invention, before the coupling of the moveable part with the fixed part;

Figure 5 is an axial cross-sectional view of the spindle according to the invention, during the coupling of the moveable part with the fixed part;

Figure 6 is an axial cross-sectional view of the spindle according to the invention, with the moveable part coupled to and locked in the fixed part.

**[0014]** With reference to the figures, a spindle according to the invention, generally designated by the reference numeral 1, comprises a fixed part 2 and a moveable part 3 which can be coupled, detachably, to the fixed part 2.

**[0015]** The fixed part 2 is substantially cylindrical, composed of multiple portions, which have mutually different diameters, which are arranged coaxially along a main axis 4.

**[0016]** Inside the fixed part 2, starting from an axial end thereof, there is a main seat 5 which extends around the main axis 4 and which has an access opening 6 at such axial end of the fixed part 2. The main seat 5 is adapted to accommodate a shank-like portion 7 of the moveable part 3.

**[0017]** Such spindle is provided with means 8 for connecting in rotation about the main axis 4 the moveable part 3 to the fixed part 2.

**[0018]** In the fixed part 2, axial locking means 9 are provided which are engageable, detachably, with the shank-like portion 7 of the moveable part 3 when this is inserted into the main seat 5 of the fixed part 2 through the access opening 6.

**[0019]** According to the invention, there are means for eliminating the axial play 10 between the moveable part 3 and the fixed part 2 when the axial locking means 9 are engaged with the shank-like portion 7 of the moveable part 3 inserted into the main seat 5.

**[0020]** Conveniently, the means for eliminating the axial play 10 comprise first elastic means 11 which are arranged in the fixed part 2 and which act on the shank-like portion 7 with a force that is oriented parallel to the main axis 4 and which goes in the opposite direction with respect to the axial direction of insertion of the shank-like portion 7 into the main seat 5. More specifically, the main seat 5 has a frustum-shaped portion 5a that narrows in the opposite direction with respect to the access opening 6.

**[0021]** Preferably, the frustum-shaped portion 5a of the main seat 5 extends starting from its access opening 6. Correspondingly, the shank-like portion 7 has a frustum-shaped segment 7a that mates with the frustum-shaped portion 5a of the main seat 5 upon the insertion of the shank-like portion 7 into the main seat 5.

**[0022]** The main seat 5 has, starting from the access opening 6 and proceeding inward into the main seat 5, the frustum-shaped portion 5a and a substantially cylindrical portion 5b, hereinafter referred to simply as "cylindrical portion 5b".

**[0023]** The frustum-shaped portion 5a of the main seat 5 is defined in a mating sleeve 12, the axis of which coincides with the main axis 4. This mating sleeve 12 is supported, so that it can slide along the main axis 4, within a main body 13 of the fixed part 2 which extends around the main axis 4. The first elastic means 11 are interposed between the mating sleeve 12 and the main body 13.

**[0024]** More specifically, the main body 13 is substantially cylindrical, and is composed of multiple cylindrical portions that have mutually different diameters and are aligned along the main axis 4. The main body 13 is provided internally hollow, being passed through coaxially by a substantially cylindrical passage 14. The passage 14 defines a portion of the cylindrical portion 5b of the main seat 5 and, starting from one axial end of the main body 13, has a portion of increased diameter inside which is accommodated, coaxially and slideably, the mating sleeve 12 in which are defined the frustum-shaped portion 5a of the main seat 5 and another portion of the cylindrical portion 5b of the main seat 5 which is aligned with the remaining part of the cylindrical portion 5b of the main seat 5, which is defined by the passage 14. Between the axial end of the mating sleeve 12, directed toward the inside of the main body 13, and the axial shoulder 15 defined by the increase in diameter of the passage 14 that passes through the main body 13, the first elastic means 11, constituted by helical springs 16, are arranged.

**[0025]** Conveniently, there are means 17 of delimiting the axial sliding of the mating sleeve 12 relative to the main body 13. The delimiting means 17, in the embodiment shown, comprise a pin 18 which protrudes from the outer lateral surface of the mating sleeve 12 and which is coupled, so that it can slide, inside an axially elongated slot 19, which passes through a side wall of the main body 13.

**[0026]** The axial locking means 9 comprise an axial shoulder 20 which is defined on the shank-like portion 7 and at least one coupling element 21 which is accommodated in the fixed part 2 and which can move from a release position, in which it does not interfere with the axial shoulder 20 of the shank-like portion 7, to a coupling position, in which it protrudes radially from the lateral surface of the main seat 5 and engages with the axial shoulder 20 of the shank-like portion 7 in order to actuate the retention thereof in the main seat 5, and vice versa.

**[0027]** More specifically, the axial shoulder 20 is defined by a groove 22 which extends circumferentially on the lateral surface of the shank-like portion 7, between the frustum-shaped segment 7a and the free end thereof.

**[0028]** The moveable part 3 consists of a substantially cylindrical portion 23, hereinafter referred to simply as "cylindrical portion 23", from one axial end of which ex-

tends the shank-like portion 7 which has a smaller diameter than that of the cylindrical portion 23. The shank-like portion 7 has, starting from the cylindrical portion 23 from which it extends, the frustum-shaped segment 7a and a substantially cylindrical portion 7b in which the groove 22 is defined.

**[0029]** The at least one coupling element 21 is arranged along the cylindrical portion 5b of the main seat 5 and, preferably, comprises at least one ball 24 susceptible of protruding radially toward the inside of the main seat 5 through a corresponding hole 25, which is defined in the main body 13, so as to interfere with the axial shoulder 20.

**[0030]** More specifically, along the cylindrical portion 5b of the main seat 5 three holes 25 are provided, the axes of which are angularly and regularly mutually spaced apart about the main axis 4, which pass through the main body 13. Arranged at each one of the holes 25 a ball 24 is provided that can partially pass through the corresponding hole 25 so as to protrude radially toward the inside of the main seat 5. Around the region of the main body 13 occupied by the holes 25, a locking sleeve 26 is fitted which can move parallel to the main axis 4 relative to the main body 13 from a locking position, in which it locks radially the balls 24 of the coupling element 21 in the coupling position in engagement with the axial shoulder 20, to an unlocking position, in which it allows the radial movement of the balls 24 of the coupling element 21 relative to the main body 13 in order to allow their passage from the coupling position to the release position and vice versa.

**[0031]** The locking sleeve 26 is slideable axially from the locking position to the unlocking position in contrast with the action of second elastic means 27 which are interposed between the locking sleeve 26 and the main body 13. More precisely, the second elastic means 27 are constituted by springs, only one of which is visible in the figures, which are interposed between one axial end of the locking sleeve 26 and a flange 28 of the main body 13 provided at its opposite axial end with respect to the axial end in which the access opening 6 is defined.

**[0032]** Conveniently, the locking sleeve 26 engages with the balls 24 by way of a conical surface 29 so that the passage of the locking sleeve 26 from the locking position to the unlocking position can also be obtained owing to the thrust exerted by the balls 24 against the locking sleeve 26 upon the insertion of the shank-like portion 7 into the main seat 5.

**[0033]** Conveniently, a presser sleeve 31 is provided which is arranged around the main body 13 of the fixed part 2 and which can move axially with respect to the main body 13 in order to act on the locking sleeve 26 and cause its transition from the locking position to the unlocking position in contrast with the action of the second elastic means 27. More specifically, the presser sleeve 31 is fitted, so that it can slide, around the main body 13 and engages, with an axial end thereof, against a flange 30 of the locking sleeve 26. The presser sleeve 31 is

retained on the main body 13 by a covering element 32, from which it protrudes in the direction of the axial end of the main body 13 in which the access opening 6 is defined. The covering element 32 is fixed to the main body 13 by way of one or more screws 33.

**[0034]** The means 8 for connecting in rotation about the main axis 4 of the moveable part 3 with the fixed part 2 comprise a tab 34 which is fixed to the cylindrical portion 23 and which can engage with its end a slot 35 defined on the edge of the access opening 6 of the main seat 5. More precisely, in the embodiment shown, the tab 34 is fixed by way of a screw 36 to the cylindrical portion 23 of the moveable part 3 and protrudes axially from this in the direction of the shank-like portion 7. The tab 34 is insertable into the slot 35 that is defined in the main body 13 of the fixed part 2 starting from the axial end thereof in which the access opening 6 is defined.

**[0035]** The free end of the shank-like portion 7, intended to be inserted first into the main seat 5, is conveniently beveled so as to press the balls 24 radially away from the main axis 4.

**[0036]** For the sake of completeness of the description, it should be noted that, at the axial end of the main body 13 of the fixed part 2, there is a flange 28, passed through by holes 37 into which screws 38 are inserted which can be used to couple the fixed part 2 of the spindle to the output shaft of a gearmotor that can be actuated in order to make the fixed part 2 rotate about the main axis 4.

**[0037]** In the axial end of the moveable part 3 that lies opposite with respect to the shank-like portion 7, threaded holes 39 are defined which can be used for fixing, to the moveable part 3, a spool-holder element, which is conventional and not shown for the sake of simplicity.

**[0038]** Use of the spindle according to the invention is the following.

**[0039]** When the moveable part 3 is disengaged from the fixed part 2, the first elastic means 11 push the mating sleeve 12, in which the frustum-shaped portion 5a of the main seat 5 is defined, toward the access opening 6, i. e. toward the outside. The mating sleeve 12 is retained inside the main body 13 by the pin 18 which abuts against an axial end of the slot 19 into which it is inserted. The locking sleeve 26 is kept in the locking position by the action of the second elastic means 27, as illustrated in Figure 4.

**[0040]** When the shank-like portion 7 is inserted into the main seat 5, thus engaging with its beveled end against the balls 24, it pushes them radially away from the main axis 4 and, following the coupling of the balls 24 with the locking sleeve 26 by way of the conical surface 29, causes the passage of the locking sleeve 26 from the locking position to the unlocking position. In this manner, the shank-like portion 7 can proceed in its insertion into the main seat 5 thus bringing its frustum-shaped segment 7a to engage with the frustum-shaped portion 5a defined in the mating sleeve 12, as illustrated in Figure 5.

**[0041]** After the coupling between the frustum-shaped portion 5a of the main seat 5 and the frustum-shaped

segment 7a of the shank-like portion 7, the shank-like portion 7 proceeds further for a portion so that the groove 22 will reach the balls 24. This further continuing of the axial advancement of the shank-like portion 7 inside the main seat 5 causes the compression of the springs 16 that constitute the first elastic means 11.

**[0042]** When the groove 22 reaches the balls 24, these, by virtue of the action of the thrust exerted on them, through the conical surface 29, are pushed by the locking sleeve 26 to protrude radially inward from the corresponding holes 25 thus engaging with the groove 22 and therefore axially locking the shank-like portion 7 inside the main seat 5. In this position, the elastic reaction of the springs 16, which constitute the first elastic means 11, pushes the shank-like portion 7 in the opposite direction with respect to the direction of insertion, thus eliminating the axial play that may be present between the balls 24 and the axial shoulder 20, as illustrated in Figure 6. It should be noted that this elimination of the axial play between the balls 24 and the axial shoulder 20 is executed while at the same time maintaining the coupling between the frustum-shaped portion 5a of the main seat 5 defined in the mating sleeve 12 and the frustum-shaped segment 7a of the shank-like portion 7. In this manner, the elimination of any radial plays between the shank-like portion 7 and the main seat 5 is also ensured.

**[0043]** When it is desired to disengage the moveable part 3 from the fixed part 2, one acts on the presser sleeve 31 in the direction of the locking sleeve 26 so as to cause the axial movement of the locking sleeve 26 relative to the main body 13 in contrast with the action of the second elastic means 27 from the locking position to the unlocking position. In this manner, the balls 24 can move radially away from the main axis 4 and therefore the shank-like portion 7 of the moveable part 3 can be extracted from the main seat 5.

**[0044]** In practice it has been found that the spindle according to the invention fully achieves the set aim in that, by eliminating the axial play between the moveable part and the fixed part, it makes it possible to obtain an extremely precise coupling between these two parts. Such precision in the coupling between the moveable part and the fixed part makes it possible to obtain a perfect alignment between the spindles arranged on a same machine and therefore makes it possible to eliminate or at least reduce the winding differences between the spools produced by a same machine.

**[0045]** In particular, the elimination of the axial play between the moveable part and the fixed part of the spindles enables a greater repeatability and precision in the steps of layering of the wire that is wound onto the various spools.

**[0046]** Another advantage of the spindle according to the invention is that it also obtains an elimination of the radial play between the moveable part and the fixed part.

**[0047]** The spindle, thus conceived, is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims. Moreover, all

the details may be substituted by other, technically equivalent elements.

**[0048]** In practice the materials employed, and the dimensions, may be any according to requirements and to the state of the art.

**[0049]** The disclosures in Italian Patent Application No. 102015000086236 (UB2015A009353) from which this application claims priority are incorporated herein by reference.

**[0050]** Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

## Claims

1. A spindle with quick coupling, particularly for machines for winding electric coils, which comprises:

- a fixed part (2), which extends around a main axis (4) and can be actuated with a rotary motion about said main axis (4);

- a movable part (3), which can be mated detachably with a main seat (5) defined in said fixed part (2), said main seat (5) extending around said main axis (4) and having an access opening (6), which is defined at an axial end of said fixed part (2) and can be passed through by a shank-like portion (7) of said moveable part (3);

- means (8) for connecting in rotation about said main axis (4) said moveable part (3) to said fixed part (2);

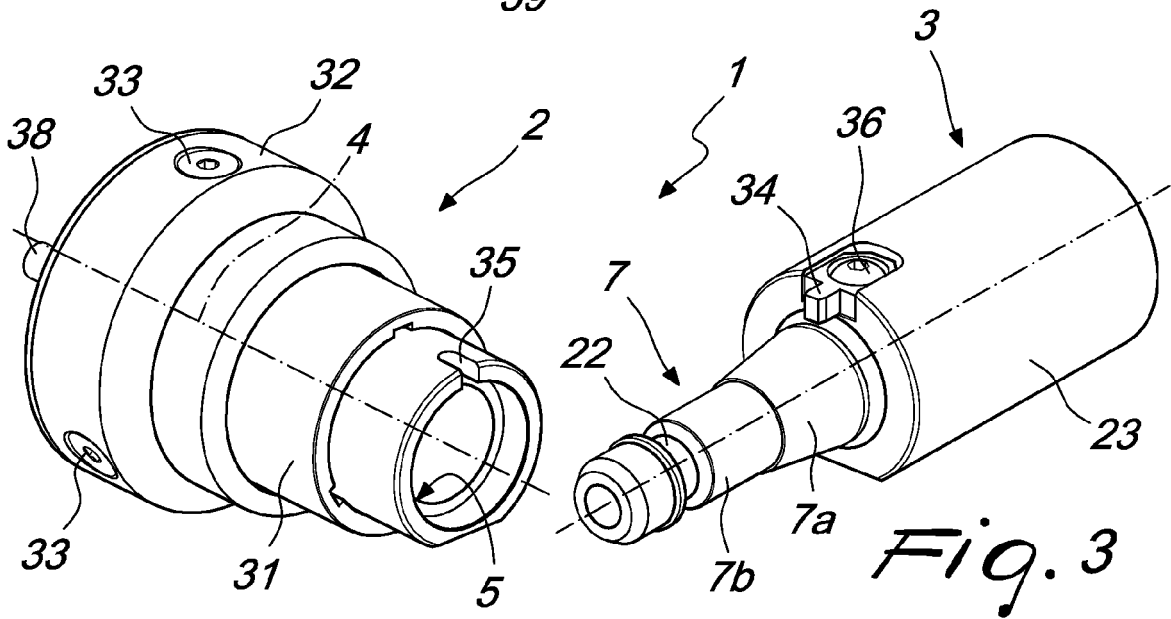
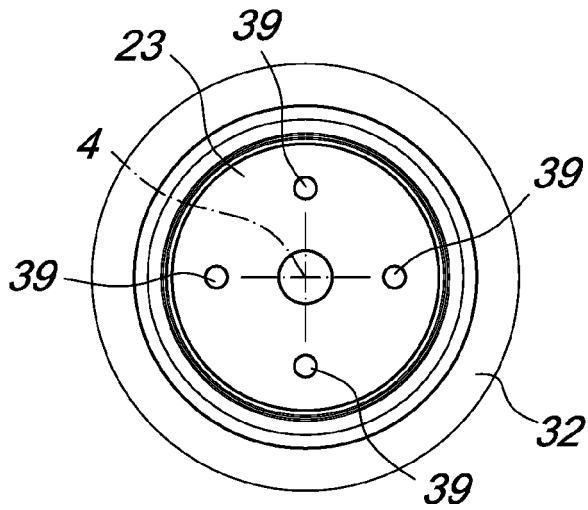
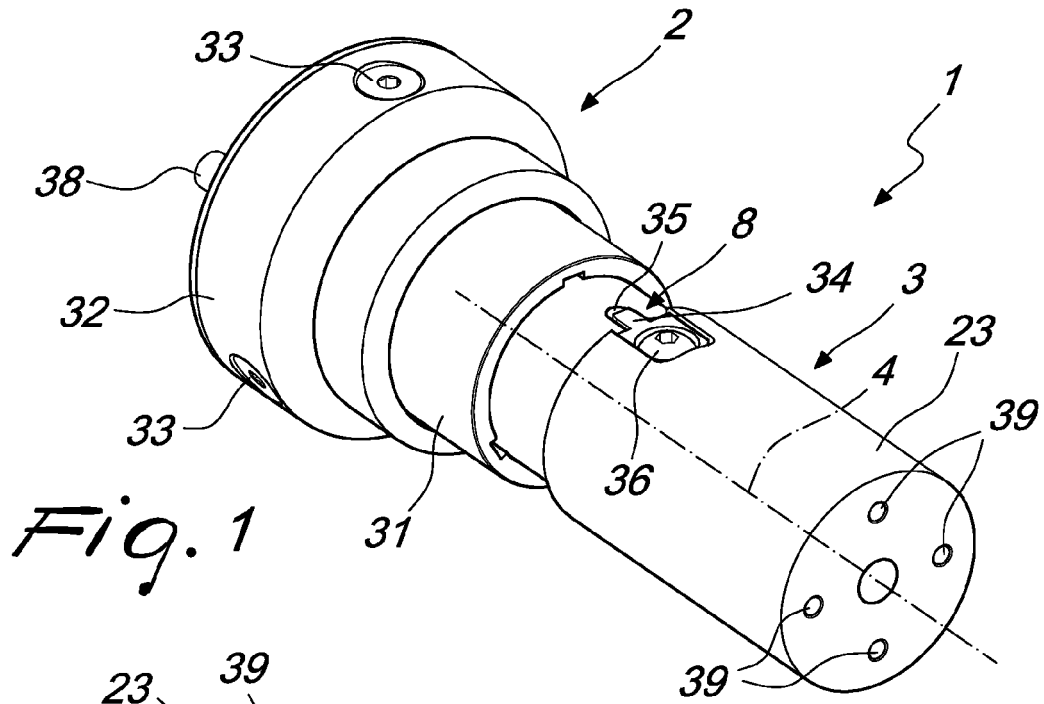
- axial locking means (9), which are arranged in said fixed part (2) and can be engaged detachably with said shank-like portion (7) of the moveable part (3) which is inserted into said main seat (5) of the fixed part (2);

**characterized in that** it comprises means for eliminating the axial play (10) between said moveable part (3) and said fixed part (2) with said axial locking means (9) engaged with said shank-like portion (7) of said moveable part (3) inserted into said main seat (5).

2. The spindle according to claim 1, **characterized in that** said axial locking means (9) comprise an axial shoulder (20) defined on said shank-like portion (7) and at least one coupling element (21) which is accommodated in said fixed part (2) and can move from a release position, in which it does not interfere with said axial shoulder (20) of the shank-like portion (7), to a coupling position, in which it protrudes radially from the lateral surface of said main seat (5) and

engages with said axial shoulder (20) of the shank-like portion (7) for the retention thereof in said main seat (5), and vice versa.

3. The spindle according to claim 1, **characterized in that** said means for eliminating the axial play (10) comprise first elastic means (11) arranged in said fixed part (2) and acting on said shank-like portion (7) in the opposite axial direction with respect to the axial direction of insertion of said shank-like portion (7) into said main seat (5). 5
4. The spindle according to one or more of the preceding claims, **characterized in that** said main seat (5) has a frustum-shaped portion (5a), which tapers in the opposite direction with respect to said access opening (6); said shank-like portion (7) having a frustum-shaped segment (7a) that mates with said frustum-shaped portion (5a) of the main seat (5) upon the insertion of said shank-like portion (7) into said main seat (5). 10
5. The spindle according to one or more of the preceding claims, **characterized in that** said main seat (5) has, proceeding from said access opening (6) toward the inside of said main seat (5), said frustum-shaped portion (5a) and a substantially cylindrical portion (5b). 15
6. The spindle according to one or more of the preceding claims, **characterized in that** said frustum-shaped portion (5a) of said main seat (5) is defined in a mating sleeve (12), the axis of which coincides with said main axis (4); said mating sleeve (12) being supported, so that it can slide along said main axis (4), by a main body (13) of said fixed part (2) which extends around said main axis (4); said first elastic means (11) being interposed between said mating sleeve (12) and said main body (13). 20
7. The spindle according to one or more of the preceding claims, **characterized in that** said at least one coupling element (21) is arranged along said cylindrical portion (5b) of said main seat (5). 25
8. The spindle according to one or more of the preceding claims, **characterized in that** said at least one coupling element (21) comprises at least one ball (24) that is susceptible of protruding radially toward the inside of said main seat (5) through a corresponding hole (25), defined in said main body (13), in order to interfere with said axial shoulder (20); a locking sleeve (26) being provided which is fitted over said main body (13) and can move parallel to said main axis (4) with respect to said main body (13) from a locking position, in which it locks radially said at least one ball (24) in the coupling position in engagement with said axial shoulder (20), to an unlocking position, in which it allows the radial movement of said at least one ball (24) with respect to said main body (13) for its passage from the coupling position to the release position and vice versa. 30
9. The spindle according to one or more of the preceding claim, claims, **characterized in that** said locking sleeve (26) can slide axially from said locking position to said unlocking position in contrast with the action of second elastic means (27) interposed between said locking sleeve (26) and said main body (13). 35
10. The spindle according to one or more of the preceding claims, **characterized in that** said axial shoulder (20) is defined by a groove (22) which extends circumferentially on the lateral surface of said shank-like portion (7). 40
11. The spindle according to one or more of the preceding claims, **characterized in that** said locking sleeve (26) engages with said at least one ball (24) by way of a conical surface (29) for the passage of said locking sleeve (26) from said locking position to said unlocking position owing to the thrust of said at least one ball (24) against said locking sleeve (26) upon the insertion of said shank-like portion (7) into said main seat (5). 45
12. The spindle according to one or more of the preceding claims, **characterized in that** said groove (22) is defined on a portion of said shank-like portion (7) that is comprised between said first frustum-shaped segment (7a) and the free end thereof. 50
13. The spindle according to one or more of the preceding claims, **characterized in that** it comprises a presser sleeve (31) which is arranged around said main body (13) of the fixed part (2) and can move axially with respect to said main body (13) in order to act on said locking sleeve (26) for its transition from said locking position to said unlocking position in contrast with said second elastic means (27). 55
14. The spindle according to one or more of the preceding claims, **characterized in that** it comprises means (17) for delimiting the axial sliding of said mating sleeve (12) with respect to said main body (13).
15. The spindle according to one or more of the preceding claims, **characterized in that** said means (8) for connecting in rotation about said main axis (4) said moveable part (3) to said fixed part (2) comprise a tab (34) which is fixed to said shank-like portion (7) and which can engage with its end a slot (35) defined on the edge of said access opening (6) of said main seat (5).



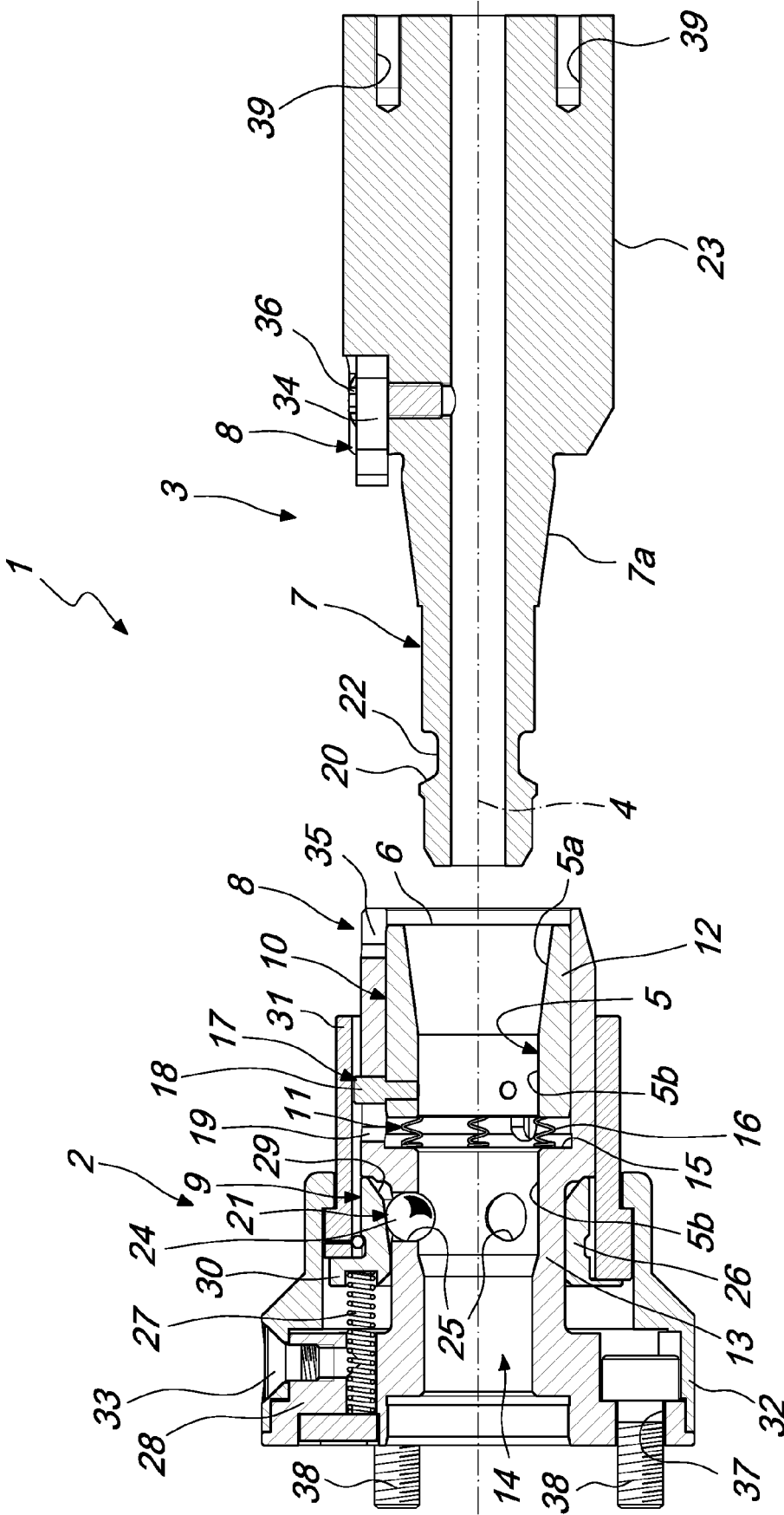


Fig. 4

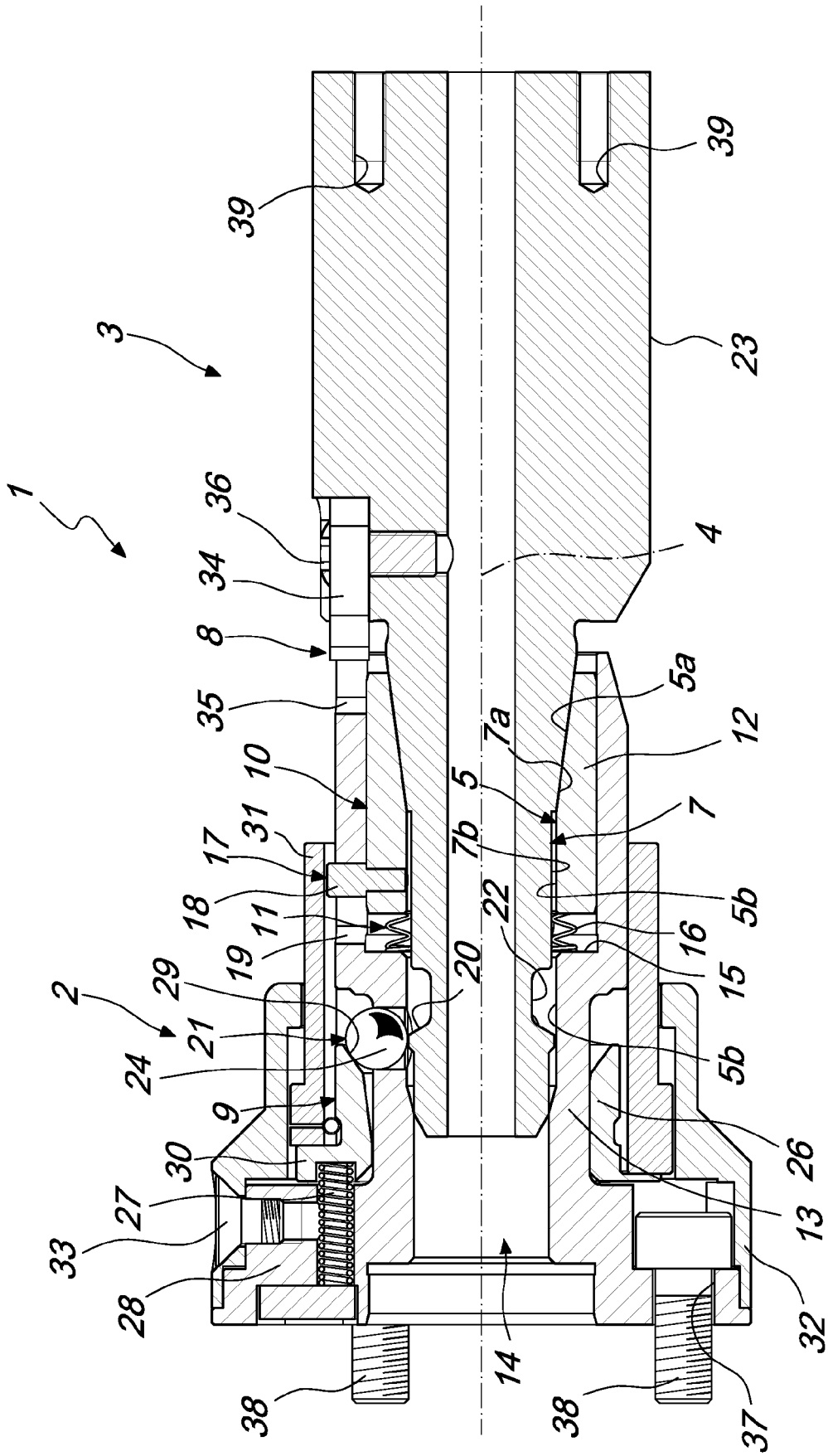
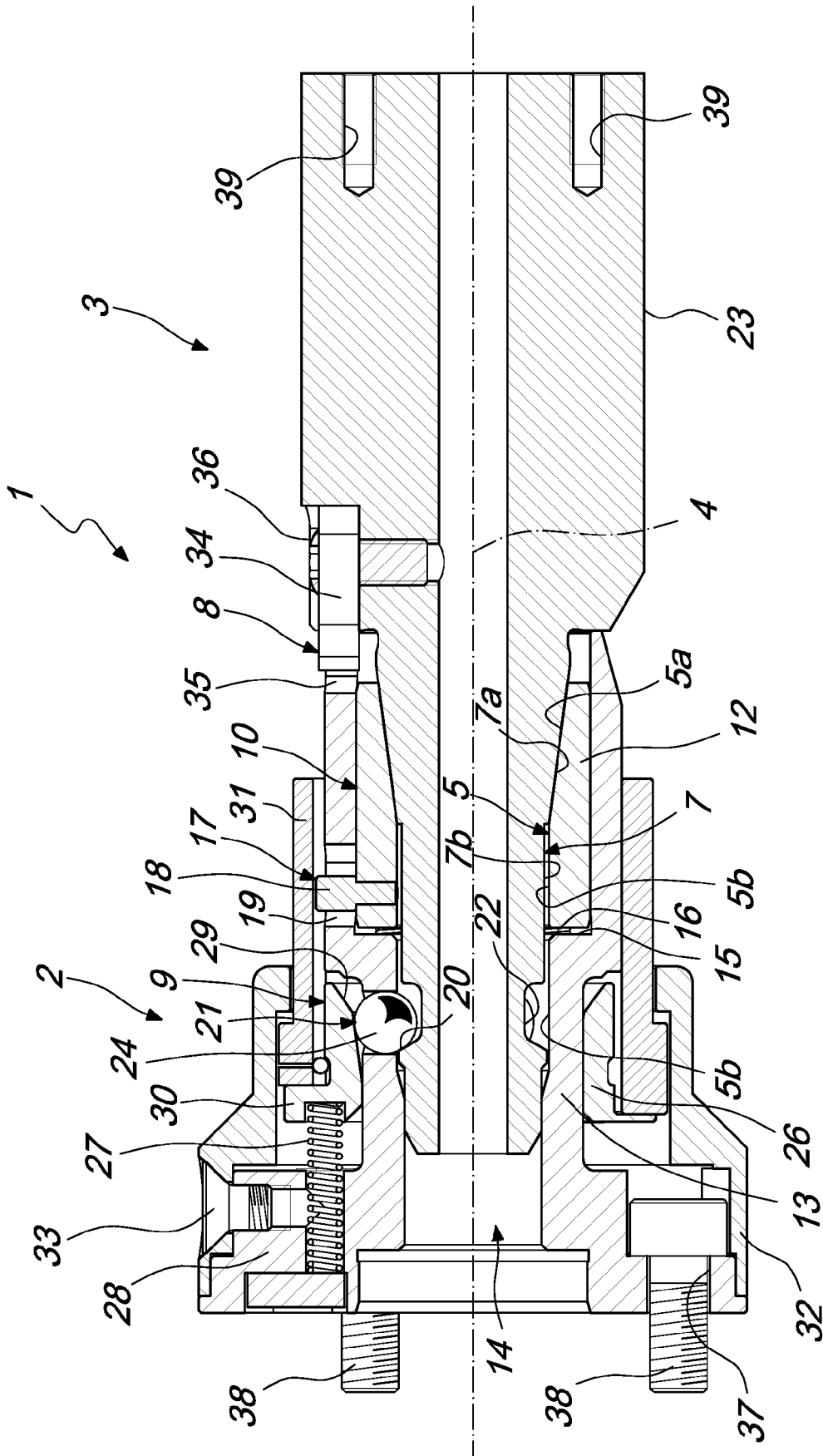


Fig. 5





EUROPEAN SEARCH REPORT

Application Number  
EP 16 20 5454

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2009/090807 A1 (NOMURA TOMOHIRO [JP] ET AL) 9 April 2009 (2009-04-09) * abstract; figures 1, 7-15 * * paragraph [0064] - paragraph [0107] * -----	1-7,10,12,14,15	INV. H01F41/098 B65H75/02
A	EP 2 680 283 A2 (NITTOKU ENG [JP]) 1 January 2014 (2014-01-01) * abstract; figures 5, 11-16 * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC)  H01F B65H H02K
A	EP 2 246 865 A2 (MARSILLI & CO [IT]) 3 November 2010 (2010-11-03) * abstract; figures 5, 25 * -----	1-15	
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>26 April 2017</b>	Examiner <b>Tano, Valeria</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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