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(54) Four-for-one twisting spindle for twisting machines or similar

Vierfachdraht-Zwirnspindel für Zwirnmaschinen oder ähnliche Vorrichtungen

Broche à retordre à quadruple torsion pour des métiers à retordre ou similaires

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Description

[0001] The present invention relates to a four-for-one twisting spindle for twisting machines, and in particular to a device for transmitting the rotation motion to the various rotating elements of said spindle.

[0002] The invention relates to the field of twisting machines and similar. Twisting operations have the purpose of twisting two or more threads together. The yarn obtained is called single yarn or multi-yarn, according to the number of threads used. The operation is effected by two machines, the doubling frame, which combines two or more threads, and the twister, which twists the threads once they have been joined. Alternatively, the threads to be twisted each derive from a different bobbin.

[0003] As is known, the multiple twist spindles currently used in this field as twisters, envisage that the double threads which are wound onto a bobbin, or the single threads wound onto two bobbins superimposed in the same spindle, are wound from the bobbin along a run which, passing through devices which rotate around the bobbin, give them torsions. The importance of these torsions is due to the fact that the yarn obtained has a higher resistance and regularity, in addition to an enhanced aspect, specifically due to the torsions, with respect to its initial conditions. The twisting is then used to produce higher-quality yarns.

[0004] In particular, various twisting machines are available on the market, which differ in that they give the yarn obtained a different number of torsions. In order to obtain a number of torsions suitable for conferring the desired characteristics to the final product, the rotational rate of the rotating parts of the spindle can be increased, or the collection rate of the yarn can be reduced. Alternatively, a higher number of torsions can be conferred to the same yarn for each revolution of the rotating parts, without increasing the rotation rate of the same rotating parts, thus avoiding greater wear and without reducing the collection rate of the yarn, thus avoiding a lower production rate.

[0005] According to patent EP 1007773, in the name of Armando D'Agnolo, a twisting spindle for multiple torsions for textile threads and yarns, comprises a support for the feeding bobbin, which is kept still, two parts rotating in opposite directions, an inner rotating part and an outer rotating part, respectively, situated under the bobbin, the rotating part being coaxial with each other and with respect to the axis of the spindle, and a deflecting element situated above the bobbin. The thread which is unwound from the bobbin first passes through the deflecting element situated above the bobbin, it then descends towards the inner rotating part, defining an inner balloon around the bobbin, and passes through a passage created on said inner rotating part. When it reaches the exit of said passage, arranged on the rotation axis of the spindle, the yarn passes through a second deflecting element, integral with the outer rotating part, and subsequently a passage obtained inside said outer rotating part, it exits therefrom and rises, defining an outer balloon and is finally sent to collection means. During this run, the yarn receives two torsions for each revolution of each rotating part. At least one thread tensioning device is included above the bobbin, and the bobbin is situated inside a closed container or basket, which extends from the support of the spindle to the upper deflecting element. A characteristic of the spindle consists in the fact that the thread, for at least a part of its run, can form free balloons, i.e. which are not externally delimited by a container.

[0006] With reference to the driving of the rotating parts, according to patent EP 1007773, one of the two rotating parts of the spindle is driven by traditional driving means, such as, for example, a transmission belt which transmits the motion from a motor to a pulley integral with the rotating part, whereas the other is operated by a brushless motor.

[0007] The solution proposed in patent application EP 0611841 in the name of Teijin Seiki Co., comprises two rotating parts which impart the desired rotations to the yarn and a basket wherein the feeding means of the thread, or sleever to be twisted are positioned, even if the run followed by the yarn to be subjected to the necessary twisting is different with respect to patent EP 1007773. Furthermore, with reference to the rotating parts, in patent application EP 0611841 the transmission belt transmits the motion to one of the two rotating elements, but the transfer of the motion from the rotating element directly connected to the transmission belt to the second rotating element is effected by an epicycloidal reducer.

[0008] As is known, an epicycloidal reducer is a motion transfer system consisting of an inner element having a circular section, in contact with three or more intermediate elements having a circular section, which surround it, said intermediate elements being, in turn, in contact with the inner surface of a hollow element having a circular section, which, in turn, surrounds them. A reducer of this type is also called planetary reducer, as, by maintaining the outer hollow element fixed, the rotation around its axis of the inner element (also called solar) causes a rotation movement of the intermediate elements (also called planetary elements) around their axis and, at the same time, a revolution movement of these planetary elements around the solar element. By interposing in suitable free spaces between contiguous planetary elements, the prongs of a circular element, also called planetary-holder, said prongs sustain the thrust imparted by the planetary elements in their movement, and begin to follow the same circular orbit around the solar element, conferring to the planetary-holder element a rotational movement at a reduced rate with respect to the solar element. It is also known that the characteristics which make the epicycloidal reducers particularly interesting consist in that these motion transmission mechanisms allow high reduction ratios to be obtained, by transmitting high torques and supporting heavy loads on the exit shaft.

[0009] The solution proposed by patent application EP

0611841 is a variation of the epicycloidal system described above, wherein the planetary-holder is maintained still. Moreover, the motion is not transmitted to the planetary elements by the inner element of the epicycloidal reducer, but by the outer element. The planetary elements, as a consequence of the rotation imparted by the external element, rotate around themselves, without being able to move around the solar element, as their revolution movement around the solar element is prevented by the contact with the prongs of the planetary-holder, which are still.

[0010] As the planetary elements can only rotate around themselves, they transmit the rotation movement to the solar element, which is induced to rotate in the opposite direction with respect to the external element. The patent application has various embodiments of the epicycloidal reducer, but they are described very briefly, without disclosing their production and assembly in detail.

[0011] The solution proposed in patent application EP 0611841 is therefore not practicable, as, on the basis of the information given, it is not possible to obtain a disclosure on the real actualization methods of the epicycloidal reducer entrusted with transferring the movement from the rotating part activated by the transmission belt to the rotating part whose rotation motion is transmitted through said epicycloidal reducer.

[0012] Furthermore, even if this lack of description were to be surmounted by a technical expert in the field, who were to complete the lack of description on the basis of further considerations, which are, in any case not evident and not obvious, and the reducer were consequently produced, the information obtainable from patent application EP 0611841, would lead to the production of a four-for-one twisting spindle wherein the weight of the basket and the weight of the planetary-holder are sustained by the planetary elements. Therefore, between the planetary holder and the planetary elements, not only is stress generated due to the contact which prevents the revolution of the planetary elements around the solar element, but also additional stress due to the contact for sustaining the weight of the planetary-holder and the basket. This additional stress has several drawbacks, such as an increase in the absorbed power, possible exceeding of the ultimate PV in the contact between planetary elements and planetary-holders (the PV value is the product of the specific load P on the projection of the contact surface, by the rate V of the contact surface; the ultimate PV is reached when the temperature generated by the friction increases to the maximum value allowed for the materials in contact with each other), a higher friction in the rolling of the planetary elements and a consequent significant reduction in the fatigue life of the elements of the epicycloidal reducer, in particular of the planetary-holder (suitably made of materials having a low friction coefficient, which, however, are subjected to higher wear).

[0013] Furthermore, the variation in stress on the reducer elements, due to the progressive decrease in the weight of the spindle formation (or the decrease in the weight of the bobbin during the unwinding of the yarn from the same) and its increase as a consequence of the insertion of a new bobbin in substitution of an exhausted bobbin, involves a variation in the stress which acts on the reducer elements which, in some situations, could be loadless. This possibility should be avoided by using suitably positioned pre-loading springs. This solution however requires an increase in the overall stress in the contact points of the device and a consequent decrease in the fatigue life.

[0014] Not only this, but, according to the configuration which can be derived therefrom, within the limits already discussed, on the basis of the description of patent application EP 0611841, the planetary-holder would also be subjected to stress along force lines on a plane perpendicular to the rotation axis of the spindle elements, said stress being attributable to the oscillations of the basket caused by the rotation of the thread around itself.

[0015] This type of stress requires the use of a specific anti-overturning bearing. Moreover, with reference to the analogous oscillations due to the rotation of the yarn around the bobbin from which it unwinds, the description of patent application EP 0611841 is not capable of clarifying if and when the reducer can perform the anti-overturning function or if, also in this case, an anti-overturning bearing should be enclosed.

[0016] An objective of the present invention is therefore to provide a multi-twisting spindle for twisting machines which, thanks to a perfected transmission device for the transmission of the rotation motion to the different rotating components of said spindle, in particular of the epicycloidal type, in which stress interfering with the motion transmission function is carefully avoided, is characterized by a better distribution of the stress and a longer fatigue life.

[0017] Furthermore, an objective of the present invention is to provide a transmission device of the rotation motion to the different rotating components of a spindle, in particular of the epicycloidal type, which is simple and easy to assemble, even out-of-line, i.e. without the necessity of inserting the different elements of the transmission device, one by one onto the spindle, but with the possibility of assembling it separately and subsequently assembling it onto the spindle.

[0018] A further objective of the present invention is to guarantee a higher productivity of the multi-twisting spindle, though a longer operating factor.

[0019] These objectives according to the present invention are achieved by providing a four-for-one twisting spindle for twisting machines of textile yarns, comprising a cylindrical basket, kept immobile and in which a feeding bobbin is supported, an upper rotating part and a lower rotating part, situated behind the cylindrical basket, coaxial with the same, which rotate in opposite directions to each other and define a first passage and a second passage respectively, along the run of the yarn, said run

being further defined by a deflecting element positioned above the bobbin, a deflecting element situated along said first passage and a deflecting element situated along said second passage, said upper rotating part or said lower rotating part being operated by external motion transmission means and transmitting the motion to said lower rotating part and to said upper rotating part, respectively, through an epicycloidal transmission device, whose inner element is integral with said lower rotating part and whose outer element is integral with said upper rotating part, in which the planetary elements rotate around themselves, being maintained in the same position by a planetary-holder element and are arranged so as to form two crowns, a lower crown and an upper crown, respectively, the planetary elements of each of said two crowns transmitting forces, which are exerted between the components of said epicycloidal transmission device, along oblique force lines, the planetary elements of at least one of said two crowns, transmitting forces along force lines converging downwards, in order to transmit the weight of the spindle, which rests on said upper rotating part, to said lower rotating part.

[0020] According to the invention, the planetary elements of one of said two crowns preferably transmit forces along force lines converging downwards and the planetary elements of the other of said two crowns transmit forces along force lines converging upwards.

[0021] In a first alternative, according to the invention, the weight of the spindle is transmitted through the planetary elements of the lower crown and the inner element of said device of epicycloidal transmission can preferably consist of a lower inner ring and an upper inner ring and the outer element of said device of epicycloidal transmission consists of at least one external ring.

[0022] Moreover, said lower inner ring and said upper inner ring can be assembled with interference on a rotating shaft, which rotates integrally with said lower rotating part and said at least one outer ring is assembled with interference on said upper rotating part; or said upper inner ring can move freely along the direction of the rotation axis, a load spring and a joint acting thereon, which prevents rotation with respect to said lower inner ring; or again, the outer element of said device for epicycloidal transmission consists of a lower outer ring and an upper outer ring, said lower outer ring being assembled with interference on said upper rotating part and said upper outer ring being free to move along the direction of the rotating axis, a load spring and a joint acting thereon, which prevents rotation with respect to said lower outer ring.

[0023] In a second alternative of the present invention, the weight of the spindle is transmitted through the planetary elements of the upper crown, and in this case the inner element of said device for epicycloidal transmission preferably consists of at least one inner ring, whereas the outer element of said device for epicycloidal transmission made up of a lower outer ring and an upper outer ring.

[0024] Furthermore, said at least one inner ring can be assembled with interference on a rotating shaft which rotates integrally with said lower rotating part, and said lower outer ring and said upper outer ring are assembled with interference on said upper rotating part; or said lower outer ring can move freely along the direction of the rotating axis, a load spring and a joint acting thereon, which prevents rotation with respect to said upper outer ring; or again, the inner element of said device for epicycloidal transmission consists of a lower inner ring and an upper inner ring, said upper inner ring being assembled with interference on a rotating shaft, which rotates integrally with said lower rotating part and said lower inner ring being free to move along the direction of the rotating axis, a load spring and a joint acting thereon, which prevents rotation with respect to said upper inner ring.

[0025] Still according to the invention, the weight of said planetary-holder can rest directly on the planetary elements of said two crowns or does not rest directly on the planetary elements of neither of the two crowns, as it is sustained by the structure of the spindle.

[0026] Still according to the invention, said planetary elements can have the shape of spheres, rolls or similar shapes, said inner and outer rings comprising tracks which adapt themselves to the shape of said planetary elements so as to increase the contact surface.

[0027] In these cases, said planetary-holder preferably consists of a cage with a substantially cylindrical body equipped with a series of prongs situated along the generatrices of the cylindrical body and which define housing spaces between each other for said planetary elements; or it consists of a cage with a substantially cylindrical body, equipped with a series of openings, situated on two different circumferences which define housing spaces for said planetary elements; or it consists of a cage with a substantially cylindrical body equipped with a series of prongs placed along the generatrices of the cylindrical body and which define housing spaces between each other for the planetary elements belonging to the upper crown and a series of openings which define housing spaces for the planetary elements belonging to the lower crown.

[0028] Alternatively, said planetary elements have the shape of a rotation solid with two parallel and coaxial bases at whose the centre there are two cylindrical pins, said planetary-holder consisting of a frame with a cylindrical wall, equipped with a series of openings, situated on two different circumferences, which define housings for said planetary elements, each opening also being equipped with a pair of flaps with holes for the housing of said cylindrical pins.

[0029] The present invention will be now described, for illustrative, but non-limiting purposes, according to a preferred embodiment, with particular reference to the figures of the enclosed drawings, in which:

figure 1 shows a sectional view of a four-for-one twisting spindle for twisting machines, according to

an embodiment of the present invention;

figure 2 shows a sectional view of a device for the transmission of the rotation movement to the different rotation components of a spindle in accordance with the present invention, according to a first embodiment;

figure 3 shows a perspective view of the different elements of the transmission device of the rotation motion of figure 2, with the exclusion of the spherical planetary elements;

figure 4 shows a sectional view of a device for the transmission of the rotational motion to the different components in rotation, of a spindle in accordance with the present invention, according to a second embodiment;

figure 5 shows a perspective view of the different elements of the transmission device of the rotation motion of figure 4, with the exclusion of the spherical planetary elements;

figure 6 shows a sectional view of a device for the transmission of the rotational motion to the different components in rotation, of a spindle in accordance with the present invention, according to a third embodiment;

figure 7 shows a perspective view of the different elements of the transmission device of the rotation motion of figure 6, with the exclusion of the spherical planetary elements; and

figure 8 shows a sectional view of a transmission device of the rotation motion to the different rotation components of a spindle in accordance with the present invention, according to a fourth embodiment.

[0030] With reference to figure 1, a preferred embodiment of the multi-twisting spindle according to the present invention is schematically shown. A twisting machine comprises one or more spindles. The spindle consists of a feeding bobbin 1, onto which the thread is wound, situated inside a cylindrical basket 2, which is kept still by the magnetic attraction between one or more magnets 26, integral with the cylindrical basket 2, and corresponding fixed magnets, integral with the winding machine. An upper rotating disk 3 and a lower rotating disk 4 are situated behind the cylindrical basket 2, which rotate in opposite directions. The cylindrical basket 2 is assembled idle on the upper rotating disk 3. The yarn which is to be twisted is unwound from bobbin 1 and, by means of deflecting means, not shown, situated above the cylindrical basket 2, is directed downwards, defining an inner balloon, as far as the entry 5 of a passage 6 of the upper rotating disk 3. Running through the passage 6, the yarn radially pass through the upper rotating disk 3, from the periphery to its rotating axis, which coincides with the axis of the spindle, it then bends and continues axially as far as the lower exit 7. A deflecting pulley 8 is present in correspondence with the curve formed by the passage 6.

[0031] Through the whole passage 6 down to the lower exit 7, the yarn continues its run through a second passage 9, along the rotation axis of a hollow shaft 10, coinciding with the spindle axis. The hollow shaft 10 is maintained under rotation by means of a pulley 11, operated by a drive belt, not shown, connected to a motor.

[0032] The yarn then reaches a second deflecting pulley 12 and passes through a passage 13 of the lower rotating disk 4, integral with the hollow shaft 10. After defining a second outer balloon in its ascending run, the yarn reaches deflecting elements situated above the cylindrical basket 2, and from these is directed to collecting means.

[0033] Rotation in the opposite direction of the two rotating disks 3 and 4, allows the yarn to be subjected, during its run, to a series of twists, in particular undergoing two twists for every revolution of each rotating part.

[0034] The solution according to the present invention consists in providing the spindle with a particular element for the transmission of the motion, of the epicycloidal type, which allows the hollow shaft 10, driven by traditional systems, such as a drive belt, to impart a rotational movement in the opposite direction with respect to the upper rotating disk 3.

[0035] With reference to figures 2 and 3, in a first embodiment, the transmission device of the rotational movement according to the present invention consists of two inner rings 14 and 15, situated one above the other around the hollow shaft 10 and which rotate together with said hollow shaft 10, acting as a solar element of the epicycloidal reducer, a series of spheres 16 situated on two crowns which surround and are in contact with the surface of the lower inner ring 14 and the upper inner ring 15, respectively, which act as planetary elements, and an outer ring 17, whose inner surface surrounds and is in contact with both the crown spheres 16. The outer ring 17 is integral with the upper rotating ring 3.

[0036] The spheres 16 of the two crowns are free to rotate around themselves, but their rotation around the inner ring 14 and 15 is prevented by a planetary-holding element consisting of a cage 18, equipped with prongs 19 which define housing spaces of the spheres 16.

[0037] With reference also to figure 1, the cage 18 is coupled with a fixed disk 27, assembled on the upper rotating disk 3 by means of a ball bearing, which makes the fixed disk 27 independent of the rotation of the upper rotating disk 3, and kept immobile by means of fins having magnets 20 at the ends, attracted by corresponding magnets 21 integral with the cylindrical basket 2. The material of the cage 18 is preferably selected from those having a low friction coefficient and a good wear resistance. Whereas the spheres 16 rotate substantially without slippage on the inner rings 14 and 15 and the outer ring 17, they are in continuous contact with slippage with the prongs 19 of the cage 18, which, specifically as a result of this contact, prevent the spheres 16 from rotating around the inner rings 14 and 15.

[0038] More specifically, the lower inner ring 14 is assembled with interference on the hollow shaft 10 and

rotates together with it, whereas the upper inner ring 15 is free to slide with precise coupling on the hollow shaft 10. The lower inner ring 14 and the upper inner ring 15 are connected to each other by means of a joint 22, which prevents the reciprocal rotation of the two rings 14 and 15, without preventing however the sliding of the axis. The joint 22 may not be necessary, provided that the two inner rings 14 and 15 are equipped with flaps which, by insertion in each other, prevent the reciprocal rotation of the two rings 14 and 15 even if the axial sliding is not prevented. Assembly with clearance of the upper inner ring 15 could cause fretting corrosion phenomena due to oscillations of a small amplitude and high frequency to which it is subjected. In order to prevent this from occurring, the assembly of the upper inner ring 15 on the hollow shaft 10 must be effected after treatment of the surface of the hollow shaft 10 or with solutions suitable for avoiding the triggering of vibrations, a first cause of the above corrosion effect. For example, o-rings can be used or Nylon® ferrules. It is also possible to avoid fretting corrosion phenomena by assembling the inner rings 14 and 15 with interference on the hollow shaft 10.

[0039] The spheres 16 are assembled so as to transmit the motion according to oblique force lines with respect to the rotation axis of the epicycloidal reducer, thus also acting with an anti-overturning function, making the use of a specific anti-overturning bearing ineffective, with the consequent simplification of the device. In order to reduce the contact pressures and consequently decrease the absorptions and lengthen their life, between the spheres 16 and the inner rings 14 and 15, and outer ring 17, the contact surfaces on the rings are curved so as to correspond with the curvature of the spheres 16, i.e. according to the typical terminology of the field, radiated (like a gothic arch).

[0040] The load on the transmission device, necessary for transmitting power, is imparted on the upper crown of spheres 16 through the upper inner ring 15, on which a loading spring 23 acts, which in turn rests on a disk 24 fitted onto a specific seat of the hollow shaft 10. Only the load of the loading spring 23 weighs on the upper crown of spheres. In this way, the load can be calibrated with extreme precision and is preferably produced with elements having a non-linear characteristic so as to control the load imparted in a pre-established form also in the presence of ample tolerances and wear with time.

[0041] When both the inner rings 14 and 15 are assembled with interference on the hollow shaft 10, the presence of the loading spring 23 is not necessary, but it will be necessary to calibrate the height of the inner rings 14 and 15 so as to guarantee the necessary preloading in the contact points between the elements of the reducer.

[0042] The cage 18 does not rest on the spheres 16, thus avoiding any accelerated wear phenomenon of the cage 18 itself, contrary to the specific function of the cage 18, which is to prevent the rotation of the spheres 16 around the inner rings 14 and 15. The cage 18, on the other hand, is integral with the fixed disk 27 and is kept raised with respect to the spheres 16 due to the coupling of said fixed disk 27 with the upper rotating disk 3.

[0043] The weight of the bobbin 1 and basket 2 is concentrated, on the other hand, on the lower crown of spheres 16, through the outer ring 17. In this way, the weight is discharged onto the lower inner ring 14 and consequently onto the hollow shaft 10.

[0044] The device for the transmission of rotational movement is completed by a sealing washer 25 and grease cups suitably arranged for lubricating the movement of the spheres 16, which allow the elimination of the exhausted grease in the case of relubrication operations.

[0045] In embodiments which envisage that the upper inner ring 15 be assembled without interference onto the hollow shaft 10, the device for the transmission of rotational movement according to the present embodiment can be opened and washed.

[0046] The assembly of the device for the transmission of rotational movement according to the present invention is effected by first fitting the lower inner ring 14 (together with the joint 22 when present) onto the hollow shaft 10, then the spheres 16 of the lower crown, followed by the outer ring 17, subsequently the spheres 16 of the upper crown and then the upper inner ring 15. Finally, when present (i.e. when the upper inner ring 15 is assembled on the hollow shaft 10 without interference), the loading spring 23 and contrast disk 24 are assembled. The cage 18 is assembled after assembling the spheres 16, which must therefore be suitably distanced during assembly. The cage 18, which must be assembled on the fixed disk 27, is preferably assembled last of all, together with said fixed disk 27.

[0047] With reference to figures 4 and 5, these show a second embodiment of the device for the transmission of rotational movement to the various rotating components of a spindle according to the present invention.

[0048] The transmission device according to this embodiment differs from the previous embodiment in the form of the planetary-holder element, in this case consisting of a different cage 28, made up of a substantially cylindrical body, tapered to about half of its height and equipped with openings 29 which define housing spaces of the spheres 16. The openings 29 are substantially cylindrical with an axis oriented towards a direction along which the forces between the inner and outer elements of the reducer are transmitted.

[0049] The remaining parts of the spindle and movement transmission device, in addition to the movement transmission procedure according to this embodiment of the transmission device are identical to those of the device according to the first embodiment.

[0050] The assembly of the device for the transmission of rotational movement according to this second embodiment is effected by first fitting the lower inner ring 14 (together with the joint 22 when present) onto the hollow shaft 10, then the cage 28, followed by the spheres 16

of the lower crown (which are inserted from the outside of the cage 28 into the respective openings 29), followed by the outer ring 17, subsequently the spheres 16 of the upper crown (which are inserted from inside the cage 28 into the respective openings 29) and then the upper inner ring 15. Finally, when present (i.e. when the upper inner ring 15 is assembled on the hollow shaft 10 without interference), the loading spring 23 and contrast disk 24 are assembled.

[0051] As in the case of the first embodiment, the transmission device of rotational movement according to this embodiment can be opened and washed, at least in the embodiments wherein the upper inner ring 15 is not assembled with interference onto the shaft 10.

[0052] With reference to figures 6 and 7, these show a third embodiment of the transmission device of rotational movement to the various rotating components of a spindle according to the present invention.

[0053] Also the transmission device of this embodiment differs from the previous embodiments only in the form of the planetary-holder element, consisting of a cage 30, which represents a mixed solution between those adopted in the first two embodiments. The cage 30, in fact, has prongs 31 for the housing of the spheres 16 of the upper crown and openings 32 for the housing of the spheres 16 of the lower crown. This embodiment has expedients for simplifying the assembly of the movement transmission device.

[0054] In particular, the assembly of the movement transmission device according to this embodiment is effected by first fitting the lower inner ring 14 (together with the joint 22 when present) onto the hollow shaft 10, then the cage 30, followed by the spheres 16 of the lower crown (which are inserted from the outside of the cage 30 into the respective openings 32), followed by the outer ring 17, subsequently the spheres 16 of the upper crown (which are inserted from the upper of the cage 30 into the spaces between the prongs 31) and then the upper inner ring 15. Finally, when present (i.e. when the upper inner ring 15 is assembled on the hollow shaft 10 without interference), the loading spring 23 and contrast disk 24 are assembled. With respect to the transmission device according to the second embodiment, the assembly of the spheres 16 of the upper crown is easier, as an insertion of the spheres 16 from the inside of the cage 30 is not necessary.

[0055] The transmission device of rotational movement of this embodiment can also be opened and washed, if the upper inner ring 15 is assembled without interference on the hollow shaft 10.

[0056] Finally, with reference to figure 8, this shows a fourth embodiment of the transmission device of rotational movement to the various rotating components of a spindle according to the present invention.

[0057] The transmission device of this embodiment differs from the previous embodiments not only in the form of the planetary-holder element 33, but also in the form of the planetary elements 34. Said planetary elements 34, in fact, are in the form of a rotational solid 35, in the case shown a spherical sector, with two parallel and coaxial bases 36, equidistant from the centre of the spherical segment, in the centre of said bases, there being two cylindrical pins 37. The particular shape of the planetary elements 34 is complementary to the shape of the planetary-holder, which consists of a frame 33 with a cylindrical wall 38, equipped with a series of openings, arranged on two distinct circumferences, which define housings for said planetary elements 34, each opening also being equipped with a pair of flaps 39 with holes for the housing of the cylindrical pins 37 of said planetary elements 34.

[0058] This particular type of coupling between the planetary-holder 33 and the planetary elements 34, represents a solution which allows the entire assembly of the planetary-holder 33 and the planetary elements 34, together with the outer ring of the transmission device (not shown but completely identical to the outer ring 17 illustrated with reference to the previous figures) facilitating the subsequent assembly of the system of planetary-holder-planetary elements-outer ring in the spindle.

[0059] The assembly of the movement transmission device according to this fourth embodiment is in fact effected by first fitting the lower inner ring 14 (together with the joint 22 when present) onto the hollow shaft 10, then the block system consisting of the planetary-holders 33, planetary elements 34 and outer ring, and subsequently the upper inner ring 15. Finally, as in the previous cases, when present (i.e. when the upper inner ring 15 is assembled on the hollow shaft 10 without interference), the loading spring 23 and the contrast disk 24 are assembled.

[0060] The rotational movement transmission device according to this embodiment can also be opened and washed, if the upper inner ring 15 is assembled without interference on the hollow shaft 10.

[0061] The present invention is described for illustrative but non-limiting purposes according to its preferred embodiments. It is understood, however, that variations and/or modifications can be applied by experts in the field, all included in the relative protection scope, as defined by the enclosed claims.

Claims

1. A four-for-one twisting spindle for twisting machines of textile yarns, comprising a cylindrical basket (2), kept still and inside which a feeding bobbin (1) is supported, an upper rotating part (3) and a lower rotating part (4), situated below the cylindrical basket (2), and coaxial thereto, which rotate in opposite directions to each other and define a first passage (6) and a second passage (9) of the yarn, respectively, along the run of the yarn, said run being further defined by a deflecting element situated above the bobbin (1), said upper rotating part (3) or said lower rotating part (4) being operated by external movement

transmission means and transmitting the motion to said lower rotating part (4) or to said upper rotating part (3), by means of an epicycloidal transmission device, wherein the planetary elements (16, 34) rotate around themselves and are maintained in the same position by means of a planetary-holder element (18, 28, 30, 33) and are arranged so as to form two crowns, a lower crown and an upper crown respectively, the planetary elements (16, 34) of each of said two crowns transmitting forces, which are exerted between the components of said epicycloidal transmission device, along oblique force lines, the planetary elements (16, 34) of at least one of said two crowns transmitting forces converging downwards, so as to transmit the weight of the spindle, which is concentrated on said upper rotating part (3) to said lower rotating part (4) **characterized by** a deflecting element (8) positioned along said first passage (6) and a deflecting element (12) situated along said second passage (9) and by an epicycloidal transmission device whose internal element is integral with said lower rotating part (4) and whose outer element is integral with said upper rotating part (3).

2. The spindle according to claim 1, **characterized in that** the planetary elements (16, 34) of one of said two crowns transmit forces along downward converging force lines and the planetary elements (16, 34) of the other of said two crowns transmit forces along upward converging force lines.

3. The spindle according to claim 2, **characterized in that** the weight of the spindle is transmitted by means of the planetary elements (16, 34) of the lower crown.

4. The spindle according to claim 3, **characterized in that** the inner element of said epicycloidal transmission device consists of a lower inner ring (14) and an upper inner ring (15) and the outer element of said epicycloidal transmission device consists of at least one outer ring (17).

5. The spindle according to claim 4, **characterized in that** said lower inner ring (14) and said upper inner ring (15) are assembled with interference on a rotating shaft (10) which rotates integrally with said lower rotating part (4) and said at least one outer ring (17) is assembled with interference on said upper rotating part (3).

6. The spindle according to claim 4, **characterized in that** said upper inner ring (15) is free to move along the direction of the rotation axis, a loading spring (23) and a joint (22) acting thereon, which prevents rotation with respect to said lower inner ring (14).

7. The spindle according to claim 4, **characterized in that** said outer element of said epicycloidal transmission device consists of a lower outer ring and an upper outer ring, said lower outer ring being assembled with interference on said upper rotating part (3) and said upper outer ring being free to move along the direction of the rotation axis, a loading spring and a joint acting thereon, which prevents rotation with respect to said lower outer ring.

8. The spindle according to claim 2, **characterized in that** the weight of the spindle is transmitted by means of the planetary elements (16, 34) of the upper crown.

9. The spindle according to claim 8, **characterized in that** the inner element of said epicycloidal transmission device consists of an inner ring and the outer element of said epicycloidal transmission device consists of a lower outer ring and an upper outer ring.

10. The spindle according to claim 9, **characterized in that** said at least one inner ring is assembled with interference on a rotating shaft (10) which rotates integrally with said lower rotating part (4), and said lower outer ring and said upper outer ring are assembled with interference on said upper rotating part (4).

11. The spindle according to claim 9, **characterized in that** said lower outer ring is free to move along the direction of the rotation axis, a loading spring and joint acting thereon, which prevents rotation with respect to said upper outer ring.

12. The spindle according to claim 9, **characterized in that** the inner element of said epicycloidal transmission device consists of a lower inner ring and an upper inner ring, said upper inner ring being assembled with interference on a rotating shaft (10) which rotates integrally with said lower rotating part (4) and said lower inner ring being free to move along the direction of the rotation axis, a loading spring and joint acting thereon, which prevents rotation with respect to said upper inner ring.

13. The spindle according to claim 1, **characterized in that** the weight of said planetary-holder (18, 28, 30, 33) is directly concentrated on the planetary elements (16, 34) of one of said two crowns.

14. The spindle according to claim 1, **characterized in that** the weight of said planetary-holder (18, 28, 30, 33) is not directly concentrated on the planetary elements (16, 34) of any of said two crowns, as it is sustained by the structure of the spindle.

15. The spindle according to claim 1, **characterized in that** said planetary elements (16, 34) are in the form of spheres, rolls or similar forms or derivatives, said inner rings and said outer rings comprising tracks

which adapt to the form of said planetary elements (16, 34) so as to increase the contact surface.

16. The spindle according to claim 15, **characterized in that** said planetary-holder consists of a cage (18) with a substantially cylindrical body equipped with a series of prongs (19) arranged along the generatrices of the cylindrical body and which define housing spaces between each other for said planetary elements (16).

17. The spindle according to claim 15, **characterized in that** said planetary-holder element consists of a cage (28) with a substantially cylindrical body equipped with a series of openings (29) arranged on two distinct circumferences, which define housing spaces for said planetary elements (16).

18. The spindle according to claim 15, **characterized in that** said planetary-holder consists of a cage (30) with a substantially cylindrical body equipped with a series of prongs (31) arranged along the generatrices of the cylindrical body and which define housing spaces for the planetary elements (16) belonging to the upper crown and a series of openings (32) which define housing spaces for the planetary elements (16) belonging to the lower crown.

19. The spindle according to claim 1, **characterized in that** said planetary elements (34) are in the form of a rotation solid (35) with two bases (36) with two parallel and coaxial bases at whose the centre there are two cylindrical pins (37), said planetary-holder consisting of a frame (33) with a cylindrical wall (38), equipped with a series of openings, situated on two different circumferences, which define housings for said planetary elements (34), each opening also being equipped with a pair of flaps (39) with holes for the housing of said cylindrical pins (37).

20. The spindle according to claim 1, **characterized in that** the contact tracks of said elements of said epicycloidal transmission device with said planetary elements (16, 34) are curved so as to correspond with the curvature of the surface of the planetary elements (16, 34).

Patentansprüche

1. Vierfachdraht-Zwirnspindel für Zwirnmaschinen für Textilgarne, umfassend einen zylindrischen Korb (2), der sich nicht bewegt und in dem eine Zuführspule (1) aufliegt, und ein oberes Drehteil (3) und ein unteres Drehteil (4), die unter dem zylindrischen Korb (2) und koaxial zu diesem angeordnet sind, sich in einander entgegengesetzte Richtungen drehen und einen ersten Durchgang (6) beziehungsweise einen zweiten Durchgang (9) für das Garn längs des Verlaufs des Garns definieren, wobei dieser Verlauf des Weiteren durch ein über der Spule (1) befindliches Ablenkelement definiert wird, wobei das obere Drehteil (3) oder das untere Drehteil (4) durch externe Bewegungsübertragungsmittel betätigt werden und die Bewegung auf das untere Drehteil (4) oder das obere Drehteil (3) mit Hilfe einer Planetengetriebevorrichtung übertragen wird, wobei sich die Planetenelemente (16, 34) um sich selbst drehen und mit Hilfe eines Planetenhalterelements (18, 28, 30, 33) in derselben Position gehalten werden und so angeordnet sind, dass sie zwei Kränze, einen unteren Kranz beziehungsweise einen oberen Kranz, bilden, wobei die Planetenelemente (16, 34) von jedem der zwei Kränze Kräfte übertragen, die zwischen den Komponenten der Planetengetriebevorrichtung entlang schrägen Kraftlinien ausgeübt werden, wobei die Planetenelemente (16, 34) von mindestens einem der zwei Kränze nach unten konvergierende Kräfte übertragen, um das Gewicht der Spindel, das auf das obere Drehteil (3) konzentriert ist, auf das untere Drehteil (4) zu übertragen, **gekennzeichnet durch** ein längs des ersten Durchgangs (6) angeordnetes Ablenkelement (8) und ein längs des zweiten Durchgangs (9) angeordnetes Ablenkelement (12) und **durch** eine Planetengetriebevorrichtung, deren inneres Element mit dem unteren Drehteil (4) ein Ganzes bildet und deren äußeres Element mit dem oberen Drehteil (3) ein Ganzes bildet.

2. Spindel nach Anspruch 1, **dadurch gekennzeichnet, dass** die Planetenelemente (16, 34) von einem der zwei Kränze entlang nach unten konvergierenden Kraftlinien Kräfte übertragen und die Planetenelemente (16, 34) des anderen der zwei Kränze entlang nach oben konvergierenden Kraftlinien Kräfte übertragen.

3. Spindel nach Anspruch 2, **dadurch gekennzeichnet, dass** das Gewicht der Spindel mittels der Planetenelemente (16, 34) des unteren Kranzes übertragen wird.

4. Spindel nach Anspruch 3, **dadurch gekennzeichnet, dass** das innere Element der Planetengetriebevorrichtung aus einem unteren Innenring (14) und einem oberen Innenring (15) besteht und das äußere Element der Planetengetriebevorrichtung aus mindestens einem Außenring (17) besteht.

5. Spindel nach Anspruch 4, **dadurch gekennzeichnet, dass** der untere Innenring (14) und der obere Innenring (15) mit Presspassung auf eine Drehwelle (10) montiert sind, die sich als Ganzes mit dem unteren Drehteil (4) dreht, und dass mindestens ein Außenring (17) mit Presspassung auf das obere Drehteil (3) montiert ist.

6. Spindel nach Anspruch 4, **dadurch gekennzeichnet, dass** sich der obere Innenring (15) entlang der Richtung der Drehachse bewegen kann, wobei eine Belastungsfeder (23) und ein Verbindungsstück (22) auf denselben wirken, was eine Drehung gegenüber dem unteren Innenring (14) verhindert.

7. Spindel nach Anspruch 4, **dadurch gekennzeichnet, dass** das äußere Element der Planetengetriebevorrichtung aus einem unteren Außenring und einem oberen Außenring besteht, wobei der untere Außenring mit Presspassung auf das obere Drehteil (3) montiert ist und sich der obere Außenring entlang der Richtung der Drehachse bewegen kann, wobei eine Belastungsfeder und ein Verbindungsstück auf denselben wirken, was eine Drehung gegenüber dem unteren Außenring verhindert.

8. Spindel nach Anspruch 2, **dadurch gekennzeichnet, dass** das Gewicht der Spindel mit Hilfe der Planetenelemente (16, 34) des oberen Kranzes übertragen wird.

9. Spindel nach Anspruch 8, **dadurch gekennzeichnet, dass** das innere Element der Planetengetriebevorrichtung aus einem Innenring besteht und das äußere Element der Planetengetriebevorrichtung aus einem unteren Außenring und einem oberen Außenring besteht.

10. Spindel nach Anspruch 9, **dadurch gekennzeichnet, dass** mindestens ein Innenring mit Presspassung auf eine Drehwelle (10) montiert ist, die sich als Ganzes mit dem unteren Drehteil (4) dreht, und dass der untere Außenring und der obere Außenring mit Presspassung auf das obere Drehteil (4) montiert sind.

11. Spindel nach Anspruch 9, **dadurch gekennzeichnet, dass** sich der untere Außenring entlang der Richtung der Drehachse bewegen kann, wobei eine Belastungsfeder und ein Verbindungsstück auf denselben wirken, was eine Drehung gegenüber dem oberen Außenring verhindert.

12. Spindel nach Anspruch 9, **dadurch gekennzeichnet, dass** das innere Element der Planetengetriebevorrichtung aus einem unteren Innenring und einem oberen Innenring besteht, wobei der obere Innenring mit Presspassung auf eine Drehwelle (10) montiert ist, die sich als Ganzes mit dem unteren Drehteil (4) dreht, und sich der untere Innenring entlang der Richtung der Drehachse bewegen kann, wobei eine Belastungsfeder und ein Verbindungsstück auf denselben wirken, was die Drehung gegenüber dem oberen Innenring verhindert.

13. Spindel nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gewicht des Planetenhalters (18, 28, 30, 33) direkt auf die Planetenelemente (16, 34) von einem der zwei Kränze konzentriert ist.

14. Spindel nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gewicht des Planetenhalters (18, 28, 30, 33) nicht direkt auf die Planetenelemente (16, 34) von einem der zwei Kränze konzentriert ist, da es von der Spindelkonstruktion getragen wird.

15. Spindel nach Anspruch 1, **dadurch gekennzeichnet, dass** die Planetenelemente (16, 34) die Form von Kugeln, Rollen oder ähnlichen Formen oder Ableitungen haben, wobei die Innenringe und die Außenringe Bahnen umfassen, die sich an die Form dieser Planetenelemente (16, 34) anpassen, um die Berührungsfläche zu vergrößern.

16. Spindel nach Anspruch 15, **dadurch gekennzeichnet, dass** der Planetenhalter aus einem Käfig (18) mit einem im Wesentlichen zylindrischen Körper besteht, der mit einer Reihe von Zacken (19) versehen ist, die längs der Mantellinien des zylindrischen Körpers angeordnet sind und zwischen einander Aufnahmeräume für die Planetenelemente (16) definieren.

17. Spindel nach Anspruch 15, **dadurch gekennzeichnet, dass** das Planetenhalterelement aus einem Käfig (28) mit einem im Wesentlichen zylindrischen Körper besteht, der mit einer Reihe von auf zwei verschiedenen Umfängen angeordneten Öffnungen (29) versehen ist, die Aufnahmeräume für die Planetenelemente (16) definieren.

18. Spindel nach Anspruch 15, **dadurch gekennzeichnet, dass** der Planetenhalter aus einem Käfig (30) mit einem im Wesentlichen zylindrischen Körper besteht, der mit einer Reihe von Zacken (31), die längs der Mantellinien des zylindrischen Körpers angeordnet sind und Aufnahmeräume für die zum oberen Kranz gehörenden Planetenelemente (16) definieren, und einer Reihe von Öffnungen (32) versehen ist, die Aufnahmeräume für die zum unteren Kranz gehörenden Planetenelemente (16) definieren.

19. Spindel nach Anspruch 1, **dadurch gekennzeichnet, dass** die Planetenelemente (34) die Form eines Rotationskörpers (35) mit zwei parallelen und koaxialen Grundflächen (36) haben, in deren Mitte sich zwei zylindrische Stifte (37) befinden, wobei der Planetenhalter aus einem Rahmen (33) mit einer zylindrischen Wand (38) besteht, die mit einer Reihe von auf zwei verschiedenen Umfängen angeordneten Öffnungen versehen ist, die Aufnahmen für die Planetenelemente (34) definieren, wobei jede Öffnung außerdem mit einem Paar Laschen (39) mit Löchern zum Aufnehmen der zylindrischen Stifte (37) verse-

hen ist.

20. Spindel nach Anspruch 1, **dadurch gekennzeichnet, dass** die Bahnen für den Kontakt der Elemente der Planetengetriebevorrichtung mit den Planetenelementen (16, 34) so gekrümmt sind, dass sie der Krümmung der Oberfläche der Planetenelemente (16, 34) entsprechen.

Revendications

1. Broche à retordre à quadruple torsion pour des métiers à retordre de fils textiles, comprenant un panier cylindrique (2), maintenu immobile et à l'intérieur duquel une bobine d'alimentation (1) est supportée, une partie rotative supérieure (3) et une partie rotative inférieure (4), situées au-dessous du panier cylindrique (2) et coaxiales avec celui-ci, qui tournent dans des directions opposées entre elles et définissent un premier passage (6) et un deuxième passage (9) du fil, respectivement, suivant le parcours du fil, ledit parcours étant défini en outre par un élément de déviation situé au-dessus de la bobine (1), ladite partie rotative supérieure (3) ou ladite partie rotative inférieure (4) étant actionnée par un moyen de transmission de mouvement externe et transmettant le mouvement à ladite partie rotative inférieure (4) ou à ladite partie rotative supérieure (3), au moyen d'un dispositif de transmission épicycloïdal, dans lequel les éléments planétaires (16, 34) tournent autour d'eux-mêmes et sont maintenus dans la même position au moyen d'un élément porte-planétaires (18, 28, 30, 33) et sont agencés de manière à former deux croix, respectivement une croix inférieure et une croix supérieure, les éléments planétaires (16, 34) de chacune desdites deux croix transmettant des forces qui sont exercées entre les composants dudit dispositif de transmission épicycloïdal, suivant des lignes de force obliques, les éléments planétaires (16, 34) d'au moins une desdites deux croix transmettant des forces convergeant vers le bas, de manière à transmettre le poids de la broche, lequel est concentré sur ladite partie rotative supérieure (3), à ladite partie rotative inférieure (4), **caractérisée par** un élément de déviation (8) positionné le long dudit premier passage (6) et un élément de déviation (12) situé le long dudit deuxième passage (9) et par un dispositif de transmission épicycloïdal dont l'élément intérieur est d'une seule pièce avec ladite partie rotative inférieure (4) et dont l'élément extérieur est d'une seule pièce avec ladite partie rotative supérieure (3).

2. Broche selon la revendication 1, **caractérisée en ce que** les éléments planétaires (16, 34) d'un desdites deux croix transmettent des forces suivant des ligne de force convergeant vers le bas et les éléments planétaires (16, 34) de l'autre desdites deux croix transmettent des forces suivant des lignes de force convergeant vers le haut.

3. Broche selon la revendication 2, **caractérisée en ce que** le poids de la broche est transmis au moyen des éléments planétaires (16, 34) de la croix inférieure.

4. Broche selon la revendication 3, **caractérisée en ce que** l'élément intérieur dudit dispositif de transmission épicycloïdal consiste en un anneau intérieur inférieur (14) et un anneau intérieur supérieur (15) et l'élément extérieur dudit dispositif de transmission épicycloïdal consiste en au moins un anneau extérieur (17).

5. Broche selon la revendication 4, **caractérisée en ce que** ledit anneau intérieur inférieur (14) et ledit anneau intérieur supérieur (15) sont assemblés avec interférence sur un arbre rotatif (10) qui tourne intégralement avec ladite partie rotative inférieure (4) et ledit au moins un anneau extérieur (17) est assemblé avec interférence sur ladite partie rotative supérieure (3).

6. Broche selon la revendication 4, **caractérisée en ce que** ledit anneau intérieur supérieur (15) est libre de se déplacer suivant la direction de l'axe de rotation, un ressort de charge (23) et un joint (22) agissant sur celui-ci, lequel empêche une rotation par rapport audit anneau intérieur inférieur (14).

7. Broche selon la revendication 4, **caractérisée en ce que** ledit élément extérieur dudit dispositif de transmission épicycloïdal consiste en un anneau extérieur inférieur et un anneau extérieur supérieur, ledit anneau extérieur inférieur étant assemblé avec interférence sur ladite partie rotative supérieure (3) et ledit anneau extérieur supérieur étant libre de se déplacer suivant la direction de l'axe de rotation, un ressort de charge et un joint agissant sur celui-ci, lequel empêche la rotation par rapport audit anneau extérieur inférieur.

8. Broche selon la revendication 2, **caractérisée en ce que** le poids de la broche est transmis au moyen des éléments planétaires (16, 34) de la croix supérieure.

9. Broche selon la revendication 8, **caractérisée en ce que** l'élément intérieur dudit dispositif de transmission épicycloïdal consiste en un anneau intérieur et l'élément extérieur dudit dispositif de transmission épicycloïdal consiste en un anneau extérieur inférieur et un anneau extérieur supérieur.

10. Broche selon la revendication 9, **caractérisée en**

ce que l'au moins un anneau intérieur est assemblé avec interférence sur un arbre rotatif (10) qui tourne intégralement avec ladite partie rotative inférieure (4) et ledit anneau extérieur inférieur et ledit anneau extérieur supérieur sont assemblés avec interférence sur ladite partie rotative supérieure (4).

11. Broche selon la revendication 9, **caractérisée en ce que** ledit anneau extérieur inférieur est libre de se déplacer suivant la direction de l'axe de rotation, un ressort de charge et un joint agissant sur celui-ci, lequel empêche la rotation par rapport audit anneau extérieur supérieur.

12. Broche selon la revendication 9, **caractérisée en ce que** ledit élément intérieur dudit dispositif de transmission épicycloïdal consiste en un anneau intérieur inférieur et un anneau intérieur supérieur, ledit anneau intérieur supérieur étant assemblé avec interférence sur un arbre rotatif (10) qui tourne intégralement avec ladite partie rotative inférieure (4) et ledit anneau intérieur inférieur étant libre de se déplacer suivant la direction de l'axe de rotation, un ressort de charge et un joint agissant sur celui-ci, lequel empêche la rotation par rapport audit anneau intérieur supérieur.

13. Broche selon la revendication 1, **caractérisée en ce que** le poids dudit porte-planétaires (18, 28, 30, 33) est directement concentré sur les éléments planétaires (16, 34) de l'une desdites deux croix.

14. Broche selon la revendication 1, **caractérisée en ce que** le poids dudit porte-planétaires (18, 28, 30, 33) n'est pas directement concentré sur les éléments planétaires (16, 34) de l'une quelconque desdites deux croix, du fait qu'il est soutenu par la structure de la broche.

15. Broche selon la revendication 1, **caractérisée en ce que** lesdits éléments planétaires (16, 34) sont sous la forme de sphères, rouleaux ou formes similaires ou dérivés, lesdits anneaux intérieurs et lesdits anneaux extérieurs comprenant des pistes qui s'adaptent à la forme desdits éléments planétaires (16, 34) de manière à augmenter la surface de contact.

16. Broche selon la revendication 15, **caractérisée en ce que** ledit porte-planétaires consiste en une cage (18) avec un corps sensiblement cylindrique muni d'une série de branches (19) agencées suivant les génératrices du corps cylindrique et qui définissent des espaces de logement entre elles pour lesdits éléments planétaires (16).

17. Broche selon la revendication 15, **caractérisée en ce que** ledit élément porte-planétaires consiste en une cage (28) avec un corps sensiblement cylindrique pourvu d'une série d'ouvertures (29) agencées sur deux circonférences distinctes, lesquelles définissent des espaces de logement pour lesdits éléments planétaires (16).

18. Broche selon la revendication 15, **caractérisée en ce que** ledit porte-planétaires consiste en une cage (30) avec un corps sensiblement cylindrique muni d'une série de branches (31) agencées suivant les génératrices du corps cylindrique et qui définissent des espaces de logement pour les éléments planétaires (16) appartenant à la croix supérieure et une série d'ouvertures (32) qui définissent des espaces de logement pour les éléments planétaires (16) appartenant à la croix inférieure.

19. Broche selon la revendication 1, **caractérisée en ce que** lesdits éléments planétaires (34) sont sous la forme d'un solide de rotation (35) avec deux bases (36) avec deux bases parallèles et coaxiales au centre desquelles se trouvent deux goupilles cylindriques (37), ledit porte-planétaires consistant en un cadre (33) avec une paroi cylindrique (38), muni d'une série d'ouvertures, situées sur deux circonférences différentes, qui définissent des logements pour lesdits éléments planétaires (34), chaque ouverture étant également pourvue d'une paire de volets (39) avec des trous pour le logement desdites goupilles cylindriques (37).

20. Broche selon la revendication 1, **caractérisée en ce que** les pistes de contact desdits éléments dudit dispositif de transmission épicycloïdal avec lesdits éléments planétaires (16, 34) sont courbes de manière à correspondre à la courbure de la surface des éléments planétaires (16, 34).

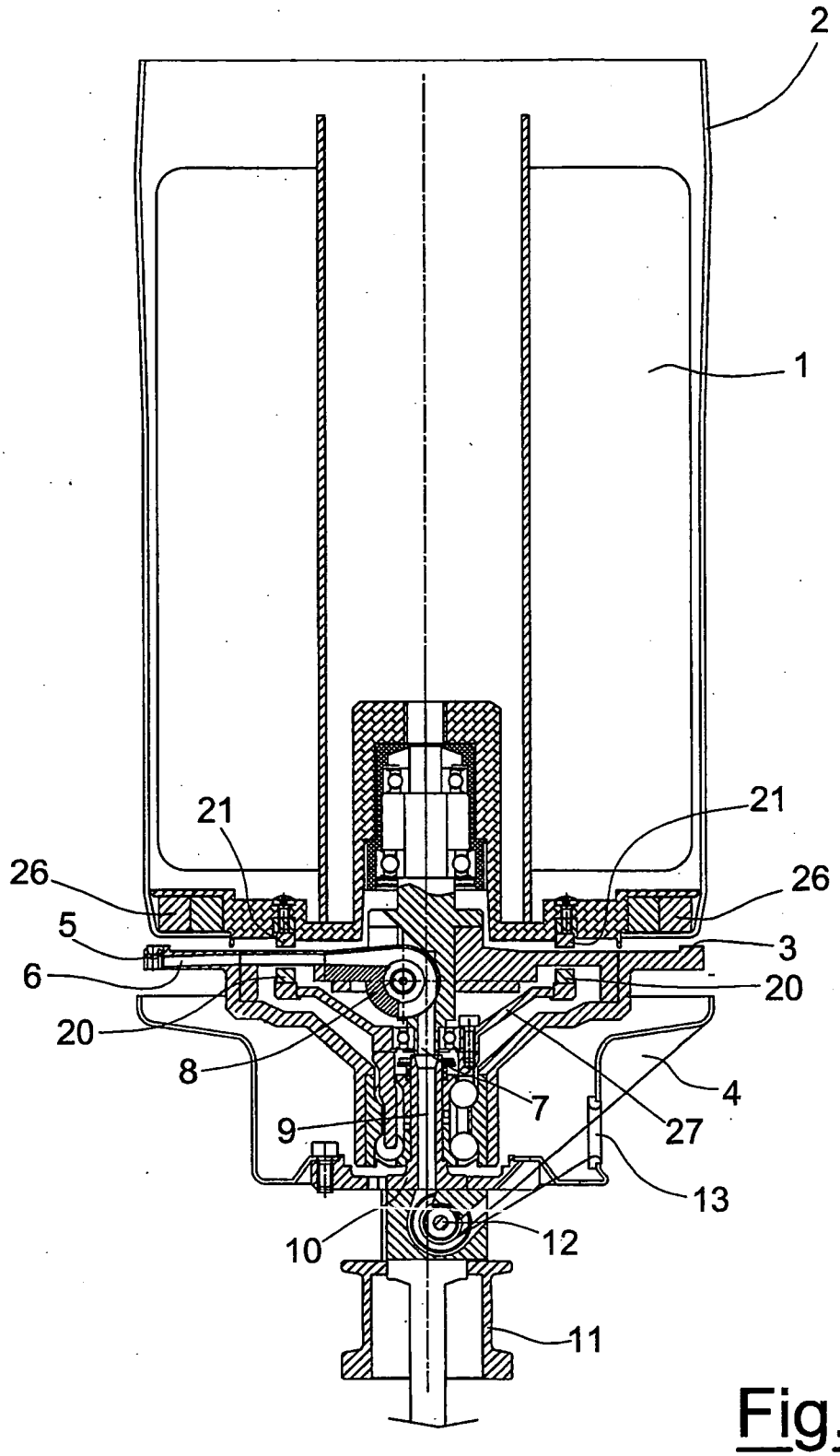


Fig. 1

Fig. 2

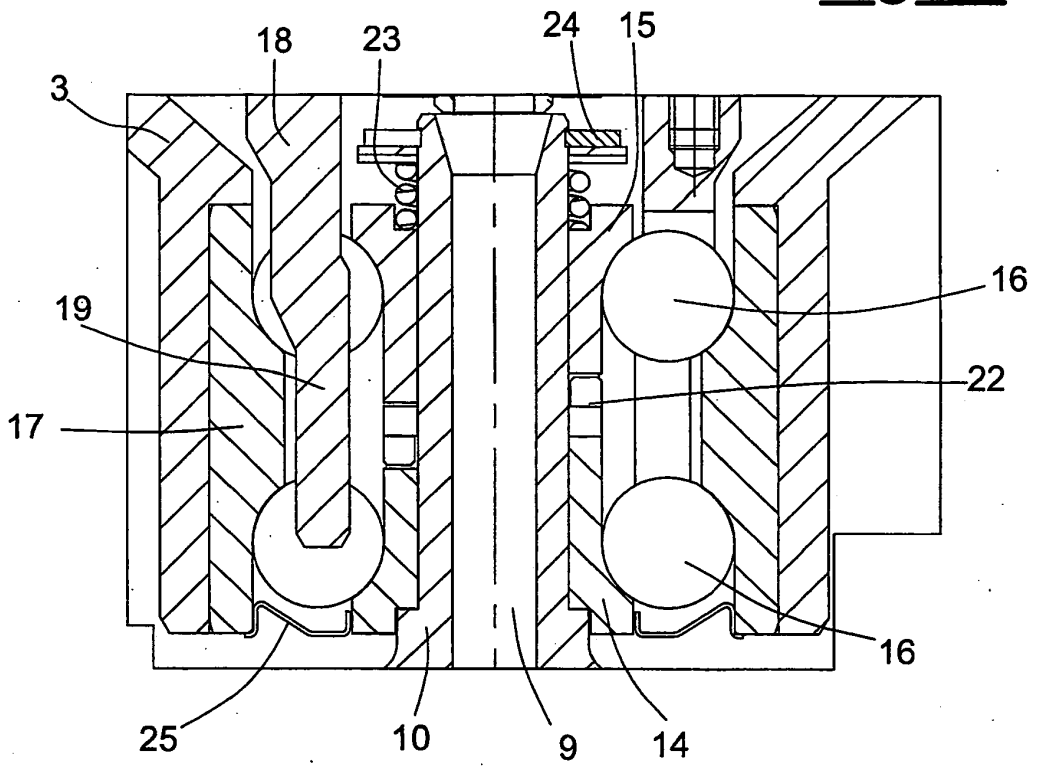
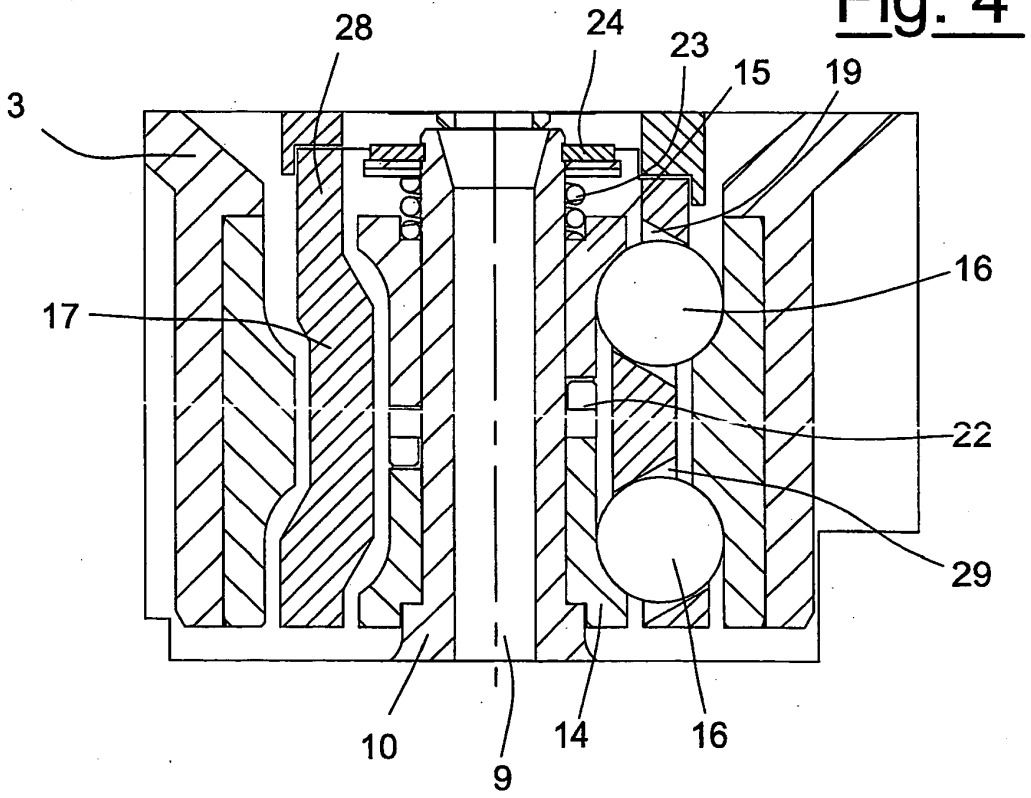

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Fig. 4


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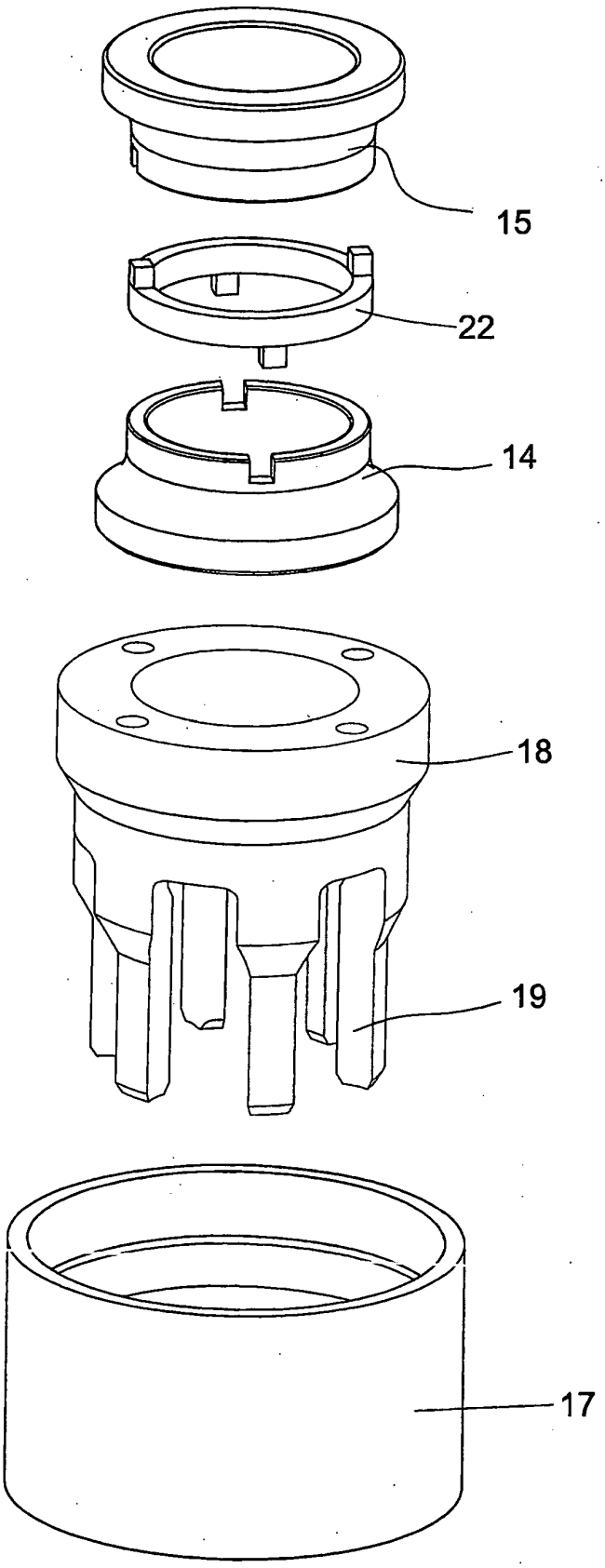


Fig. 3

Fig. 5

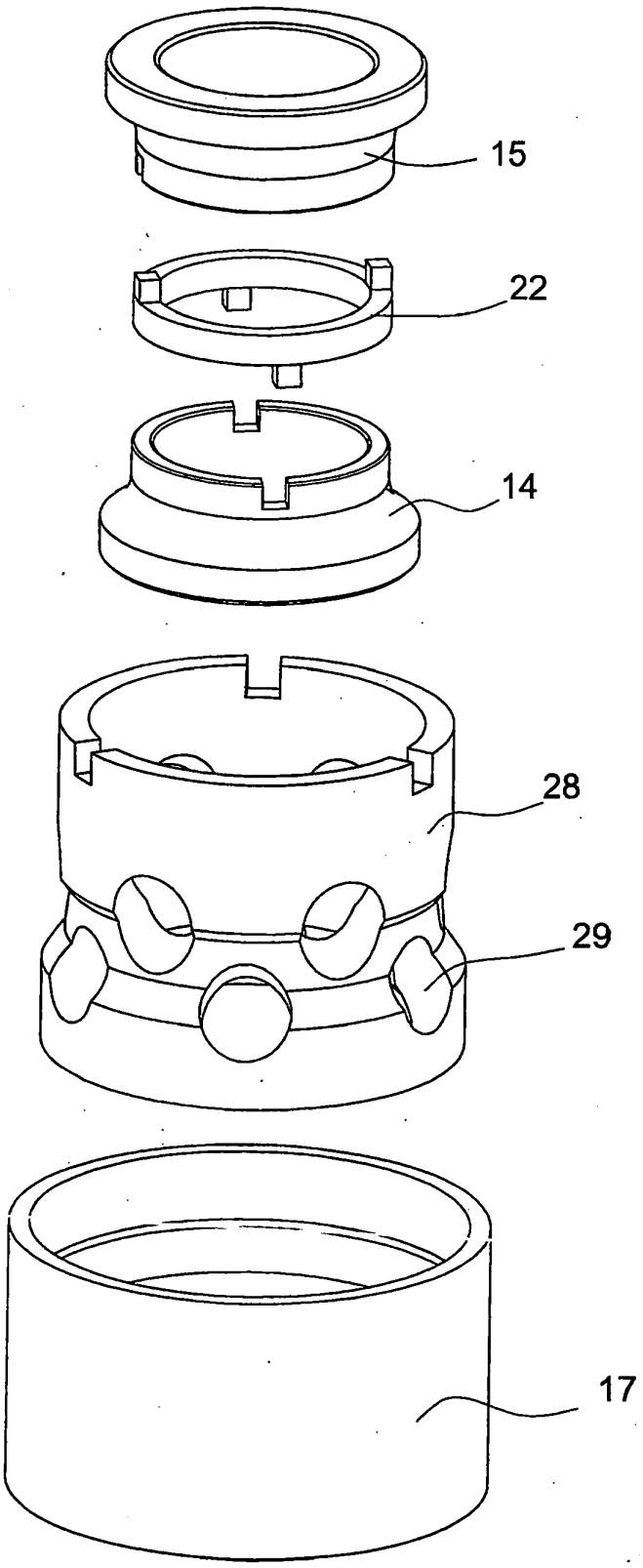


Fig. 6

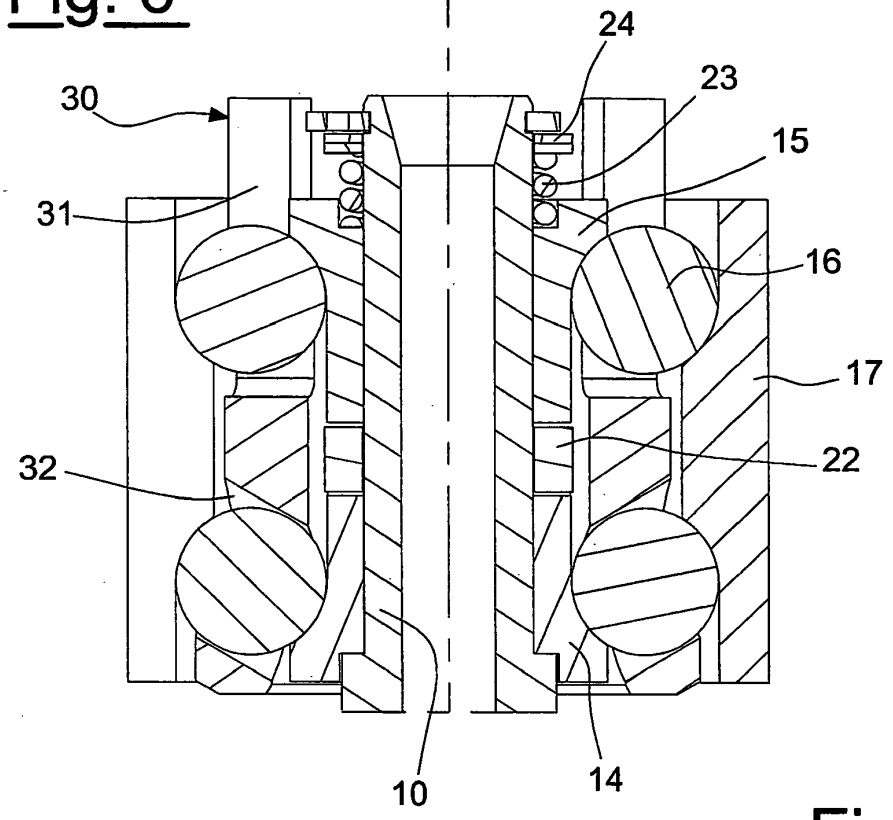
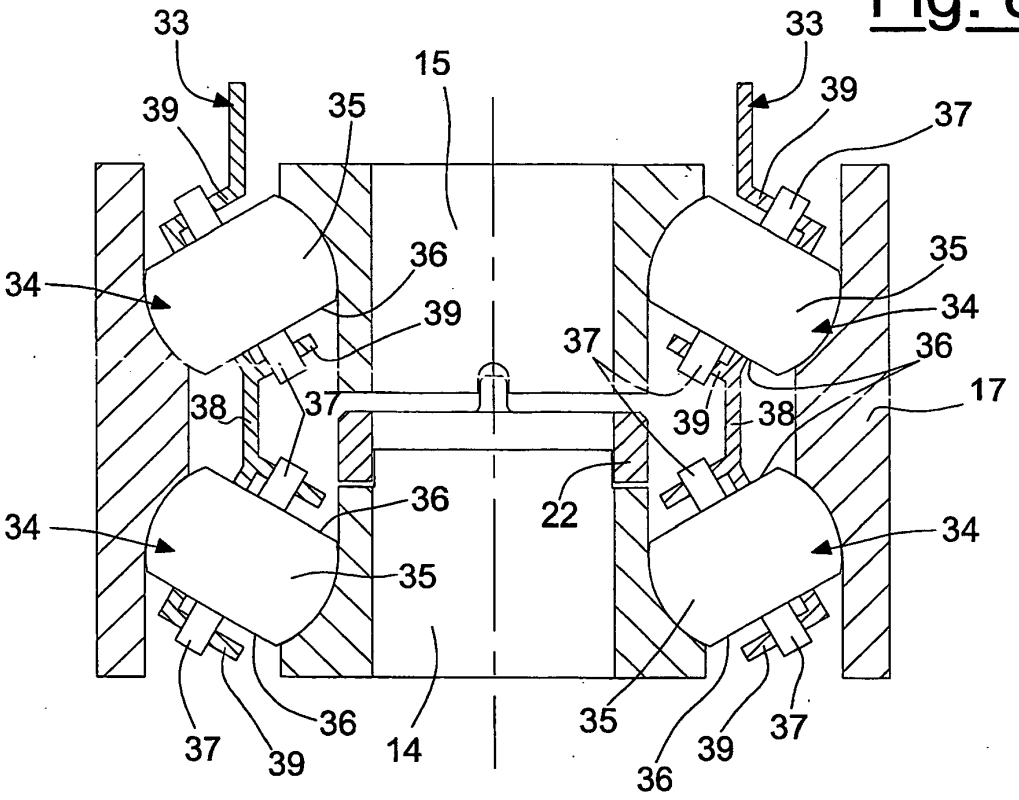

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Fig. 8


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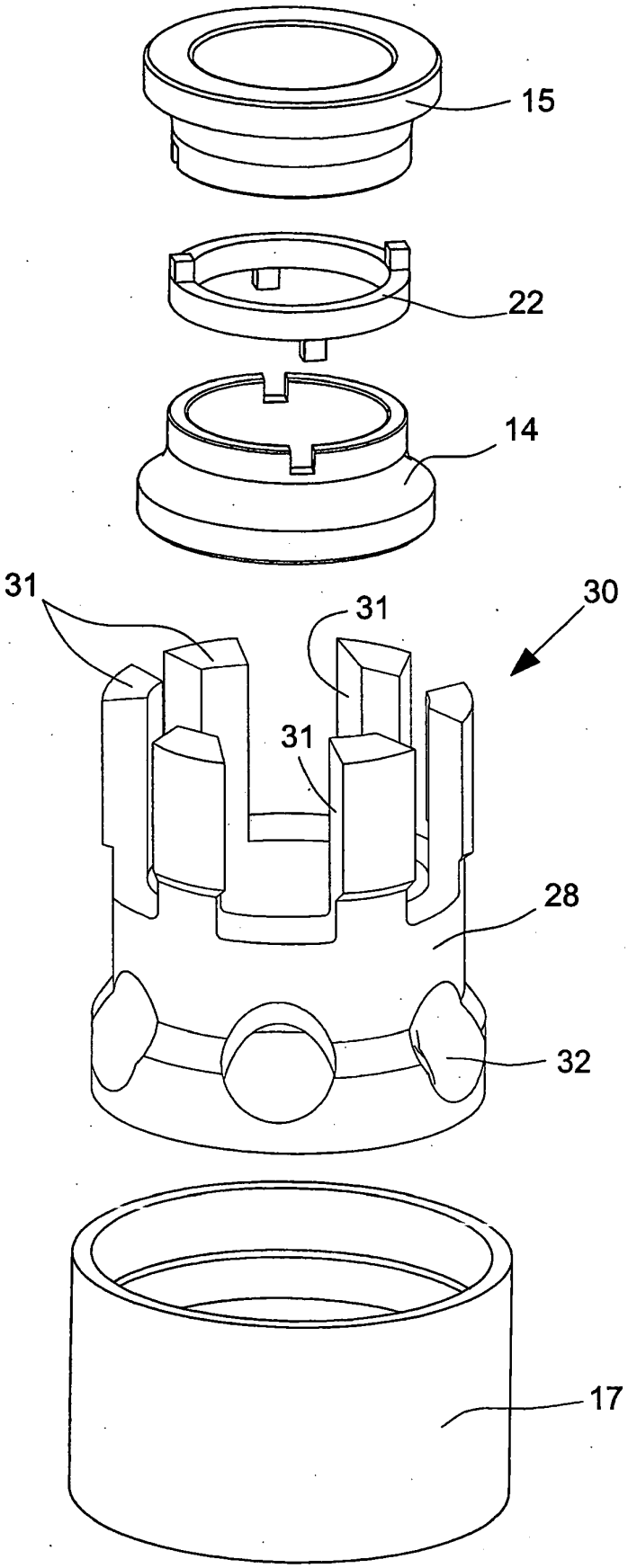


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- EP 0611841 A **[0007] [0009] [0011] [0012] [0014] [0015]**