The invention relates to a telescopic column with one outer and at least one inner rod element capable of telescoping relative to each other, where at least the outer rod element surrounds at least one ball arrangement with at least one ball, which acts as a rolling bearing between the outer and inner rod elements during telescoping movement. In order to create a telescopic column which, while having a low weight and low manufacturing costs, displays high lateral stability, the at least one inner rod element is provided with a longitudinal groove, which surrounds part of the circumference of at least one ball of the ball arrangement and serves as a ball guide. The longitudinal groove can provide two or more laterally separated running surfaces for the at least one ball. An area with a larger radial distance can be provided on at least one rod element between adjacent running tracks for an assigned ball, this being able to act as an abutment for the ball in the manner of an overload protector.
TELESCOPIC COLUMN

TECHNICAL FIELD

[0001] The invention relates to a telescopic column with one outer and at least one inner rod element capable of telescoping relative to each other, where at least the outer rod element surrounds at least one ball arrangement with at least one ball, which acts as a rolling bearing between the outer and inner rod elements during telescoping movement.

BACKGROUND OF THE INVENTION

[0002] Generic telescopic columns are known for a wide variety of applications. In particular, telescopic columns of this kind are used in variable-height furniture or furniture elements, such as variable-height tables, desks and the like, or in other variable-height or laterally displaceable furnishings. However, generic telescopic columns are also used in other fields, such as in mechanical engineering.

[0003] Generic telescopic columns are known in which the outer rod element consists of a section of tubing with an essentially rectangular cross-section, with a section of tubing with a roughly oval cross-section arranged coaxially to it. Provided as the rolling bearings between the two telescoping rod elements are balls, which roll on the inner surface of the outer rod element and the rounded outer surfaces of the inner rod element. It has proven to be disadvantageous in telescopic columns of this kind that they display a lateral stability which is insufficient for certain applications because, when exposed to lateral forces exceeding a certain intensity, undefined deformation of the ball running surfaces results, particularly on the inner rod element. This deformation also results in uncontrollable deformation of the areas adjacent to the ball running surfaces, this resulting in undesirable and undefined play between the telescoping rod elements.

[0004] However, for certain applications of telescopic columns, and especially in the furniture sector, e.g. in variable-length table or desk legs, it is necessary to have high lateral stability, as well as torsional stability. Although the lateral stability can be improved by increasing the wall thickness of the rod elements, these results in additional weight and manufacturing costs. Moreover, it should take as little force as possible to telescope the telescopic column.

SUMMARY OF THE INVENTION

[0005] The object of the invention is thus to create a generic telescopic column which, while having a low weight and low manufacturing costs, displays high lateral and torsional stability and can be telescoped by applying little force.

[0006] According to the invention, the object is solved by a telescopic column in which at least the inner rod element displays a longitudinal groove, which surrounds part of the circumference of the at least one ball of the ball arrangement and serves as a ball guide. As a result of providing the groove, part of the circumference of the ball is still surrounded by the groove even after deformation of the ball running surface or of an adjacent area of the rod element, meaning that defined guidance of the ball is still possible. Moreover, the groove, which surrounds part of the circumference of the ball and has a convex curvature relative to the center point of the ball, provide a profile which is relatively resistant to deformation when exposed to forces perpendicular to the groove opening.

[0007] The inner rod element is preferably provided with several ball arrangements distributed around the circumference, so that the rod element can absorb forces in all directions perpendicular to its longitudinal extension via the balls. In this context, all the balls assigned to one or all rod element(s) can be guided in longitudinal grooves that surround part of the circumference of the respective balls and are designed as ball guides. If appropriate, however, only some of the balls may be assigned to corresponding longitudinal grooves.

[0008] The longitudinal grooves of the inner rod element are preferably of linear design, although an arc-shaped, e.g. spiral, configuration can also be used, if appropriate.

[0009] It has proven to be particularly advantageous if, in the longitudinal groove of the at least one inner rod element, two or more, laterally separated ball running surfaces, which preferably run parallel to the longitudinal extension of the assigned groove, are assigned to at least one or all of the balls. The lateral spacing of the running surfaces permits better absorption of lateral forces acting on the telescoping arm by the groove. Moreover, the lateral spacing of the running surfaces makes it possible to adjust the ratio of the movements of adjacent rod elements relative to each other to the coupled movement of the corresponding balls. The term “running surfaces” is generally taken here to mean any areas of contact between the rod element and the ball for guidance of the same. These may, for example, be of groove-type design and of more or less great width.

[0010] Additionally or alternatively, the inner side of the outer rod element relative to a ball arrangement can surround part of the circumference of at least one ball, where preferably two or more, laterally separated running tracks are provided for the respective ball.

[0011] The number and spacing of the running tracks of the inner and outer rod element can in each case be adapted to the lateral forces to be absorbed and the movements of the rod elements and the associated ball arrangements.

[0012] The longitudinal groove on the inner and/or outer rod element can surround the respectively assigned ball(s) over an angle of more than 20 or more than 40 degrees, in order to obtain sufficiently defined ball guidance. The groove preferably surrounds the respective ball(s) over approx. 50 to approx. 140 degrees or more, particularly preferably over approx. 70 to 90 degrees. In this context, the groove has a concave curvature towards the center point of the ball or the essentially plane groove flanks have a corresponding inclination. Over this angular range, the groove preferably has a cross-section curvature that essentially corresponds to the curvature of the ball, i.e. the groove-to-ball distance in this area is less than approx. 1/4 or less than 1/8, preferably less than 1/10 to 1/100 or less, of the ball diameter. In this context, a groove-like area can also be formed at the inner and/or outer rod element by laterally separated ball running surfaces, regardless of the other geometry of the component(s) provided with the ball guides. The laterally separated ball running surfaces of a rod element assigned to a ball thus preferably enclose an angular range of the guided ball of approx. 50 to approx. 140
degrees, particularly preferably approx. 70 to approx. 90 degrees, without being limited to this. Preferably, only two running tracks are provided over the circumferential angles mentioned, although several, preferably equally spaced, running tracks can also be provided. The angular ranges mentioned have proven to be favorable, both for obtaining high lateral stability of the telescopic column and for achieving a ratio expedient for many applications between the displacement movement of adjacent rod elements relative to each other and the resultant displacement movement of the balls.

[0013] On at least one ball, or on all balls, the ball running surfaces at the front and rear side of the ball preferably enclose an angle of 140 to 220 degrees, more preferably 160 to 200 degrees, and particularly preferably 180 degrees, with the center point of the ball.

[0014] The ball running surfaces of at least one ball are preferably located roughly at the level of at least one of the turning points, or at least one of the end-points, of the essentially linear sections of the side walls of the rod elements following on from the respective groove.

[0015] The width of the ball running surfaces when the telescopic column is operated as intended, i.e. following any necessary running-in period but without wear phenomena on the running surfaces, can be approx. 1 to 15%, preferably approx. 3 to 6% of the ball circumference. Given a ball diameter of 10 mm, the ball running surfaces thus preferably display a width of approx. 1 to 2 mm.

[0016] If at least three or more rod elements telescoping relative to each other are provided that display two or more groove-like ball guides in the radial direction, the connecting axes of the center points of the balls guided or guidable in the guides, or the extensions thereof, preferably lie outside the center point of the telescopic column, which can be defined as its geometrical center point or its center of gravity. This geometry makes it possible to achieve a maximum cross-section of the rod elements and thus maximum lateral stability of the telescopic column. The ball guides arranged behind one another in the radial direction can be immediately consecutive, i.e. separated only by the rod element walls themselves, or they can also be separated from each other by several rod elements. All the balls located in the groove-type ball guides of the telescopic column can be of the same diameter, although balls located between different rod elements can also have different diameters.

[0017] Preferably, particularly if three or more rod elements are provided, these can display an essentially polygonal profile cross-section, such as a triangular, rectangular, pentagonal or polygonal profile cross-section given an idealized rod geometry in the groove areas, where the guide grooves with ball running surfaces are preferably located in the corner areas of the profiles. However, the cross-sections can also have a different cross-section, such as a round, elliptical, oval or otherwise curved cross-section.

[0018] In particular, in the case of radially separated balls preferably separated only by rod element walls, the ball running surfaces assigned to these balls can essentially lie on the connecting line of the center points of the balls, particularly on an exactly or essentially straight line. In the radial direction referred to the respective ball, both one front and one rear ball running surface preferably lie on the line connecting the balls. Particularly preferably, each ball is assigned a front and a rear running surface lying on the line connecting the two or more balls. As a result, lateral forces can be absorbed by the balls in the radial direction, thus obtaining a telescopic column of great stiffness. The deviation of the ball running surfaces in the circumferential direction of the ball from the line connecting several balls can be 20 degrees or less, preferably 0 to 10 degrees or less, without being limited to these values.

[0019] Particularly high lateral forces can be absorbed by the telescopic column in defined fashion, without generating undesirable play of the arms, if an area with a larger radial distance is provided on the outer and/or inner rod element between laterally adjacent running surfaces for the at least one ball of the at least one ball arrangement, in order to act as an abutment for the ball in the manner of an overload protector. In the event of lateral forces that induce deformation of the rod elements in the area of the ball running surfaces, the ball can thus be caught by an adjacent area previously not serving as a ball running surface. The abutment area is preferably provided in the middle between adjacent running surfaces and, when the ball is in its intended position, preferably displays a distance from the ball surface of 0.25 to 5%, more preferably 0.5 to 5%, particularly preferably 1 to 2% of the ball diameter. Given a ball diameter of 10 mm, the radial distance between the abutment area and the ball surface can thus preferably be 0.1 to 0.2 mm. This distance can refer to the area of greatest depth of the abutment area or to the outer edge area of the abutment. If appropriate, values other than those mentioned can also be realized, depending on the necessary lateral stability and the choice of material in each case.

[0020] The connecting line from the overload abutment area located between adjacent ball running areas to the center point of the respective ball preferably lies outside the circumference of the subsequent ball in radial direction, so that the radially separated ball guides are not directly affected even in the event of deformation of a rod element in the area of the ball guide.

[0021] The telescopic column is preferably designed in such a way that at least one rod element is made of a metal sheet or a section of tubing, a groove in the form of an impression on the sheet or tubing being provided on the rod element. This impression can be produced, for example, by manufacturing the section of tubing by the continuous casting method or by related production methods. It is particularly advantageous to manufacture the rod element from sheet metal by a rolling process with subsequent joining of the longitudinal seam, making it possible to obtain particularly sharp inner corners and rounded outer corners, which can represent groove-limited edges, for example. The impression in the sheet or section of tubing produces a corresponding protuberance on the inside of the resultant rod element that can be designed, for example, as a guide surface for an inside ball assigned to an inner rod element. Particularly in the groove area, the rod element can have the same material thickness as in the adjacent side wall areas of the rod elements. The groove is preferably impressed in the sheet metal or section of tubing in such a way that the groove-side outer or inner surface of the rod element can be
used directly, or after only little machining, such as groove-like preforming of a ball running surface, for assembly of the telescopic column.

[0022] The hollow-profile areas of the rod elements can, if appropriate, display areas of different wall thickness distributed around the circumference. In particular, greater wall thicknesses can be realized in the area of the grooves than in adjacent areas. The geometry of the interior of the hollow profile can thus differ from the geometry of the outside of the hollow profile, where the inner walls of the hollow profile can again be designed as guide areas for running balls in this case. By designing the inner walls of the hollow profile accordingly, it is possible for rod elements of different geometry or of essentially identical geometry to be rotated about their longitudinal axis and inserted into one another, thereby realizing ball guides.

[0023] The wall thickness of consecutive rod elements in radial direction can increase in the radially inward direction, where, if appropriate, consecutive rod elements can also display essentially the same wall thickness.

[0024] The individual rod elements can each have several laterally and/or axially separated guide areas that are assigned to a given ball arrangement. In this context, several or all of the guide areas can be provided with balls, or just a few of the guide areas can be fitted with balls. In particular, the guide areas and the rod elements that telescope relative to each other can be designed in such a way that the rod elements can be rotated about their longitudinal axes and inserted into each other in various positions in order to obtain a telescopic column. With a given geometry of the rod elements, the telescopic column can be adapted to various demands on stability in this way. In this context, a ball arrangement, which may also comprise a single ball, is taken to mean an arrangement in which the balls within a given arrangement are closer to each other than to an adjacent arrangement. The ball arrangements can, in particular, each display several balls spaced apart in the lateral and/or axial direction. Thus, groups of laterally separated grooves can be located in the corners of polygonal profiles or distributed around the circumference of the rod elements, there being little or no space between the grooves within the groups and a larger space between the groups. In particular, separate grooves assigned to different side walls can be located in a corner area of a polygonal profile.

[0025] A particularly advantageous configuration is obtained if at least one ball, preferably at least one ball per rod element, particularly preferably all the balls assigned to a rod element or, in particular, all the balls of the telescopic column, display a slight oversized referred to their target position in disassembled condition of the telescopic column and make or impress running grooves in at least one of the inner and outer rod elements that telescope relative to each other by means of at least the first telescoping movement, or possibly also a small number (for example 2 to 5, without being limited to this) of further telescoping movements. Impression of the running grooves causes a plastic deformation of the rod element material, the deformed region of the rod element providing a running surface for the ball. In this way, the running balls essentially create their own running surfaces, this significantly facilitating the manufacture of the telescopic column and affording it particularly high lateral and torsional stability. During further telescoping movements, once the running grooves have been impressed, a virtually constant frictional resistance occurs during the telescoping movement. The ball diameter of at least one ball or of a plurality of balls, and the rod elements located inside and outside this ball in the radial direction, which thus surround the ball, are advantageously designed in such a way that the ball impresses its own running tracks in both the inner and the outer rod element during the first telescoping movement or after a small number of further telescoping movements. During the running-in process, the respective ball preferably impresses two or more running grooves in the inner or outer rod element, particularly preferably in the inner and the outer rod element, where the ball impresses at least one running groove in the respective other rod element. Preferably, all the balls of the telescopic column each impress at least two running grooves in both rod elements to which they are assigned. This characteristic is of special importance, particularly in connection with grooves partially surrounding the balls, as the grooves already provide defined guidance for the balls during their running-in process. The above-mentioned configurations of the telescopic columns with balls which impress their own running grooves in the rod elements thus preferably each relate to a telescopic column in which the respective ball or all the balls are guided or guide grooves by the respectively assigned inner or outer rod element, preferably by the inner and the outer rod element, so that the running grooves are impressed into the inner and/or outer guide grooves (also known as the longitudinal grooves). Hereby, at least one, a plurality or all of the balls of corresponding inner and outer rods may be surrounded by at least three walls, being groove walls or side walls of the rods. Preferably, each rod element displays more than two laterally separated impressed guide grooves designed as described above, these preferably being located in the corner areas of rod elements with polygonal cross-sectional profiles, particularly preferably in diametrically opposite guide grooves. Moreover, the above descriptions regarding the arrangement of the ball running surfaces particularly also apply to running surfaces impressed by the balls themselves.

[0026] In case the telescopic column comprises three telescopic rod elements, some or all of the balls arranged between an outer and a radial inwardly (middle) rod element and/or between the middle and the radial inner rod element may be arranged in impressed running surfaces.

[0027] The running-in movement of the balls is facilitated if the running grooves are pre-machined in disassembled condition of the telescopic column, i.e. if they do not display the definitive geometry, particularly the groove depth, so that the definitive running surfaces are created as a result of the oversize of the running balls located between the rod elements.

[0028] Great stability of the telescopic column is obtained if at least one or all of the inner rod elements essentially have a polygonal profile and the at least one longitudinal groove is provided in the corner area of at least one or all of the profiles. Advantageously, all corner areas of one or all inner rod elements are provided with corresponding guide grooves.

[0029] The grooves can be designed in such a way that one or both of the adjacent lateral surfaces of the polygonal profile enclosing the respective groove at least essentially
point towards the center point of the ball to be guided in the groove. As a result, the balls can be supported particularly effectively by the adjacent lateral surfaces of the polygonal profiles when exposed to lateral forces. The ball running surfaces are advantageously located directly adjacent to one or both of the adjacent lateral surfaces of the polygonal profile.

[0030] Advantageously, all the rod elements of the telescopic column essentially display a polygonal cross-section into which the longitudinal grooves are incorporated. In this context, two, three or more consecutive rod elements can essentially—apart from the dimensioning required to permit insertion of the rod elements into each other—display the same cross-sectional form. In particular, consecutive rod elements or all the rod elements of a telescopic column can display an equilateral or non-equilateral triangular, rectangular, pentagonal and/or polygonal cross-section. The cross-sections of the rod elements of a telescopic column can each have the same or a different basic geometry. The guide grooves can be located in all or some of the corner areas and/or in the middle areas of the side walls of the polygonal rod elements.

[0031] Preferably, all the guide grooves of the rod elements are fitted with running balls, or only some of the guide grooves if appropriate. Preferably, at least two essentially opposite guide grooves of the respective rod elements are fitted with running balls.

[0032] In particular, the inner and outer walls of adjacent rod elements can approach each other, essentially over the entire circumference of the rod elements with the sole exception of the longitudinal grooves for accommodating the corresponding balls, to within a distance which corresponds roughly to the wall thickness of the rod elements or is less than this or does not exceed two to three times the wall thickness.

[0033] The ball arrangements of the telescopic columns according to the invention can be designed to move in the longitudinal direction relative to both rod elements, i.e. the respective outer and inner rod elements, during telescoping movement, meaning that the balls partially follow the movement when adjacent rod elements are displaced relative to each other. The balls or ball arrangements can, however, also be secured to prevent longitudinal displacement in relation to one of the rod elements, or be of stationary design.

[0034] For additional stabilization of the telescopic column, guide elements that absorb forces acting laterally on the rod elements, at least after slight angling of the rod elements relative to each other, can be provided in the longitudinal direction of the rods, above and/or below at least one ball arrangement on at least one rod element, preferably above and/or below all the ball arrangements on the respective rod element. The guide elements may thus be at a certain lateral distance from the corresponding rod element, so that the rod elements are guided exclusively on the corresponding balls when only little or no lateral force is exerted. The guide elements are preferably located at the ends of the rod elements and preferably cap the ends, although they can also be at a distance from the ends of the rod elements. The travel of adjacent rod elements relative to each other can be limited by the guide elements in one or both sliding directions, this eliminating the need for separate travel limits stops.

[0035] It is particularly advantageous if at least one guide element is provided that can be fixed in position on the respective rod element by means of a snap-in connection, this snap-in connection engaging at least one corner of the rod element designed as a polygonal profile. Alternatively or in addition, the snap-in connection can also be designed for fixing in position on the respectively adjacent, radially outer rod element in the region of a longitudinal groove. This makes the snap-in connection readily accessible and it also has sufficient space. In particular, the respective longitudinal groove can be provided in the corner area of a polygonal profile. However, the snap-in connections can also be provided at other suitable points. Advantageously, a corresponding snap-in connection is provided at each of the corners of a polygonal profile. In the case of profiles of a different design, e.g. round profiles, a suitable number of snap-in connections can be provided. The snap-in connections can be designed for actuation from the outside of the rods.

[0036] The guide element described above can simultaneously be designed as a face-end groove limiter. In particular, two guide elements a distance apart can be assigned to one groove, so that one or more balls are arranged in captive manner between the guide elements. Furthermore, the ball retainer itself can retain the ball(s) in captive manner, e.g. by providing a ball cage. However, as an alternative, a ball guide with recirculating balls can also be assigned to one or more of the grooves, particularly the groove(s) immediately surrounded by the radially innermost rod element, so that a ball removed from a groove during a telescoping movement is returned to the groove at some other point.

[0037] The holders for the balls guided between adjacent rod elements can be of a wide variety of designs. In particular, the holders can, if necessary, be fixed in place on one of the telescopic columns in a manner preventing displacement, if this is required. The holders can also be designed to be essentially freely replaceable over part or virtually all of the length of the rod elements.

[0038] The ball retainers preferably display at least two or more retaining areas, which can be assigned to laterally and/or axially separated ball arrangements.

[0039] It is particularly advantageous if the retaining area, or the two or more retaining areas, of a ball retainer are connected to each other or to a main body by means of an articulated connection, particularly in the form of an integral hinge. In this way, the retaining areas can be angled in relation to each other within the telescopic column and, owing to the articulated connection, the ball retainer can be positioned essentially flat in disassembled condition, this arrangement being particularly simple to manufacture in a molding tool. In this context, different areas of the ball retainer can lie at different levels relative to each other. The ball retainer can, in particular, be made of a plastic material and be produced by an appropriate manufacturing process, such as an injection molding process.

[0040] In the case of polygonal rod elements, the ball retainers can span one lateral surface of the same and jointly retain the balls located in the circumferential direction of adjacent guide grooves. The ball retainers each preferably span only one lateral surface of rod elements having a polygonal profile, particularly preferably respectively oppo-
site lateral surfaces of a rod element, where the ball retainers of the rod element located immediately further inwards or outwards in the radial direction can be arranged at a distance from the first ball retainers mentioned. Furthermore, with this arrangement, several balls positioned axially one above the other can be provided on at least one groove, preferably on all grooves. The balls are preferably combined in groups of two or more balls in the lateral and/or axial direction.

[0041] If three or more rod elements are provided, the ball retainers for consecutive rod pairs in the radial direction can be of identical or different design.

[0042] If the ball retainers span the groove areas of two of more profile corners or laterally separated groove arrangements, which are preferably adjacent to each other, the ball retainers for pairs of consecutive rod elements can be congruent or staggered relative to each other in the circumferential direction. A staggered layout permits a particularly space-saving arrangement and thus maximum cross-sections of the rod elements. The ball retainers are advantageously provided on opposite sides of the rod elements.

[0043] An example of the invention is described below and explained on the basis of the figures. The figures show the following:

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] FIG. 1 A cross-section of a telescopic column according to the invention in retracted condition,

[0045] FIG. 2 A perspective view of a telescopic column according to FIG. 1 in partially extended condition,

[0046] FIG. 3 A telescopic column according to FIG. 2 with guide elements,

[0047] FIG. 4 A cross-section of a telescopic column according to FIG. 1 with ball retainers,

[0048] FIG. 5 A detail view of the middle rod element according to FIG. 2 with ball retainer,

[0049] FIG. 6 A detail view of the inner rod element according to FIG. 2 with ball retainer, and

[0050] FIG. 7 A cross-section of a telescopic column according to another embodiment according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0051] In the practical example illustrated in FIGS. 1 to 6, telescopic column 1 consists of three rod elements 2, 3, 4, which can be telescoped relative to each other and each have an essentially rectangular cross-section. Radially outer rod elements 2 and 3 display roughly or exactly the same wall thickness, while the wall thickness of inner rod element 4 is approx. 50% greater. The corner areas of inner rod elements 3 and 4 display guide grooves 5, 6 (see FIG. 2) which are open towards the outside, run in the longitudinal direction of the rod elements, serve to accommodate running balls 7, 8 and surround these over a circumferential angle of approx. 90 degrees (radially outer running ball 7) or approx. 70 degrees (radially inner running ball 8) on the respective inner side. The axes connecting opposite ball running surfaces enclose an angle of 70 degrees. Running balls 7, 8 are capable of moving relative to both adjacent rod elements (2 and 3 or 3 and 4) in the longitudinal direction of the rod elements.

[0052] Radially outer running ball 7 is guided on outer rod element 2 on two running surfaces 9, which are a distance apart on the circumference of the ball and enclose an angle of approx. 90 degrees. On the opposite side of the ball, a running surface is provided for each of these running surfaces on the corresponding guide groove. In this context, the running surface is located at roughly the level of the adjacent side wall 10 of rod element 3, which forms the narrower side wall of rod element 3, so that laterally acting forces can be absorbed. A similar situation applies to the two other radially outer and inner ball running surfaces 9 and 11, which are opposite each other in relation to the center point of the ball, where ball running surface 11 lies essentially at the level of lateral surface 12, in this case at a radial distance of roughly one wall thickness of the same.

[0053] Ball running surfaces 9 and 11 are each located roughly or exactly at the level of the turning points or end-points of the essentially linear sections of the adjacent side walls of the rod elements or of areas 14 parallel to them.

[0054] With a ball diameter of approx. 10 mm, the width of the ball running surfaces is approx. 1 to 2 mm. Ball running surfaces 9, 11 and 20, 21 are essentially worked into the rod elements by the balls themselves during the first telescoping movement of the rod elements relative to each other, where, during a preceding process step, only running grooves 38 (FIG. 1) were incorporated into the rod elements, their width being small compared to the width of the definitive ball running surfaces, for instance ⅗ to ⅓ of the same or less. Thus, the definitive running surfaces are formed during the first telescoping movement, or the first few telescoping movements, the direction of ball travel being defined by running grooves 38 provided.

[0055] Ball running surfaces 20, 21 of the radially inner ball—the same could also apply, at least facultatively, to balls lying radially farther inwards—are located on a side wall 12 and on a concave groove rear side 22 in relation to the outer rod element. The same applies to the radially inner running surfaces of the same ball on the inner rod element, where, instead of the side wall, a section 14 running parallel to it is provided with a ball running surface. In this context, the lines connecting radially separated balls 7, 8, which are each assigned to different rod elements, are located on a connecting line that does not pass through the geometrical center point or the center of gravity of the rod elements. The connecting line in the practical example includes a smaller angle in relation to the side wall against which the balls lie.

[0056] The same design principle can also be applied to triangular, pentagonal or polygonal cross-sectional profiles or to curved, e.g. round, oval or elliptical cross-sectional profiles. Thus, if a further, inner rod element were to be provided, the further balls would preferably be located in angular area 23, although location in angular area 24 would, however, also be possible, in which case the balls of the radially separated rod elements would then lie on a straight or essentially straight line.

[0057] According to the practical example with groups of two radially separated balls 7, 8 each, three ball running surfaces lie on an at least essentially straight line V1.
According to the practical example, this line runs between the diagonal and the side walls of the rod elements. It is also possible for more than three ball running surfaces to lie on one line, particularly if more than two radially inner rod elements 3, 4 are provided. The ball running surfaces lying on a line can be the immediately consecutive ones in the radial direction, as in the practical example, although, if appropriate, ball running surfaces can be provided between these, whose position deviates substantially from the straight line. This deviation can also apply to the radially innermost and/or outermost ball running surfaces in each case, preferably only to these. According to the practical example, the deviation of the ball running surfaces from the straight line is approx. ¾ to ½ of the ball diameter or less, without being limited to this.

[0058] Provided between adjacent running surfaces assigned to a ball are rod areas 15, 16, 17, which are at a slightly larger radial distance from the balls, so that a gap arises between the ball and the rod area. The gap depth according to the practical example is approx. 0.1 to 0.2 mm. If the rod elements are deformed in the area of the ball guides, these areas 15 to 17 can support the ball and form additional running surfaces. The overload abutments are preferably located radially inwards relative to the ball, or alternatively or additionally radially outwards relative to the ball, if appropriate, and lie roughly on connecting line V2 between the respective corner of the idealized profile of the rod element and its center point. The deviation from the straight line is preferably ¼ to ½ or less of the ball diameter, without being limited to this. The deviation mentioned can apply to some or all of the overload areas.

[0059] The rod elements are manufactured from sheet metal material by means of a rolling process with subsequent formation of a weld seam, which runs in the longitudinal direction of the rod element and can be provided in the side area. The rolling process makes it particularly easy to incorporate the grooves, where inner shaping angles 18 can be made to be particularly sharp, while outer shaping angles 19 are rounded. At the same time, this also makes it possible to manufacture ball guide grooves 5, 6 with sufficient accuracy.

[0060] FIG. 3 shows a telescopic column with guide elements 25, which are fitted onto or inserted into the face ends of the rod elements and can be fixed in position by means of snap-in connections provided in the corner areas. The snap-in connections can be released from the outside via slits in the rod elements. In this context, the snap-in tabs of the snap-in connections are located at the level of the ball guide grooves, so that the snap-in tabs have sufficient play. This permits simple fastening of the guide elements if, over virtually the entire circumference, essentially only with the exception of the areas of the ball guide grooves, the inner and outer walls of adjacent rod elements are only separated by a small distance that is essentially in the region of the wall thickness of the rod elements, for instance in the region of once to twice the wall thickness, or even less.

[0061] Supplementary to FIG. 1, FIG. 4 shows ball retainers 27, which jointly retain ball arrangements of adjacent corner areas of the rod elements and span the respective side walls for this purpose. The ball retainers display conventional ball cages 28 and intermediate connecting pieces 29, these being interconnected via articulated connections 30 in the style of integral hinges. Thus, when in disassembled condition, ball cages 28 can be swung essentially into the plane of connecting piece 29 or into a parallel plane, this greatly facilitating the manufacture of the ball retainers, which can be made of a plastic material. Ball retainers 27 and 31 are assigned in pairs to opposite lateral surfaces of rod elements 3 and 4 and are arranged in staggered fashion in the circumferential direction of the rod elements or arranged with gaps between them. It goes without saying that, particularly also in the case of other cross-sectional geometries of the rod elements, ball retainers 27 and 31 can be assigned to several or just one guide groove or guide groove arrangement with several immediately adjacent guide grooves.

[0062] FIGS. 5 and 6 show rod elements 3, 4 with the respective ball retainers 27, 31.

[0063] Ball retainers 27 and 31 each display axially separated retaining areas 33 and 34, which are each assigned to adjacent corners of the polygonal profiles. Ball arrangements 35 each display two axially separated balls 37, one behind the other in the longitudinal direction of the rod element. In this context, main piece 29 extends over a relatively great axial length of the respective rod element, roughly over once to twice the transverse extension of the longer cross-sectional axis of the inner or outer rod element. In this context, retaining areas 33 themselves extend only slightly more over the respective ball circumference, meaning that the axially and laterally separated retaining areas can be pivoted independently of each other relative to connecting area 33.

[0064] FIG. 7 shows a section of a further telescopic column according to the present invention having inner and outer rod elements 40, 41. The inner rod element 40 is provided with a guiding longitudinal groove 46 and a ball 42 being in engaging contact with a side wall 44 of the outer rod element. The diameter of the ball is chosen so that it makes two running surfaces in the inner rod element and one running surface in the outer rod element at least during the first telescopic movement. It is obvious for someone skilled in the art that rod element may be designed so that the ball is positioned between two walls of a groove of the outer rod element and one side wall of the inner rod element, so that during the at least first telescopic movement two running surfaces are made in the outer rod element and one running surface is made in the inner side element. In both embodiments two running surfaces 44 are made in opposite walls of one groove.

Patent claims:

1. A telescopic column with one outer and at least one inner rod element capable of telescoping relative to each other, where at least the outer rod element surrounds at least one ball arrangement with at least one ball, which acts as a rolling bearing between the outer and inner rod elements during telescoping movement, characterized in that the at least one inner rod element displays a longitudinal groove which surrounds part of the circumference of the at least one ball of the ball arrangement and serves as a ball guide.

2. A telescopic column according to claim 1, characterized in that the longitudinal groove provides at least two laterally separated running surfaces for the at least one ball.

3. A telescopic column according to claim 2, characterized in that the inside of the outer rod element surrounds part of
the circumference of the at least one ball and provides at least two more laterally separated running surfaces for the at least one ball.
4. A telescopic column according to claim 3, characterized in that an area with a larger radial distance is provided on at least one rod element between adjacent running surfaces for an assigned ball constituting an overload protector in the form of an abutment for the ball.
5. A telescopic column according to claim 2, characterized in that the laterally separated running surfaces of a groove of the radially inner and/or outer rod element enclose an angular range of the respectively guided ball of approx. 50 degrees to approx. 120 degrees.
6. A telescopic column according to claim 1, characterized in that the at least one rod element is manufactured from a metal sheet or a section of tubing by a rolling method and the groove is an impression made in the sheet or section of tubing.
7. A telescopic column according to claim 1, characterized in that the rod elements each have two or more laterally and/or axially separated guide areas for at least one given ball arrangement and that the at least one ball arrangement displays two or more balls separated in the lateral and/or axial direction or is suitable for accommodating two or more balls separated in the lateral and/or axial direction.
8. A telescopic column according to claim 1, characterized in that at least one ball displays a slight oversize referred to its target position in disassembled condition of the telescopic column and, as a result of at least the first telescoping movement, impresses a running surface for the intended purpose in the inner and/or outer of the rod elements capable of telescoping relative to each other.
9. A telescopic column according to claim 8, characterized in that the ball is located in a longitudinal groove of at least one of the inner and outer rod elements and two laterally separated running surfaces are impressed in the longitudinal groove of at least one of the inner and outer rod elements by means of a telescoping movement.
10. A telescopic column according to claim 9, characterized in that the ball impresses at least two laterally spaced running surfaces in one of the inner and outer rod elements and at least one running surface in the corresponding of the inner and outer rod elements by means of a telescopic movement.
11. A telescopic column according to claim 8, characterized in that the impressed running surfaces are provided with pre-machined running grooves for the balls, where the balls are pre-machined to the oversize of the ball existing in disassembled condition of the telescopic column.
12. A telescopic column according to claim 1, characterized in that at least one of the inner rod elements essentially displays a polygonal profile and the at least one longitudinal groove is provided in the corner area of the profile.
13. A telescopic column according to claim 1, characterized in that at least three rod elements capable of telescoping relative to each other are provided, which are at least partially designed as hollow profiles in the groove area and in that the rear side of the groove of the hollow profile of at least one rod element serves as a guide for a ball lying radially farther inwards, which forms the rolling bearing for the directly adjacent, radially inner rod element.
14. A telescopic column according to claim 13, characterized in that at least three rod elements capable of telescoping relative to each other are provided, where two or more essentially groove-like ball guides are formed consecutively in radial direction, and in that the connecting axis of the center points of the balls guided in the guides lies outside the center point of the telescopic column.
15. A telescopic column according to claim 1, characterized in that two or more rod elements capable of telescoping relative to each other are provided and in that, at least in pairs, the outer cross-section of an inner rod element essentially corresponds to the inner cross-section of the respective outer rod element.
16. A telescopic column according to claim 1, characterized in that guide elements that absorb forces acting laterally on the rod elements, at least after slight angling of the rod elements relative to each other, are provided in the longitudinal direction of the rods, above and/or below at least one ball arrangement on adjacent rod elements.
17. A telescopic column according to claim 16, characterized in that at least one guide element is provided that can be fixed in position on the assigned rod element by means of a snap-in connection and engages at least one corner of a rod element designed as a polygonal profile and/or a groove area of a rod element.
18. A telescopic column according to claim 1, characterized in that at least one ball retainer is provided that displays at least two retaining areas, which are assigned to axially and/or laterally separated balls or ball arrangements and in that the ball retainer extends over one side wall of an assigned rod element.
19. A telescopic column according to claim 1, characterized in that at least one rod element is provided with at least two ball retainers with retaining areas for running balls which extend over only part of the circumference of the assigned rod element and in that the ball retainers are located in diametrically opposite positions on the rod element.