(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 200215476 B2
(10) Patent No. 782894

(54) Title
Connecting element including a screw and a captive supporting element

(51)[6] International Patent Classification(s)
F16B 033/02 F16B 043/00
F16B 041/00

(21) Application No: 200215476 (22) Application Date: 2002.02.07

(30) Priority Data

(31) Number	(32) Date	(33) Country
10106093	2001.02.08	DE

(43) Publication Date : 2002.08.15
(43) Publication Journal Date : 2002.08.15
(44) Accepted Journal Date : 2005.09.08

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(56) Related Art
US 3118718
US 3560132

ABSTRACT

A connecting element includes a screw including a head and a shank. The shank has an end, and it includes a shank portion, a threaded portion and a stop element. The threaded portion has an outer diameter, and it includes a thread runout facing the head. The thread runout has an axial extension and a circumference. The shank portion has a diameter which is less than the outer diameter of the threaded portion. The stop element is produced by removing the thread runout at least over a part of the axial extension and of the circumference of the thread runout in a way that the stop element has a diameter which approximately corresponds to the outer diameter of the threaded portion. The connecting element also includes a supporting element being captively connected to the screw and including a narrowing location having a diameter which is less than the outer diameter of the threaded portion.

AUSTRALIA

Patents Act 1990

COMPLETE SPECIFICATION

STANDARD PATENT

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Invention Title:

CONNECTING ELEMENT INCLUDING A SCREW AND A CAPTIVE SUPPORTING ELEMENT

The following statement is a full description of this invention, including the best method of performing it known to me/us:

CONNECTING ELEMENT INCLUDING A SCREW AND A CAPTIVE SUPPORTING ELEMENT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of co-pending German Patent Application No. 101 06 093.9-12 entitled "Verbindungselement mit einer Schraube und einem daran unverlierbar angeordneten Stützelement", filed on February 8, 2001.

FIELD OF THE INVENTION

The present invention generally relates to a connecting element including a screw and a supporting element being captively connected to the screw. More particularly, the present invention relates to a special design of the thread runout of the screw facing the head of the screw.

BACKGROUND OF THE INVENTION

Connecting elements including a screw and a supporting element being captively connected to the screw to prevent unintentional detachment of the two elements are produced in series to attain a great pre-production level, and to simplify assembly of the connecting element. The connecting elements serve to connect components.

A connecting element is known from *German Patent Application No. 199 24 502 A1*. The known connecting element includes a screw having a head with a head supporting surface and a shank. The shank includes a cylindrical shank portion and a threaded portion. The shank portion faces towards the head of the screw, while the threaded portion is more or less located at the free end of the shank of the screw facing away from the head. The threaded portion may also be arranged in a middle region of the shank, for example in the case of the screw at its free end including a centering element. The supporting element may be designed

as a bush or as a plain washer. The supporting element may also include more of such supporting elements. The supporting element includes a narrowing location having a diameter which is less than the outer diameter of the thread of the threaded portion of the screw. The narrowing location may be produced in different ways, for example by impressions being located on the circumference of the bush, or by a continuous protrusion protruding towards the inside. It is also possible to use separate elements, for example a securing ring, being located in the inner diameter of the bush. When a plain washer is used as the supporting element, the bore of the plain washer forms the narrowing location. In this way, the bore forms a continuous enlarging element protruding towards the inside. The shank portion has a comparatively reduced diameter - meaning a diameter which is less than the outer diameter of the thread being located on the threaded portion. The reduced diameter of the shank portion may correspond to the rolling diameter of the screw during its manufacture.

When a thread is to be produced on the shank of a screw - especially by rolling - this is only possible by producing a thread runout facing the head of the screw. The diameter of the thread convolution (or of the thread convolutions) increases in the region of the thread runout facing the head of the screw from the rolling diameter, for example, to the outer diameter of the thread in the threaded portion being located adjacent to the runout. Standardization of the thread runout differentiates between a "standard case" and a so called "short design". In the standard case, the thread convolution extends about 2.5 rotations of the screw - meaning about 900° - while changing its outer diameter. The short design of the thread runout relates to 1.25 rotations - meaning 450°. Even shorter thread runouts would be theoretically possible, but their production is expensive due to comparatively reduced usable times of the tools for rolling these threads. In the prior art, in the region of each thread runout - no matter whether in the standard case or in the short design case - there is a conical surrounding cone at the screw, the surrounding cone contacting the narrowing location of the supporting element. When one imagines winding down the thread convolution of the thread runout, one attains a very long

inclined plane with a slowly increasing angle of inclination. The surrounding cone and the inclined plane, respectively, have the effect of the danger of the supporting element getting clamped in the region of the thread runout. Such known connecting elements are especially used as bulk good at assembly stations. Usually, a feeding apparatus and a conveying apparatus, respectively, is prearranged to the assembly station, the feeding apparatus ensuring that the connecting elements are located in a row, for example. Such conveying apparatuses often use vibration drives. Using vibration drives, there is the danger of the supporting element being vibrated in a way that it is located on the screw too fixedly such that it can no longer be assembled in the assembly station. Even in case such known connecting elements are separately fed to reach their desired place of application, there also is the danger of – at least in some of the connecting elements – the supporting element in the region of the thread runout having a clamped seat at the screw during transportation of the known connecting elements as bulk goods. These disadvantages do not only occur when the narrowing locations are designed as impressions being located at the supporting element in a spaced apart manner, but also when the narrowing locations are designed to be continuous over the circumference of the supporting element. In case of using local impressions, there is the danger of these impressions being vibrated and clamped in the position in which they engage two adjacent portions of the thread convolution in the region of the thread runout facing the head of the screw.

SUMMARY OF THE INVENTION

The present invention provides in a first aspect a connecting element including a screw including a head and a shank. The shank has an end, and it includes a shank portion, a threaded portion and an increasing element. The threaded portion has an outer diameter, and it includes a thread runout facing the head. The thread runout has an axial extension and a circumference. The shank portion has a diameter which is less than the outer diameter of

the threaded portion. The increasing element is produced by removing the thread runout at least over a part of the axial extension and of the circumference of the thread runout in a way that the increasing element has a diameter which approximately corresponds to the outer diameter of the threaded portion. The connecting element also includes a supporting element being captively connected to the screw and including a narrowing location having a diameter which is less than the outer diameter of the threaded portion.

The present invention provides in a second aspect a connecting unit including a screw including a head and a shank. The shank has an end, and it includes a shank portion, a threaded portion and a stop element. The threaded portion has an outer diameter, and it includes a thread end facing the head. The thread end has an axial extension and a circumference. The shank portion has a diameter which is less than the outer diameter of the threaded portion. The stop element is produced by removing the thread end at least over a part of the axial extension and of the circumference of the thread end in a way that the stop element has a diameter which approximately corresponds to the outer diameter of the threaded portion and that the screw in the region of the removed thread end has a surrounding diameter which has an approximately cylindrical shape and which is less than the diameter of the narrowing location. The connecting unit further includes a supporting element being connected to the screw and including a narrowing location having a diameter which is less than the outer diameter of the threaded portion. The narrowing location is designed and arranged to cooperate with the stop element to prevent unintentional removal of the supporting element from the screw.

With the novel connecting element, the tendency of clamping effects acting between the screw and the supporting element is substantially reduced, especially when automatically conveying the connecting element. Usually, the screw and the supporting element are made of metal. However, different materials, for example plastic material, may also be used for the novel connecting element.

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In the novel connecting element, the thread runout or - in other words - the end of the thread facing the head of the screw is at least partially removed. It may also be completely removed. In this way, the (conical) surrounding cone in this region is eliminated, and it is deformed to have the shape of a (cylindrical) surrounding cylinder, respectively. It is desired to produce an inclination element, a step or a stop at the beginning of the threaded portion facing the head of the screw. It is to be understood that the thread always has two ends or runouts, one of them facing the free end of the screw, and the other one facing the head of the screw. The present invention relates to the design of the end of the thread facing the head of the screw. The novel inclination element serves as a stop for the narrowing location being located at the supporting element. The stop is effective as it prevents movement in an axial direction and possibly also in a tangential direction. In the region of the inclination element, the diameter of the screw increases in a tangential direction. However, this increase in diameter takes place over a comparatively shorter length than it is known in the prior art. For example, the increase in the outer diameter of the thread convolution or at the intersecting surface with the flank of the thread convolution only extends over a fraction of one rotation of the screw.

In this way, there is a sudden transition between the shank portion and the threaded portion in an axial direction and in a tangential direction. This sudden transition strongly reduces and eliminates, respectively, the tendency of the supporting element getting clamped at the screw. This especially applies when the supporting element is located at the screw to be rotatable. The thread runout may be entirely or partly reduced by removing material or without removing material. Especially, it is possible to produce the novel runout by rolling. In this way, the outer diameter of the thread runout is reduced by rolling it flat. Usually, there is a remainder of the thread runout. However, the remainder is at least approximately surrounded by the imaginary surrounding cylinder. However, the remainder cannot cause clamping of the supporting elements during movement of the supporting

element with respect to the screw.

It is especially preferred to design the screw such that it has a surrounding diameter which is axially cylindrical in the region of the thread runout facing the head of the screw. However, the screw may also be designed in a way that the thread runout ends in a slightly conical surrounding diameter since different amounts of material have to be rolled down over the axial length of the thread runout. It is desired to chose the design such that there is no clamping contact with respect to the narrow location or to the narrow locations of the supporting element. The beginning of the thread (or in other words, the end of the thread facing the head of the screw) includes a contact surface or a supporting surface in the form of a step. The step substantially extends in a radial direction, it is substantially effective in an axial direction, and it only covers part of the circumference of the screw. There also is some sort of a step in a tangential direction. However, this does not have a negative effect in combination with the design of the supporting element. It is especially preferred when the surrounding diameter or the surrounding cylinder is substantially less than the diameter of the narrow location. It is preferred to chose an arrangement allowing for increased play or clearance to securely prevent the tendency of clamping effects. On the other hand, it is preferred that the surrounding diameter is more - but especially only slightly more - than the reduced diameter of the shank portion. A design of the step at the beginning of the remainder of the thread of the threaded portion in which the step is rather big and in which the step starts suddenly is advantageous. The preferred design is to arrange the step at the place where the thread runout is connected to the thread portion. However, the step may also be arranged in the beginning portion of the thread portion. It is possible to arrange the step within the primary thread runout such that the step itself is located on a comparatively smaller outer diameter compared to the outer diameter of the thread of the threaded portion. In all cases, it is preferred that the novel screw includes a stop or an inclination element which extends over a part of the circumference, and which cooperates with the narrowing

location of the supporting element in an axial direction.

The increasing element may be designed and arranged to cover less than approximately 180° of the circumference of the thread runout. Preferably, the increasing element is designed and arranged to cover approximately 90° of the circumference of the thread runout. When the step is designed to extend in a radial direction - meaning a direction perpendicular with respect to the longitudinal axis of the screw - there is a sectional surface of the surrounding cylinder with respect to the respective thread convolution of approximately 90° of the circumference. The thread convolution of the thread runout or of the thread is not removed in this region. Consequently, the outer diameter increases and enlarges in a tangential direction. In the case of threads including a plurality of convolutions, there is a plurality of smaller sectional surfaces. The remainder of the inclined thread convolution of the thread runout preferably extends over less than 180°.

The thread runout of the threaded portion of the screw may be produced by removing material or without removing material. It is especially advantageous to roll the thread runout facing the head of the screw down to the rolling diameter of the shank portion. Rolling means that masses only have to be deformed and moved instead of being removed. Consequently, when great deformation is desired - especially when deforming the screw to reach the rolling diameter or even less than the rolling diameter - the length of the screw is increased. However, there are no negative effects. In the case of removing material - for example by turning on a lathe or by grinding - it is easily possible to reduce the diameter to reach the rolling diameter. When the screw is deformed by cold forming without removing chips, it is even possible that the screw in the region of the removed thread runout includes an enlarged portion formed by rolling. In this case, the enlarged portion functions as the counter supporting surface for the narrow locations of the supporting element. In this way, they form the increasing element being arranged in the region of the thread runout instead of at its end. However, the attained effect is similar to the above described constructions. The

continuous enlarging element may also be produced by removing chips.

When the supporting element is designed as a bush, the inner diameter of the bush may be more than the outer diameter of the threaded portion. A plurality of impressions may be located about the circumference of the bush in a spaced apart manner, as it corresponds to the number of convolutions of the thread. Usual threads only include one convolution. However, screws including threads having more than one convolution are also used in the art. The number of spaced apart impressions preferably is more than the number of convolutions of the thread to ensure that at least one of the impressions contacts the step in each relative position between the supporting element and the screw. When the step extends over approximately 90° of the circumference, it is preferred to use at least five impressions spaced apart about the circumference. When the step extends over approximately 180° of the circumference, it is preferred to use at least three impressions spaced apart about the circumference to ensure that at least one impression contacts the step in all relative positions.

When the supporting element is designed as a plain washer, the plain washer may have an inner diameter which is less than the outer diameter of the threaded portion to form the narrowing place. In such a case, it is not necessary to arrange separate impressions or other counter surface elements.

There are a number of different possibilities of arranging the step-like increasing element. The design may be chosen in a way that the increment of the surrounding diameter towards the outer diameter of the threaded portion is located in the region of the threaded portion. The step-like increasing element may also be located at the transition location between the thread runout and the thread of the threaded portion. Furthermore, it is possible to chose the thread runout to have a comparatively shorter axial extension.

The present invention provides in a third aspect a connecting element comprising a screw and a supporting element, the supporting element being

captively connected to and in general rotatably arranged on the screw, the screw including a head and a shank, the shank having a threaded portion including a thread runout facing the head and a shank portion, the shank portion having a diameter which is less than the outer diameter of the threaded portion, the supporting element having an inner aperture and including a narrowing location at which a diameter of the inner aperture is reduced, the supporting element having a diameter which is less than the outer diameter of the threaded portion, wherein the thread runout facing the head is removed with respect to at least over a part of the axial extension and at least over a substantial part of the circumference resulting in a step-like or stop element ending at least about the outer diameter of the threaded portion.

Other features and advantages of the present invention will become apparent to one with skill in the art upon examination of the following drawings and the detailed description. It is

intended that all such additional features and advantages be included herein within the scope of the present invention, as defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. In the drawings, like reference numerals designate corresponding parts throughout the several views.

Fig. 1 is a partly sectional lateral view of a first exemplary embodiment of the novel connecting element.

Fig. 2 is an enlarged semi-cut view of the end of a thread as known in the prior art.

Fig. 3 is an enlarged view of the novel end of a thread in comparison with the prior art thread as shown in Fig. 2.

Fig. 4 is a semi-cut view of another exemplary embodiment of the novel end of the thread.

Fig. 5 is a semi-cut view of another exemplary embodiment of the novel end of the thread.

Fig. 6 is a semi-cut view of another exemplary embodiment of the novel end of the thread.

Fig. 7 is a semi-cut view of another exemplary embodiment of the novel end of the thread.

Fig. 8 is a semi-cut view of a prior art screw having a conventional end of the thread and a diagram illustrating the changes in diameter over the length of the screw.

Fig. 9 is a semi-cut view of a novel screw having a conventional end of the thread and a diagram illustrating the changes in diameter over the length of the screw.

Fig. 10 is a diagram of the increase in diameter of the end of the thread in a tangential

direction following the helical line.

Fig. 11 is a lateral view of another exemplary embodiment of the novel connecting element.

Fig. 12 is a lateral view of another exemplary embodiment of the novel connecting element.

DETAILED DESCRIPTION

Referring now in greater detail to the drawings, **Fig. 1** illustrates a first exemplary embodiment of the novel connecting element 1. The connecting element 1 includes at least two elements. The connecting element or connecting unit 1 includes a screw 2 and a supporting element 3.

In the illustrated exemplary embodiment of the novel connecting element 1, the screw 2 is designed as a collar screw. The screw 2 includes a head 4 having a noncircular engagement surface 5 for a torsional tool for operating the screw and a collar 6 including a surface 7 serving to transmit an axial force. A shank 8 is located close to the head 4 and to the surface 7, respectively. The shank 8 extends up to a free end 9 of the screw 2. The shank 8 at the free end 9 may be designed as a centering element. The shank 8 at the side facing the head 4 of the screw 2 has a portion 10 having a diameter 11 which is less than the diameter of the thread to be described hereinafter. The shank 8 at its side facing the free end 9 of the screw 2 includes a threaded portion 12. The thread of the threaded portion 12 includes a core diameter 13 and an outer diameter 14. An end of the thread or a thread runout 15 extends between the portion 10 of the shank 8 (which has the diameter 11 being reduced compared to the outer diameter 14 of the threaded portion 12) and the threaded portion 12. This is the end of the thread which faces the head 4 of the screw 2. The end of the thread 15 extends over a length 16 in a longitudinal direction of the screw 2. The threaded portion 12 and a thread runout facing the free end 9 have a length 17.

It is already to be seen from Fig. 1 that the end of the thread 15 has an envelope diameter 18 or a surrounding diameter. While thread runouts known in the prior art have a conical design at this place - meaning an envelope cone - the novel connecting element 1 includes a thread runout 15 which has an at least approximately cylindrical design. In other words, the thread runout 15 has a surrounding diameter 18 being approximately constant over the length 16. The surrounding diameter 18 is in the range of the reduced diameter 11 of the shank portion 10. However, the surrounding diameter 18 may also be slightly more or less than the diameter 11. The shank element 10 extends over a length 19 between the surface 7 of the head 4 of the screw 2 and the beginning of the end of the thread 15 facing the head 4 of the screw 2. In this way, the diameter (outer diameter) suddenly increases at the transition between the end of the thread 15 and the outer diameter 14 of the threaded portion 12 to form a step 20.

The exemplary embodiment of the supporting element 3 in Fig. 1 is designed as a bush 21. The bush 21 approximately has the design of a hollow cylinder with respect to the axis 22 of the screw 2, and it includes an inner diameter 23. In the illustrated exemplary embodiment, the inner diameter 23 is more than the outer diameter 14 of the threaded portion 12 such that the bush 21 after producing the thread at the threaded portion 12 may be pushed onto the screw 2 and onto its shank 8, respectively. The bush 21 at its ends may include flanges 24 and 25 protruding in a radial direction. The bush 21 has a length 26 extending in an axial direction - meaning parallel with respect to the axis 22. Usually, the length 26 is more than the sum of the lengths 16 and 19 such that the bush 21 ends in the region of the thread runout 15. However, the length 26 may also be designed to be shorter when overscrewing of the threaded portion 12 is possible or desired. Due to the coordination of diameters, the bush 21 and the supporting element 3, respectively, may be rotated with respect to the screw 2. The supporting element 3 includes a narrow location 27 having a diameter 28 or forming a diameter 28. The diameter 28 is less than the outer diameter 14 of the threaded portion 12. The narrow location 27 may be

formed by a plurality of impressions 29 which are produced after rolling the thread of the threaded portion 12 and after inserting the bush 21 onto the screw 2. However, the narrow location 27 may also be designed and produced in a different way, for example, by a continuous enlarged portion protruding towards the inside, by a securing ring and the like.

The design of the novel thread runout 15 is different than designs known in the prior art. The differences may be well seen from a comparison of Figs. 2 and 3. Fig. 2 (prior art) illustrates an enlarged section (as a semi-sectional view) of a known screw 2 with a conventional thread runout 30 extending over the length 16. The conventional thread runout 30 is located between the shank portion 8 and the threaded portion 12. The thread of the threaded portion 12 ends in the thread runout 30. The outer diameter is limited by an imaginary surrounding cone 31. The diameter of the thread runout 30 increases over the length 16. For example, the diameter starts at the rolling diameter 32, and it ends at the outer diameter 14 of the threaded portion 12. Usually, the length 16 corresponds to 2.5 rotations of the respective thread. In a short design, it corresponds to 1.25 rotations of the thread.

Compared to the prior art screw as known from Fig. 2, Fig. 3 illustrates the novel design of the thread runout 15. The thread runout 15 extends over the length 16. In a first step, the thread runout 15 may be produced as it is known from the prior art (Fig. 2). Then, the surrounding diameter 18 is produced in the region of the threat runout 15. The surrounding diameter 18 has the shape of a cylinder, and its extends over the length 16. The surrounding diameter 18 may be produced by removing material or without removing material. Fig. 3 illustrates an exemplary embodiment in which the surrounding diameter 18 has been produced without removing material by rolling in a way that parts of the thread impressions in the region of the thread runout 15 may still be seen in Fig. 3. The end of the surrounding diameter 18 facing away from the head 4 of the screw 2 may coincide with the end of the thread runout 15. However, it may also end before or after the end of the thread runout 15. However, the novel connecting element 1 includes the step 20. The step 20 may also be called a step-like inclining

element 20 or a stop element. The element 20 is located in the region of the thread runout 15, or it may also be located within the threaded portion 12 in case it is not located at the location of transition. The surrounding diameter 18 is only slightly different compared to the rolling diameter 32. In the illustrated exemplary embodiment, the surrounding diameter 18 is designed to be slightly more than the rolling diameter 32. The surrounding diameter 18 substantially differs from the outer diameter 14 of the threaded portion 12 in a way that the element 20 is rather big in a radial direction. The element 20 forms a stop cooperating with the narrow location 27 of the supporting element 3. It is designed and arranged to assure the captive arrangement of the supporting element at the screw 2, and to prevent clamping of the elements with respect to one another.

Figs. 4 through 7 illustrate further exemplary embodiments of the novel thread runout 15. **Fig. 4** illustrates an exemplary embodiment in which the shank portion 10 of the shank 8 has a diameter 33 being more than the rolling diameter 32. The diameter 33 is slightly less than the outer diameter 14 of the threaded portion 12. This exemplary embodiment may also be produced by cold forming (for example by rolling), but also by a process including a plurality of steps, for example a milling process which removes material.

The exemplary embodiment of **Fig. 5** makes it clear that the arrangement may also be different than illustrated in Fig. 4. The diameter 34 is less than the rolling diameter 33. The thread runout 15 has been produced with our without removing material. The above described exemplary embodiments include the element 20 being located more or less at the transition between the thread runout 15 and the thread of the threaded portion 12.

Fig. 6 illustrates another exemplary embodiment of the novel connecting element 1 in which the process area of the thread runout 15 ends within the length 16. The element 20 has a design which is slightly smaller in a radial direction, and it is located at a place of the thread of the thread runout 15. The radial extension with respect to the outer diameter 14 of the threaded portion 12 is less by a distance 35. However, the element 20 is sufficient to fulfill its

functions. This especially applies when the diameter 18 is identical or at least approximately identical to the rolling diameter 32.

Fig. 7 shows the possibility of designing the axial extension of the later processed portion of the thread runout 15 in a way that the step 20 is located in the region of the length 17 of the thread of the threaded portion 12 - meaning outside the length 16 of the thread runout 15. In this way, the step 20 extends in a way to reach the outer diameter 14 of the thread of the threaded portion 12. The radial extension of the step 20 is insofar up to its maximum. The maximum is also reached when the step 20 is located exactly at the transition between the lengths 16 and 17. The exemplary embodiments as explained with reference to Figs. 6 and 7 may be produced by processes removing material (Fig. 7) or not removing material (Fig. 6) in the region of the thread runout 15.

Fig. 8 is similar to Fig. 2, and it also illustrates the screw 2 as known from the prior art as a semi-section and an associated diagram illustrating the diameter starting from the rolling diameter 32 in the region of the shank portion 10, the diameter in the region of the end of the thread 30 to the outer diameter 14 in the region of the threaded portion 12. It is to be seen that the diameter in the region of the end of the thread 30 increases over the length 16, as it corresponds to the surrounding cone 31.

Fig. 9 illustrates the general design of the novel thread runout 15 with the step 20. Starting from the shank portion 10 - which may have a rolling diameter 32 - the surrounding diameter 18 in the end of the thread 15 is located slightly higher, and it then suddenly changes over the length l of the screw 2 at the step 20 to reach the outer diameter 14. The comparison of Figs. 8 and 9 relates to the longitudinal direction of the screw 2.

Fig. 10 illustrates relationships schematically as winding down the circumference of the screw 2 - meaning in a tangential direction along the helical line of the thread. For this purpose, one axis of the diagram relates to the angle α, and the other axis indicates the diameter d. The angle α and the diameter d are illustrated with respect to the circumference of the screw 2. The

continuous line 36 relates to a prior art screw including a thread runout 30 of conventional design. It is to be seen from Fig. 10 that the tip of the thread has an enlarging diameter which extends over a total of 900°. The line 36 forms a very flat inclined plane. In the prior art showing line 36 - especially when using single impressions 29 - there is the danger of the inwardly directed tip of an impression 29 clamping between two threads of the thread runout 30. It is also possible that clamping occurs at the tips of the threads. The dashed line 37 indicates the design of a novel thread runout 15. The novel thread runout 15 or end of the thread 15 with its envelope diameter or surrounding diameter 18 first maintains the rolling diameter 32. The inclination element or step 20 is located in the transition region between the thread runout 15 and the thread of the threaded portion 12. The comparatively strong inclination of the outer diameter covers an angle of approximately 90°. The dash-dotted line 38 illustrates another exemplary embodiment of the novel connecting element in which the surrounding diameter 18 first is slightly more than the rolling diameter 32, and then extends over most part of the length 16 of the thread runout 15. The inclination element 20 is located in the region of the length 16. The strong inclination also covers a region of approximately 90°. The line 39 including double points illustrates an embodiment in which the surrounding diameter 18 is less than the rolling diameter 32. Furthermore, the inclination element 20 is located in the region of the thread of the threaded portion 12 - meaning outside the primary thread runout 15.

Fig. 11 illustrates another exemplary embodiment of the novel connecting element 1 similar to the embodiment of Fig. 1. The supporting element 3 is also designed as a bush 21. The narrowing location 27 is formed by an infinite number of impressions 29 - meaning an enlarging element 40 being deformed towards the inside. The thread runout 15 may have the same design as this has already been described with respect to the other exemplary embodiments of the novel connecting element 1.

Fig. 12 illustrates an exemplary embodiment of the novel connecting element 1 in which the supporting element 3 is designed as a plain washer 41. The plain washer 41 has an inner

diameter 42 which forms the narrowing location 27. The shank portion 10 has a comparatively short design, and it immediately verges into the thread runout 15. Again, the step 20 cooperates with the inner diameter 42. It is to be understood that the thread of the threaded portion 12 is produced after having mounted the plain washer 41. The same applies to the respective processing step taking place in the region of the thread runout 15. Processing of the thread runout 15 is possible since the plain washer 41 has a thickness which is less than the length of the shank portion 10.

Many variations and modifications may be made to the preferred embodiments of the invention without departing substantially from the spirit and principles of the invention. All such modifications and variations are intended to be included herein within the scope of the present invention, as defined by the following claims.

A reference herein to a prior art document is not an admission that the document forms part of the common general knowledge in the art, in Australia or in any other country.

A reference herein to a prior art document is not an admission that the document forms part of the common general knowledge in the art in Australia.

CLAIMS

1. A connecting element comprising a screw and a supporting element, the supporting element being captively connected to, and in general rotatably arranged on the screw, the screw including a head and a shank, the shank having a threaded portion including a thread runout facing the head and a shank portion, the shank portion having a diameter which is less than the outer diameter of the threaded portion, the supporting element having an inner aperture and including a narrowing location at which a diameter of the inner aperture is reduced, the supporting element having a diameter which is less than the outer diameter of the threaded portion, wherein the thread runout facing the head is removed with respect to at least over a part of an axial extension of the thread runout and at least over a substantial part of a circumference of the thread runout resulting in a step-like or stop element ending at least about the outer diameter of the threaded portion.

2. Connecting element of claim 1 wherein the supporting element is a bush.

3. Connecting element of claim 1 wherein the supporting element is a washer.

4. Connecting element of any one of claims 1 to 3, wherein the screw in the region of the removed thread runout has a surrounding diameter which has an approximately cylindrical shape in an axial direction.

5. Connecting element of claim 4, wherein the surrounding diameter is less than the diameter at the narrowing location.

6. Connecting element of claim 5, wherein the surrounding diameter is more, especially only slightly more, than the reduced diameter of the shank portion.

7. Connecting element of any one of claims 1 to 3, wherein the screw in the region of the removed thread runout has a surrounding diameter and wherein the step-like or stop increase of the surrounding diameter to the outer diameter of the threaded portion of the screw in the region of the runout facing the head is designed and arranged to cover less than approximately 180° of the circumference.

8. Connecting element of any one of claims 1 to 3 wherein the screw in the region of the removed thread runout has a surrounding diameter and wherein the step-like or stop increase of the surrounding diameter to the outer diameter of the threaded portion of the screw in the region of the runout facing the head is designed and arranged to cover less than about 90° of the circumference.

9. Connecting element of claim 1, wherein the thread runout of the threaded portion of the screw facing the head is produced by removing material or without removing material.

10. Connecting element of any one of claims 1 to 9 wherein the screw in the region of the removed thread runout facing the head includes an enlarged element being produced by rolling.

11. Connecting element of claim 1 or 2 or any one of claims 4 to 10 when dependent on claim 2 wherein the supporting element is designed as a bush having an inner diameter which is more than the outer diameter of the threaded portion, and in that the bush includes a plurality of impressions being spaced apart about the circumference, wherein the number of the impressions is more than the number of the convolutions of the thread.

12. Connecting element of claims 1 or 3 or any one of claims 4 to 10 when dependent on claim 3 wherein the supporting element is designed as a plain washer having an inner diameter which is less than the outer diameter of the threaded portion, the inner diameter being associated with the narrowing location.

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13. Connecting element of claim 1, wherein the step-like or stop increase of the surrounding diameter to the outer diameter of the threaded portion of the screw is arranged in the region of the threaded portion.

14. A connecting element substantially as herein described with reference to figures 1 and 4 to 12.

Dated this 5th day of May 2005
KAMAX-WERKE RUDOLF KELLERMANN GMBH & CO. KG
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
Trade Mark Attorneys of Australia

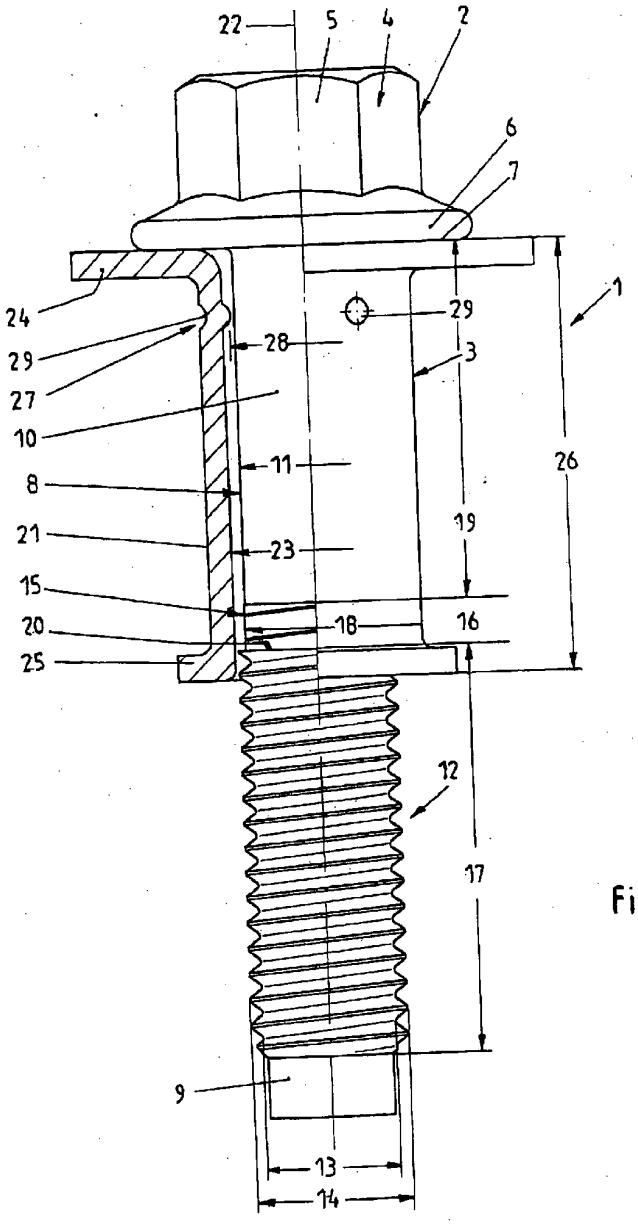
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Fig.1

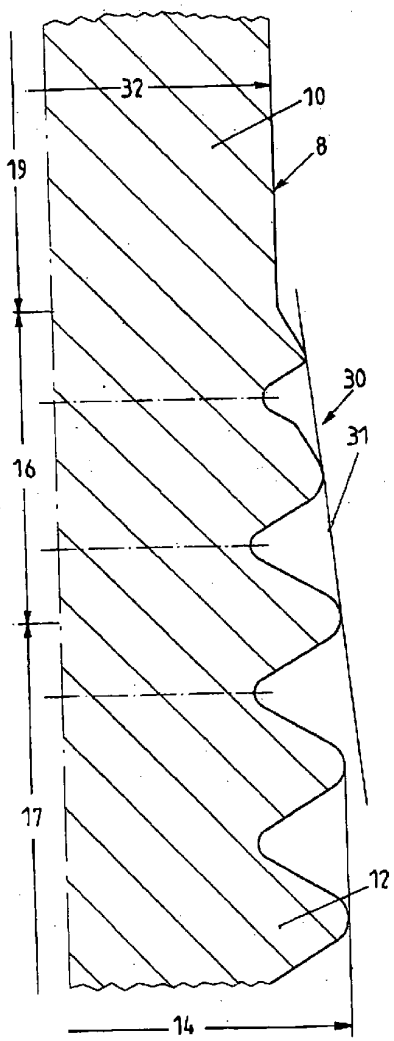


Fig. 2 (prior art)

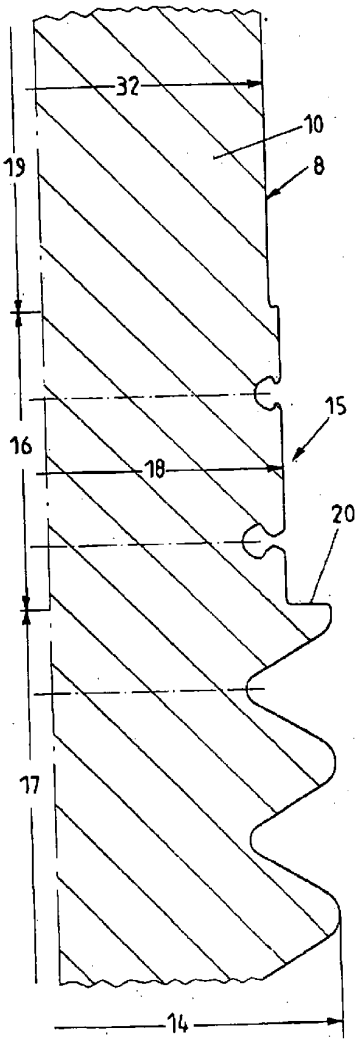


Fig. 3

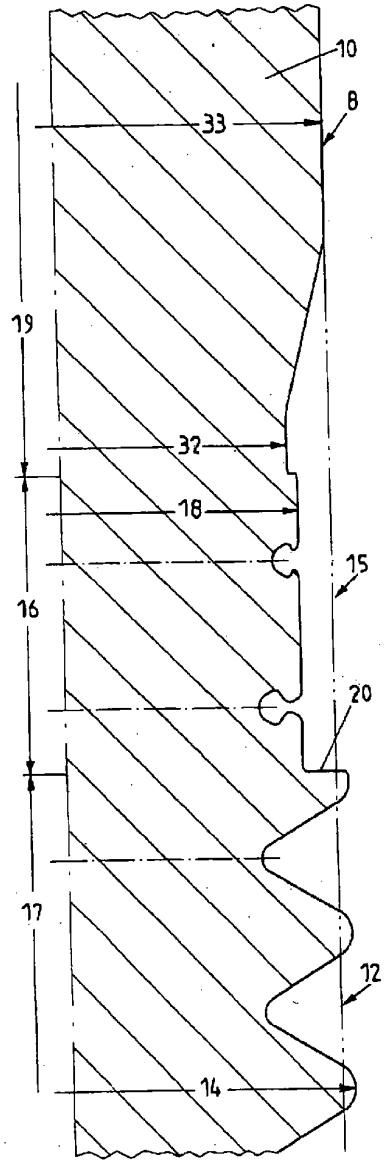


Fig. 4

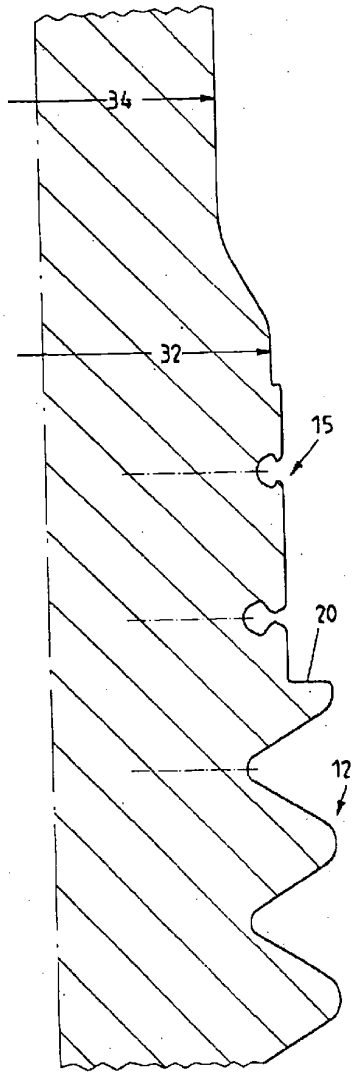


Fig. 5

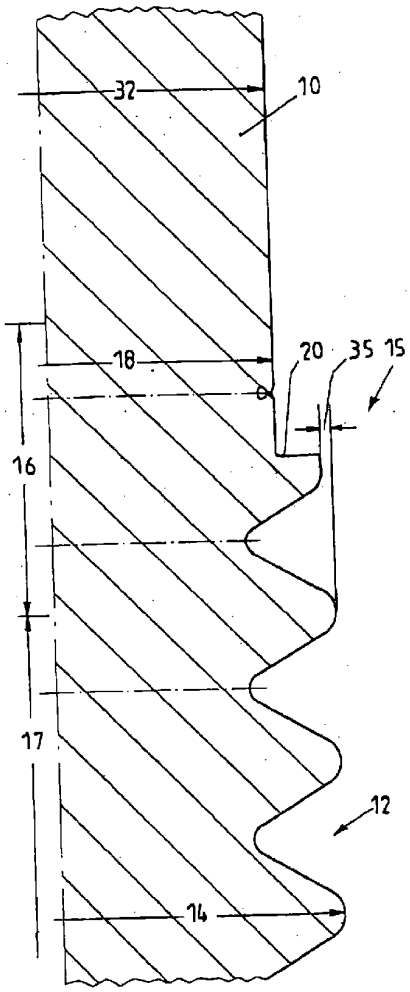


Fig. 6

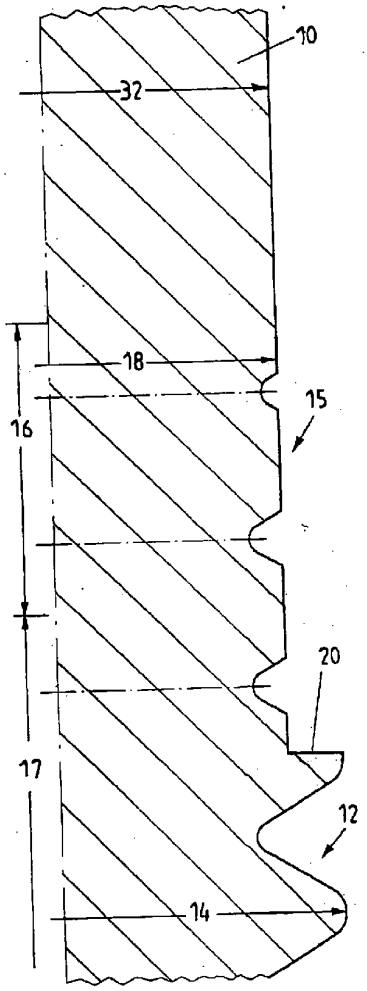


Fig. 7

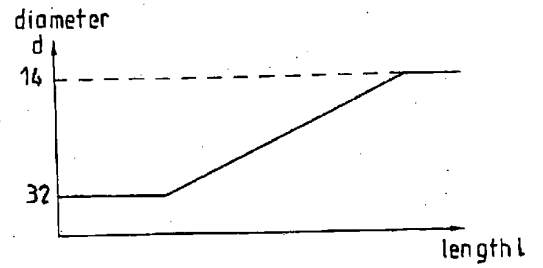
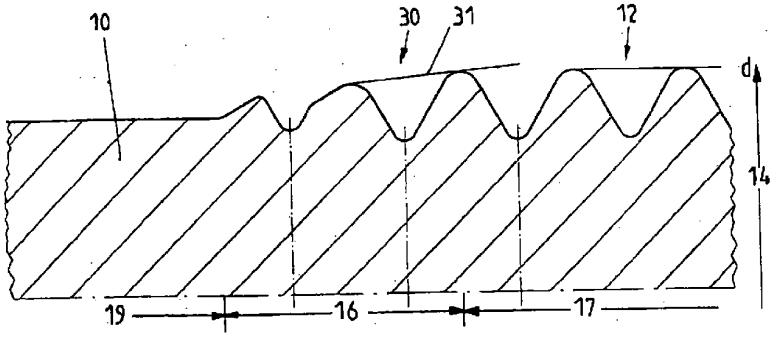


Fig. 8
(prior art)



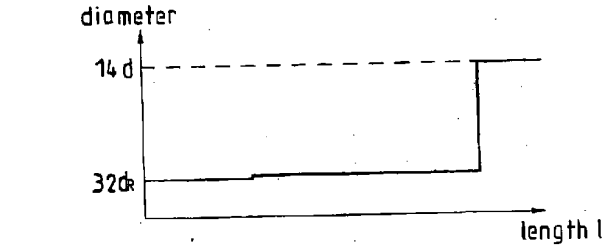
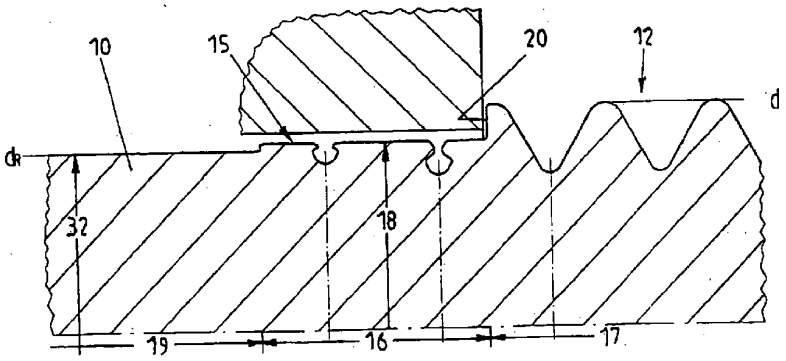


Fig. 9



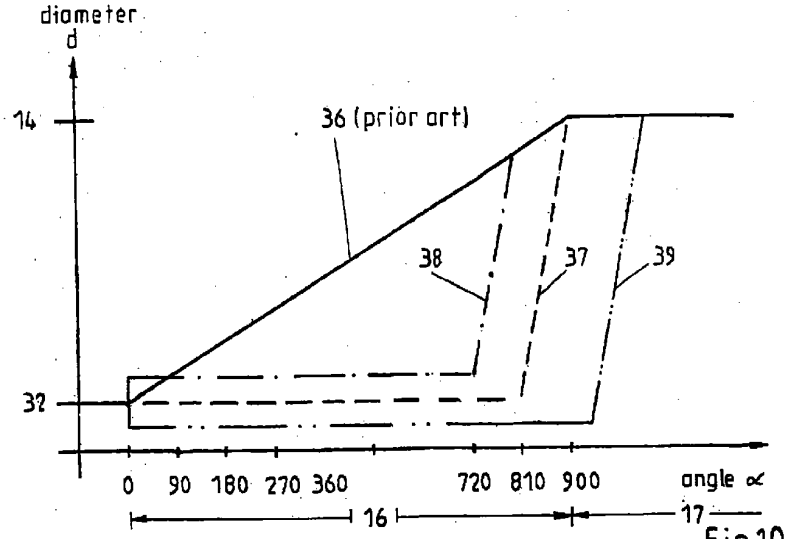


Fig.10

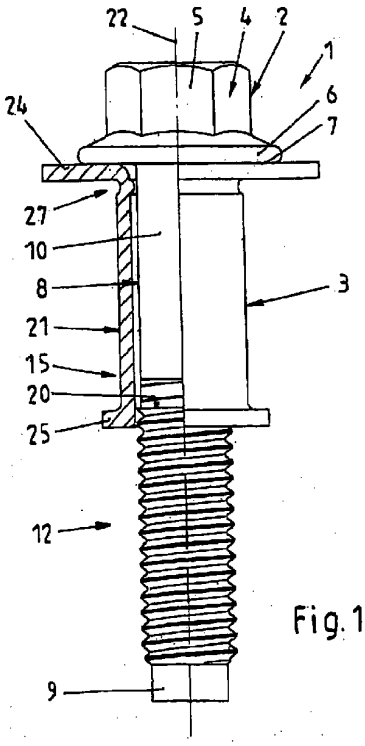


Fig. 11

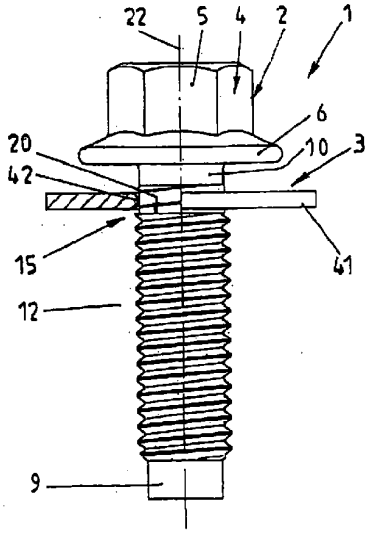


Fig. 12