

LOCKING DEVICE FOR USE WITH SHAFTS OR TUBES

The present invention relates to a device which can be selectively locked or clamped to a shaft or tube.

In many mechanical applications it is necessary to clamp one component, such as a bearing, a sprocket or a pulley, to a rotatable component, such as a shaft or spindle.

One simple way of clamping the component in place is to use one or more grub or set screws which engage with the outer surface of the shaft. The set screws can then be received in screw threaded or tapped bores in the component. In the case of a bearing the screws are placed in tapped bores in the inner ring. The screws tend to damage the shaft particularly if the component is removed from the shaft from time to time. The tightening of the screws also cause high tensile stresses in the inner ring and fracture can occur. The provision of the tapped bores also entails additional operations. Another well known design utilizes an eccentric collar with a set screw which when engaged also tends to damage the shaft. Moreover it is not easy to establish the direction of tightening or loosening when releasing the collar and the collar is prone to damage. The eccentric collar also

requires specifical machining.

A general object of the present invention is to provide an improved form of locking device.

According to the invention there is provided a device for locking to a component rotatable about an axis; said device comprising a collar or the like with an end wall with a contact surface confronting a surface of the component and a region extending axially from the end wall, a ring or the like disposed between the axial region of the collar and the component, the ring having a first contact surface confronting the surface of the component and a second contact surface which is inclined relative to the axis of rotation to converge with respect to the axis of rotation in a direction away from the end wall and several screw-threaded elements received in threaded bores extending radially through the axial region of the collar which can be tightened to bear into or against the second contact surface of the ring to cause the contact surface of the collar and the first contact surface of the ring to exert clamping force on the component at diametrically opposed zones.

The ends of the screw-threaded elements may have plane surfaces parallel to the rotational axis or set at an angle which may have the same sense as the angle of

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the second contact surface of the ring. It is possible to provide shallow depressions, recesses, or blind bores in the second contact surface for receiving the ends of the screw-threaded elements.

Preferably the surfaces of the collar and the ring which contact the component and exert clamping force therein lie directly alongside one another along the axis of rotation. Between these contact surfaces there may be radial surfaces of the ring and the collar which engage on one another and slide against one another as the screw elements are tightened or released.

The rotatable component may be a shaft or spindle with the locking device fitted onto its exterior periphery or a hollow shaft or tube with the locking device fitted inside. In the first case the contact surface of the collar can be formed by a bore in the end wall whilst in the second case the contact surface of the collar can be formed by the outer periphery of the end wall.

It is not essential for the rotatable component to have a circular cross-section and the component can have a polygonal cross-section.

The invention may be understood more readily and various other aspects and features of the invention may



become apparent, from consideration of the following description and accompanying drawings.

Embodiments of the invention will now be described by way of examples only, with reference to the accompanying drawings therein:

Figure 1 is a part sectional representation of an assembly employing a locking device constructed in accordance with the invention and

Figure 2 is an schematic representation of another assembly and locking device constructed in accordance with the invention.

As shown in Figure 1, to a shaft 10 there is fitted a rolling-element bearing 11 and a locking device 12. The bearing 11 is composed of an extended inner ring 13 which is to be secured to the shaft 10 in a non-rotatable manner. The ring 13 has an inner contact surface 9 extending parallel to the outer peripheral surface of the shaft 10. A set of rolling elements, here in the form of balls 14, is disposed in raceways 15 between the inner ring 13 and an outer ring 16. The balls 14 are spaced apart round the raceways 15 with a cage 27 and seals 8 are mounted between the rings 13, 16.

An axial end region 17 of the inner ring 13 is surrounded by an axial portion 18 of a collar 19. The



collar 19 has an end wall 25 with a bore forming a contact surface 22 fitted over the shaft 10 with the surface 22 forming a continuation of the inner contact surface 9 of the ring 13.

The outer surface of the region 17 of the bearing inner ring 13 is relieved to provide an outer contact surface 20 which is tapered to extend at an angle to the axis of the shaft 10. The surface 20 converges towards the shaft axis in the direction of the bearing 11. A typical angle for the surface 20 is 3° and generally an angle in the range 1° to 5° is preferred.

Two screws 21 are located in threaded bores 6 in the axial portion 18 of the collar 19 disposed 120° apart around the axis of the shaft 10. This angle is not critical and may vary depending on the application. The screws 21 can be displaced inwardly of the bores 6 to engage on the outer contact surface 20 of the ring 13. In a modified arrangement the surface 20 has shallow recesses or depressions or blind bores for locating and receiving the ends 23 of the screws 21. The inner ring 13 of the bearing 11 and the collar 19 can be easily fitted onto the shaft 10 and the screws 21 are then tightened to some predetermined torque. The ends 23 of the screws 21, which can be tapered at the same angle as

the contact surface 20, press on the outer contact surface 20 to displace the axial end region 17 of the inner ring 13 and the axial portion 18 of the collar 19 radially apart. This in turn causes diametrically opposed contact surface zones 24, 26 of the inner contact surface 9 of the ring 13 and of the contact surface 22 in the end wall 25 of the collar 19 to clamp against the shaft 10 uniformly without causing damage to the shaft 10. To release the locking device 12, the screws 21 are untightened to permit the collar 19 and the bearing 11 to be withdrawn from the shaft 10.

The end wall 25 of the collar 19 and the end of the axial region 17 of the ring 13 abut to form sliding guide surfaces 50 as the screws 21 are tightened or released.

Figure 2 depicts another locking device 12 which is fitted inside a hollow shaft or tube 120. The locking device is again composed of a collar 190 with an axial region 180 with two angularly offset threaded bores 220 receiving screws 210. An end wall 250 of the collar has an outer peripheral contact surface 280 which is parallel to and confronts an inner surface 300 of the tube 120. A ring 170 has an outer peripheral contact surface 240 which is parallel to and likewise confronts the inner

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surface 300 of the tube 120 and an inner contact surface 200 which is tapered at an angle to the axis of the tube 120. As with the Figure 1 embodiment, the surface 200 can be inclined at an angle of 1 to 5° and preferably 3° to the axis of the tube 120 and/or the surface 200 can contain shallow recesses, depressions or blind bores for receiving the ends 230 of the screws 210.

The device 12 is locked to the tube 120 by tightening the screws 210 to cause their ends 230 to displace the axial region 180 of the collar 190 and the ring 170 radially apart. This in turn causes diametrically opposed contact surface zones 290, 291 of the contact surface 280 of the collar end wall 250 and of the surface 240 of the ring 170 to bear against the inner surface 300 of the tube 120 to lock the device in place.

The ring 170 and the end wall of the collar 190 have radial faces which abut and establish slidable guide surfaces 350 as the screws 210 are tightened or released. The device can be used to provide an abutment or location for some other components such as a bearing.

In contrast to some known forms of locking device or mechanisms, a device in accordance with the invention does not damage the rotatable component and is easily fitted and removed repeatedly. In the Figure 1



arrangement the inner ring 13 is simply extended and easily machined in one operation. There is no need to provide tapped bores in the ring 13. Also since no excessive tensile stresses are created on the inner ring 13 there is no danger of fracture for this reason. There is also no distortion so the raceways for the balls are unaffected.

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CLAIMS

1. A device for locking to a component rotatable about an axis; said device comprising collar means having an end wall with a contact surface confronting a surface of the component and a region extending axially from the end wall, a ring disposed between the axial region of the collar means and the component, the ring having a first contact surface confronting the surface of the component and a second contact surface which is inclined relative to the axis of rotation to converge with respect to the axis of rotation in a direction away from the end wall and several screw-threaded elements received in threaded bores extending radially through the axial region of the collar means which can be tightened to bear into or against the second contact surface of the ring to cause the contact surface of the collar and the first contact surface of the ring to exert clamping force on the component at diametrically opposed zones.
2. A device according to Claim 1, wherein the contact surface of the collar means and the first contact surface of the ring lie closely adjacent to form a continuation of one another.
3. A device according to Claim 2, wherein between the

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contact surface of the collar and the first contact surface of the ring there are radially abutting contact guide surfaces of the collar means and of the ring which slide against one another as the screw-threaded elements are tightened or released.

4. A device according to Claim 1, 2 or 3 wherein the screw-threaded elements have end surfaces for contacting for contacting the second contact surface of the ring which are inclined relative to the axis of rotation.

5. A device according to any one of Claims 1 to 4, wherein there are two screw-threaded elements.

6. A device according to Claim 5, wherein the threaded bores for receiving the screw-threaded elements are spaced apart by 120° relative to the axis of rotation.

7. A device according to any one of Claims 1 to 6, wherein the second contact surface of the ring has depressions, recesses or blind bores for receiving the ends of the screw-threaded elements.

8. A device according to any one of Claims 1 to 7, wherein the rotatable component is a solid shaft or spindle and the contact surface of the end wall of the collar is an inner peripheral bore surface which confronts the exterior surface of the component.

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9. A device according to Claim 8, wherein the ring is itself another component of, or part of, some other structure which is to be locked with the device.
10. A device according to Claim 9, wherein the ring is formed by an extended region of the inner ring of a rolling element bearing.
11. A device according to any one of Claims 1 to 7, wherein the component is a hollow shaft or tube and contact surface of the end wall of the collar means and the first contact surface of the ring are outer peripheral surfaces which confront the interior of the component and the axial region of the collar means is disposed radially inwardly from the interior of the component.
12. A device according to any one of the preceding claims, wherein the second contact surface of the ring is inclined at an angle of 1° to 5° to the axis of rotation.
13. A device substantially as described with reference to and as illustrated in Figure 1 or Figure 2 of the accompanying drawing.

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FIG. 1.

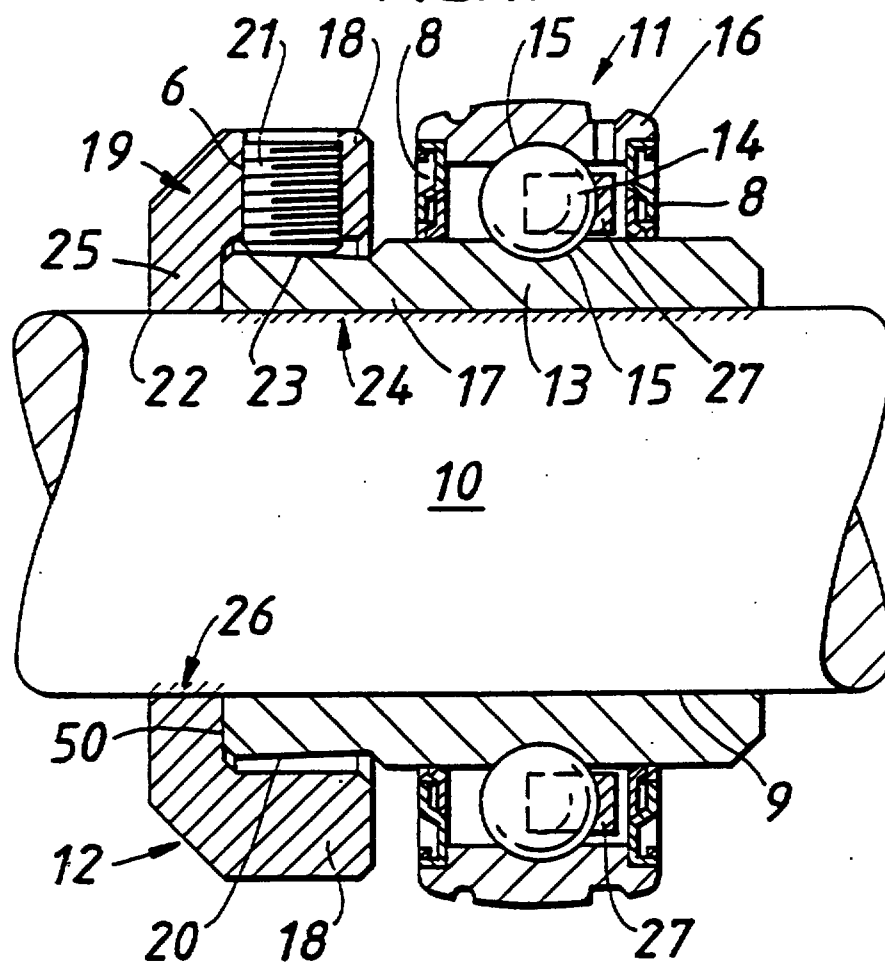
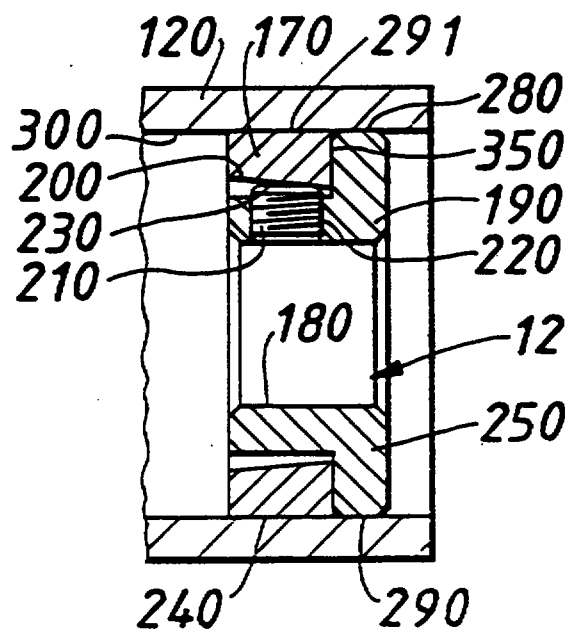


FIG. 2.



ABSTRACT

LOCKING DEVICE FOR USE WITH SHAFTS OR TUBES

A locking device for clamping onto a shaft (10) is composed of a collar (19) and a ring (3, 17) fitted onto the shaft (10). The collar (19) has an end wall (25) and an axial region (18) extending over an outer inclined contact surface (20) of the ring (13, 17). The ring (13, 17) and the collar end wall (25) have inner contact surfaces (9, 22) confronting the outer surface of the shaft (10) which are separated by sliding radial surfaces (50) of the collar (19) and the ring (13, 17). Screw-threaded elements (21) set in threaded bores (6) in the axial region (18) of the collar (19) can be tightened against the outer contact surface (20) of the ring (13, 17) to cause the inner contact surfaces (9, 22) to exert clamping force on the shaft (10).

Figure 1.

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requires specific machining.

A general object of the present invention is to provide an improved form of locking device.

According to one aspect of the invention there is provided a device for locking to a component rotatable about an axis; said device comprising collar means having an end wall with a bore defining a surface for confronting an outer surface of the component and a region extending axially from the end wall, a ring for disposing between the axial region of the collar means and the component, the ring having a first inner surface for confronting the outer surface of the component and a second outer surface which is inclined relative to the axis of rotation to converge with respect to the axis of rotation in a direction away from the end wall and several screw-threaded elements received in threaded bores extending radially through the axial region of the collar means and spaced apart relative to the rotational axis other than at 180° , the arrangement being such that the screw-threaded elements can be tightened to bear into or against the second outer surface of the ring to cause the bore surface of the collar means and the first surface of the ring to act as contact surfaces with respect to the outer surface of the component which exert clamping force on the component at diametrically opposed zones.

According to another aspect of the invention here is provided a device for locking to a hollow component rotatable about an axis; said device comprising collar means having an end wall with an outer surface for confronting an inner surface of the

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component and a region extending axially from the end wall; a ring for disposing between the axial region of the collar means and the component, the ring having a first outer surface for confronting the inner surface of the component and a second inner surface which is inclined relative to the axis of rotation to diverge with respect to the axis of rotation in a direction away from the end wall and several screw threaded elements received in threaded bores extending radially through the axial region of the collar means and spaced apart relative to the rotational axis other than at 180° the arrangement being such that the screw-threaded elements can be tightened to bear into or against the second inner surface of the ring to cause the outer surface of the ring and the outer surface of the end wall of the collar means to act as contact surfaces with respect to the inner surface of the component which exert clamping force on the component and diametrically opposed zones.

As will become apparent in the following description, the rotatable component may be a shaft or spindle with the locking device fitted onto its exterior periphery or a hollow shaft or tube with the locking device fitted inside.

It is not essential for the rotatable component to have a circular cross-section and the component can have a polygonal cross-section.

The ends of the screw-threaded elements may have plane surfaces parallel to the rotational axis or set at an angle which may have the same sense as the angle of the

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second surface of the ring. It is possible to provide shallow depressions, recesses or blind bores in the second surface for receiving the ends of the screw-threaded elements.

Preferably the confronting surfaces of the collar means and the ring which contact the component and exert clamping force therein lie directly alongside one another along the axis of rotation. Between these contact surfaces there may be radial guide surfaces of the ring and the collar means which engage on one another and slide against one another as the screw elements are tightened or released.

The invention may be understood more readily and various other aspects and features of the invention may become apparent, from consideration of the following description and accompanying drawings.

Embodiments of the invention will now be described by way of example; only, with reference to the accompanying drawings therein:

Figure 1 is a part sectional representation of an assembly employing a locking device constructed in accordance with the invention and

Figure 2 is an schematic representation of another assembly and locking device constructed in accordance with the invention.

As shown in Figure 1, to a shaft 10 there is fitted a rolling-element bearing 11 and a locking device 12. The bearing 11 is composed of an extended inner ring 13 which is

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to be secured to the shaft 10 in a non-rotatable manner. The ring 13 has an inner confronting surface 9 extending parallel to the outer peripheral surface of the shaft 10. A set of rolling elements, here in the form of balls 14, is disposed in raceways 15 between the inner ring 13 and an outer ring 16. The balls 14 are spaced apart round the raceways 15 with a cage 27 and seals 8 are mounted between the rings 13,16.

An axial end region 17 of the inner ring 13 is surrounded by an axial portion 18 of a collar 19. The collar 19 has an end wall 25 with a bore forming a confronting surface 22 fitted over the shaft 10 with the surface 22 forming a continuation of the inner surface 9 of the ring 13.

The outer surface of the region 17 of the bearing inner ring 13 is relieved to provide an outer surface 20 which is tapered to extend at an angle to the axis of the shaft 10. The surface 20 converges towards the shaft axis in the direction of the bearing 11. A typical angle for the surface 20 is 3° and generally an angle in the range 1° to 5° is preferred.

Two screws 21 are located in threaded bores 6 in the axial portion 18 of the collar 19 disposed 120° apart around the axis of the shaft 10. This angle is not critical and may vary depending on the application. The screws 21 can be displaced inwardly of the bores 6 to engage on the outer surface 20 of the ring 13. In a modified arrangement the surface 20 has shallow recesses or depressions or blind bores for locating and receiving

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the ends 23 of the screws 21. The inner ring 13 of the bearing 11 and the collar 19 can be easily fitted onto the shaft 10 and the screws 21 are then tightened to some predetermined torque. The ends 23 of the screws 21, which can be tapered at the same angle as the contact surface 20, press on the outer surface 20 to displace the axial end region 17 of the inner ring 13 and the axial portion 18 of the collar 19 radially part. This in turn causes diametrically opposed surface contact zones 24, 26 of the inner surface 9 of the ring 13 and of the bore surface 22 in the end wall 25 of the collar 19 to clamp against the shaft 10 uniformly without causing damage to the shaft 10. To release the locking device 12, the screws 21 are untightened to permit the collar 19 and the bearing 11 to be withdrawn from the shaft 10.

The end wall 25 of the collar 19 and the end of the axial region 17 of the ring 13 abut to form sliding guide surfaces 50 as the screws 21 are tightened or released.

Figure 2 depicts another locking device 12 which is fitted inside a hollow shaft or tube 120. The locking device is again composed of a collar 190 with an axial region 180 with two angularly offset threaded bores 220 receiving screws 210. An end wall 250 of the collar has an outer peripheral surface 280 which is parallel to and confronts an inner surface 300 of the tube 120. A ring 170 has an outer peripheral surface 240 which is parallel to and likewise confronts the inner surface 300 of the tube 120 and an inner surface 200 which is tapered at an angle to the axis of the tube 120. As with the figure 1 embodiment, the surface 200 can be inclined at an angle of 1 to 5° and preferably 3° to

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the axis of the tube 120 and/or the surface 200 can contain shallow recesses, depressions or blind bores for receiving the ends 230 of the screws 210.

The device 12 is locked to the tube 120 by tightening the screws 210 to cause their ends 230 to displace the axial region 180 of the collar 190 and the ring 170 radially apart. This in turn causes diametrically opposed surface contact zones 290, 291 of the surface 280 of the collar end wall 250 and of the surface 240 of the ring 170 to bearing against the inner surface 300 of the tube 120 to lock the device in place.

The ring 170 and the end wall of the collar 190 have radial faces which abut and establish slidable guide surfaces 350 as the screws 210 are tightened or released. The device can be used to provide an abutment or location for some other components such as a bearing.

In contrast to some known forms of locking device or mechanisms, a device in accordance with the invention does not damage the rotatable component and is easily fitted and removed repeatedly. In the Figure 1 arrangement the inner ring 13 is simply extended and easily machined in one operation. There is no need to provide tapped bores in the ring 13. Also since no excessive tensile stresses are created on the inner ring 13 there is no danger of fracture for this reason. There is also no distortion so the raceways for the balls are unaffected.

**Claims**

1. A device for locking to a component rotatable about an axis; said device comprising collar means having an end wall with a bore defining a surface for confronting an outer surface of the component and a region extending axially from the end wall, a ring for disposing between the axial region of the collar means and the component, the ring having a first inner surface for confronting the outer surface of the component and a second outer surface which is inclined relative to the axis of rotation to converge with respect to the axis of rotation in a direction away from the end wall and several screw-threaded elements received in threaded bores extending radially through the axial region of the collar means and spaced apart relative to the rotational axis other than at 180°, the arrangement being such that the screw-threaded elements can be tightened to bear into or against the second outer surface of the ring to cause the bore surface of the collar means and the first surface of the ring to act as contact surfaces with respect to the outer surface of the component which exert clamping force on the component at diametrically opposed zones.
2. A device for locking to a hollow component rotatable about an axis; said device comprising collar means having an end wall with an outer surface for confronting an inner surface of the component and a region extending axially from the end wall; a ring for disposing between the axial region of the collar means and the component, the ring having a first outer surface for confronting the inner surface of the component and a second inner surface which is inclined relative to the axis of rotation to diverge with



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respect to the axis of rotation in a direction away from the end wall and several screw threaded elements received in threaded bores extending radially through the axial region of the collar means and spaced apart relative to the rotational axis other than at 180° the arrangement being such that the screw-threaded elements can be tightened to bear into or against the second inner surface of the ring to cause the outer surface of the ring and the outer surface of the end wall of the collar means to act as contact surfaces with respect to the inner surface of the component which exert clamping force on the component at diametrically opposed zones.

3. A device according to claim 1 or 2, wherein the confronting surface of the collar means and the first surface of the ring lie closely adjacent to form a continuation of one another.
4. A device according to claim 3, wherein between the second confronting surface of the collar means and the first surface of the ring there are radially abutting guide surfaces of the collar means and of the ring which slide against one another as the screw-threaded elements are tightened or released.
5. A device according to any one of claims 1 to 4, wherein the screw-threaded elements have end surfaces for contacting the second surface of the ring which are inclined relative to the axis of rotation.
6. A device according to any one of claims 1 to 5, wherein there are two screw-threaded elements.
7. A device according to claim 6, wherein the threaded bores for receiving the screw-threaded elements are spaced apart by 120° relative to the axis of rotation.



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8. A device according to any one of claims 1 to 7, wherein the second surface of the ring has depressions, recesses or blind bores for receiving the ends of the screw-threaded elements.
9. A device according to claim 1 or according to any one of claims 3 to 8, when appended to claim 1, wherein the rotatable component is a solid shaft or spindle.
10. A device according to claim 9, wherein the ring is itself another component of, or part of, some other structure which is to be locked with the device.
11. A device according to claim 10, wherein the ring is formed by an extended region of the inner ring of a rolling element bearing.
12. A device according to claim 2 or any one of claims 3 to 8 when appended to claim 2, wherein the component is a hollow shaft or tube.
13. A device according to any one of the preceding claims, wherein the second surface of the ring is inclined at an angle of 1° to 5° to the axis of rotation.
14. An assembly composed of a device according to any one of the preceding claims in combination with the rotatable component.
15. A device or assembly substantially as described with reference to and as illustrated in Figure 1 or Figure 2 of the accompanying drawing.