DEVELOGE FOR REMOVING ARTICLES FROM THEIR SUPPORTS

Fig. 12

Fig. 13

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[Signature]
DEVICE FOR REMOVING ARTICLES FROM THEIR SUPPORTS

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Application April 20, 1950, Serial No. 156,963

2 Claims. (Cl. 29—261)

The present invention relates to a device for removing an article from its support, particularly a ring-shaped article held by the support with pressure. The present invention is particularly useful for removing a race of a ball bearing from the end of a shaft on which the race is held by pressure.

It is an object of the present invention to provide a device of the kind described, which is simple to manipulate.

It is another object of the present invention to provide a device of the kind described which is reliable in operation.

It is a further object of the present invention to provide a device of the kind described which is not likely to slip off from the article to be removed, thus rendering unnecessary special devices and precautionary means for preventing a slipping.

A device according to the present invention comprises in combination, a threaded spindle being adapted to abut on the support, a member having a thread engaging said spindle, a plurality of links, each being pivotally connected to the member, a plurality of clamping means pivotally connected to the links, respectively, and means connected to said clamping means for exerting a force on the same in a direction substantially at right angles to said spindle whereby when a pull is exerted on said clamping means by means of the member, said clamping means clamp the article with a force proportional to the exerted pull.

In an embodiment of the present invention the clamping means are connected to the links by means of two-armed levers pivoted, respectively, to the links and the clamping means. Preferably, a second member is loosely arranged on the spindle and has pivots for the two-armed levers, respectively. Preferably a nut is adjustably screwed to the spindle, the second member being adapted to abut against the nut.

An embodiment of the present invention comprises a first member having a thread engaging said threaded spindle, a plurality of links, each being pivotally connected to said first member, a plurality of first two-armed levers pivoted, respectively, to the links, a second member loosely arranged on said spindle and having first pivots for said first two-armed levers, respectively, a plurality of second two-armed levers pivoted, respectively, to said first two-armed levers, a plurality of clamping means pivotally connected to said second two-armed levers, respectively. Preferably a third member is provided having second pivots for the second two-armed levers, respectively.

In another embodiment of the present invention a sleeve loosely surrounds the spindle and has an outer thread which is engaged by the second member having pivots for the two-armed levers, respectively. Preferably, the outer thread of the sleeve has an opposite sense to the thread of the spindle.

Preferably the clamping means are exchangeably arranged on their carriers.

In an embodiment of the present invention the threaded spindle does not abut against the support and means pivotally connected to the clamping means are adapted to abut against the support.

In an embodiment of the present invention curved portions are arranged on the back of the clamping means for exerting a force on the same in a direction substantially at right angles to said spindle.

According to another embodiment of the present invention a threaded nut is arranged on the threaded spindle and has a plurality of circumferential apertures, in at least part of which a plurality of screw bolts is arranged, respectively, to which links are pivoted, respectively, with which the clamping means are pivotally connected, the clamping means having curved portions on the back thereof for exerting a force substantially at right angles to the spindle. Preferably, the nut is designed as a disc and each of the screw bolts carries bearings for pivots to which the links are connected, respectively. Preferably, the circumferential apertures are spaced apart by angular distances from one another corresponding to a regular polygon, the apices of which coincide with the centers of the apertures. For instance, the apertures may be spaced apart from one of them by angular distances equivalent substantially to 72°, 90°, 120°, 144°, and 180°.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Figure 1 shows an elevation, partly in section, through one embodiment of the present invention.

Figure 2 is a plan view of the device shown in Figure 1;
3

Figure 3 is an elevation, partly in section, of a modification of the device shown in Fig. 1; Figure 4 is an elevation, partly in section, of another embodiment of the present invention; Figure 5 is a cross-section in the line A—B of Fig. 4; Figure 6 shows part of a modification of the device shown in Fig. 4; Figure 7 is an elevation, partly in section, of another modification of the device shown in Fig. 4; Figure 8 is a cross-section taken along the line C—D of Fig. 7; Figure 9 is a side elevation, partly in section, of a further embodiment of the present invention; Figure 10 is a cross-section taken along the line E—F of Fig. 9. Figure 11 shows the lower part of Fig. 9 in a different position; Figure 12 is a side elevation, partly in section, of a further embodiment of the present invention; and Figure 13 is a plan view of the device shown in Fig. 12.

Referring now to the drawings, and first to Figs. 1 and 2, a threaded spindle b provided with a hexagonal head a has a tip c adapted to abut against the center of the end of a shaft (not shown). The threaded spindle b carries a first member d provided with an internal thread engaging the thread of the spindle b. The member d is designed as a central hub d' provided with three arms d' spaced at substantially equal angular distances about the central hub d'. Each of the arms d' carries at its end a pivot e' connected to a link e which is in turn pivotally connected at e" to a two-armed lever f. The two-armed levers f are pivoted at an intermediate point g thereof to the longer arm of a second member h preferably shaped similarly to the first member d, but having a central aperture h' which has a slightly larger diameter than the spindle b, so that the second member h is loosely arranged on the spindle b. A nut k provided with an internal thread is screwed up and down along the spindle b and serves as a stop for the second member h. In Fig. 1 two positions of the nut k are indicated respectively, in full and dotted lines. The shorter arm of each two-armed lever f is pivoted at f' to a clamping means i shaped as an exchangeable jaw having pointed ends f'.

The operation of this device is as follows:

In Fig. 1 the position of the parts shown in full lines is the position in which the clamping means i touch the ball race (not shown) to be removed from the end of the shaft (not shown). The dotted lines show the position of the parts in which the clamping means i have the largest possible distance from one another. Actually, the maximum distance between the clamping means i can be limited by an adjustment of the nut k.

The tip c of the spindle b is placed on the center of the end of the shaft (not shown). Then the spindle b is turned by turning the hexagonal head a thereof, whereupon the links e and the two-armed levers f approach a position in which they are in alignment with one another so that the jaws i tightly clamp the article to be removed. On a further turning of the spindle b the first member d is further lifted and exerts an axial pull on the article. The larger a resistance is offered by the article against the removal, the larger is the exerted pull and the tighter the article is held by the jaws i.

In the embodiment shown in Fig. 1 it is supposed that the article to be removed is near the end of the shaft. Referring now to Fig. 3 of the drawings, a modification is shown which allows to withdraw articles arranged at a larger distance from the end of the shaft. This embodiment differs from that shown in Fig. 1 in that the clamping means i are not directly pivoted to the two-armed levers f, but by means of intermediate two-armed levers m which are connected to one another by a third member o, preferably designed as a ring or a cross of arms similar to the second member h and provided with pivots p for the two-armed levers m.

The operation of this device is substantially the same as that of the device shown in Fig. 1.

In the embodiments shown in Figs. 1 and 3 the device grips the article to be removed from the outside. It could be modified so that it grips the articles, such as an inner race of a ball bearing, from the inside, as shown hereinafter in connection with Figs. 9-11. In this case, the links e are turned away from the spindle b in the direction of the arrows shown in Fig. 1 and the tips f' of the jaws i are inserted so that they are directed to the outside. If the spindle b is rotated, the jaws i grip the inner race of the ball bearing from the inside.

In the embodiments shown in Figs. 1 and 3, the nut k may be an impediment in removing the article because it stops the member h at a certain position. This drawback is avoided in the embodiments shown in Figs. 4 to 11, in which a sleeve j is loosely arranged on the spindle b and has a thread p on its lower end to which the second member h is threaded. The external thread p has preferably a sense which is opposite to that of the thread of the spindle b. For instance, if the thread of the spindle b is a right hand thread, the thread p is a left hand thread. The sleeve j can be rotated by means of a hexagonal nut u forming one piece with the sleeve so that it can be screwed up and down in the second member h. The operation of this device is as follows:

The sleeve j abuts with the uppermost edge thereof against the first member d, so that on a rotation of the sleeve j the two-armed levers f are turned about their pivots g by means of the links e and jaws i grip the article to be removed, for instance the outer race r of a ball bearing, from the outside, as clearly shown in Fig. 4. When the spindle b is rotated the tip c thereof comes to abut against the end s of the shaft and finally the jaws i together with the race r of the ball bearing are lifted from the support. It should be understood that the race r is gripped the tighter by the jaws i, the larger the resistance is which is offered against the withdrawal of the race r.

The jaws i may be exchanged after loosening the screw bolts v. In order to limit a rotation of the jaws with respect to the two-armed levers j, they are provided with suitable abutting faces or with cross pins w.

In Fig. 6 a slightly modified shape of the jaws i is shown.

It should be understood that these embodiments may easily be modified, so that the articles, such as a race of a ball bearing, is gripped from the inside as described hereinafter in connection with Figs. 9-11.

Referring now to the embodiment shown in
Figs. 7 and 8, a second set of two-armed levers \( z \) is inserted between the first set of two-armed levers \( f \) and the jaws \( i \). The two-armed levers \( x \) are interconnected by a third member \( x' \) carrying pivots \( x' \) for the two-armed levers \( z \). Otherwise this embodiment is designed as the embodiments shown in Figs. 4–6. The extension of the entire system obtained by the second set of two-armed levers \( x \) renders it possible to remove articles such as ball bearing races \( r \) which are fixed at a distance from the end of the shaft \( s \) which is engaged by the tip \( c \) of the spindle \( b \). The dotted lines in Fig. 7 indicate a modification of the reduced part of the shaft \( s \) having a greater length.

Referring now to Figs. 9–11 of the drawings an embodiment is shown suitable for cases in which the tip of the spindle \( b \) cannot abut against the support of the article to be removed. Such cases arise particularly when the articles to be removed are to be gripped from the inside so that no room is left for the passage of the tip of the spindle \( b \), or else if the support \( s \) has no central face against which the tip \( c \) of the spindle \( b \) can abut.

In such cases, according to the embodiment, shown in Figs. 9–11, a disc \( d \) or member \( f \) having cross arms is preferably connected to the pivots \( y \) of the jaws \( i \) and the two-armed levers \( f \). The disc \( d \) is provided with members such as extensions \( y \) which can abut against the circumferential portion of the support or shaft \( s \).

The operation of this device is substantially the same as that of the embodiments shown in Figs. 1–5, except that the jaws \( i \) are moved from their initial position shown in Fig. 11 to the position shown in Fig. 9 by a rotation of the lever \( f \) and then the jaws \( i \) together with the inner race \( r \) of the ball bearing are withdrawn from the supporting shaft \( s \), against which the extensions \( y \) abut.

Referring now to the embodiment shown in Figs. 12 and 13, the spindle \( b \) provided with a hexagonal head \( c \) and a tip \( a \) arranged on opposite ends, respectively, of the spindle carries a member \( d \) which is in screw connection with the spindle and designed as a cross of arms preferably as a circular disc as shown in Fig. 13 of the drawings.

The disc \( d \) has circumferential apertures \( e \), which are parallel to the spindle \( b \). In some of the apertures \( e \) screw bolts \( 3 \) are arranged which are fixed in position by means of nuts \( 4 \) screwed to the upper ends of the bolts \( 3 \). At the opposite ends the screw bolts \( 3 \) have enlarged portions \( 5 \) abutting against the lower face of the disc \( d \) and forming bearings for the pivots \( c' \) of the links \( e \), which are arranged in pairs on each pivot \( c' \). On the other ends of each pair of links \( e \) is pivoted a lever \( f \) ending in a jaw \( i \) adapted to engage the article to be removed such as an outer race \( r \) of a ball bearing. The back of the jaws has a curved portion \( g' \) which cooperates with the article to be removed, for instance the inner race \( r' \) of the ball bearing, and acts as a pivot and a rolling surface.

The device operates as follows: After placing the jaws \( i \) against the article to be removed as shown in Fig. 12, the spindle \( b \) is screwed down until the tip \( c \) comes into contact with the support \( s \). On further turning of the spindle \( b \) the disc \( d \) is screwed away from the support \( s \), so that the lever \( f \) is pulled on the levers \( f \) and the jaws \( i \) by which the curved portions \( g' \) come into contact with the inner race \( r' \) of the ball bearing. In consequence thereof the jaws \( i \) act as a short lever acted upon by the long arm represented by the lever \( f \) and pull the race \( r \) out of the support \( s \) with a force which is the larger the greater the friction between the race \( r \) and the support \( s \).

As in the ball bearing the number of the balls is different according to circumstances, it is important to be able to choose the number of the jaws \( i \) and their distribution over the circumference of the disc \( d \) accordingly. For instance, if the number of balls in the bearing is a multiple of three, three jaws \( i \) should be provided which are equally spaced around the circumference of the disc \( d \). If the number of balls is a multiple of four or five, the number of jaws should be equal to four or five, respectively.

In order to accomplish this, the disc \( d \) is provided with circumferential apertures \( e \) which are spaced apart by angular distances from one another corresponding to a regular polygon, the apices of which coincide with the centers of the apertures. For instance, the apertures may have an angular distance from one of them equivalent to \( 72^\circ \), \( 60^\circ \), \( 120^\circ \), \( 144^\circ \), and \( 180^\circ \).

While I have illustrated and described the invention as embodied in a device for removing a ring-shaped article held by the support with pressure, I do not intend to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of my invention.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of devices for removing the article from its support, differing from the types described above.

Without further analysis, the foregoing will so fully reveal the gist of my invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. A pulling tool for pulling articles from shafts and the like, comprising, in combination, an elongated screw member having a free bottom end; a carrier formed with a central threaded bore and being threadedly mounted, at said bore thereof, on said screw member between opposite ends of the latter, said carrier having a plurality of portions spaced from and distributed about said screw member and located along a circle of predetermined diameter, said circle having its center in the axis of said screw member; a plurality of first links pivotally connected, each at one end thereof, to said portions of said carrier, respectively, for turning movement in planes, respectively, which include the axis of said screw member and which intersect at said axis, said first links extending from said carrier toward one end of said screw member; a plurality of second links pivotally connected, each at one end thereof, to said portions of said screw member extending toward said one end of said screw member and respectively forming obtuse angles with said first links; a guide member formed with a central opening through which said screw member freely extends and being located between said
carrier and said one end of said screw member, said guide member having portions spaced from and distributed about said screw member and located along a circle of substantially the same diameter as said predetermined diameter and having its center in said axis of said screw member, said portions of said guide member respectively being aligned with said portions of said carrier and respectively being pivotally connected to said second links, intermediate the ends of each second link, to guide said second links for turning movement in said planes, respectively: a plurality of claw means respectively joined to said second links at end portions thereof distant from said first links and on the side of said guide member opposite to said carrier for engaging an article to be removed from a shaft or the like; and a nut larger than said opening of said guide member thereadly mounted on said screw member between said guide member and carrier.

2. A pulling tool as defined in claim 1 and wherein said claw means are in the form of a plurality of third links respectively and pivotally connected to said second links and carrying a plurality of claws, respectively, at parts of said third links distant from said second links, and wherein a second guide member having portions respectively aligned with said portions of said first-mentioned guide member and said carrier is pivotally connected at said portions thereof to said third links, respectively, intermediate the ends thereof, said second guide member being formed with a central opening located about said axis of said screw member.

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