ABSTRACT
A rotary shaft and a rotary closure-engaging device which entrainingly engages a closure to be threaded onto a container, are connected by a coupling arrangement having one coupling member connected with the shaft and another coupling member connected with the closure-engaging device. One of these members is provided with a plurality of torque-transmitting elements which engage a circumferential surface of the other member in torque-transmitting relationship but are so yieldably mounted that when a predetermined torque limit is exceeded, a small fraction of the torque-transmitting elements becomes disengaged from the circumferential surface.

13 Claims, 5 Drawing Figures
APPARATUS FOR THREADING CLOSURES ONTO BOTTLES AND SIMILAR CONTAINERS

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for threading closures onto bottles and similar containers.

The use of screw top bottles, that is, bottles provided with screw-on closures are becoming more and more popular. According to one approach in the industry, the so-called "pillar-proof" closure is used, a sleeve having one closed end and consisting of metal. This sleeve is placed over the neck and the open end of the bottle and is then pressed into sealing engagement with the neck under simultaneous deformation of its material, by appropriate rollers. This type of closure has the disadvantage that a relatively large number of bottles will be broken under the pressure of the rollers.

Another type of closure which is often preferred because it does not involve breakage of the bottle when it is applied to the same, is a pre-fabricated screw-on closure, frequently of synthetic plastic material, which must be threaded onto the bottle or similar container after the latter has been filled.

Evidently, the number of bottles which must be so closed per unit of time in a modern bottling installation, precludes any thought of applying the screw closures manually. For this reason, equipment has been developed which threads the closures onto the bottle or similar container. This equipment is intended to uniformly tighten the screw closures, but experience has shown that in many instances it does not do so, due to inherent structural difficulties. The result is that some closures may be excessively tightened and others may not be sufficiently tightened due to the inability of the equipment to apply uniform torque to the closure.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the invention to overcome the disadvantages of the prior art.

More particularly, it is an object of the invention to provide an improved apparatus for threading closures onto bottles and similar containers, which is not possessed of the aforementioned disadvantages.

Still more particularly, it is an object of the invention to provide such an improved apparatus which affords a more precise transmission of torque from the driving component of the apparatus to the threaded closure.

An additional object of the invention is to provide such an improved apparatus which permits the torque limit, that is the limit which must not be exceeded to assure that the closure is threaded onto the container tightly but not too tightly, will be precisely maintained.

In keeping with the above objects, and with others which will become apparent hereafter, one feature of the invention resides in an apparatus for threading closures onto bottles and similar containers, in a combination which comprises a rotary shaft and rotary closure-engaging means for entrainingly engaging a closure to be threaded onto a container. Coupling means is provided for coupling the engaging means with the shaft. It comprises a first coupling member connected for joint rotation with the shaft, and a second coupling member connected for joint rotation with the engaging means. A plurality of torque-transmitting elements are provided on one of the members and so yieldably engage a circumferential surface of the other of the members that in the event torque exceeds a predetermined limit, a small fraction of the plurality of torque-transmitting elements will yieldingly disengage from the circumferential surface.

The torque-transmitting members could be in form of roller bodies, which are currently preferred, or in form of sliding bodies. For the sake of convenience, reference will hereafter be made to "roller bodies" although it should be understood that this term includes sliding bodies also.

With this construction as outlined above, slippage of the coupling upon exceeding of the predetermined torque limit prevents the torque from dropping to zero, but instead reduces the torque only by a relatively small fraction which essentially has the same relationship to the overall torque as the small fraction of disengaged roller bodies to the total number of the plurality of roller bodies. Evidently, the number of roller bodies involved should be as large as possible, and the number of roller bodies which at any one time yieldingly disengage should be as small as possible. It is advantageous if only a single roller body at a time will become disengaged.

The torque-transmitting surface portions which are engaged by the roller bodies can be in form of a flat sawtooth-shaped profile the distribution of which circumferentially of the axis of rotation will be different from the distribution of the roller bodies. The torque-transmitting surface can be recessed or can be projecting, the only important consideration here being that if the roller bodies are arranged with uniform distribution, the distribution of the sawtooth-shaped profile must be uneven, or vice versa.

It is currently preferred if the torque-transmitting surface portions of that member of the coupling which is not provided with the roller bodies, are configured as a gently inclined ramp or groove, which at its highest point forms an abrupt drop back to the level of its lowest point. The drop can be so abrupt that even if the roller bodies are closely adjacent, only one of them can at any time be located at the highest point where it does not transmit any torque. All other roller bodies are located on the gently inclined surface of the ramp or groove and thus transmit torque. If a relatively strong torque is to be transmitted, then the spring force which urges the roller bodies into contact with the torque-transmitting surface portion, must be appropriately great. The torque transmission behavior can also be regulated by appropriate selection of the spring constants. It is advantageous if each roller body is provided with a separate spring which acts only upon it alone.

One of the members of the coupling can be in form of a flat cylindrical disc which is formed at its circumference with the ramp or groove or sawtooth-shaped profile. In this case the other coupling member must surround the first-mentioned one and is preferably provided with radial bores in which roller bodies are located which are urged inwardly against the first-mentioned coupling member by appropriate springs.

However, we currently prefer a construction in which the roller bodies are mounted in their associated coupling member shiftable in axial direction, and the ramp or groove is inclined also in axial direction, as will be discussed subsequently.

The roller bodies are either spherical members, which are currently preferred, or they are cylindrical rollers or conical rollers.
It is advantageous if the spring force acting upon the respective roller bodies can be varied, to thereby be able to increase or decrease the torque limit at which the coupling will experience a torque drop. The supports against which the springs bear may be adjustable to permit such variation.

It is advantageous if the ramp or groove has a gentle but uniform inclination. This reduces non-uniformity of the transmitted torque when the coupling slips, and also facilitates the manufacture of the components.

The ramp or groove advantageously extends over almost the entire circumference of the coupling, so that only a very short region exists in which preferably only a single roller body at a time will be in a position in which it will not transmit torque.

The roller bodies are advantageously evenly distributed over the circumference of that coupling member on which they are provided.

The supports for the springs may be pins which are shiftable and have free ends that are engaged by a member that can be threadedly adjusted, to thereby displace the pins inwardly or outwardly and compress or relax the springs.

The coupling according to the present invention can be provided in the spindle which carries the rotary closure-engaging device. However, it is currently preferred that it either be located in the closure-engaging device itself, or directly between the same and the spindle. The closer the coupling is located to the closure device, the smaller the inertial forces of the component or components which must be rotated by the coupling and which act upon the latter.

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 drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an axial section illustrating an apparatus according to the present invention;
FIG. 2 is a plan view showing a detail of FIG. 1;
FIG. 3 is a partly sectioned side view showing a detail of a further embodiment;
FIG. 4 is a vertical section showing a detail of still another embodiment; and
FIG. 5 is a top-plan view of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing it will be seen that we have illustrated a rotary closure-engaging device provided with a receiver 1 which receives a screw-type closure, for instance of synthetic plastic material or the like, that has not been shown but will be understood to be accommodated in the recess 3 the lower end of which conically diverges at 4. This means that the receiver 1 can be readily placed onto the cap or closure that is already located on the neck of a bottle which is to be closed. Also, centering is facilitated with this arrangement. The inner diameter of the recess 3 is slightly larger than the maximum outer diameter of the closure.

Located in the recess 3 is an abutment member 5 mounted on a bolt 6 which is axially shiftably mounted in a central bore 7 of the receiver 1. A threaded pin 8 is provided in a transverse bore of the receiver 1 and extends into an upwardly and downwardly closed axial slot 9 of the bolt 6, thus preventing a turning or falling-down of the same and of the member 5. The outer diameter of the member 5 is slightly smaller than the installed inner diameter of the recess 3. A spring 10 permanently urges the member 5 to its lowest position which is illustrated in FIG. 1, so that the member 5 urges the closure (not shown) against the neck of the bottle in overlying relationship with the opening of the bottle. The downward movement of the member 5 is delimited by engagement of the upper end of the slot 9 with the pin 8, and the upward movement is limited by engagement with the pin of the other end of the slot 9. It is preferable if the member 5 is a hardened steel disc which is removably connected to the bolt 6.

The circumferential wall of the receiver 1 is provided with three radial slots in which three engaging members 12 are located, which are preferably of hardened steel also. As shown in FIG. 1, these members 12 each extend inwardly into the recess 3 by approximately 1 mm so that they can engage the closure. Each of the members 12 fills the associated radial slot almost completely. Adjacent the upper ends, the members 12 are provided on their radially outer edges with a kerf which is aligned with an annular groove formed in the outer surface of the receiver 1 and in which a spring ring 13 is located. Since the spring ring also extends through the kerfs of the members 12, it defines for the same a pivot axis. The radially inner upper end of the members 12 is mounted on a radius the center of which coincides at least substantially with the center of the spring ring 13 and which is equal to the width of the members 12, so that the latter can pivot about the center of the spring ring 13 but cannot fall out of their slots in normal use. The members 12 extend upwardly beyond the spring ring 13 by a distance which is smaller than their width, so that they can be pivoted far enough in outward direction to be removed, or to be removed, which facilitates their removal for inspection and for replacement. Also, it makes it possible to insert differently configured members which can then act upon closures with differently formed shoulders. Adjacent the lower ends of the members 12 the receiver 1 is formed with the two further annular grooves which are also so located as to coincide with respective kerfs formed in the members 12. Each of these grooves accommodates an elastic ring 14 of rubber or synthetic plastic material, or else a fine helical spring. The purpose of the rings 14 is to maintain the members 12 in the position shown in FIG. 1.

A coupling is provided which limits the torque transmitted by the receiver 1 upon the non-illustated closure, in that when a maximum predetermined torque limit is exceeded, it begins to slip but, in accordance with the present invention, continues to transmit torque at a level which is only slightly decreased.

As FIG. 1 shows the coupling is provided with a coupling ring 16 which is mounted by means of a screw 15 on a portion of the receiver 1 and in this embodiment constitutes the driven coupling member. The upper side of the coupling ring 16 is formed with a uniformly inclined groove 16', that is a groove the bottom wall of which is uniformly inclined upwardly in the direction of
rotation which is indicated by the arrow in FIG. 2. Torque-transmitting members in form of spherical elements 17 engage in this groove 16' which extends along an essentially helical line 17'.

FIGS. 4 and 5 show that the torque-transmitting surface portion 16a' of the member 16a in another embodiment may also be configured as a gently inclined ramp which at its highest point forms an abrupt drop back to the level of its lowest point.

The torque transmitting members 17, which are roller bodies in the illustrated embodiment, are carried by a further coupling member 21 which is the driving coupling member in this embodiment. Each of the members 17 is accommodated in one of a plurality of axial bores 20 of the member 21. The bores 20 are uniformly and concentrically distributed over the circumference of the member 21 and the members 17 are each axially shiftable in the associated bore 20. Springs 19 are provided in the bores 20 and permanently urge the members 17 via pressure members 18 against the bottom of the groove 16', so that by appropriate turning of the member 21 the members 17 will transmit torque to the member 16 and cause the same to rotate, thus rotating the receiver 1.

The drawing also shows in FIG. 3 that the members 17 and 18 could be replaced by axially shiftable pins 17a located in the respective bores 20, having free end faces which are accommodated to the cross-sectional configuration of the groove 16' and are slidably received in the latter. However, roller bodies are currently preferred.

If, during the operation of this apparatus, the torque becomes too great, that is if it exceeds a predetermined torque limit, then the members 17 begin to travel in the groove 16', but continue to transmit torque. Only in the region 39 will the transmission of torque be interrupted, and then only for the single member 17 (or, if the region 39 is long enough, the small number of members 17) which can at any one time be located in the region 39.

The member 21 is indirectly but fixedly connected with a rotary spindle or shaft which is driven in appropriate manner but not illustrated since it is conventional. The receiver 1 is turnably journalled on the member 21 by means of two ball bearings 23. A screw 24 and a ring 25 prevent it from falling downwardly out of the member 21 which latter is concentrically mounted on a member 26 by means of screws 27.

To make it possible to adjust the force exerted by the springs 19, pins 30 are axially shiftable accommodated in the bores 20 above the springs 19. These pins 30 form the abutments for the springs 19 and their outer ends contact a member 31 which can be turned and thereby be shifted in axiale direction. The member 31 is provided with an upwardly extending threaded portion 32 which is threaded with its external thread into an internal tap bore 33 of the member 26. When it is axially shifted by rotating, the axial position of the pins 30 is changed and thereby the springs 19 may be compressed or relaxed as required. The member 31 and the portion 32 are advantageously of one piece with one another.

The portion 32 serves also to connect the entire receiver and coupling with the previously mentioned spindle. It is provided with a counternut 34 to hold it against the member 26. A non-illustrated connecting member can be threaded upon the upper portion of the outer thread of the portion 32, to connect the same with the spindle.

FIG. 2 shows the member 16 in top plan view, to indicate the configuration of the groove 16'. It will be seen that from a starting point 36 the bottom wall of the groove 16' rises uniformly to a terminal point 37, forming a helical line. The arcuate angle included between the points 36 and 37 is approximately 350' in the embodiment shown in FIG. 2. Intermediate the point 37 and the point 36, as seen in direction of rotation, a substantially horizontal portion 38 is provided in the cam 17' which guides the member 17, from which portion 38 the cam 17 drops abruptly at 39 to return to the starting point 36. Given the dimensions shown in FIG. 2, twelve of the members 17 may for instance be provided along the cam 17', being uniformly distributed over the circumference of the member 16.

In operation of the apparatus according to the present invention, the latter descends—while being rotated—from above onto the closure which is already located on a bottle. Different bottle heights can be accommodated by yielding of the member 3 against the effect of the spring 10. When the receiver first engages the closure, the members 12 are initially pressed radially outwardly against the effect of the members 14, until they can snap into axial grooves which are formed in the circumference of the closure in accordance with a practice known per se. As soon as this has taken place, the members 12 entrain the closure and thread it onto the neck of the bottle. As soon as the closure is tightly threaded onto the neck, the torque acting upon the coupling increases until the torque limit has been reached, whereupon the coupling slips and the rotation of the receiver is terminated. After a certain predetermined time, within which the threading-on of a closure will under all circumstances have been completed, and which can be readily and empirically determined, the receiver 1 is retracted in upward direction, or else the now closed bottle is removed in downward direction. The term "bottle" used herein for the sake of convenience, is intended to include all such containers which can be provided with a screw top, e.g. jars, flasks and the like.

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 constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for threading closures onto bottles and similar containers, it is not intended 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 the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present 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 is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. In an apparatus for threading closures onto bottles and similar containers, a combination comprising a ro-
tary shaft; rotary closure-engaging means for entrain-
ingly engaging a closure to be threaded onto a con-
tainer; and coupling means for coupling said engaging
means with said shaft, comprising a first coupling mem-
ber connected for joint rotation with said shaft, a sec-
ond coupling member connected for joint rotation with
said engaging means, a plurality of torque transmitting
elements arranged on one of said members around the
axis of rotation of said rotary shaft, and a ring surface
on the other of said members, said torque transmitting
elements yieldably engaging said ring surface and said
ring surface surrounding said axis of rotation, said
torque transmitting elements being movable in direc-
tions the inclination of which relative to said axis of ro-
tation is common for all torque transmitting elements
and said ring surface gradually rising slightly from a
first level to a second level and descending steeply at
only one part of its circumference from said second
level to said first level, the direction of rising and de-
sceding of said ring surface being the direction in
which said torque transmitting elements are movable.
2. A combination as defined in claim 1, wherein said
surface of said second member is provided with a saw-
tooth-shaped profile having profile portions which are
arranged at a different spacing than said torque-
transmitting elements.
3. A combination as defined in claim 1, wherein said
torque-transmitting elements are roller bodies.
4. A combination as defined in claim 1, wherein said
torque-transmitting elements are glide bodies.
5. A combination as defined in claim 1, wherein said
surface has a portion which forms a ramp.
6. A combination as defined in claim 1, wherein said
surface has a portion which forms a groove.
7. A combination as defined in claim 5, wherein said
ramp extends axially of the axis of rotation of said cou-
ping means, said torque-transmitting elements being
shiftable axially of said axis of rotation.
8. A combination as defined in claim 1; further com-
prising spring biasing means acting upon said torque-
transmitting elements and biasing them towards said
surface, said biasing means being adjustable for varying
said predetermined limit.
9. A combination as defined in claim 1, wherein said
rise is of uniform pitch.
10. A combination as defined in claim 1, wherein said
torque-transmitting elements are uniformly distributed
about said surface.
11. A combination as defined in claim 8, wherein said
biasing means comprises biasing springs, and adjustable
supports on which said biasing springs bear and which
are adjustable toward and away from said surface.
12. A combination as defined in claim 11, wherein said
supports are shiftable pins each having a free end;
and further comprising adjusting means engaging said
free ends and operative for shifting said pins.
13. In a slip clutch, a combination comprising a ro-
tary shaft; rotary means; and coupling means for cou-
pling said rotary means with said shaft, comprising a
first coupling member connected for joint rotation with
said shaft, a second coupling member connected for
joint rotation with said rotary means, a plurality of
torque transmitting elements arranged on one of said
members around the axis of rotation of said rotary
shaft, and a ring surface on the other of said members,
said torque transmitting elements yieldably engaging
said ring surface and said ring surface surrounding said
axis of rotation, said torque transmitting elements
being movable in directions the inclination of which
relative to said axis of rotation is common for all torque
transmitting elements and said ring surface gradually
rising slightly from a first level to a second level and de-
sceding steeply at only one part of its circumference
from said second level to said first level, the direction
of rising and descending of said ring surface being the
direction in which said torque transmitting elements
are movable.