

July 4, 1967

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3,328,982

CONTINUOUS FIBER TREATING APPARATUS

Filed July 14, 1965

2 Sheets-Sheet 1

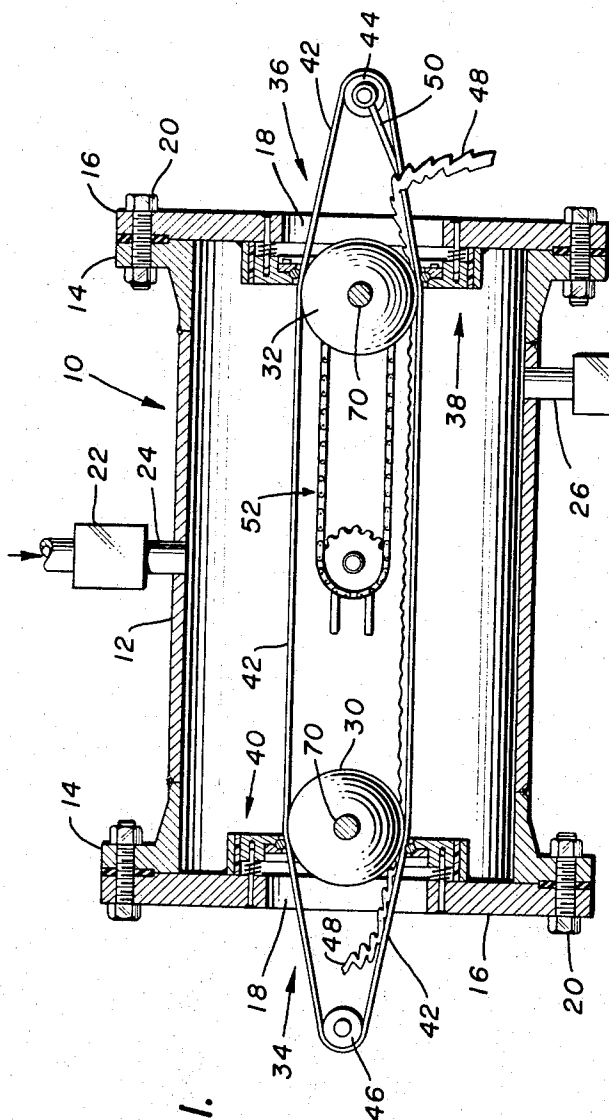


FIG. 1.

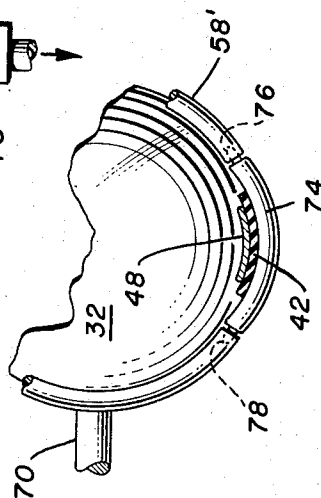


FIG. 3.

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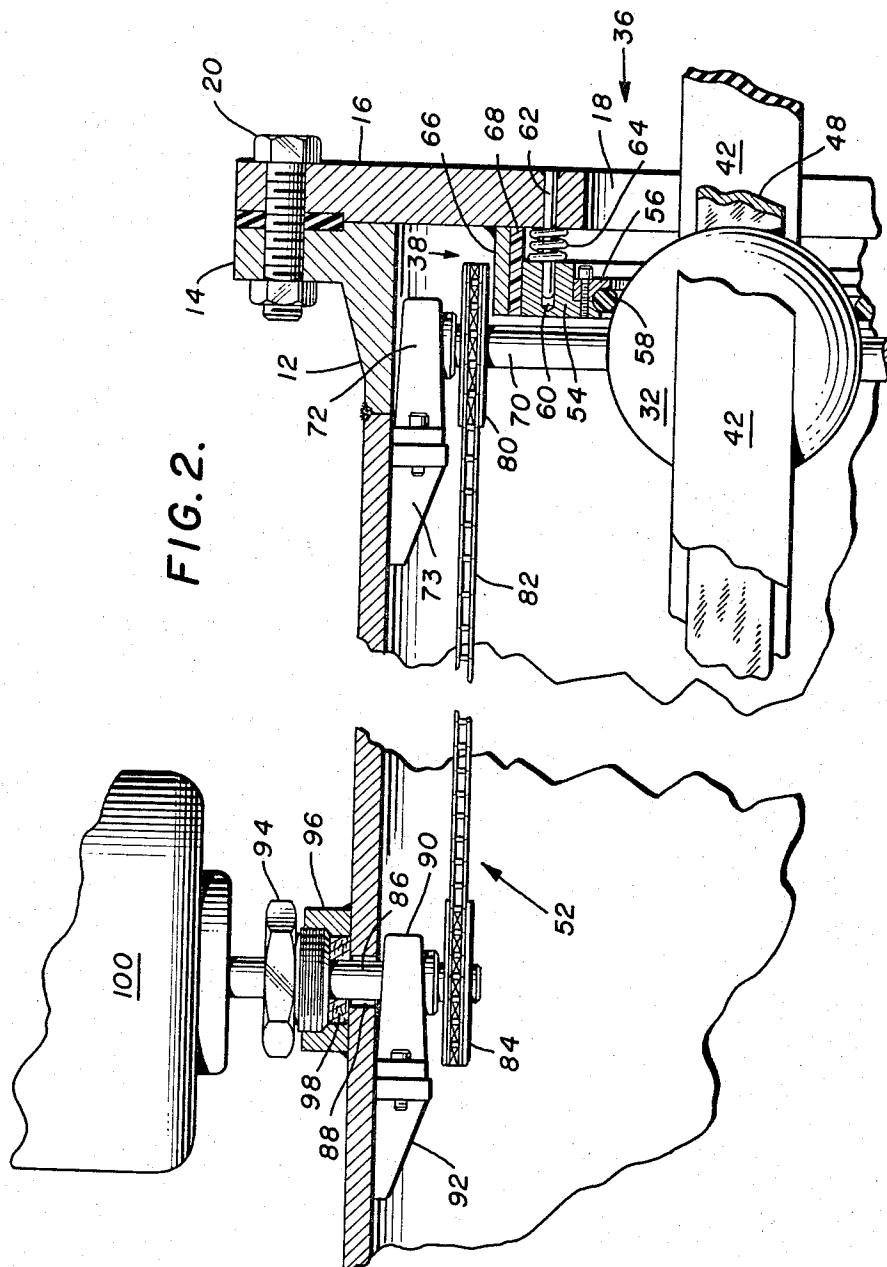
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CONTINUOUS FIBER TREATING APPARATUS
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Filed July 14, 1965, Ser. No. 471,940
12 Claims. (Cl. 68—5)

This invention relates to apparatus for the treatment of fibers or yarn and more particularly relates to the continuous annealing of acrylic and other synthetic fibers or yarn.

During the spinning and drawing of many synthetic fibers, stresses are set up therein which, if not relieved, cause them to be brittle which, in addition to obvious disadvantages, affects dye level. Brittle fibers are, therefore, impractical for commercial usage. These stresses can be relieved by heating the fiber while it is relaxed, a process generally known as annealing.

Presently, the above described annealing process is carried out in batch lots wherein the fibers are placed in closed containers and subjected to heat. Performing the step in this manner is costly, time consuming, and interrupts the flow of the fiber making process. Obviously, if the fibers could be continuously annealed without interruption of the production process, product uniformity could be improved and great savings in time and money could be effected.

Previous continuous annealers have been very costly, complex and have permitted leakage from the apparatus, thus losing both heat and pressure. In addition previous annealers of the continuous type have not produced a uniform product because of difficulties in maintaining a steady motion of fibers through the container.

According to the present invention it has been found that the above enumerated difficulties may be overcome by utilizing a chamber having an opening at each end closed by spherical drive balls. Each drive ball is partly surrounded by a seal pressured against it in a manner similar to a rotating ball valve. A thin, flexible, continuous belt is inserted between the ball and the seal and passes from a loading station across the bottom of an entrance port drive ball, through the annealing chamber, across the bottom of the exit port drive ball, to an unloading station and is looped back through the chamber across the tops of the drive balls to the loading station. If desired, that portion of the sealing member in contact with the belt can be arranged to rotate.

In operation, steam is metered into the annealing chamber at the proper pressure to provide a suitable environmental condition for fiber relaxation. The fiber material requiring annealing is fed onto the belt at the loading station and passed into the chamber between the drive ball and the belt. Egress to the unloading station is accomplished in the same manner where the fiber is cleared from the belt and transported to subsequent production steps.

Accordingly, it is an object of this invention to provide apparatus for treating textile fibers without interrupting the flow of the manufacturing process.

A further object of this invention is to provide apparatus for annealing a textile fabric without interrupting the flow of the manufacturing process.

A still further object of this invention is to provide a continuous annealing chamber having entrance and exit ports therein through which leakage of the annealing medium is held to a minimum.

Yet another object of this invention is to provide an annealing chamber having entrance and exit ports sealed against leakage of the annealing medium by a rotating ball partly surrounded by a sealing member.

Another object of this invention is to provide a continuous annealing chamber sealed against leakage of the

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annealing medium yet allowing the passage of a fiber carrying belt.

These and other objects and advantages of this invention will be more apparent upon reference to the following specification, appended claims and drawing wherein:

FIGURE 1 is a partly sectional side view showing the arrangement of the entrance and exit port spherical drive balls and the fiber carrying belt relative to the annealing chamber according to the instant invention;

FIGURE 2 is a fragmentary, partly sectional, top view of the chamber illustrated in FIGURE 1 showing details of the ball driving mechanism and the sealing member; and

FIGURE 3 is a fragmentary view of a portion of the sealing member having a rotatably mounted section according to one embodiment of the instant invention.

In order to better understand the construction and use of this novel, continuous annealing chamber, it will be described in relaxation to the relaxation of synthetic fibers. It is to be understood, however, that various other uses may be found for this novel apparatus. For example, the chamber could be utilized for adding moisture to a fiber, dyeing, or adding other substances to the fiber. Other uses will be readily apparent to those skilled in the art.

With continued reference to the accompanying figures wherein like numerals designate similar parts throughout the various views, and with initial attention directed to FIGURE 1, reference numeral 10 designates generally an annealing chamber comprised of an elongated tubular portion 12 having an outstanding flange 14 at each of its ends. Plates 16 having circular or other suitably shaped openings 18 therein are secured to the flanges 14 to partly close the ends of the tubular portion 12. As illustrated, bolts 20 are utilized in securing the plates to the flanges. Obviously, other suitable means such as welding, brazing, or removable clips could be utilized to perform this function. Steam or other suitable annealing fluid passes through a pressure regulating and metering valve 22 and tube 24 into the annealing chamber. Condensation is bled from the tube 12 through a tube 26 and a valve 78.

Large spherical, ball-shaped members 30 and 32 partly close entrance and exit ports 34 and 36 respectively, as formed by the openings 18 in plates 16. A sealing member 38, to be hereinafter described in more detail, closes that portion of the exit port 36 not filled by ball 32 while a similar sealing member 40 performs the same function at entrance port 34.

A flexible conveying belt 42 passes beneath the ball 30 at entrance port 34, through the chamber 10, beneath ball 32 at the exit port 36, is looped around a second idler roll 46 completing its circuit. At both entrance 34 and exit port 36, the belt passes between balls 30 and 32 and sealing members 38 and 40. A tow of crimped synthetic fibers 48 is laid on the belt 42 at a loading station proximate the entrance port 34 and passes into the chamber 10 with the belt 42 between the sealing element 40 and the ball 30 in a relaxed state to contact the annealing fluid therein. In the presence of such fluid the fiber is annealed to remove its tendency toward brittleness and passed from the chamber 10 with belt 42 between the roll 32 and the sealing member 38. A blade 50 clears the tow 48 from the belt 42 at a discharge station proximate the exit port 36. Due to some degree of shrinkage which occurs during the time spent in passing through the chamber 10, the crimp in the tow 48 becomes attenuated to some degree and can be, if desired, restored by a subsequent crimping operation.

As described the entrance and exit ports lie at opposite ends of the tube 12. It is obvious, however, that both ports and port closures could be in one side of the tube with the belt looping through the chamber.

Movement of the belt 42 is caused by rotation of the ball 32 as part of a drive mechanism 52 which will be described later in more detail. Obviously, the drive could be imparted to ball 30 rather than ball 32 or, alternatively, both balls could be driven simultaneously.

The belt 42 and closure balls 30 and 32 may be constructed of any suitable heat resistant material. Stainless steel is preferred, however, because of its resistance to corrosion and outstanding strength characteristics.

As shown in detail in FIGURE 2, the seal 38 consists of a mounting ring 54 to which a deformable annulus 58 constructed of Teflon or other suitable material having similar sealing and self-lubrication properties is clamped by a retaining ring 56. The mounting ring 54 includes a plurality of elongated cylindrical openings 60 into which a corresponding number of dowels 62 suitably secured to the plate 16 are received. A spring 64 is mounted on each dowel 62 and serves to bias the mounting ring 54 away from the plate 16. Sealing ring 66 is secured to the plate 16 and serves, with a packing ring 68 closely contacting it and the mounting 54, to prevent communication to the interior of the chamber around the edge of the mounting ring. Again, the packing ring 68 may be constructed out of any suitable material having the property of being relatively impervious to the passage of a fluid or gas while still allowing movement of the mounting ring 54 relative to it.

As shown in FIGURE 2, the ball 32, and its corresponding closure ball 30 are firmly supported within the chamber tube on a shaft 70 rotatably mounted in pillow blocks 72 (only one shown) secured to the walls of the tube 12 through clip angles 73. Thus, closure balls 30 and 32 are both held in constant position relative to one another to aid in maintaining an effective seal as will be described below.

Annulus 58 contacts the surface of the ball 32 along a circle on its surface having a circumference less than that of a great circle of a sphere. Further, this circle lies in a plane which is between a vertical plane passing through the center of the spherical ball and the vertical plane in which the plate 16 is disposed. Thus, the action of the spring 64 pushes the mounting ring 54 and its associated annulus 58 into tight, sealing engagement with the ball 32. Obviously, the springs 64 must be picked such that they have sufficient strength to overcome the pressure within the elongated tube 12 as well as the pressures exerted against the seal 38 by the passage of the belt 42.

In the discussion of FIGURE 1 it was stated that the belt 42 passes between the seals 38 and 40 and the balls 32 and 30. It is now obvious that the only portion of the seal contacted as the belt 42 passes therethrough, is the deformable annulus 58. As best shown in FIGURE 3 for example, the pressure of the belt 42 and the tow 48 bearing against the annulus 58 will cause deformation of the latter element to sealingly pass the tow into and out of the chamber 10. Due to the lubricious nature of the Teflon annulus 58, binding of the tow 48 between it and the balls 30 or 32 which might be otherwise expected does not materialize.

In order to be doubly sure that the tow will be passed smoothly into and out of the chamber by sealing members 38 and 40, the embodiment of the invention illustrated in FIGURE 3 may be utilized. There, the annulus 58' includes sections 74 which freely rotate at the points at which the belt 42 pass them. Axles 76 and 78 on opposed ends of the section 74 extend into corresponding openings in the annulus 58' to provide a secure mounting. As the balls 30 and 32 rotate under the influence of the drive mechanism 52 and the tow carrying belt 42 is moved thereby, section 74 of annulus 58 will also be rotated to provide a smooth movement of the belt 42 past the sealing members 38 and 40.

While the arrangement of the sealing closure at the exit port 36 has been described in detail, it is understood that

a similar arrangement exists at the entrance port 34. The only differences in the two closures lies in the fact that they may be in opposite ends of the tube 12.

Details of the drive mechanism 52 are best shown in FIGURE 2 and include a sprocket 80 mounted on the shaft 70 and connected through chain 82 to drive sprocket 84. A drive shaft 86 extends through an opening 88 in the wall of the tube 12 and is rotatably secured within the chamber 10 in a pillow block 90 mounted on a clip angle 92 which is fastened in turn to the tube 12. Gland nut 94 combined with a half coupling 96 and packing 98 prevent leakage of annealing fluid through opening 88 around the drive shaft 86. A rotating motive force is applied to the drive shaft 86, and, hence to the sprocket 84, the chain 82, the sprocket 80, shaft 70 and ball 32 by an electric motor 100 or other suitable driving means. Thus, rotation of the motor 100 is translated into movement of the belt 42 frictionally engaging the ball 32. Corresponding movement of the ball 30 is produced as a consequence of its frictional engagement with the belt 42 and tow 48.

It will be apparent that by following the teachings of this invention a simple, inexpensive apparatus for the continuous annealing of a tow of synthetic fibers can be constructed and utilized. Such is accomplished by providing entrance and exit ports having sealing closure means therein including rotating spherical shaped balls sealingly engaging a deformable annulus of Teflon or other suitable material characterized by a self-lubrication property.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, in all changes which come within the means and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. Apparatus for continuously annealing a fiber comprising:

- (a) a chamber having
 - (1) entrance and exit ports whereby a tow of fibers can be passed into, through and out of said chamber, and
 - (2) means for supplying an annealing fluid under pressure thereto;
- (b) entrance and exit port closure members including
 - (1) elements having substantially hemispherical ends rotatably mounted in said chamber proximate each of said ports and sized to block a portion of each of said ports, and
 - (2) deformable sealing means mounted in said chamber for blocking the remaining portion of said ports; and
- (c) means for transporting a tow of fibers in a relaxed state into and through said chamber with a minimum loss of said fluid by passing between said elements and said deformable sealing means whereby said fibers will be annealed.

2. Apparatus for continuously annealing a tow of fibers comprising:

- (a) a chamber having
 - (1) entrance and exit ports and
 - (2) means for supplying an annealing fluid under pressure thereto;
- (b) entrance and exit port closure means including
 - (1) ball-shaped elements rotatably mounted proximate each of said ports and sized to block the greater portion of each of said ports, and
 - (2) deformable sealing means mounted in said chamber for blocking the remaining portion of said ports; and
- (c) means for transporting a tow of fibers in a relaxed state into and through said chamber with a minimum

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loss of said annealing fluid by passing between said element and said deformable sealing means whereby said fibers will be annealed.

3. Apparatus for continuously annealing a fiber comprising:

- (a) a chamber having
 - (1) circular entrance and exit ports and
 - (2) means for supplying an annealing fluid under pressure thereto;
- (b) entrance and exit port closure means including
 - (1) ball-shaped elements having a diameter smaller than that of said ports, rotatably mounted in said chamber proximate each of said ports and
 - (2) deformable means mounted in said chamber encircling said ball-shaped element and extending beyond the periphery of said opening for sealing the chamber; and
- (c) means for transporting a tow of fibers in a relaxed state into and through said chamber with a minimum loss of said annealing fluid by passing between said element and said deformable means for sealing and through said ports whereby said fibers will be annealed.

4. Apparatus for continuously annealing a fiber comprising:

- (a) a chamber having
 - (1) circular entrance and exit ports and
 - (2) means for supplying an annealing fluid under pressure thereto;
- (b) entrance and exit port closure means including
 - (1) ball-shaped elements rotatably mounted in said chamber proximate each of said ports,
 - (2) mounting rings sealingly secured in said chamber around the periphery of each of said ports, and
 - (3) a deformable annulus mounted in each of said rings and slidably contacting said ball-shaped elements along a circle on their surfaces to thereby seal the chamber;
- (c) continuous belt means passing between said deformable annulus and said ball-shaped element and through said ports for transporting a tow of fibers into and through said chamber in a relaxed state whereby said fiber will contact said fluid and be annealed.

5. Apparatus for continuously annealing a fiber comprising:

- (a) a chamber having
 - (1) circular entrance and exit ports and
 - (2) means for supplying an annealing fluid thereto under pressure;
- (b) entrance and exit port closure means including
 - (1) spherical, ball-shaped elements rotatably mounted proximate each of said ports,
 - (2) sealing rings having a resilient portion, secured to said chamber, and extending around each of said ports,
 - (3) mounting rings movably secured to said chamber and sealingly contacting said resilient portion, and
 - (4) a deformable annulus secured to each of said mounting rings and sealing and slidably contacting said ball-shaped elements along a circle on their surfaces to thereby seal the chamber;
- (c) a continuous belt means passing between said deformable annulus and said ball-shaped element and through said ports for transporting a tow of fibers into and through said chamber in a relaxed state whereby said fibers will contact said fluid and be annealed.

6. Apparatus for continuously annealing a fiber comprising:

- (a) a chamber having
 - (1) circular entrance and exit ports and

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(2) means for supplying an annealing fluid thereto under pressure;

- (b) entrance and exit port closure means including
 - (1) spherical, ball-shaped elements rotatably mounted in said chamber proximate each of said ports,

(2) sealing rings secured within said chamber concentric with each of said ports,

(3) a plurality of dowel pins secured in said chamber around each of said ports,

(4) a mounting ring movably mounted on said dowel pins adjacent each of said ports,

(5) resilient rings disposed between and sealingly contacting said sealing rings and said mounting rings,

(6) a deformable annulus secured to each of said mounting rings and sealingly and slidably contacting said ball-shaped elements along a circle on their surfaces having a circumference less than that of a great circle of the sphere, and

(7) means biasing said mounting rings toward said ball-shaped elements to assure a good seal of the chamber;

- (c) continuous belt means passing between said deformable annulus and said ball-shaped element and through said ports for transporting a tow of fibers into and through said chamber in a relaxed state whereby said fibers will contact said fluid and be annealed.

7. Apparatus for continuously annealing a fiber according to claim 6 wherein means for driving one of said ball-shaped elements is associated with said chamber.

8. Apparatus for continuously annealing a tow of fibers comprising:

- (a) a chamber having
 - (1) circular entrance and exit ports in opposed walls of said chamber, and
 - (2) means for supplying an annealing fluid thereto under pressure;

(b) entrance and exit port closure means including

- (1) spherical, fluid impervious elements rotatably mounted proximate each of said ports with their centers disposed in said chamber,

(2) sealing rings secured to said chamber walls concentric with each of said ports,

(3) a plurality of dowel pins secured to and extending into said chamber from said walls between the periphery of each of said ports and said sealing rings,

(4) mounting rings movably mounted on said dowel pins proximate each of said ports,

(5) resilient rings disposed between and sealingly contacting said sealing rings and said mounting rings,

(6) a deformable annulus, round in cross section, secured to each of said mounting rings and sealing and slidably contacting said spherical elements along a circle on their surfaces located between said center of said spherical elements and said ports and having a circumference less than that of a great circle of the sphere, and

(7) spring means on said dowel pins for biasing said mounting rings toward said spherical elements to assure a good seal of the chamber;

- (c) means connected to one of said spherical elements for imparting rotational movement thereto

(d) a continuous belt passing

(1) through said entrance port between a first portion of said deformable annulus and said spherical element,

(2) through said chamber,

(3) through said exit port between a first portion of said deformable annulus and said spherical element,

(4) around in a loop back to said exit port,

(5) through said exit port between a second por-

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tion of said deformable annulus and said spherical element,

- (6) through said chamber,
- (7) through said entrance port between a second portion of said deformable annulus and said spherical element, and
- (8) around in a loop back to said entrance port whereby said belt is moved by the rotation of said spherical element to transport a tow of fibers in a relaxed state through said chamber where they contact said fluid and are annealed.

9. Apparatus for continuously annealing a tow of fibers according to claim 8 wherein said first and second portions of said deformable annulus are rotatable.

10. A closure for an opening in a container comprising:

- (a) a spherical, ball-shaped element adapted to be mounted proximate an opening;
- (b) a sealing ring adapted to be mounted concentric with an opening;
- (c) a plurality of dowel pins adapted to be mounted around an opening;
- (d) a mounting ring movably mounted on said dowel pins;
- (e) a resilient ring disposed between and sealingly contacting said sealing ring and said mounting ring;
- (f) a deformable annulus secured to each of said mounting rings and sealingly and slidably contacting said ball-shaped element along a circle on its surface having a circumference less than that of a great circle of the sphere; and
- (g) means biasing said mounting ring toward said ball-shaped element to assure good contact therebetween.

11. A closure for an opening in a container comprising:

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- (a) a spherical, fluid impervious element having a center and adapted to be rotatably mounted proximate an opening;
- (b) a sealing ring remote from said center and adapted to be mounted concentric with an opening;
- (c) a plurality of dowel pins disposed interiorly of said sealing rings and adapted to be mounted around an opening;
- (d) a mounting ring movably mounted on said dowel pins;
- (e) a resilient ring disposed between and sealingly contacting said sealing ring and said mounting ring;
- (f) a deformable annulus, round in cross section, secured to said mounting ring and sealingly and slidably contacting said spherical element along a circle on its surfaces located between said center of said spherical element and said sealing ring having a circumference less than that of a great circle of the sphere;
- (g) spring means on said dowel pins for biasing said mounting ring toward said spherical element to assure a good seal whereby material can be passed between said annulus and said spherical element.

12. A closure according to claim 11 wherein first and second portions of said deformable annulus are rotatable.

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