ABSTRACT

The specification describes a rotatable closure device for use with a container in which a rotatable ball type valve element is supported by stud shafts on a cylindrical barrel body, the latter being mountable on a spout of a container and being curroundable by a rotatable cap device carrying a rack adapted to articulate a pinion on the ball valve when turned. The valve member being adapted to deliver measured portions of container contents if desired.

9 Claims, 8 Drawing Figures
CLOSURE HAVING GEARED ROTATABLE BALL VALVE

This invention relates to a rotatable closure device for a container.

Rotatable closure devices for containers having a rotatable ball type valve element rotatable on a ball axis by relative rotation of two cap members one of which supports the ball and the other of which embodies rack gearing adapted to articulate with a ball spur gear that has been provided in a variety of forms heretofore. Such devices must be of small size for most closure applications of utility to the public. The manufacture of the parts of such devices must be carried out at low cost in order to achieve any possibility of commercial utility. While prior rotatable closure devices may be workable, the manufacture of same at sufficiently reasonable cost has not been achieved in the past enabling the commercial exploitation of such devices in a volume market.

While prior rotatable closure devices for containers provide for a simple valving function by way of a through bore in the ball valve element, the present invention provides for a portion measuring device associated with the valve element in such manner as to enable the portion dispensing of powders and granular substances as well as the portion dispensing of objects such as pills and unit portions of medical products, foods and the like in solid gel or paste or liquid state.

The rapid production by pressure injection of plastic material of molded plastic parts is characterized by a greater volume of production per unit time for a lesser maximum wall thickness of the part being produced. In addition, the difficulties of molding are minimized by providing a substantially uniformed part thickness at substantially all points of the part being produced. This is especially important in the production of small parts in plastic material for in such instances localized heat distortion or shrinkage of plastic in the mold may occur.

Rotatable closure devices of the prior art are characterized by a ball having a through bore of non-uniform wall thickness and adapted only for an on/off valving action. Such may be suitable only for the expression of liquids or pastes from a container.

It is the main object of the invention to provide a rotatable valve closure device for a container adapted to serve as a closure for a container carrying a liquid, granulated solid, a paste, a gel or unit objects such as pills.

It is another object of the invention to provide a container closure as herein set forth adapted for high production molding technique useful in automatic packaging machinery.

It is a further object of the invention to provide a container closure adapted to be molded from a plastic material with all its associated parts related in the molding in such manner that upon mounting of same upon a container it is mounted in a closed position but upon being actuated by the user is thereby released for use thereafter.

It is another object of the invention to provide an injection molded container closure of the rotatable ball type in which certain related openings of the closure device are molded in operative relationship and connected to such molding by connecting feed runner plastic material adapted to be ruptured or broken when said closure is put into operation by the user by the application of manual force adapted to rotate the rotatable ball valve element of same from a closed position into an operative open position.

Other objects of the invention will be appreciated by a study of the following specification taken in conjunction with the accompanying drawings.

In the drawings:
FIG. 1 is a sectional perspective of a preferred arrangement of components of a container closure of the invention in the 'as molded' condition in exploded position relative to a container spout.
FIG. 2 is a plan view of the ball valve structure of FIG. 1.
FIG. 3 is a section of a ball valve similar to that of FIGS. 1 and 2 but embodying rotation limiting means thereon and associated with a modified form of cap member having co-operating stop means.
FIG. 4 is an exploded perspective of a modified form of a container closure according to the invention and wherein the ball valve element is of simple socket form or may be of the form of FIG. 2.
FIG. 5 is an elevation of a series of containers of FIG. 4 supported in a natural position of use on a shelf to demonstrate the closure end thereof serving as a base for the container thus to provide a feature of safety in use for the dispensing of drugs and medicines.
FIG. 6 is a sectional elevation of the closure and container of FIG. 4 in the upright position.
FIG. 7 is a section of a modified form of preferred closure device of the invention in which the ball valve element is rotatable through a small limited arc only and embodies a stop member limiting such motion.
FIG. 8 is a detailed perspective of a portion of the closure device of FIG. 7.

Referring to the drawings and especially FIGS. 1, 2, and 3, the preferred form of dispensing closure 10 of the invention for assembly with a container spout 11 comprises three main components in the form of a barrel like body portion 12, a rotatable valve member 13 and a rotatable cap structure 14, the body 12 having suitable fastening means such as female threads 15 adapted to thread upon male threads 16 of container spout structure 11, the rotatable valve member embodying one or more openings defining a cavity or pocket therein, the said openings 16 and socket 17 being adapted upon rotation of valve member 13 to register with an opening 18 in the rotatable cap member 14.

The container spout 11 is preferably of a form providing a suitable end sealing surface or terminal edge 19 adapted to form a seal with the barrel body structure 12 upon assembly therewith to affect engagement of surfaces 19 with the annular flange surfaces 20 of the sealing ring portion 21 of barrel body 12 upon the latter being firmly threaded on to the spout thread 16. Preferably both the spout structure 11 and barrel body 12 are made of an elastomer-like pressure injection molding plastic material especially of the usual types suitable for forming manually squeezable containers although substantially any injection moldable plastic material will form a workable and useful closure or closure-container combination of the invention.
The barrel body 12 is formed in such manner that the valve member 13 is formed in situ therewith in the same molding operation. Accordingly, the spur gear pinion 22 extending from the spherical surface 23 of valve 13 on the transverse axis of stud shafts 24, 25 has material supplied thereto during molding by small spigot or feeder connections or pipes 26 extending from the ends 27 of such shafts 24, 25 to the other surface 28 of a radial notch 29 in the sealing ring structure 21 whereby the plastic material forming the barrel body 12 communicates during molding through the pip connections 26 to supply plastic material for the formation of the substantially spherical or ball shaped valve member 13. The width W of each notch is such as to provide clearance only for the cylindrical surfaces of the stud shafts 24, 25. Observe that pinion 22 preferably embodies 6 pinion teeth 30, so oriented relative to a lateral mold parting line 31 having regard to suitable draft angles for the side surfaces 33 of said teeth, that mold components forming the interior surfaces of the barrel body and the ball valve 13 itself may move actually at right angles to a theoretical transverse plane containing the parting line 31.

The cap structure is preferably connected by a feeder 34 of molded material to the barrel body 12 whereby the same is molded in the same molding operation about the same mold parting plane. The form of cap structure 14 shown embodies a sealing socket 35 extending inwardly from the cap opening 18 to define rack teeth 36 contained in a spherical surface adapted to slidably and sealably engage a spherical surface of the ball valve 13 in such manner as to effect engagement of rack teeth 36 with pinion teeth 30. In such sealing position of the surfaces and engagement of the rack teeth with the pinion teeth, the cap body portion 37 extends outwardly and over the retaining ring 38 rising outwardly from the sealing ring 21 of barrel body 12 to effect clamping and rotary sliding engagement of its clamping sealing surface 29 with the corresponding clamping sealing surface 40 of retaining ring 38. The outer surfaces 41 of the cap may be serrated in the manner indicated to provide a suitable gripping surface.

FIG. 2 reveals a plan view of the valve member 13 of FIG. 1 having in its outer spherical surfaces 42 a middle region 43 bounded by web members 44 in turn defined by the circular openings 45 separating same, the thickness of the wall 46 of the ball valve member being substantially uniform, the effective diameter of the region 43 being hereinafter referred to as the occluding portion being of an effective diameter greater than the diameter of the cap opening 18. The general form of the valve member of FIG. 2 is revealed in the modification of FIG. 3.

In FIG. 3 is shown a modified form of valve member of the kind shown in FIGS. 1 and 2 but wherein the valve member has integrally formed thereon stop members limiting its angular rotation between closed and open positions. Thus the modified valve member 47 of FIG. 3 having walls 48 of substantially uniform thickness has a large inward opening or cavity of a diameter D and is supported on stud shafts 49 within a cap structure 50 the latter having a small exit or nozzle opening 51. The opening 51 is surrounded within the inner surfaces 52 of the cap by the motion limiting anulus 53 depending therefrom to sealably engage the outer spherical surfaces 54 of the valve member 43 and to serve as a motion limiting stop for the stop members 55, 56 molded in situ to project outwardly from the ball valve member. The latter embodies a plurality of vents or openings 57 thus to define an occluding portion 58 of the kind described with reference to FIG. 2. On rotating the valve member 47 counter clockwise in the direction of arrow Y, the opening 57 will come into registry with the nozzle opening 51 at a position at which the stop 56 is in engagement with the stop 53. Upon rotating in a clockwise direction, stop 55 meets with annular stop 53 defining the closed position of the thus described valve components.

The openings of the vents in the valve member not only provide a convenient path for the communication of powder or liquid through the valve closure device of the invention but also contribute a substantial advantage to the uniform molding of a spherical outer surface on the ball valve member without resulting in heat sinks, cracking or the like due to molding stresses during cooling of the plastic during injection molding. This assists in ensuring a satisfactory heat pattern for the plastic material to produce the true spherical shape defined by the mold, thus to enable a precision seal with the cap.

In FIGS. 4 to 6 is disclosed a modified form of the invention in which the structure provides for a seal in a different location in direct contact with the ball valve member and the ball valve member is adapted to sit in recesses directly in the container or spout of the container. Thus container 58 preferably of cylindrical form having an open end 59 defining a spout portion 60 contains ball shaft sockets 61 in the peripheral edge 62 of the spout 60 adapted to receive stud shafts 63 of ball valve member 64 which latter may be of the same form in every respect as ball valve member 47 or ball valve member 13. Stud shafts 63 communicate for support when molded by a small feeder or communicating pip such as indicated at 26 in FIG. 1 to the cylindrical mounting collar 65 having in an internal groove 66 thereon adapted to articulate with the external bead 67 of the container 58. In assembly therefore, mounting collar 65 carrying ball 64 is set over the spout portion 60 until recess 66 clamps over bead 67 then collar 65, is rotated slidably about spout 60 and bead 67 until stud shafts 63 sit into the stud shaft mounting sockets 61. The outer rotatable cap 68 is preferably formed to define a support for container 58 thus to serve as a base in the manner suggested by a row 69 of inverted containers 70, 71, 72, 73 of the invention shown standing on a shelf 74 on bracket 75 in FIG. 5. Accordingly, the end formation 76 of cap 68 embodies concave surfaces 77 terminating inwardly in an opening or orifice 78 with inwardly diverging surfaces 79 adapted to slidably seal with the spherical surfaces 80 of ball 64 and further inwardly to present the rack gear teeth 81 adapted to articulate with pinion 82 of ball 64. In this way the cap 68 rotatable on groove 83 thereof over outer bead 84 of ball support collar 65 effects rotation of ball valve member 64 rupturing or otherwise breaking by twisting the feed pipes (not shown) of stud shaft 63 on collar 65.

In operation, while the ball is slidably sealed against the inner surfaces 79 of cap 68, the container is sealed
to the ball by a hopper flange 85 having an opening 86 through which contents of the container may find their way to the cavity 87 of the ball valve member 64.

The container 58 may be provided in a variety of shapes especially at the uppermost closed end 58a thereof in the manner suggested by the forms 70 to 73 of FIG. 5. As indicated in FIG. 4, one of the containers may be designed in its base structure 74a to serve for the dispensing of medical and other pills 75a. Another container may dispense liquid, another powder and yet another a cream or gel. Regardless, the cavity type valve member of the invention characterized by walls of substantially uniform thickness and at least one opening extending inwardly thereof and preferably having a plurality of openings as shown to define an occluding region as described is useful without modification for the measured quantity delivery of unit solids such as pills, or of powders or liquids if the valve member has one opening only. With plural openings, the valve member still is useful for delivering unit quantities of a solid such as a pill and the continuous delivery of powders, gels, creams and liquids.

A modified form of the invention is shown in FIGS. 7 and 8 in which the container 88 has a spout portion 89 embodying external threads 90 and terminating outwardly in the sealing lip flange 91 having an acute angled rim 92 sealable in sealing engagement with the annular seating recess 93 of the barrel body 94 having inner threads 95 adapted to articulate with threads 90 to draw the barrel body into tight sealed assembly with said spout. The external cylindrical surfaces 96 of the barrel body 94 rotatably receive the cap 97 having an inner annular sealing bead 98 which sealably presses into the surfaces 96 in rotatable press fit rotation therewith and is retained in assembly with the barrel body 94 by retaining lip 99 rotatably engaged by the outer lower flange 100 of the barrel body. It will be understood that the barrel body and cap at least are formed of a plastic material of elastomer nature as for example nylon.

The annular sealing socket 93 of the barrel body 94 defines the inner surfaces of the intumed sealing flange portion 101 thereof carrying by spigot or feeder members 102 aligned with stud shafts 103, the hemispherical hollow ball valve member 104 having a uniform thickness of curved wall 105 with a contents conducting aperture 106 adapted to be brought into alignment with the outlet opening 107 of the cap 97. As will be evident in more detail in FIG. 8, one of said shafts 103 carries a gear pinion portion 108 molded with the valve member 104 and adapted to articulate with the ring gear teeth 109 of the cap upon rotation of the cap relative to the barrel body 94 as for example in a clockwise direction to rotate such valve in the direction of the arrows 109 of FIG. 8 for a sufficient distance to align the hole 106 with the axis 110 of the cap opening 107 at which point the pinion stop member 111 engages sealing surface 92 spaced therefrom as indicated by predetermined spacing 112 (see FIG. 7). In this way, a very limited rotary motion will affect an opening of the container for expression of the contents therefrom or rotation in the opposite direction of the ball valve member to cause the opening 106 thereof to register with the annular spherical surface sealing portion 113 extending inwardly from the cap opening 107 to firmly engage the total surfaces 114 of the valve member 104 under tension of the valve member and barrel body in assembly with the cap 97. This feature is indicated by comparing in FIG. 7 the right-hand portion of sealing surface 113 designated as 113a falling slightly into the region of a portion 115 of the valve member cut away from the drawing section to illustrate that there is a resilient pressure engagement affecting the sealing of the surfaces of the ball valve member with surfaces of the cap member.

The spigot or feed members 102 are intended to continue to connect the ball valve member to the barrel body, the elastomer nature of the material of these two members permitting the continued opening and re-opening motion of the ball valve member without affecting failure of the spigot member 102 by twisting. The spigot members thus serve to support the ball valve member against motion relative to the barrel body upon twisting of the cap member.

The utilization of the rotatable cap as the base for a container according to the invention and in which the ball valve member serves as a portion measuring device is especially useful in protecting children against accidental overdose of drugs which may be packaged in such containers. The accidental use of such container by a child which might possibly be successful in removing one unit measure of contents from the container nevertheless requires a further cycle of appropriate cap rotation and the holding of the container in the inverted position to achieve the removal of further contents. This affords a greater degree of protection for children than would first be apparent in that dangerous dosages will require a plurality of accidental manipulations of the container and cap. In addition, the curiosity of the very young will tend to cause a small child to watch the working parts thus suspending the container and the cap in the upright position rather than in the inverted operative position and thus present a successful unworkable puzzle for the very young.

What I claim as my invention is:

1. A rotatable closure device for a container having a spout portion defining by its terminal edges an open end thereof, said closing being mountable on said spout and comprising a spherical surfaced ball valve member having axially transverse stud shafts thereon and at least one opening in the surface thereof extending inwardly of the member; a spur gear pinion rising outwardly from the spherical surface of the ball valve member about one of said stud shafts; a cylindrical barrel body molded integrally with and surrounding said valve member and connected thereto by a feeder pipe respectively connecting to each of said stud shafts; means for fastening said barrel body to a container spout; a cap member rotatable on said barrel body and having an opening therein; spherical sealing surfaces internally adjacent said cap opening for slidable sealing engagement with the spherical surface of the ball valve member; and at least a portion of a gear rack in said cap adapted to articulate with said pinion upon rotation of said cap on said body for rotation of said valve member to selectively expose the opening thereof in registry with the opening in said cap.

2. The container closure of claim 1 in which the opening of the rotatable cap defines an inner terminus of external concave surfaces adapted to provide an end
for the container which the closure device serves and providing with said barrel body a supporting base for said container.

3. The closure device of claim 1 in which the opening in said valve member defines a cavity adapted to receive a quantity of container contents measured thereby.

4. A closure according to claim 1 in which the opening in the valve member surface defines a unit quantity measuring cavity for the contents of the container which the closure device serves and defines with the spherical surface of said ball valve member a spherical wall of substantially uniform thickness.

5. A closure according to claim 1 in which the opening in the valve member surface defines a unit quantity measuring cavity for the contents of the container which the closure device serves and defines with the spherical surface of said ball valve member a spherical wall of substantially uniform thickness; and a plurality of additional openings in said walls spaced about a portion thereof substantially opposed to said first opening to define by said portion a closure area in said wall of an effective diameter greater than that of the opening in said cap.

6. The closure device of claim 1 and a sealing flange on said barrel body extending inwardly toward said ball valve member and having sealing surfaces adapted to engage the terminal edges of the container spout opening.

7. A closure device as claimed in claim 1 and cooperating stop members on said cap and on said valve member limiting the range of rotational movement of the ball valve member between a fully closed and a fully opened operating position thereof with respect to the cap member opening.

8. A closure device as claimed in claim 1 and a hopper device extending from slideable sealing engagement with the spherical surface of said ball valve member into sealed connection within a container which the closure device serves.

9. A closure device as claimed in claim 1 in a combination with a container including a spout formation having stud shaft accommodating recesses adapted to rotatably support the stud shafts of the ball valve member during rotation thereof effected by rotation of said cap member.

* * * * *