Aug. 27, 1963 A. F. DRISCOLL 3,101,877

CLOSURE FOR SEALING CONTAINER OUTLET

Original Filed June 27, 1955 2 Sheets-Sheet 1

Fig. 1

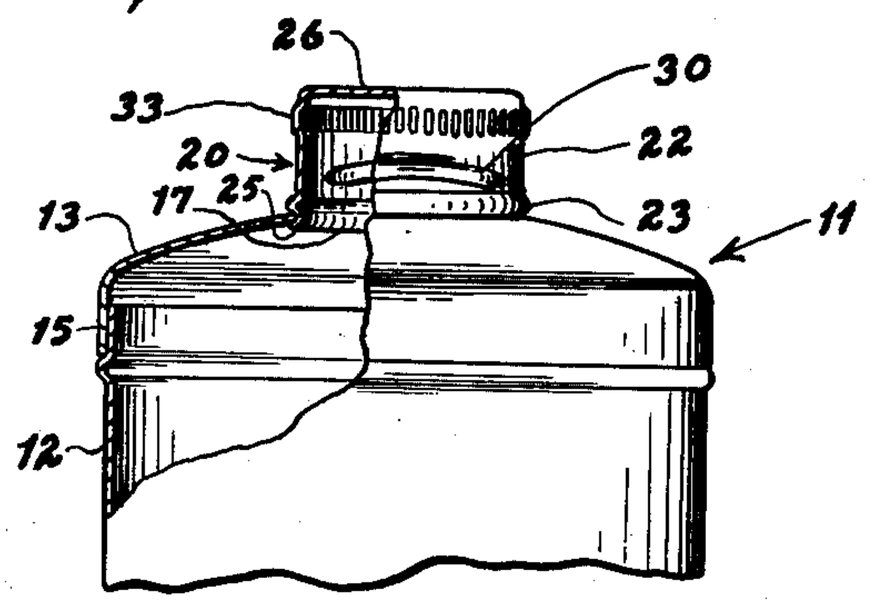


Fig. 2

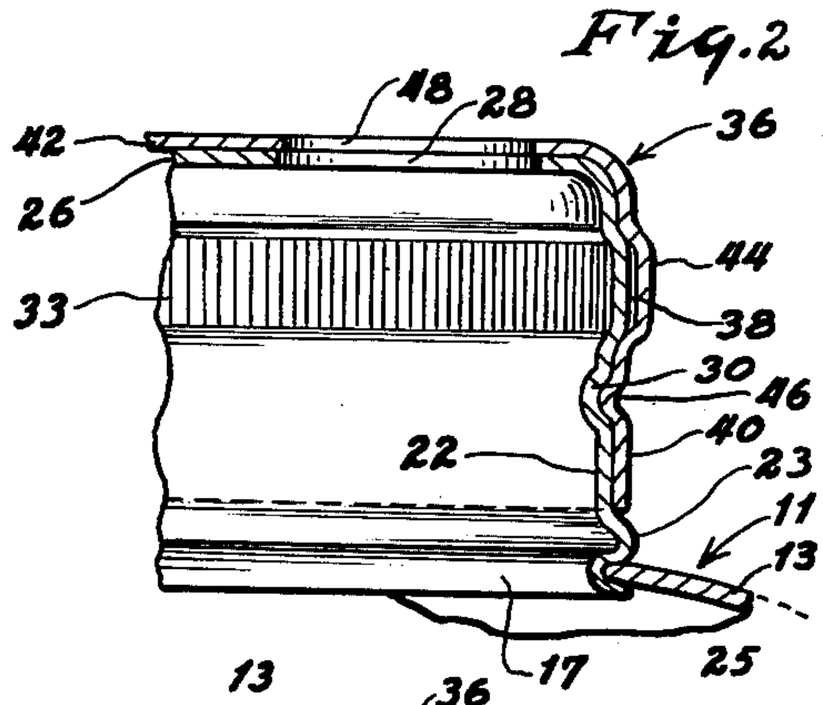


Fig. 3

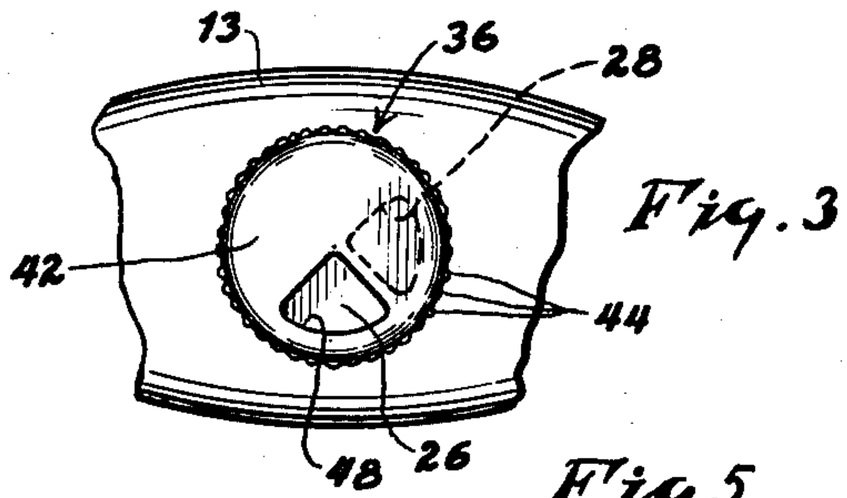


Fig. 4

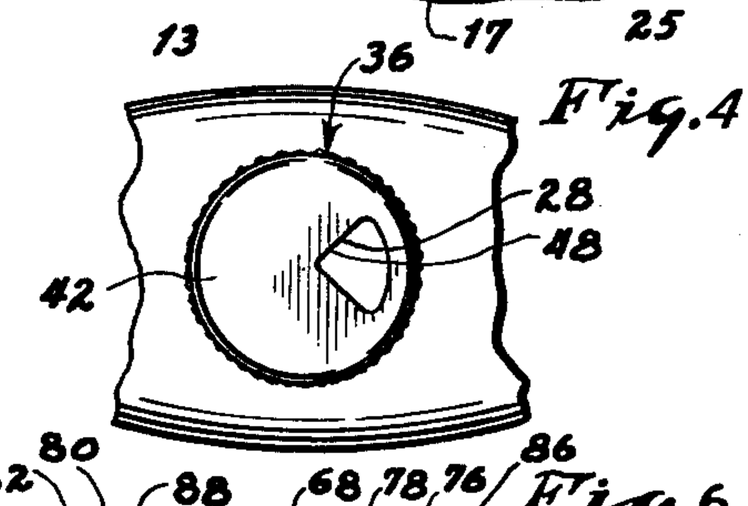


Fig. 5

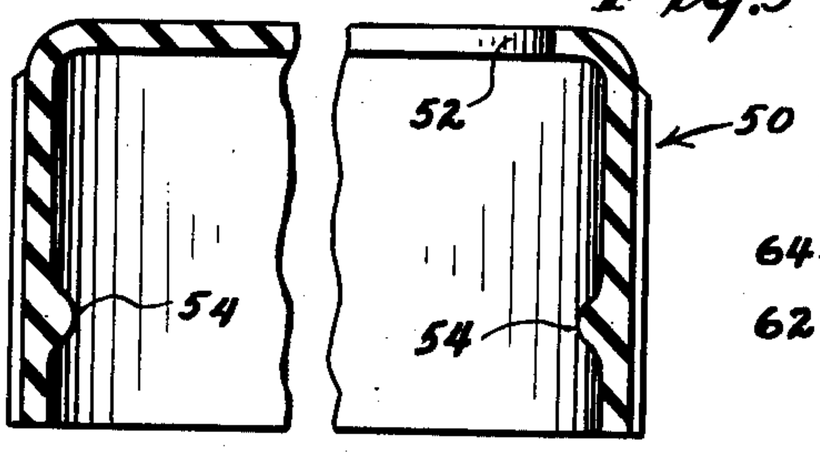


Fig. 6

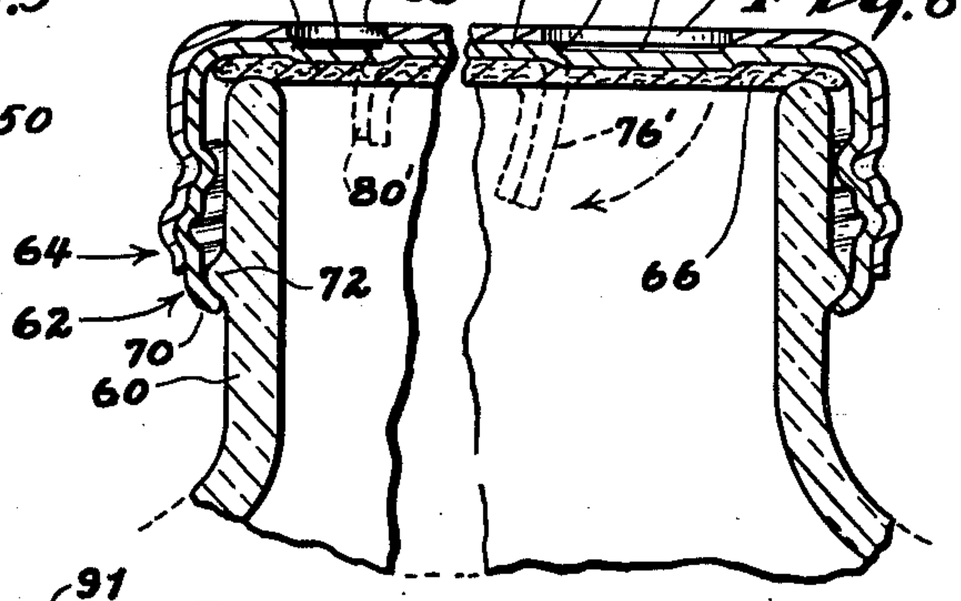


Fig. 7

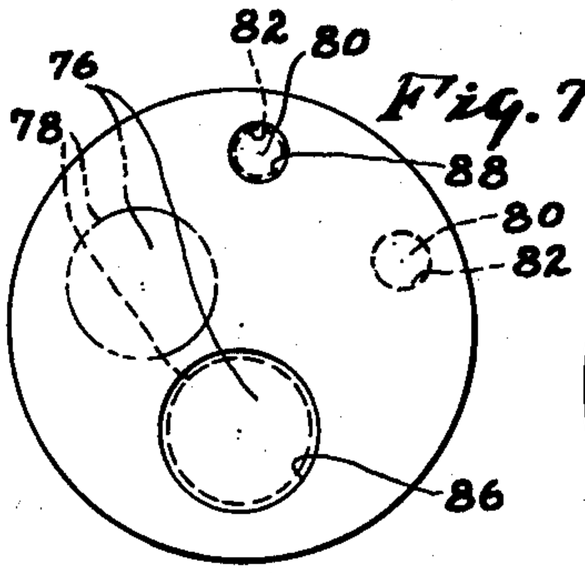


Fig. 8

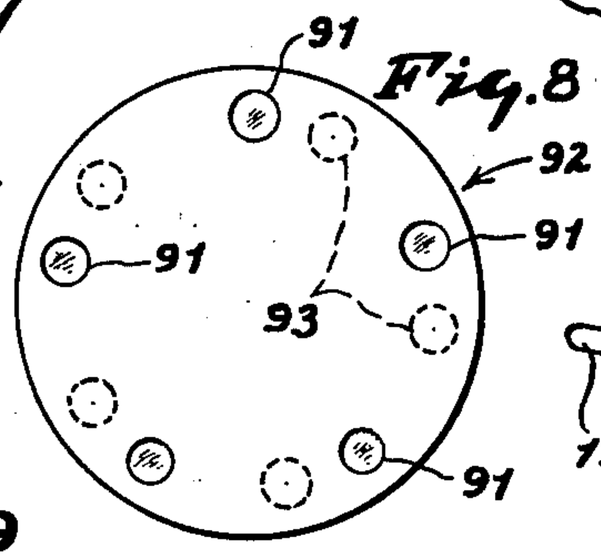


Fig. 10

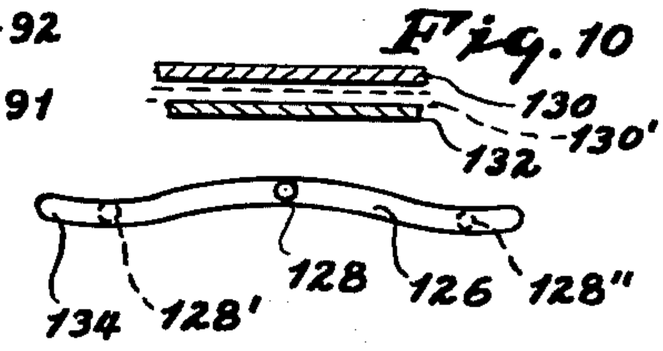
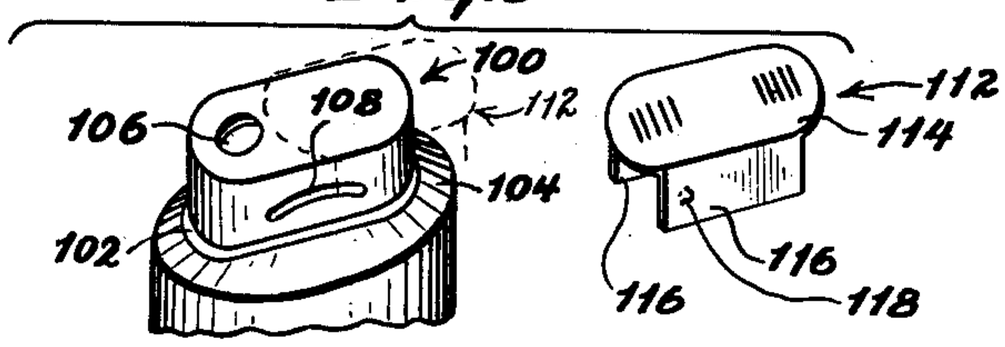


Fig. 9



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Aug. 27, 1963 A. F. DRISCOLL 3,101,877

CLOSURE FOR SEALING CONTAINER OUTLET

Original Filed June 27, 1955 2 Sheets-Sheet 2

Fig. 11

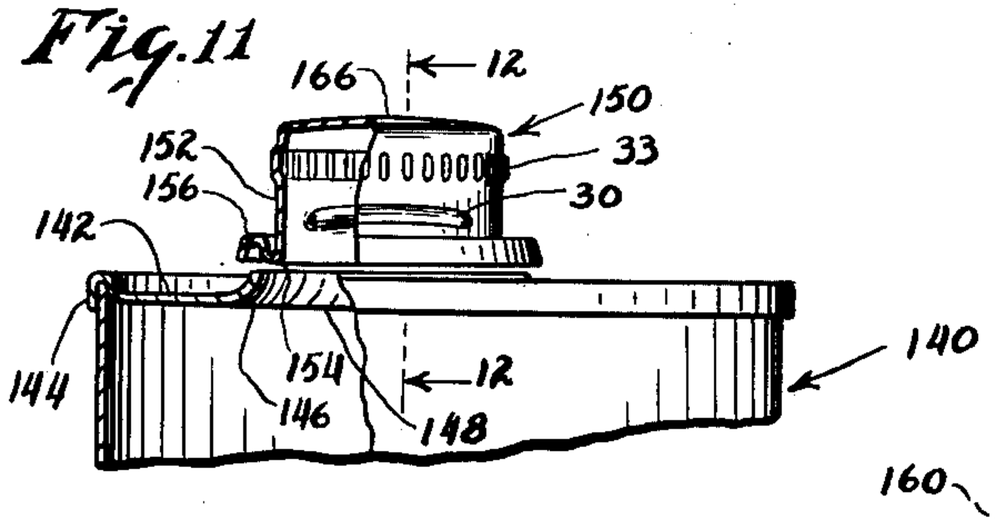


Fig. 12

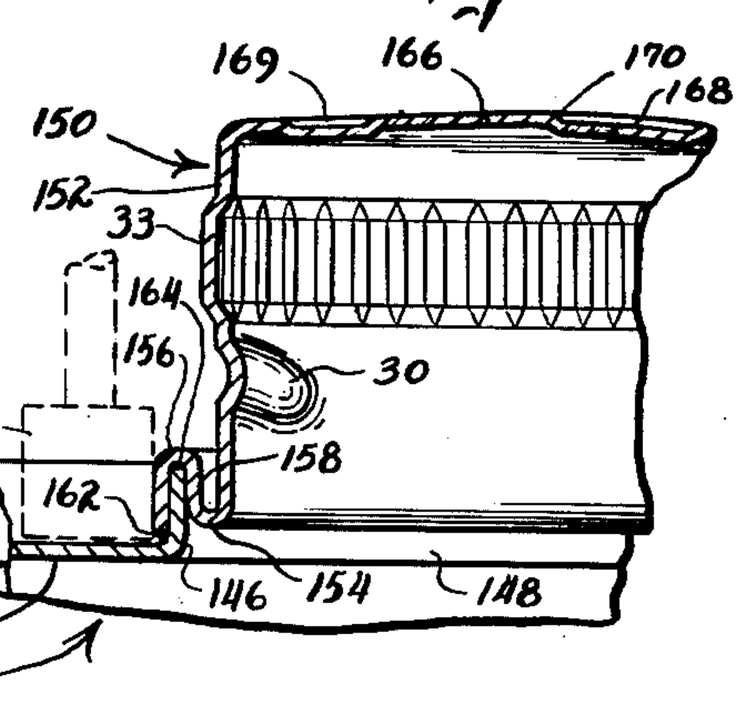


Fig. 13

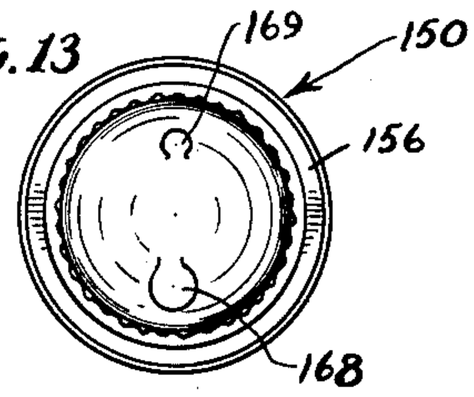


Fig. 14

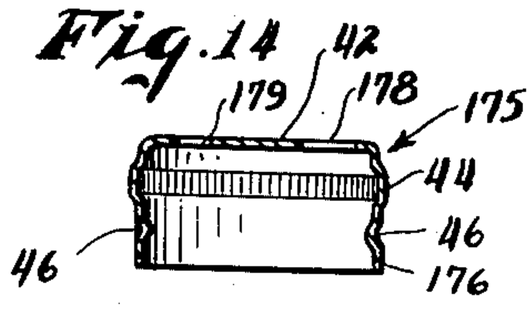


Fig. 15

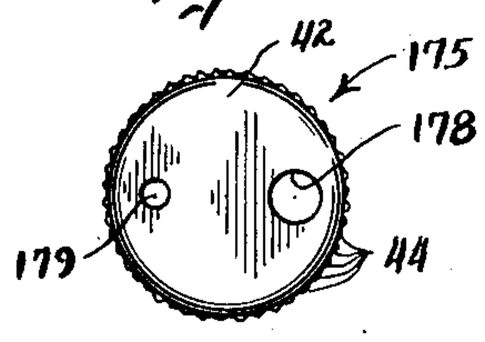


Fig. 16

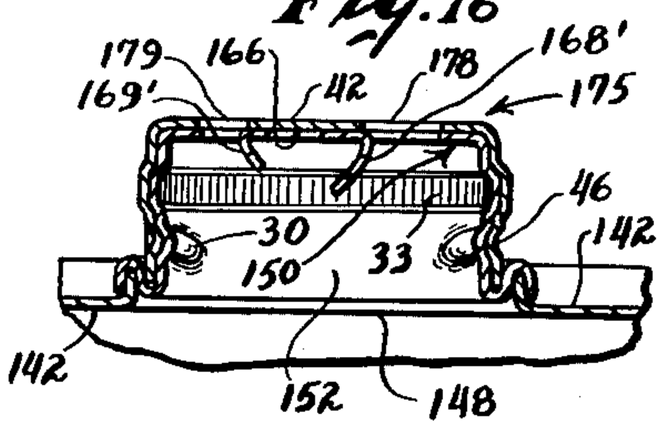


Fig. 17

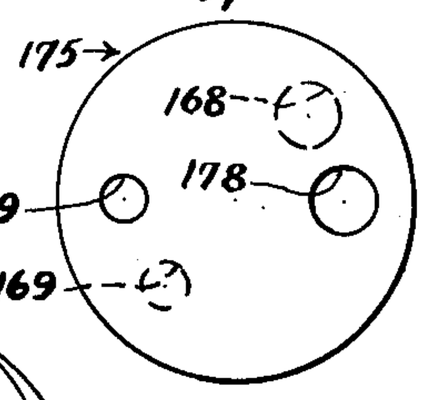


Fig. 18

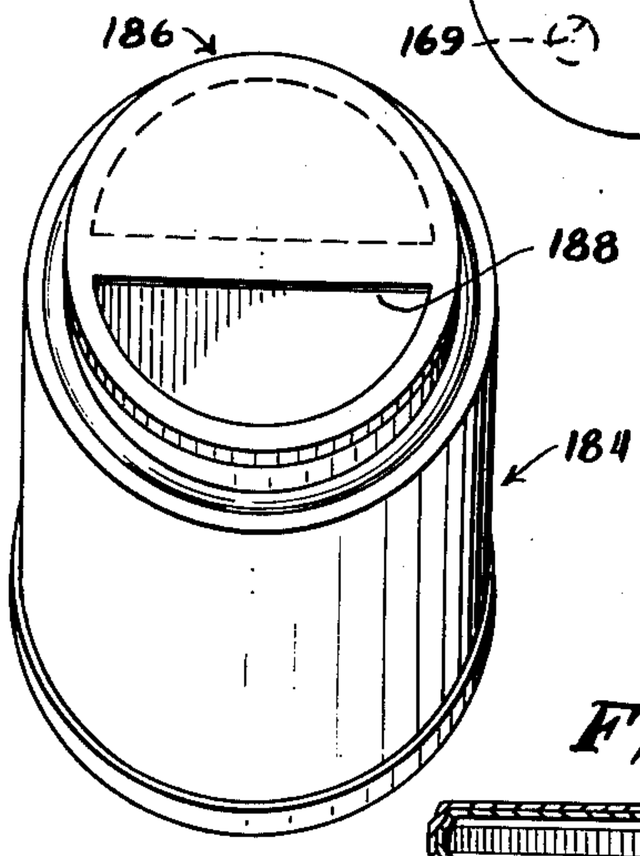


Fig. 19

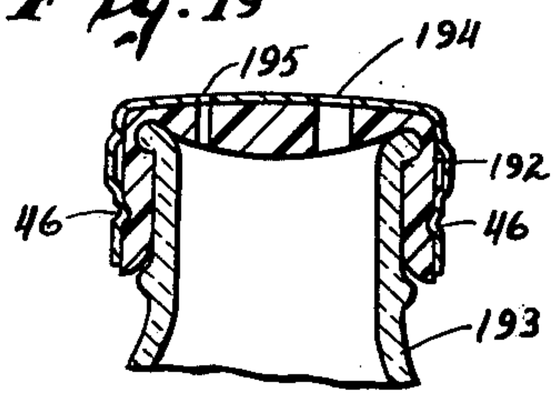


Fig. 20

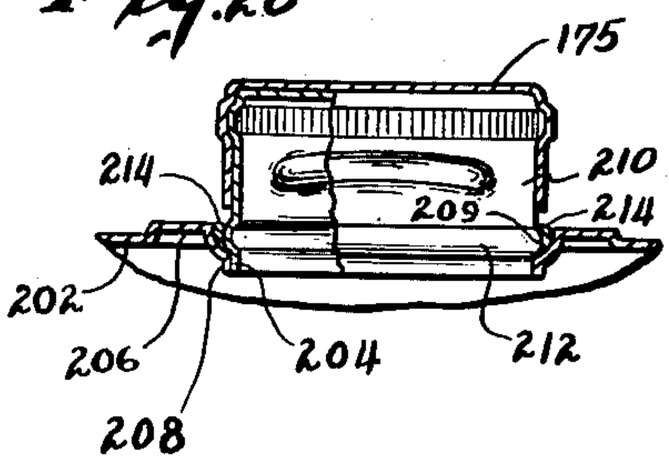
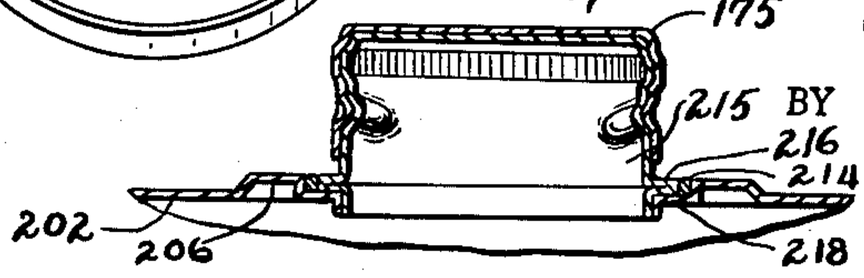


Fig. 21



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United States Patent Office

3,101,877

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3,101,877
CLOSURE FOR SEALING CONTAINER OUTLET

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Continuation of application Ser. No. 518,318, June 27, 1955. This application Feb. 9, 1959, Ser. No. 791,903

11 Claims. (Cl. 222—520)

This invention relates to closures for jars, tubes, bottles or other containers.

Screw caps for containers have numerous advantages and probably the most outstanding is the cam action in tightening of the cap to seal the container as the cap is turned in the direction to screw it on the container. Ordinary screw caps have two important disadvantages, however, in that they are easily lost when removed from the container, and they open the entire mouth of the container when removed to permit the contents to be poured. A container closure having the advantages of the screw cap without the disadvantages is disclosed in Patent No. 2,123,907, issued July 19, 1938, to Masbach and Driscoll.

It is an object of this invention to provide an improved container closure of the type disclosed in the Masbach and Driscoll patent. More specifically, it is an object of the invention to provide a construction, and method of making it, which insures more uniform operation of closures of the character indicated when such closures are made by mass-production methods. With this invention, manufacturing tolerances in the closure become less critical, and the closures produced in accordance with this invention seal effectively and are uniform in the ease of operation.

Another object of the invention is to provide constructions which make closures of the Masbach and Driscoll type suitable for use on containers in which liquids are sold. The improved construction is even suitable with bottles.

Still another object of the invention is to provide a slide cap which is particularly useful for collapsible tubes, and these slide caps operate on a principle similar to the rotary cap and are held on the container even when in open position.

The cost of a closure is of the utmost importance on containers in which any goods are sold. No matter how good a closure may be, if it is high in cost it is impractical for commercial use on containers which are used as packages and then discarded. By providing improvements which reduce the necessary manufacturing tolerances, with resulting reduction in cost, this invention provides an important improvement in making thread or cam-operated closure caps.

This application is a continuation of my application Serial No. 518,318, filed June 27, 1955, now abandoned.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views;

FIGURE 1 is a side view, partly broken away and in section, showing a closure hub made in accordance with this invention and attached to the top of a powder can;

FIGURE 2 is an enlarged sectional view of the hub, shown in FIGURE 1, with the cap of the closure in assembled relation with the hub;

FIGURES 3 and 4 are fragmentary, reduced-scale, top plan views of the closure shown in FIGURE 2 with the cap shown in closed and open positions in FIGURES 3 and 4, respectively;

FIGURE 5 is a fragmentary sectional view of a modified form of closure cap constructed of plastic material;

FIGURE 6 is a sectional view showing a cap and

closure hub of a modified form of the invention used on a bottle neck;

FIGURE 7 is a top plan view of the assembly shown in FIGURE 6;

FIGURE 8 is a top plan view of another modified form of the invention for use on powder cans;

FIGURE 9 is a perspective view of still another modified form of the invention in which the closure is a slide cap for use primarily on collapsible tubes but which can be used on other types of containers, if desired;

FIGURE 10 is a displacement diagram showing the relationship of the hub to the cap as the indentation in the cap moves in the cam track;

FIGURE 11 is a view, partly in section, showing another modified form of the invention;

FIGURE 12 is a greatly enlarged sectional view taken on the line 12—12 of FIGURE 11 but with the hub attached to the upstanding flange of the top of the container;

FIGURE 13 is a top plan view of the hub shown in FIGURE 12;

FIGURE 14 is a sectional view through a cap which fits over the hub shown in FIGURE 12;

FIGURE 15 is a top plan view of the cap shown in FIGURE 14;

FIGURE 16 is a sectional view showing the cap of FIGURE 14 assembled with the hub of FIGURE 12 to make the complete closure assembly, and shows openings formed in the top wall of the hub;

FIGURE 17 is a top plan view of the structure shown in FIGURE 16, but with the cap rotated to close the openings through the closure;

FIGURE 18 is a perspective view showing another modified form of the invention;

FIGURE 19 is a sectional view through a modified form of inner cap for an assembly such as shown in FIGURE 6, and

FIGURES 20 and 21 are fragmentary views, partly in section, showing two more modified forms of the invention.

FIGURE 1 shows a powder can **11** having a side wall **12** and a top wall **13** connected to the side wall by interlocking corrugations **15**. There is an opening **17** through the top wall, and a closure hub **20** is connected to the top wall **13** around the edge of the opening **17**.

In the construction shown, the closure hub **20** has a side wall **22** with a shoulder **23** formed by an outwardly extending corrugation near the lower end of the wall **22**. This shoulder **23** limits the extent to which the hub **20** can be inserted into the opening **17** in the initial assembly of the hub and can; and the bottom edge of the side wall **22** is flared out at **25** to clamp the edge of the top wall **13**, around the opening **17**, firmly against the shoulder **23**. This secures the closure hub **20** to the top wall **13** and it is an operation which is performed before the top wall **13** is assembled with the side wall **12** of the can **11**.

The closure hub **20** has a top wall **26** and there is an opening **28** (FIGURES 2, 3 and 4) in the top wall **26** on one side of the center of the top wall and extending for only a limited angular distance. In the construction shown, the opening **28** is shaped like a sector of a circle. There are grooves **30** (FIGURE 1) on opposite sides of the closure hub **20**, and each of these grooves **30** extends for a substantial angular distance around the circumference of the closure hub **20**; the angular extent being preferably more than 90 degrees and less than 180 degrees. Each of these grooves **30** is preferably highest near the center of its length and shaped so that it slopes downwardly toward both ends of the groove. The grooves **30** serve the function of a cam for

moving a cap up and down on the closure hub 20 in a manner similar to the operation of a screw thread.

There is a circumferentially-extending row of small ridges 33 around the hub 20 at a short distance below the juncture of the side wall 22 with the top wall 26. The ridges in this row 33 extend transversely of the circumferential extent of the row and they are formed by a feed roller on a machine which rotates the closure hub 20 during the manufacture of the hub. By making the hub with the ridges 33, a much more positive drive is obtained and a more uniform product in the manufacture of the closure hubs 20. The ridges 33 reinforce the hub and hold it to the desired shape. These ridges do provide a roughness, however, on the outside side surface of the hub on which the closure cap rotates. This does not interfere with the operation of the closure because a cap 36, which fits over the hub 20, is provided with a clearance, indicated by the reference character 38, from the circumferential area of the hub on which the row of ridges 33 is located.

The cap 36 has a side wall 40 and a top wall 42. The side wall has a circumferential area of increased diameter located immediately over the row of ridges 33 for obtaining the clearance 38. This area of increased diameter is preferably made with axially extending ribs 44 or knurling to facilitate the gripping of the cap in order to turn it when the fingers are wet and slippery.

There is an inwardly-projecting indentation 46, preferably of substantially circular cross section, on each side of the cap 36 in position to engage in one or the other of the grooves 30. These indentations 46 are diametrically opposite one another on the cap 36.

As the cap 36 is rotated about the longitudinal axis of the hub 20, the indentations move along the cam grooves 30 and serve as cam followers to move the cap 36 axially in accordance with the component of axial displacement of the cam grooves 30. The inside surfaces of the cap 36, below the cam groove 30 and above the row of ridges 33, turn on the outside surface of the closure hub 20 as a bearing. The running clearance of the cap 36 on the outside surface of the hub 20 is not critical and a fairly wide degree of manufacturing tolerance is permissible without affecting the practical operation of the cap 36 as a closure for the can.

There is an opening 48 in the top wall 42 of the cap 36; and this opening 48 is preferably of the same shape as the opening 28 in the top wall 26 of the closure hub 20. The openings 28 and 48 are located at substantially the same distance from the center of the hub 20 so that the openings register, as shown in FIGURE 2, when the cap 36 is in a particular angular position.

Rotation of the cap 36 in a clockwise direction through an angle of approximately 90 degrees brings the opening 48 into the position shown in FIGURE 3 where no portion of it overlaps the opening 28. With the cap 36 in this position, the container is closed. FIGURE 4 shows the openings 28 and 48 in substantial alignment with one another, the positions occupied when the container is open and previously illustrated in FIGURE 2.

The construction shown in FIGURES 1 through 4 are preferably made of metal. In all modifications of the inventions, when made of metal, the temper of the material is important. A certain hardness is necessary to obtain spring action in the parts for correct performance. If too hard, it is difficult to form the metal. Best results are obtained with metal from commercial ¼ to ½ hardness, but the cap can be of plastic construction. FIGURE 5 shows a plastic cap 50 with an opening 52 corresponding to the opening 48 of the metal cap 36 shown in FIGURES 2–4.

The cap 50 has two inwardly extending nubs 54 which are molded as a one-piece construction with the side walls of the cap. It was formerly thought that plastic caps could not be made at low cost because of the necessity of complicated molds for making the nubs 54 which would prevent stripping of the cap 50 from conventional molding equipment.

This molding difficulty is overcome with this invention by constructing the nubs 54 so that their surfaces extend at a slope to the side wall, thus giving the sides of each of the nubs 54 a cam surface which exerts a radial component of force for displacing the sides of the cap 50 outwardly far enough to slip over the core when stripping the cap from the core on which it is molded.

The combined resilience of the cap 36 or 50 and the closure hub 20 permits the caps to be pushed down over the closure hub until the indentations 46 or nubs 54 engage in the cam grooves 30 of the closure hub; but the caps cannot be pulled off the hub by any force which can be exerted manually in the use of the closure.

FIGURE 6 shows a modified form of the inventions for use with liquids. This modification is constructed for connection to a bottle neck 60, and it includes a hub portion 62 and a cap 64. There is a liner disc 66 covering the bottom face of the top wall 68 of the hub 62. The purpose of this liner is to prevent the contents of the bottle from coming into contact with the metal hub 62 when the bottle is not in an upright position, or when the liquid in the bottle splashes. The hub 62 is held on the bottle neck 60 by turning the bottom edge portion 70 of the side wall of the hub 62 inwardly under a circumferential ridge 72 on the outside of the bottle neck. This inwardly-turned lower edge 70 provides a flange that clamps the top wall 68 firmly against the liner 66 and holds the liner sealed against the upper end of the bottle neck 60.

In order to provide a completely tight liquid seal, the top wall 68 of the hub 62 is made without any openings. However, there is an area 76 outlined by a score 78 (FIGURE 7) in the top wall 68 and there is preferably a smaller area 80 surrounded by a score 82 in the top wall 68 on the other side of the center of the closure from the area 76.

By applying a substantial downward pressure to the areas 76 and 80, the metal within the score lines 78 and 82 is displaced downwardly, as shown in FIGURE 6, to form tabs indicated by the reference characters 76′ and 80′. The material of the liner 66 tears along approximately the same lines as the areas 76 and 80 as the result of the downward pressure of the metal displaced from the top wall 62. This leaves openings through the top wall 68 of the hub portion 62, the edges of the openings being the score lines 78 and 82. These score lines are preferably made deepest along the portions which are nearest to the circumference of the top wall 68, and the score lines are most shallow at the regions farthest from the circumference of the top wall 68. This insures that the tabs 76′ and 80′, which are displaced from the top wall, will bend inwardly toward the center axis of the bottle neck 60; such a result being advantageous for smoother pouring of the contents from the bottle. The liquid is poured through the larger opening left by the tab 76′ and the purpose of the opening left by the tab 80′ is to admit air into the bottle so that the liquid can be poured without gurgling.

The cap 64 has openings 86 and 88 which register with the openings through the top wall 68 of the hub 62 when the cap 64 is in one angular position. As in the case of the cap 36, shown in FIGURES 2–4, the cap 64 can be rotated about its center so as to move the openings 86 and 88 into the dot-and-dash line positions shown in FIGURE 7. This closes the bottle and seals it against pouring or evaporation of its liquid contents.

FIGURE 8 shows another modified form of the invention in which a number of openings 91 extend through a cap 92 and they can be brought into register with corresponding openings 93 in the hub portion of the closure. This construction is similar to certain powder cans which have a plurality of openings which can be closed by rota-

tion of the lid, and the purpose of this figure is to illustrate the fact that such a cap can be used with the cam-operated closure of this invention provided that the cam grooves are made short enough to shift the cap axially within the reduced angular movement of the cap which is made necessary by having a plurality of openings 91.

FIGURE 9 shows the invention applied to a slide cap. In this modification of the invention there is a block 100 which serves as the hub of the closure, and this block is connected to a flange 102 at its lower end, the flange 102 being secured to a top wall 104 of a collapsible tube or other container with which the modified structure of FIGURE 9 is intended to be used. The flange 102 and block 100 cover an opening in the top wall 104, and there is a smaller opening 106 in the top wall of the block 100. Cam grooves 108 are formed in the opposite side walls of the block 100.

The modification shown in FIGURE 9 includes a slide cap 112 having a top wall 114, with a liner covering its bottom face, and side walls 116. There are indentations 118 in the side walls 116 in position to engage the cam grooves 108 of the block 100. The left-hand end of the top wall 114 of the slide cap 112 moves beyond the opening 106 when the cap 112 is moved longitudinally to bring the indentations 118 to one end of the cam grooves 108. The contents of the tube can then be discharged through the opening 106.

When the slide cap 112 is moved in the opposite direction, the indentations 118 move toward the other ends of the cam grooves 108 and the cap 112 comes to rest in a position with its top wall 114 closing the opening 106 and with its opposite ends substantially even with the corresponding ends of the block 100. Where the construction is made with fairly wide manufacturing tolerances, it is desirable to have the length of the slide cap 112 slightly less than the length of the block 100 so that the ends of the cap 112 do not project beyond the ends of the block 101 when in closed position. The forward end of the cap 112 will, of course, project substantially beyond the forward end of the block 100 when the slide is moved into the dotted line position shown in FIGURE 9 to uncover the opening 106 to discharge the contents from the container or tube 104.

The slide cap 112 is made of metal or other material having sufficient resilience to enable the walls 116 to be spread slightly when passing the indentations 118 over the sides of the block 112 to bring them into position to engage the cam grooves 108. The slide cap 112 is of sufficiently thick material, however, to prevent the side walls 116 from spreading and permitting the indentations 118 to escape from the cam grooves 108 as the result of any manual force which is applied to the closure assembly when in use.

FIGURE 10 is a displacement diagram in which a cam groove 126 is developed so that the illustration of it is not affected by the curvature of the hub portion of the closure in which the cam groove is formed. This figure is for the purpose of illustrating the principle of operation of the various closures illustrated in the other figures. The indentation in the cap is indicated by the reference character 128, the top wall of the cap by the reference character 130 and the top wall of the hub portion by the reference character 132.

When the indentation 128 is at the high part of the cam groove 126, it raises the top wall 130 out of contact with the wall 132 of the hub portion. As the indentation 128 moves toward the left, toward the position indicated by the reference character 128', the top wall 130 of the cap is moved downwardly into the dotted line position indicated by the reference character 130', and this brings the bottom surface of the top wall 130 into contact with the top surface of the wall 132 of the hub portion. This occurs when the cap has moved into position to cover the opening in the hub portion, and the pressure of the

top wall 130 against the wall 132 of the hub portion effectively seals the opening through the hub portion.

In the construction shown in FIGURE 10, the cam groove 128 extends for some distance beyond the position 128' and preferably rises slightly so that the pressure between the walls 130 and 132 is relieved somewhat and there is no danger of the cap moving back into open position as the result of vibration. This feature of the slight upward slope of the end portion 134 of the cam groove is a feature which can be used with any of the cam grooves illustrated in the other figures, but it is ordinarily not necessary because the friction of the confronting surfaces of the walls 130 and 132 is sufficient to prevent the closure from opening as the result of vibration.

It will be evident that with the indentation in the position 128', any force applied to the closure cap to move it into open position, especially in cam grooves which do not have the rest stops or upwardly sloped end portions 134, the force to rotate or move the wall 130, which is represented by movement toward the right in FIGURE 10, tends to relieve the friction between the walls 130 and 132 by moving the confronting surfaces of these walls with a component of the motion shifting the walls away from one another.

During motion of the indentation from the position 128' to the position 128, the wall 130 moves away from the wall 132 and the frictional resistance encountered is merely that slight resistance resulting from the movement of the side wall of the cap along the side wall of the hub portion. This running clearance is sufficient to prevent any substantial friction.

Continued movement of the indentation 128 toward the right in FIGURE 10 brings the cap wall 130 into position where its opening is in register with the opening in the hub wall 132; and when these openings are in register, the indentation 128 is in the position indicated by the reference character 128''. The cam groove 128 brings the cap wall 130 back into contact with the hub wall 132 when the cap reaches open position; and there is a rest stop, i.e., a slight upward slope at this end of the cam groove.

FIGURE 11 shows another modification of the invention in which a cam or canister 140 has a top wall 142 connected to it along a seam 144. The top wall 142 has an upturned flange 146 around an opening 148 through the top wall.

A closure hub 150 has a side wall 152 extending downwardly to a lower fold 154. This hub 150, which is preferably made of resilient metal, extends outwardly and then upwardly at the lower fold 154 to an upper fold 156 at which the material of the hub extends outwardly and then downwardly. The portion of the hub between the lower fold 154 and the upper fold 156 provides a wall 158 (FIGURE 12) which fits snugly within the upturned flange 146. The hub is pushed down into the opening 148 until the upper fold 156 strikes against the top of the upturned flange 146.

The hub is then secured to the upturned flange 146 by rolling, or otherwise connecting, the upper fold 156 to the outside of the flange 146. FIGURE 12 shows a phantom roller 160 rolling the outer portion of the upper fold 156 into tight contact with the flange 146 of the top wall 142. If desired, the connection of the hub 150 to the flange 146 can be supplemented with solder 162, but for most purposes this is not necessary. Where a tight seal is important, a sealing compound 164 is placed within the upper fold 156 before the hub is placed on the flange 146.

The upper portion of the hub 150 is similar to the hub 20 shown in FIGURES 1 and 2, and corresponding parts are indicated by the same reference characters as in FIGURES 1 and 2, except that the top wall, indicated by the reference character 166, is of domed contour as

compared with the flat top wall of the hub structure shown in FIGURES 1 and 2.

There are depressed areas 168 and 169 in the top wall 166 and these areas are depressed from the top wall to produce openings. The larger area 168 is used to make a discharge opening and the smaller area 169 is displaced from the top wall to provide a vent opening. In the construction shown in FIGURE 12, the area 168 is formed by displacing metal downwardly along an abrupt shoulder 170; and the metal is weakened at this shoulder. At the area 169 the downward displacement is along a gradual arc and such an indication of the area to be punched out may be used in place of the abrupt shoulder 170 or any of the other areas previously described.

FIGURES 14 and 15 show a cap 175 which is similar to the cap 36 shown in FIGURES 2–4 except for the shape of the openings through the cap, and the shape of the lower portion of the side wall of the cap. Below the indentations 46 of the cap shown in FIGURE 14, there is a circumferential corrugation 176, the lower side of which preferably includes the bottom edge of the cap. This reinforces the cap and also holds the cap to its round shape and counteracts a tendency of the cap to be distorted from the forming of the indentations 46. Corresponding parts are indicated by the same reference characters as in FIGURES 2–4. The cap 175 has a large circular opening 178 and a small circular opening 179. These openings are of the same shape as the areas 168 and 169, respectively, of the hub 150. It is desirable to have the openings in the cap and hub of the same shape, but it will be understood that various shapes may be used, such as the shapes shown in FIGURES 3 and 4.

The top wall 42 of the cap 175 is substantially flat, and the cap is preferably made of resilient metal, usually of the same kind of metal as the hub 150. The distance from the bottom surface of the top wall 42 of the cap 175 to the level of the inwardly projecting indentations 46 is correlated with the height of the hub 150 so that the top wall 166 of the hub is flattened down by the cap 175 by the time the indentations 46 engage the cam grooves 30. The correlation is such that the domed contour of the top wall 166 of the hub 150 is slightly flattended when the cam follower indentations 46 are at the high parts of the cam grooves 30; and the domed contour is pulled down to a much flatter shape when the cam follower indentations 46 move to either end of the cam grooves 30.

This expedient provides greater manufacturing tolerances in the construction of the closure and permits the cap to turn on the hub with less friction while moving from open to closed position; but the closing of the openings is tight enough to prevent leakage because of the flattening out of the domed contour of the hub when the cap is turned into closed position. The resilience of the metal of the top wall 166 maintains a spring-like pressure against the cap and this pressure is resisted by the contact of the cam follower indentations 46 with the upper surfaces of the cam grooves 30.

FIGURE 16 shows the areas 168 and 169 punched out to form tabs 168′ and 169′, respectively. As in the constructions previously described, it is desirable to have the areas 168 and 169 weakened around their entire perimeters except along lines which are to form hinge connections on which the tabs can swing inwardly. Thus, the tabs 168′ and 169′ remain connected to the hub. If desired, a liner can be used under the hub 150 in the manner illustrated and previously described in connection with FIGURE 6.

FIGURE 17 shows the cap 175 turned into a position where the openings 178 and 179 are out of register with the areas 168 and 169 when the cap is in closed position.

FIGURE 18 shows a can or canister 184 with a closure structure 186 attached to the top edge of the side wall of the can 184. In this modification of the invention, the closure structure 186 is preferably the same as shown in FIGURES 11–17 except that it is attached to the top edge of the side wall of the can instead of being attached to the top edge of an upstanding flange around an opening in the top wall.

The can 184 has no top wall except such as is provided by the closure structure 186. This makes the closure structure much larger in proportion to the cross section of the can, and an opening 188 in the closure structure 186 can be made large enough for pouring peanuts or other fairly large pieces from the can 184.

FIGURE 19 shows a modification of the invention for use with a bottle instead of a can or canister. a hub 192 constructed of plastic is applied to a bottle 193 with a tight fit over the lip of the bottle. The hub 192 has a domed surface of its top wall but the top wall is thicker at its center region so that the inside surface is convex over at least part of its area. The hub 192 has cam grooves therein; and there is an outer cap 193 that fits over the hub 192 with cam follower indentations 46 that hold the cap 193 on the hub and cause it to operate toward and from the top surface of the hub as already described for the other caps. In the case of FIGURE 19, there are pour openings 194 and vent openings 195 formed in the hub and cap when they are manufactured and before being applied to the bottle.

For some purposes, for example with edible oils that become rancid, the depression around the bottom of the hub of FIGURE 11 and FIGURE 12 is objectionable. Liquid that gets into that depression does not flow out easily.

FIGURE 20 shows a construction similar to FIGURES 11 and 12 but without a depression around the hub in the finished structure. In FIGURE 20 a top wall 202 has an opening 204 and is formed with an annular recess 206 around the opening 204 to stiffen the top wall at that region. A rim 208 extends downwardly and the rim has a flaring upper end providing a shoulder 209.

A hub 210 has a circumferential corrugation 212 extending outwardly and fitting loosely into the opening 204 above the shoulder 209. The shoulder provides a stop for limiting the extent to which the lower end of the hub fits into the opening 204; the hub preferably fitting snugly into the open cross section within the rim 208 below the shoulder.

There is a clearance between the corrugation 212 and the upper end of the rim 208. This clearance is filled with solder 214 to leave the surface around the hub substantially flush with the adjacent top surface of the wall 202.

FIGURE 21 shows a construction which is the same as that of FIGURE 20 except that a hub 215 has a corrugation formed in its side wall and which is then collapsed axially to provide a flange 216 that serves the same purpose as the corrugation 212 of FIGURE 20, but the flange 216 of FIGURE 21 can be used with a higher shoulder 218 in the opening through the can top.

The upper portions of the hubs shown in FIGURES 20 and 21 are preferably the same as in FIGURES 11 and 12 and corresponding parts are designated by the same reference characters.

The preferred embodiments of the invention have been illustrated and described, but changes and modifications can be made, and some features can be used in different combinations without departing from the invention as defined in the claims.

What is claimed is:

1. In a closure structure of the class wherein a cylindrical hub is attached to a container and the cylindrical hub has a side wall and a top wall with an opening therein, and a cap fits over the hub and has a side wall and a top wall adjacent to the corresponding walls of the hub, and the cap oscillatae on the hub to bring an

opening through the cap into register with the opening through the top wall of the hub, and there are cam means on the confronting side walls of the hub and cap including a cam track on one of the walls and a cam follower on the other of said walls with the cam track shaped to pull the top walls together when the openings through the top walls are in register and when they are shifted out of overlapping relation with one another, the intermediate portion of the cam track rising progressively and then running down again between the portions of the track that pull the top walls together, the improvement which comprises a resilient top wall on the hub having an original domed contour across the center portion of the top wall when said top wall of the hub is not distorted by pressure of the cap, the top wall of the cap being flatter than said contour, and the cam track and follower being correlated with the heights of the hub and cap to hold the cap down on the hub with pressure on the portion having the dome-shaped contour and to hold the top wall of the hub distorted to a flatter contour for all positions of the follower along the cam track.

2. The closure structure described in claim 1 and in which the cam track is indented in the side wall of the hub and the cam follower is a depression in the side wall of the cap.

3. The closure structure described in claim 2 and in which there are two cam tracks on the hub on opposite sides thereof and two oppositely-disposed cam followers on the cap for moving the cap evenly as the cam followers cause it to move up and down in response to travel of the cam followers along the track.

4. The closure structure described in claim 3 and in which the closure structure is on a container in which goods are sold and the opening in the hub is originally closed by a portion of the hub extending over the area of the hub in which the opening is to be made by the ultimate consumer.

5. The closure structure described in claim 4 and in which the top wall of the hub originally has a depressed area at the location where the opening through the top wall of the hub is to be made.

6. A closure structure for a container including in combination a top wall permanently secured to side walls of the container, an upwardly extending cylindrical flange surrounding an opening through the top wall, the flange being made of material displaced from the opening, a hub having a top wall, a cylindrical side wall, a fold having an outer wall spaced from the cylindrical side wall and extending up for a short distance from the lower end of the side wall, said fold fitting within the flange, the material of the fold at the top thereof extending radially outward across the upper end of the cylindrical flange and then downwardly across the outside of said flange, a cap that fits over the hub and that has a top wall and a cylindrical side wall confronting the corresponding walls of the hub, the cap having oscillating movement on the hub to bring openings through the top walls into register with one another, cam means on the confronting side walls of the hub and cap including a cam track on one of the walls and a cam follower on the other of said walls, the cam track being shaped to pull the top wall of the cap against the top wall of the hub with substantial pressure when the openings through the top walls are in register and when they are shifted out of overlapping relation with one another, the intermediate portion of the cam track coming down progressively toward both ends of the track.

7. The closure structure described in claim 6 and in which the side wall of the cap extends downwardly into the space between the side wall of the hub and the fold of the hub to increase the length of the cap below the cam means without increasing the overall height of the closure structure and container.

8. The closure structure described in claim 7 and in which the top wall on the hub is resilient and of domed contour across substantially the full diameter of the top wall, and the top wall of the cap is flatter than the domed contour, and the cam track and follower are correlated with the heights of the hub and cap to hold the cap down on the hub with the cap pressing down on the dome-shaped contour for all positions of the follower along the cam track.

9. In a closure structure for a container including a cylindrical hub fixed to the container and having a top wall and side wall and having a discharge outlet in the top wall, and a cap that fits over the hub and that has a top wall and side wall adjacent to the corresponding parts of the hub, the cap being oscillatable on the hub about the longitudinal axis of the hub and having a discharge outlet in its top in position to register with the discharge outlet of the hub when the cap is at one end of its oscillation stroke, a cam track and a cam follower, one of which is in the hub and the other in the cap, the follower and the cam track having relative movement as the cap is oscillated on the hub, the cam groove having a longitudinal component that pulls the top against the hub with substantial pressure when the cap is at the other end of its stroke, and the cap having a circumferential area of increased inside and outside diameter with ridges thereon to facilitate rotation of the cap, the improvement which comprises a circumferential zone on the side of the hub extending for only a part of the height of the side of the hub and at a location intermediate the upper and lower ends of the hub, said zone having ridges formed of displaced material of the side of the hub and angularly spaced from one another around the circumference of the hub, the diameter of the hub being increased locally by said ridges, the principal component of the direction of extent of the ridges being axial, and the cap having a circumferential zone outside of the zone on the hub and of a continuous larger inside diameter than the locally increased diameter of the hub zone at the ridges to leave a radial clearance between the zones on the hub and the cap, and having also longitudinal clearance for the movement of the cap by said cam track and cam follower, the zone on the cap having protuberances providing a roughened surface to provide a better grip for turning the cap on the hub portion.

10. The closure structure described in claim 9 and in which there are a plurality of cam grooves and cam followers at angularly-spaced regions around the sides of the hub and cap, and in which the ridged area of the hub is close to the juncture of the top and side wall of the hub, and the area of increased diameter of the cap is also provided with ridges extending outwardly to provide a more convenient grip for turning the cap to move it between open and closed positions.

11. The closure structure described in claim 9 and in which the cap and hub are each of one-piece construction and the cam grooves are in the wall of the hub, the ridged area of the hub being spaced from but close to the juncture of the top and side wall of the hub, and the area of increased diameter of the cap being ridged to provide a better grip for the fingers of a person turning the cap between open and closed positions.

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