

[54] CONTAINER COVER

3,638,825 2/1972 Franek et al. 220/66

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[57] ABSTRACT

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A cover for containers whose contents are under pressure which includes a substantially flat central portion, a crimping flange portion and a neck interposed between the flange portion and the central portion and connected thereto by connecting portions without any break in continuity.

[56] References Cited

UNITED STATES PATENTS

3,417,898 12/1968 Bozek et al. 220/66

4 Claims, 4 Drawing Figures

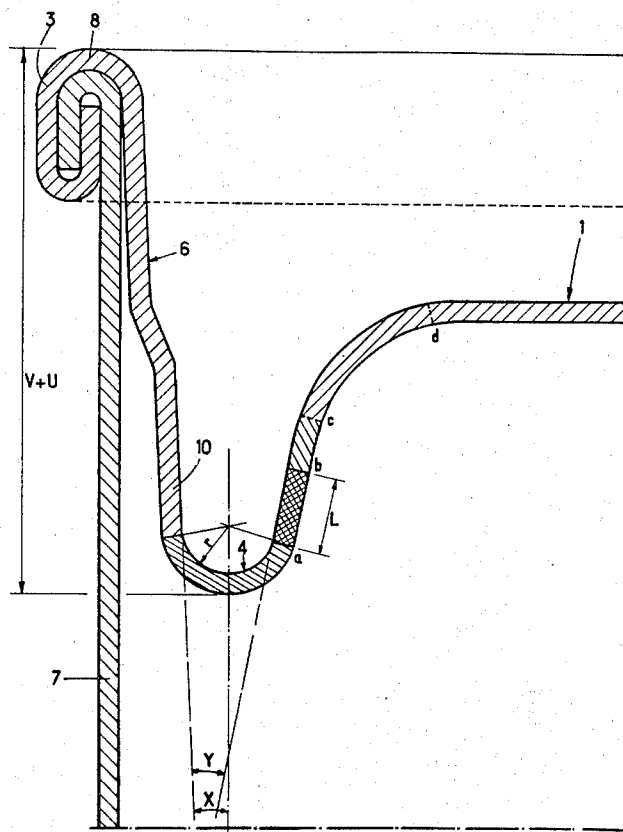
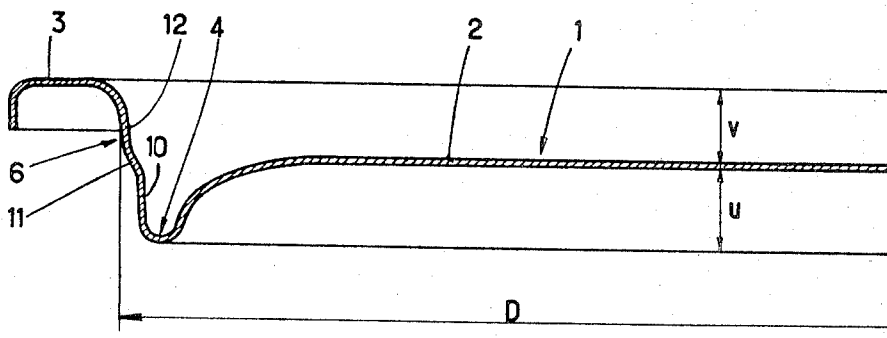


Fig. 1



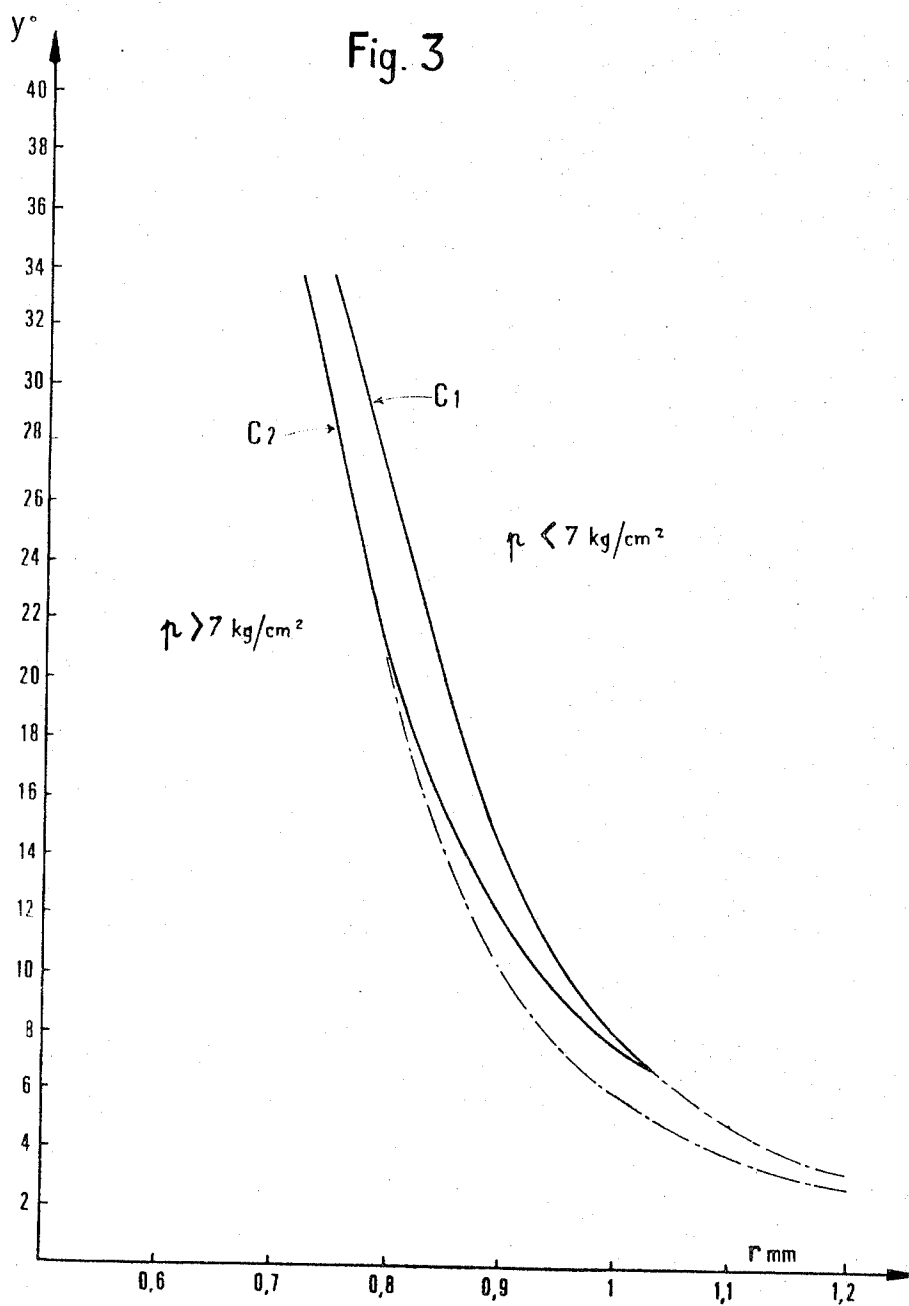
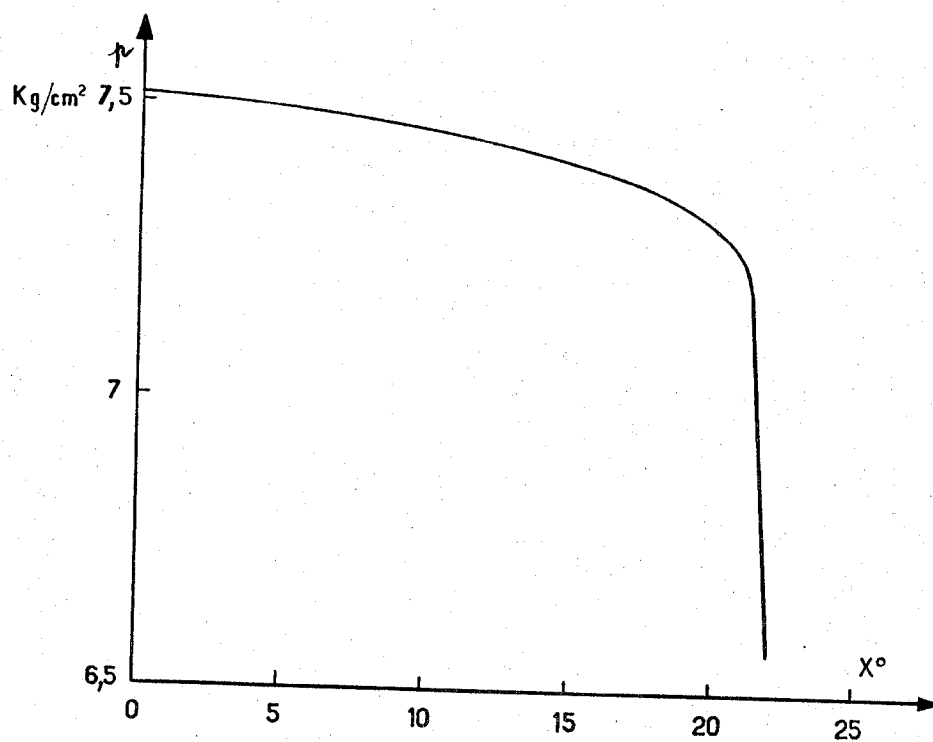


Fig. 4



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CONTAINER COVER

This is a continuation in part of copending application Ser. No. 250,598, filed May 5, 1972. The present invention relates to a metal cover for a container under pressure such as a can for beer or any other carbonated beverage.

Metal covers of this kind, for example, the cover described in the French Pat. No. 1,402,391, generally contain a central substantially planar part, a crimping flange and a peripheral throat connected to the flange and the center part. They must withstand a relatively high internal pressure which may go as high as 6.6 kg/cm² for beer during pasteurization.

In these covers according to prior art, the central plane part is connected to the throat via a transition area of lower resistance where the thickness of the metal is rarely constant.

If the critical pressure is reached, a permanent deformation of local extent of the metal is produced, in excess of the limit of elasticity, generally called "becquet" or lifted up. Consequently, the use of these covers imposed a minimum safety thickness, which is, for example, 340 microns for an effective diameter (corresponding to the inner diameter of the container) of 65 mm or 330 microns for an effective diameter of 63 mm in case of a 4.5 percent magnesium aluminum alloy.

The calculations of strength of materials show that the optimal profile for the center part of the lid would be a portion of a sphere. However, in practice this configuration offers numerous disadvantages. The internal volume of the cover which must be included into the total volume of the packing is too high in relation to the limits of contents. Stacking of the containers is no longer possible. The adaptation of a system of easy opening with a pre-incision line on the center part cannot be solved in a satisfactory manner. Thus, it is necessary to rely on a substantially flat center portion.

It is accordingly an object of the present invention to provide a container cover for containers whose contents are under pressure which overcomes the foregoing disadvantages, and it is a more specific object of the invention to provide a container cover for containers whose contents are under pressure which are capable of withstanding higher pressures within the container even though the container cover be formed with a thinner cross-section.

These and other objects and advantages of the invention will appear more fully hereinafter, and, for purposes of illustration but not of limitation, an embodiment of the invention is shown in the accompanying drawings in which:

FIG. 1 is a diametric half-section of a metal cover embodying the features of this invention prior to crimping onto the container body;

FIG. 2 is a detailed sectional view of the embodiment illustrated in FIG. 1 crimped onto a container;

FIG. 3 is a graph showing two isobar curves C_1 and C_2 for a plot of the angle Y versus the radius of curvature r ; and

FIG. 4 is a graph showing a plot of the pressure versus the angle X .

The invention relates to the creation of a metal container which, while comprising a substantially flat center portion, has a resistance which is satisfactory at least up to pressures on the order of 7 kg/cm² and this

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for a thickness which is considerably less than that of the containers of prior art.

The cover according to the invention which comprises a substantially flat center portion, provided with a system of easy opening, a crimping flange and a peripheral throat connected to the flange and to the center portion by connections of substantially constant thickness, is characterized by the fact that the radius of curvature of the throat ranges between about 0.5 and 1.2 mm, that the throat is connected without breach of continuity to the center portion by a rectilinear portion of continued section of a curved part, and that the connection between the flange and the throat or neck forms with the line perpendicular to the plane surface of the neck an angle X which is at most equal to about 20° and with the rectilinear portion an angle Y ranging up to 34° approximately, said angles X and Y being selected in such a manner that for a high value of X the value of Y will be as low as possible and vice versa.

The lower limit of about 0.5 mm for the radius of curvature of the throat is due to the fact that the danger of the formation of cracks is relatively high below this value, while the lower limit of about 3° for angle Y is dictated by considerations of a technological nature.

It could be noted that if the characterized critical pressure is exceeded, there is a sudden return of the cover without prior permanent deformation of the metal.

Under the action of the pressure prevailing in the container, the connection between the flange and the neck works at the compression while in the curved portion traction stresses build up. On the other hand, the wall of the throat or neck and the rectilinear part form a neutral undeformable zone, as opposed to the zones of preferential deformations which are typical of the covers of prior art.

For a cover of 63 mm in effective diameter designed in 4.5 percent magnesium aluminum alloy at restored hard condition, a thickness of about 300 microns suffices to guarantee holding at a minimum pressure of 7 kg/cm², while a cover of prior art of the same diameter and made with the same alloy requires a minimum thickness of 340 microns.

FIG. 1 shows a metal cover of generally circular shape for a beer can comprising a substantially planar center part 2, a crimping flange 3 and a peripheral reinforcement neck 4. The center part of the cover is provided with an easy to open system of the conventional type which is not shown.

The cover is produced, for example, by stamping a blank of aluminum alloy in hard restored condition, containing 4.5 percent magnesium and presenting the following characteristics: limit of elasticity of 32 kg/mm², break load of 36.5 kg/mm², breaking tension of 8.5 percent. The effective diameter D of the cover, corresponding to the inner diameter of the can, is 63 mm.

The distance u between the bottom planes of the neck 4 and the center part is 4.3 mm, while the distance v between the upper plane of the flange and that of the center part is 2.8 mm; in the conventional covers the distance v is in the order of 2.1 mm.

Referring to FIG. 2, it is shown that the neck 4 is connected without breach of continuity to the center part 2 by a rectilinear part in $a-b$ section, followed by a curved portion which in turn is formed from a first circular arc $b-c$ and a second circular arc $c-d$ which joins

the center part 2 tangentially. These parts have a substantially constant thickness.

The throat or neck 4 has a circular arc section of a radius $r=0.65$ mm; the rectilinear part $a-b$ has a length L of 1 mm, the circular arc $b-c$ has a radius of 1.25 mm and the circular arc $c-d$ has a radius of 25 mm, and the connection 6 between the flange 3 and the neck 4 has a substantially constant thickness and has a detachment 11 located below the plane of the center part 2, separating the two straight-line parts into sections 10, 12. The part 10 forms with the line perpendicular to the plane of the bottom of the neck an angle X practically = 0 and with the straight-lined part $a-b$ the angle Y is approximately 6° 30 minutes.

The cover thus created has a remarkable thickness of only 300 microns with a tolerance of 10 microns, and can withstand pressures on the order of 8.1 kg/cm^2 while the conventional covers with 340 microns in thickness do not hold above 6.9 kg/cm^2 .

Now the influence of angles X and Y and of the radius of curvature r will be examined with regard to the holding of the lid.

Angle X being fixed at a value practically = 0 and radius r at 0.75 mm, tests were conducted by varying angle Y . The results are shown in Table 1.

TABLE 1

Y°	7	9	15.5	22	29	34
Maximum Pressure kg/cm ²	7.7	7.6	7.4	7.3	7.1	7

The difference $(X-Y)$ being fixed at 6° and the radius r at 0.6 mm, tests were conducted by changing the angle X . The results are shown in Table 2.

TABLE 2

X°	0	14	19.5	22	30
Maximum Pressure kg/cm ²	8	7.9	7.7	6.8	6.4

With angles X and Y being fixed, the former at practically 0° , the latter 7° , tests were conducted by changing radius 4. The results are shown in Table 3.

TABLE 3

r mm	0.475	0.55	0.60	0.65	0.70	0.75
Maximum Pressure kg/cm ²	7.8	7.9	8	8.1	8.1	7.9

Beyond $r=0.75$ mm, angle Y cannot be maintained at 7° and additional tests showed that if r were increased to 1.5 mm Y to about 19° , the pressure of 7 kg/cm^2 would not be guaranteed if r exceeded 1.2 mm.

The ideal for r is located, considering the danger of formation of cracks, for low values, between about 0.6 and 0.7 mm.

The sum total of these results shows that angle Y must not exceed about 34° when $X=0$ and that angle X must be selected below about 20° , which corre-

sponds to a value of Y in the vicinity of 26° , if the pressure is 7 kg/cm^2 .

Angles X and Y are so selected that for a high value of X the value of Y is as low as possible, and vice-versa, that for a high value of Y , the value of X is as low as possible.

Preferably, values between 0° and 20° are selected for X , between 6° and 34° for Y and between 0.5 and 1 mm for r .

In this preferential area, pressure p is connected to angles X and Y as well as to the radius r , by the following formula:

$$p = 7.0 + (1 - X/22)^{0.104} x (Y - 1)^{-0.065} x r^{-0.36}$$

FIG. 3 represents the isobar curves C_1 and C_2 which separate for $X=0^{\circ}$ and 20° respectively, the zone where the limit pressure p is higher than 7 kg/cm^2 from the zone where this pressure is below 7 kg/cm^2 . The radius of curvature r is shown in abscissas and angle Y is shown in ordinates.

Curves C_1 and C_2 are extended in the area of lower values of Y by the dotted lines shown in FIG. 3 which are intended to demonstrate the increasing technological difficulties. Angles of $Y=3^{\circ}$ have, however, been produced with clean tools. In the area between $Y=20^{\circ}$ and $Y=7^{\circ}$ a solid line connects curves C_2 and C_1 . It has indeed been found that the corresponding lower values of Y are compatible with higher values of r when $X=20^{\circ}$ (curve C_2).

FIG. 4 illustrates the variation of the limit pressure p as a function of the angle X for a radius r of 0.7 mm and an angle Y of 20° .

The relation between the distance $(u+v)$ and the effective diameter D on the one hand, and the relation u/v on the other hand, are so selected as to meet the usual stacking requirements, of limitation of the total volume and the adaptation of an asy to open system.

After crimping the lid on the body 7 of a beer can (FIG. 2), the previously indicated dimensions remain approximately constant.

Under the action of the pressure present in the container, the center part of the cover is slightly inflated; the connection 6 works at the compression toward the crimping zone, while traction efforts building up in the part that is curved, $b-c-d$, from the center zone of the cover. The tip 8 of the flange 3 located perpendicularly to the flange of the body of the can 7 plays the part of a hinge, as it remains substantially stationary in view of the crimping. It could be noted that the assembly formed by the wall of the neck 4 and the straight-lined part $a-b$ constitutes a neutral undeformable zone.

Numerous tests have shown that if the critical pressure is exceeded notably, the cover is suddenly returned, without prior deformation.

For one and the same metal or alloy, the reduction in thickness of the cover, and thus the savings in metal in relation to the conventional covers, is very considerable as they are on the order of 10 to 20 percent.

At identical thickness it is possible to use a metal or alloy of lower mechanical characteristics, which are less expensive.

For example, the cover may be made of an aluminum alloy in hard restored condition, containing 2.5 percent magnesium and having the following characteristics: limit of elasticity = 27 kg/mm^2 ; break load = 32.8 kg/mm^2 ; breaking tension = 10.5 percent; or containing 1 percent manganese and less than 1 percent magne-

sium and having the following characteristics: limit of elasticity = 25.5 kg/mm²; breaking load = 30.5 kg/mm²; breaking tension = 9 percent. The thickness may vary in this case between 320 and 340 microns for an effective diameter of 65 mm.

With different qualities of steels, the thickness may vary from 280 to 350 microns for an effective diameter of 65 mm. It is possible to use regular or stainless steel, with the following characteristics respectively: limit of elasticity = 21.5 and 30.5 kg/mm²; breaking load = 33.5 and 51 kg/mm²; breaking tension = 20 and 25 percent. Cast iron and black iron also are suitable.

It will be understood that various changes and modifications can be made in the details of construction and use without departing from the spirit of the invention, especially as defined in the following claims.

We claim:

1. A cover for a container whose contents are under pressure comprising a substantially flat central portion, said central portion including a removable panel, a crimping flange portion, a peripheral neck having a radius of curvature within the range of 0.5 to 1.2 mm, a substantially rectilinear portion of continued section without break in continuity integral with and connecting the neck with the central portion, a portion integral with and connecting the crimping flange portion and the neck, with the portion connecting the crimping flange portion with the neck forming an angle X with a line perpendicular to the plane surface of the neck at

most 20° and forming with the rectilinear portion an angle Y within the range of up to 34°, said angles x and Y being selected in such a manner that for a high value of X the value of Y will be as low as possible and vice versa.

2. A cover according to claim 1 wherein Y is comprised between 6° and 34° and r between 0.5 and 1 mm.

3. A cover as defined in claim 1 which includes a scored portion having low resistance to tearing, said scored portion defining the removable panel, and means to pull the scored portion from the cover to form an opening therein.

4. In a container whose contents are under pressure having an easy opening cover, the improvement comprising a cover including a substantially flat central portion, said central portion including a removable panel, a crimping flange portion, a peripheral neck having a radius of curvature within the range of 0.5 to 1.2 mm, a substantially rectilinear portion of continued section without break in continuity integral with and connecting the neck with the central portion, a portion integral with and connecting the crimping flange portion and the neck, with the portion connecting the crimping flange portion with the neck forms an angle X with a line perpendicular to the plane surface of the neck at most 20° and forming with the rectilinear portion of angle Y within the range of 6° to 34°.

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