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Wessely

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[54] **END CLOSURES FOR METAL DRUMS**

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June 9, 1971 France 71.20846

[52] **U.S. Cl.** **220/66;** 220/67; 220/73

[51] **Int. Cl.²** **B65D 7/42**

[58] **Field of Search** ..... 229/5.5, 5.8, 43; 220/66, 220/67, 24 R, 24 A, 71, 72, 69, 73

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[57] **ABSTRACT**

The end closure comprising a peripheral cylindrical wall which is fitted in the cylindrical body and a substantially planar lateral wall axially offset relative to the free outer edge of the peripheral wall. The peripheral wall of the end closure is connected to the lateral wall by a small rounded channel followed radially inwardly by a connecting fillet. The lateral wall has at least one inverted U-shaped stiffening channel much larger than the rounded channel and extending into the cylindrical body. If the lateral wall is 8/10 mm sheet metal and the diameter of the drum 600 mm, two such stiffening channels are provided. Each stiffening channel is located in an annular peripheral zone formed by the outer third of the area of the end closure.

9 Claims, 6 Drawing Figures

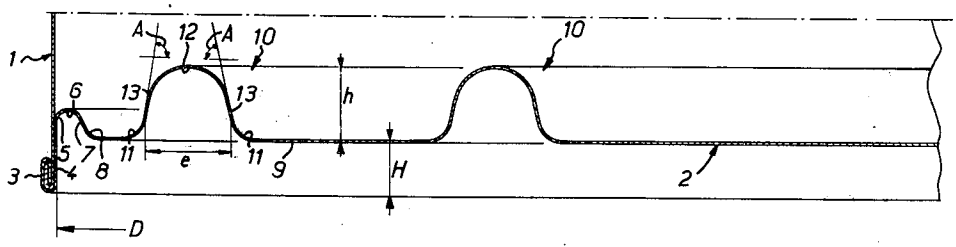

FIG. 1

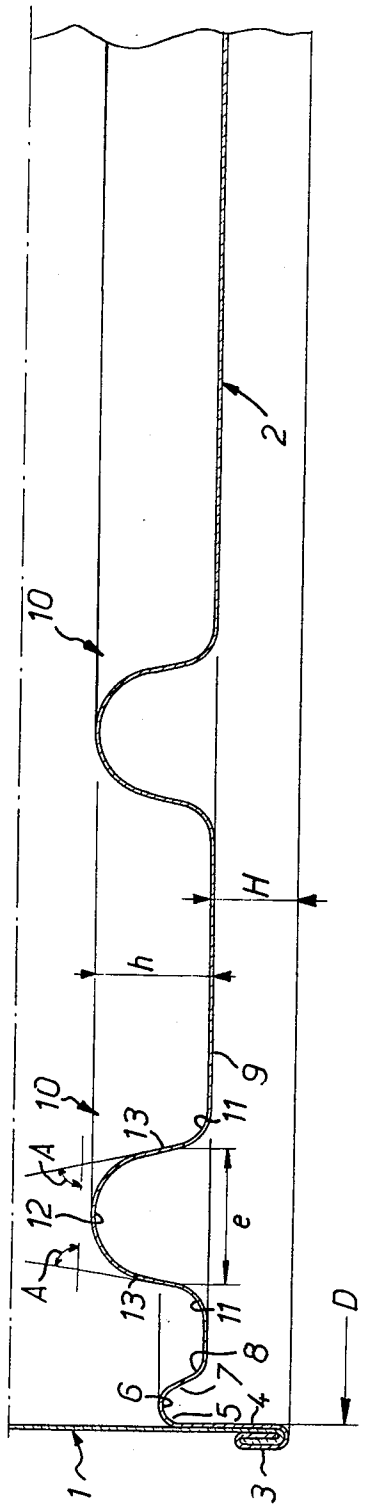
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FIG. 2

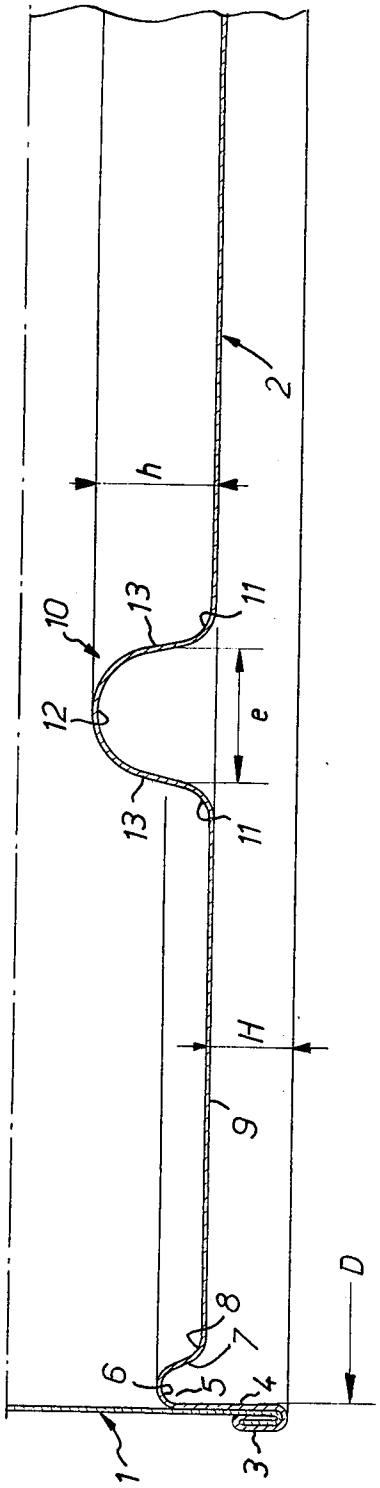
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FIG. 3

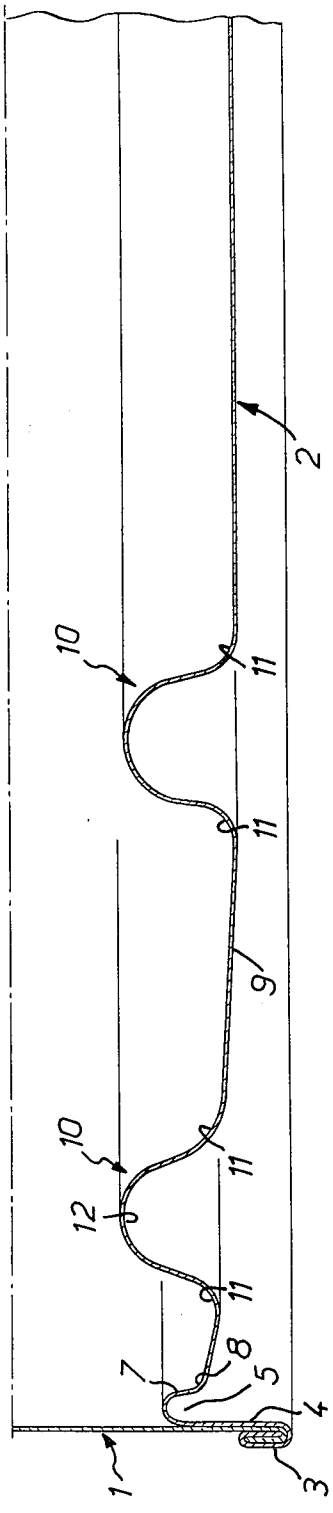


FIG. 4

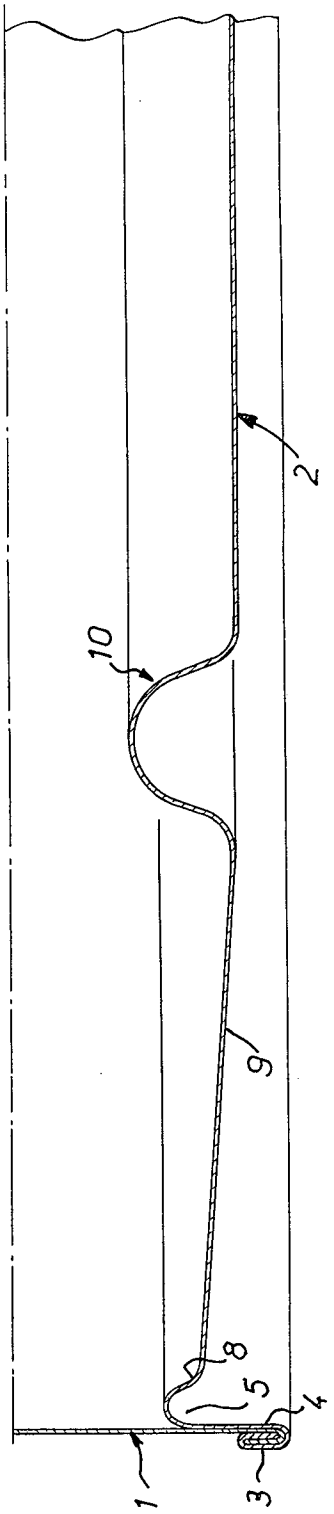


FIG. 5

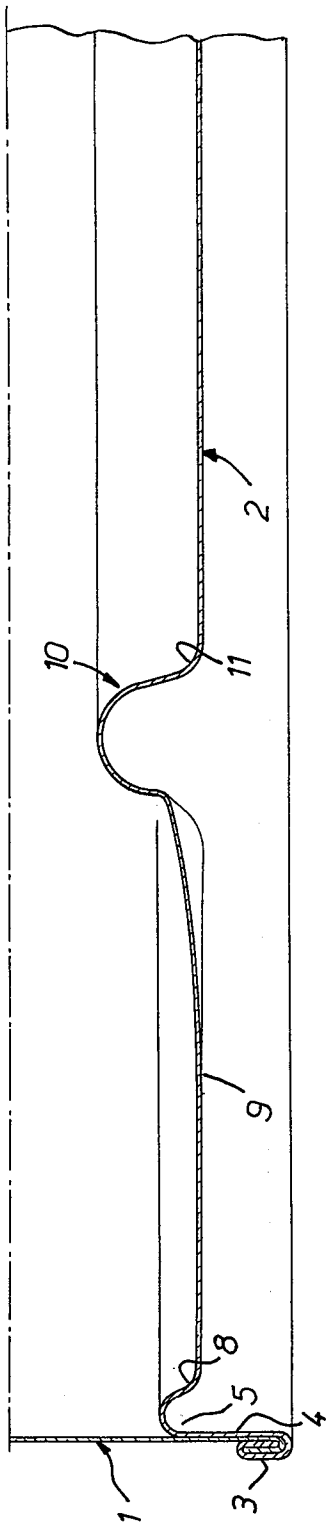
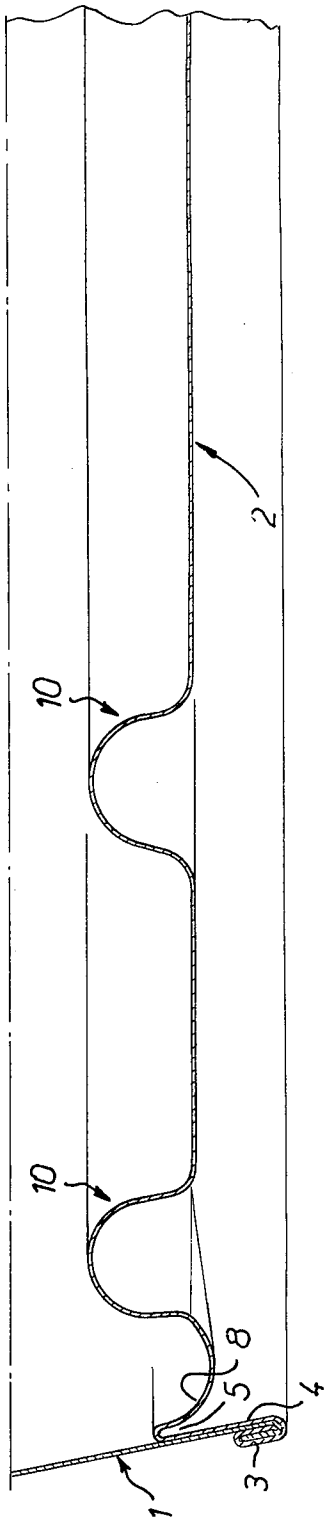


FIG. 6



END CLOSURES FOR METAL DRUMS

The present invention concerns in general metal containers, such as barrels or drums of a lightweight construction and more particularly end closures joined by seaming or the like to the cylindrical body of such a barrel or drum.

The end closure of a metal drum or barrel is low strength zone because of the narrow gauge of the sheet metal forming the same.

The end closures of metal barrels or drums are severely tried by the transportation and handling of the barrels or drums as well as by the variations in temperature to which they are subject during transportation and even during storage.

The end closure of a loaded drum transported in upright position is subject to static forces corresponding to the contents of the drum and dynamic forces of vibration due to the acceleration and deceleration of the mass caused by bumpiness in the road, along rails or other path of transportation.

Further, temperature changes effect changes in vapour pressures and therefore internal pressures which may be great depending on the nature of the product stored in the drum.

Further, the stocks received in the course of successive handling either directly on an end closure or laterally along the zone connecting the end closure and the container body cause deformations developing from localised stresses.

The combinations of the conditions to which the end enclosures are subject may bring about large deformations causing folds or weakened zones which often result in leaks when fatigued.

In practice conventional end closures of thin sheet metal hardly withstand the various trials of use as well as European and international strength test standards.

Various methods have been proposed for reinforcing the weak portions of the end closure, particularly along the periphery, for example by joining a reinforcing ring thereto.

These methods have their problems such as increasing the weight of the container, complicating manufacture and assembly which always increases the production cost, particularly in the case reinforcing rings.

It has also been proposed to make the end closures very flexible so that after being deformed it comes in contact with the surface on which it is supported. In this case the possibility of damaging the end closures is very much increased owing to supporting surface irregularities, stones, or other objects which may be present on the surface.

The present invention aims at overcoming these drawbacks by means of an end closure construction adapted to effected with a minimum of sheet metal of standard quality and having a strength enabling it to support without being damaged the inevitable shocks and deformations caused by handling, vibration and climatic conditions to which the drum provided with such an end closure may be subjected during transportation or storage.

To this end, a more particular aim of the invention consists in a thin sheet metal end closure of a particular shape and nature so as to be of a strength at least as great as conventional end closures of much greater metal thickness.

A further aim of the present invention is a metal drum or barrel having such an end closure.

The invention consists in an end closure for a metal drum or barrel with a cylindrical body or the like comprising a cylindrical peripheral wall adapted to be fitted in the said body and fixed thereto, for example by seaming a substantially planar lateral wall axially offset relative to the free edge of the peripheral wall a distance called inset depth, the peripheral wall is joined to the lateral wall by a shallow channel with a rounded closed end called a turnover groove followed by a connecting fillet, the said lateral wall having at least one channel whose height and width is at least twice as great as that of the turnover channel called a stiffening channel of rounded U-shaped profile projecting towards the interior of the drum when the end closure is in place thereon.

It will be easily understood that the number of stiffening channels will be a function of the diameter of the drum and the thickness of the sheet metal.

Preferably with a diameter in the order of 600 mm there is a single stiffening channel for an end closure of at least 8/**10** mm sheet metal and two similar stiffening channels for less than 8/**10** mm sheet metal.

In any case experience shows that such stiffening channels considerably reinforce the end closure because of their large axial inertia while at the same time offer the possibility of lateral deformation by changes in their width.

Very rigorous tests have shown that for a great internal pressure resulting from forces applied to the end closure, very much greater than those encountered in use, the stiffening channels opened outwardly and therefore increased in width and nearly totally disappeared when the test was pushed to the limit of damaging the end closure.

In any case, it is possible to attribute to the construction according to the invention the following principal advantages which have been observed:

1. complete elimination of the formation of the folds at the periphery of the end closure owing to the small turnover channel, such folds generating cracks was always noted on conventional end closures;

2. Large inertia of the deeper stiffening channel limit the bending of the end closure while allowing at a certain pressure level a natural deformation of the end closure;

3. Absorption of shocks without damage whether they are applied directly on the end closure of laterally along the joining the end closure with the cylindrical body.

The features and advantages of the invention will be brought out in the description which follows and made by way of example with reference to the accompanying schematic drawings, in which:

FIG. **1** is a partial view in axial section of an embodiment of the end closure according to the invention fixed to the body of a drum;;

FIG. **2** is a view similar to FIG. **1** and concerns an alternative embodiment;

FIGS. **3** and **4** are similar to FIGS. **1** and **2** respectively and illustrate deformation of the end closure under load conditions;

FIG. **5** relates to an end closure shown in FIG. **2** schematically illustrating the shape of a stiffening channel following a shock applied to the turnover channel of the stiffening channel; the joining

FIG. 6 relates to the end closure in FIG. 1 and schematically illustrates the shape of the turnover channel and the neighboring stiffening channel when a lateral shock is applied to the adjoining zone of the drum.

According to the embodiments illustrated in the accompanying drawings the end closure associated with a drum or barrel comprises in the usual manner a cylindrical body **1**, a bottom end closure **2** and a top end closure or cover **2** identical to the bottom end closure provided with orifices (not shown).

The body may be formed by a conventional sleeve or tubular section with rolling beads, a tubular section with successive corrugations or expansion zones or a tubular section of an entirely different shape. The end closure may be applied to any drum or barrel body irrespective of its shape.

The end closure **2** illustrated is joined to the body **1** by a seam **3** but may be joined to the latter by any other means. In any case the end closure **2** comprises radially inwardly of the seam **3** a cylindrical peripheral wall **4** having a diameter D adapted to be fittingly received in the body **1** of the drum or the barrel. The peripheral wall **4** is connected to a small bead called a turnover channel with a rounded end **6.**

A slightly inclined wall **7** is connected to the turnover channel **5** and is followed radially inwardly by a connecting fillet connecting the main end wall **9** of the end closure.

The main end wall or lateral wall **9** is substantially planar and axially offset relative to the free edge of the peripheral wall **4** by a distance H called and inset distance.

The lateral wall **9** comprises at least one channel **10** having a width *e* and a height *h* very much greater than those of the turnover channel **5** (the dimensions of the turnover channel and the radius of its closed end is chosen as small as possible within the limits of the working of the sheet metal of the end closure).

Such a channel **10** will be called hereinafter a stiffening corrugation and has a substantially inverted U-shaped profile in cross section with slightly divergent legs.

In the embodiment of FIG. 1 which is particularly suitable for end closures having a diameter of approximately 600 mm of less than 8/**10** mm sheet metal, for example 6/**10** mm, two successive similar stiffening channels are provided.

In the embodiment of FIG. 2 which is more particularly suited for end closures having a diameter of the order of 600 mm of at least 8/**10** mm sheet metal, a single stiffening channel **10** is provided which experience has shown to be sufficient ; it goes without saying, however, that such end closures could also have two stiffening corrugations.

In all cases the stiffening channel **10** projects axially from the lateral wall **9** towards the interior of the drum, the stiffening channel(s) **10** are disposed in the outer peripheral zone of the end closure comprising one-third of the area, in other words the channel(s) are disposed in an annular zone which extends from the peripheral wall **4** to an imaginery circle disposed at a distance of 1/**6** the diameter D of the end closure. Stresses are in practice found in this zone.

Each stiffening channel **10** has in cross section a generally semi-circular profile with rounded closed end **12** connected to the lateral wall **9** by two slightly divergent panels **13** each of which is followed by a connecting fillet **11.**

The angle A formed by a wall **13** relative to the general plane of the lateral wall or panel **9** is as close to 90° as possible; this angle provides the channel **10** with a height *h* measured from the lateral wall **9** with a maximum inertia.

Practical experience in stamping has shown that in such a case it is not possible to have the walls of such a channnel strictly at right angles, a certain degree of obliqueness is always present, but this must be as small as possible.

The width *e* of a channel **10** taken between the connecting fillets **11** is determined so that the relationship *h*/*e* is greater than or equal to 0.75.

The inertia of such a channel is a function of the value of its height *h*.

Since this inertia is a function of the diameter of the end closure, the load, the maximum acceptable bending under this load on which acceleration and deceleration of the contents react in response to vibrations and rough handling, the height *h* must be determined so that the end closure never comes in contact with the surface on which the drum is supported. It must also take into account the practical and economic considerations of stamping of standard quality sheet metal.

Preferably the height *h* of the stiffening channel **10** is at least equal to 2 % of the diameter D of the peripheral wall **4.** For example for a diameter of 600 mm, this height *h* will be near 20 mm.

More precisely, the following table indicates in millimetres for a diameter of 600 mm the height, width and radius of curvature which are satisfactory for 8/**10** mm sheet metal with one stiffening channel or 6/**10** mm sheet metal with two stiffening channels.

	stiffening channel	turnover channel
height	17	7
width	21-5	6-8
radius of curvature	10	25-3

It is noted that the height and the width of the stiffening channel are at least twice as great as the height and width respectively of the turnover channel.

The values specified above are given merely as illustrative and may vary in a very wide range and should not be considered as limiting the scope of the invention.

FIGS. 3 and 4 illustrate the reaction of such end closures under the effect of large growing forces directed towards the exterior.

It is noted that in the two cases a slight reduction of the peripheral turnover channel **5** occurs.

In the case of the end closure with two channels of no more than 6/**10** mm sheet metal, the portion located between the centre and the innermost stiffening channel **10** remains substantially planar whereas the annular zone between the outermost stiffening channel **10** and the turnover channel **5** is deformed progressively into a truncated conical effecting the outermost stiffening channel **10** and causing it to deform.

This extreme condition has never been encountered in use.

In normal use, the maximum bending of the end closure is at most one-third depth of the inset depth.

If the above described experiment is continued it is found that when the outermost stiffening channel **10** is sufficiently deformed, the innermost stiffening channel which during the initial deformation of the outermost channel remained unchanged begins to open progressively.

In continuing this test it is possible to FIGS. completely eliminate the two channels, though this, of course, does not occur during use.

With an end closure having a single channel, FIG. **2** and **4**, that is for a end closure of at least 8/**10** mm sheet metal, owing to the greater thickness of the sheet metal the deformation only appears for very large forces according to an identical process with an end closure having two channels.

The connecting fillet **8** which is the first subject to deformation opens progressively carrying with it the small peripheral turnover channel **5.**

The present invention is of course not limited by the embodiments illustrated and described herein but includes all variations, alternatives and modification within the scope of the appending claims.

What is claimed is:

1. A metal drum comprising a cylindrical body having steel metal end closures at both ends thereof, each said clousure having a cylindrical wall that fits inside the corresponding end of the cylindrical body of the drum, each said closure comprising a wall perpendicular to the axis of the cylindrical body of the drum and spaced axially inwardly from an outer edge of the cylindrical body, each said closure having a small downwardly opening rounded turnover channel interconnecting said cylindrical wall and said perpendicular wall, a connecting fillet in each end closure radially inwardly following said turnover channel, said perpendicular wall having at least one protective expansion zone projecting only inwardly into the cylindrical body of the drum in a direction opposite the associated outer edge of the cylindrical body of the drum, said at least one expansion zone comprising an inverted U-shaped expansible stiffening channel both the width and the height of which are very much greater than those of the said turnover channel, and said perpendicular wall being flat apart from said turnover channel and fillet and said at least one U-shaped stiffening channel.

2. A metal drum according to claim **1,** wherein when the end closures are of 8/**10** mm sheet metal and the diameter of the cylindrical body 600 mm, two expansion zones are provided.

3. A metal drum according to claim **2,** wherein said protective expansion zone which is nearest the center of the closure is substantially closer to the periphery of the closure than to the center of the closure.

4. A metal drum according to claim **1,** wherein each U-shaped expansible stiffening channel has a semicircular portion joined to said perpendicular wall by two slightly divergent panels and by connecting fillets.

5. A metal drum according to claim **4,** wherein each of the said divergent panels makes an angle approaching a right angle with said perpendicular wall.

6. A metal drum according to claim **4,** wherein the width of each U-shaped expansible stiffening channel determined at the points the connecting fillets meet perpendicular wall is at least 0.75 of the height of said U-shaped expansible stiffening channel.

7. A metal drum according to claim **1,** wherein the height of each U-shaped expansible stiffening channel measured from said perpendicular wall of the end closure is equal to at least 2% of the diameter of the cylindrical wall of the end closure.

8. A metal drum according to claim **1,** wherein the distance said perpendicular wall drum is axially offset relative to the free outer edge of cylindrical body of the drum is such that when the drum is loaded and is disposed upright on a supporting surface, the said perpendicular wall is always maintained out of contact with the supporting surface.

9. A metal drum according to claim **1,** wherein the radius of the small turnover channel is reduced to a minimum for the material forming the corresponding end closure.

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