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(54) **Can-wall with beads and can**

Behälterwand mit Bördelrand sowie Behälter

Paroi de conteneur avec des bourrelets et conteneur

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Description

[0001] The invention relates to a can-wall with beads according to the preamble of claim 1 and a can comprising such a can wall.

[0002] Such a can-wall is known from practice.

[0003] A can provided with a base and lid must fulfil certain requirements in terms of axial and radial strength. In its unfilled state the can must be able without collapsing to withstand an axial loading by a force of for example 2000 N, and in its filled state a radial loading associated with an overpressure from the outside of for example 1.2 bars. In order to fulfil these requirements of stiffness and strength, the known can is provided with beads on its can-wall. The beads provide increased axial and, to a greater extent, radial strength. In this respect reference is made to GB 22,245 which discloses a metal barrel having a casing provided along its complete length with closely arranged circumferential corrugations for stiffening purposes.

[0004] The search to reduce yet further the material quantity and the weight of the can by increasingly reducing the material thickness confronts a limit whereby the above named requirements of stiffness and strength can no longer be fulfilled.

[0005] In accordance with the invention it is now possible with smaller material thickness by modifications to the bead geometry of the can-wall to achieve the same strength as previously, and with the same material thickness to create a better can in terms of stiffness and/or strength.

[0006] In accordance with the invention the can-wall is provided to that end with a bead geometry which satisfies the conditions stated in claim 1.

[0007] Of course in principle preventing permanent deformation in the can-wall under a given loading is achieved by selecting the correct material thickness and the correct material properties. But it is possible in accordance with the invention to contribute to this to a greater extent than is known by a correct selection of the bead geometry. Apart from the undulating pattern of the bead geometry not having to display any discontinuities, favourable parameters determining the bead geometry in accordance with the invention are the following:

- greater bead depth V_i
- greater bead radius of curvature R_i
- greater beaded area.

[0008] These parameters are not independent however. It is clear that in the physical embodiment in a can, an infinitely deeper bead depth is associated with a small bead radius of curvature.

[0009] In accordance with the invention the optimum for the bead b_x most susceptible to collapsing is to select the smallest possible yet still acceptable bead length λ_x, and to give the bead length elsewhere, depending on the lesser susceptibility to collapsing there, a larger bead length $\lambda_i > \lambda_x$.

[0010] Preferably the bead length increases with the distance to the bead b_x most susceptible to collapsing.

[0011] This optimizes the material consumption in relation to the stiffness/strength of the can. More preferably this is achieved by allowing the bead length to run off with the susceptibility to collapsing of the can-wall. The invention is also embodied in a can-wall with beads, which can-wall, as seen in a cross-section perpendicular to the beads, displays a profile that, seen in one direction, comprises in succession a first joining part for joining onto a base part, a first unbeaded part, a beaded part with n beads b_i, i = 1, ..., n, each bead comprising a bead valley and a bead peak which extend over a projected length λ_i and include a bead height V_i perpendicular to them between the top of the bead peak and the bottom of the bead valley, a second unbeaded part and a second joining part for joining onto a lid part, whereby the extremities of the bead valley and bead peak comprise a segment of a circle with radius of curvature R_i, whereby for at least bead b_x of the profile $R_x \cong (\lambda_x^2 + 4 V_x^2) / 16 V_x$. The bead geometry is then in itself optimal.

[0012] For a good stiffness and strength of the can-wall it is preferable if it at least in the position of bead b_x, $1 < x < n$, where the can-wall in the state whereby the base part and lid part join onto them is the most susceptible to deformation by a radial loading, λ_i, $i \neq x > \lambda_x$ and the extremities of bead valley and bead peak comprise a segment of a circle with radius of curvature R_i and that for at least bead b_x of the profile $R_x \cong (\lambda_x^2 + 4 V_x^2) / 16 V_x$.

[0013] This achieves the effect that maximum stiffness and strength occur with minimum material loss, certainly where each bead b_i fulfils the proposed geometric proportions. In practice better cans are made in terms of stiffness and strength if the can-wall is characterized in that for each bead b_i of the profile $R_i \cong (\lambda_i^2 + 4 V_i^2) / 16 V_i$ applies.

[0014] In practice a good distribution of the fluctuation of the bead length is found with a change factor c, d of 1.05 or more.

[0015] While in part the requirements of stiffness and strength are set with a view to the withstanding of loadings of the (unfilled) can-wall, the invention is also embodied in the finished (filled) can. After filling, the axial stiffness and strength of the can are no longer critical, but a radial loading from the outside is critical.

[0016] The invention will now be illustrated by reference to the drawing in which

Fig. 1 shows lines of constant can weight in a three-part steel can with different thicknesses for can-wall and base/lid.

Fig. 2 shows a collapse loading diagram for a three-part can with different thicknesses of can-wall.

Fig. 3 gives the meanings of the parameters λ, t, R, L and V.

Fig. 4 shows a collapse loading diagram for a three-part can with different top lengths L.
Fig. 5 shows a collapse loading diagram for a three-part can of different qualities of packaging steel.
Fig. 6 shows a collapse loading diagram for a three-part can with different numbers of beads N.
Fig. 7 indicates graphically how the optimum bead geometry is found in accordance with the invention.
Fig. 8 shows an impression of a can with 24 equidistant beads whereby the beads have the optimum geometry in accordance with the invention.
Fig. 9 shows an impression of a can with 16 beads whereby, besides each having an optimum geometry, the beads in accordance with the invention also have a falling bead length.

[0017] In Fig. 1 the relationship between the thickness of the base and the lid, is expressed in mm vertically, and the thickness of the can-wall, is expressed in mm horizontally with the weight of a can Ø 73 x 100 (mm x mm) indicated by lines of constant weight of 40, 45, 50, 55, 60 g. For such a can approximately 2/3 of the weight of the can is formed by the can-wall and 1/3 by lid and base. Therefore it is certainly worthwhile to reduce the thickness of the can-wall if it is desired to reduce the weight of a can as indicated by the arrow which is drawn from a starting point selected here as reference point for the known can.

[0018] Figs. 2, 4, 5 and 6 always show horizontally the radial strength of a can-wall in bars, and vertically the axial strength in N. Each of the collapse diagrams indicates with a thick line 2060 N as critical axial strength, and 1.2 bars as critical radial strength. In the quadrant at the top right the can-wall geometry involved fulfils requirements.

[0019] Fig. 2 shows what the important effect is of changing the thickness of the can-wall t and the bead height V.

[0020] Here the number of beads was N = 20, the bead length λ = 3.22 mm, the top length (see Fig. 3) L = 0 and the material quality DR 580 packaging steel.

[0021] Fig. 3 indicates with λ the bead length, with t the thickness of the can-wall, with R the radius of curvature with which the bead peak and bead valley are entered and left respectively, with L the top length and with V the bead height.

[0022] Fig. 4 shows that in accordance with the invention the top length L = 0 must be selected.

[0023] Fig. 5 shows that preference is given to use of packaging steel with a quality indicated as DR 580.

[0024] Fig. 6 shows that the number of beads N must preferably be great, and the bead height V relatively small. This applies for a can-wall in unassembled state, that is one which lacks support from base and lid.

[0025] Fig. 7 shows schematically how λ, V and R are related in the case of a relatively smooth bead (left) and a sharp bead (right).

[0026] Fig. 8 shows an impression of a can-wall with a relatively large number of beads N = 24 and a relatively small bead length λ = 2.68 mm, whereby the bead geometry fulfils the relationship named earlier between λ, V and R: V = 0.35 mm, R = 1.58 mm.

[0027] By selecting V between 0.3 and 0.4 mm the can-wall strength is the least dependent on variations in the bead height which always occur in the practice of manufacturing.

[0028] Finally Fig. 9 shows an impression of a can-wall with 16 beads N = 16 whereby λ falls off by a factor c = d = 1.11323 such that λ_x = 2.68 and $\lambda_i = \lambda_{16}$ = 5.68 and V = 0.35 mm and R_i fulfils the relationship named earlier.

[0029] Particularly in this last can-wall an optimum compromise is found in terms of stiffness and strength with in addition a surprisingly new appearance for a finished can.

Claims

1. Can-wall comprising in succession a first joining part for joining onto a base part, a first unbeaded part, a beaded part, a second unbeaded part and a second joining part for joining onto a lid part, wherein the beaded part has n consecutively numbered beads bi, i = 1, ..,x,..., n, each bead comprising a bead valley and a bead peak which extend over a projected length λ_i **characterized in that** for the bead bx most susceptible to collapsing a relatively small bead length is selected and **in that** the bead length elsewhere depending on the lesser susceptibility to collapsing there, is given a larger bead length $\lambda_{i,i\neq x} > \lambda_x$.

2. Can-wall in accordance with Claim 1 **characterized in that** $\lambda_i > \lambda_{i+1}$ for i = 1, ..., x-1 and $\lambda_{i+1} > \lambda_i$ for i = x + 1, ..., n.

3. Can-wall in accordance with Claim 1 or 2 **characterized in that** $\lambda_i = d\,\lambda_{i+1}$ for i = 1, ..., x-1 and $\lambda_{i+1} \cong c\,\lambda_i$ for i = x + 1, ..., n, where d and c are factors which are determined by the fluctuation of the susceptibility to deformation by the radial loading over the beaded part i < x and i ≥x, wherein c ≅ d ≥ 1.05.

4. Can-wall in accordance with any of the preceding claims, **characterized in that** the extremities of the bead valley and bead peak comprise a segment of a circle with a radius of curvature R_i, and **in that** for at least bead b_x, $R_x \cong (\lambda_x^2 + 4V_x^2) / 16V_x$, wherein V_i is the bead height between the top of the bead peak and the bottom of the bead valley.

5. Can-wall in accordance with Claim 4 **characterized in that** for each bead b_i, $R_i \cong (\lambda_i^2 + 4V_i^2) / 16V_i$ applies.

6. Can comprising a can-wall in accordance with one of the preceding Claims.

Patentansprüche

1. Dosenwand, die in Aufeinanderfolge aufweist: einen ersten Fügeteil zum Fügen an einen Basisteil, einen ersten Teil ohne Wulst, einen Wulstteil, einen zweiten Teil ohne Wulst und einen zweiten Fügeteil zum Fügen an einen Deckelteil, wobei der Wulstteil n fortlaufend numerierte Wülste b_i hat, i = 1, ..., x, ..., n, wobei jeder Wulst ein Wulsttal und einen Wulstgipfel aufweist, die sich über eine projizierte Länge λ_i erstrecken, **dadurch gekennzeichnet, daß** für den Wulst b_x, der für Einknicken am anfälligsten ist, eine relativ geringe Wulstlänge ausgewählt ist, und daß die Wulstlänge woanders in Abhängigkeit von der geringeren Anfälligkeit für Einknicken dort eine größere Wulstlänge erhält: λ_i, $i \neq x > \lambda_x$.

2. Dosenwand nach Anspruch 1, **dadurch gekennzeichnet, daß** $\lambda_i > \lambda_{i+1}$ für i = 1, ..., x -1 und $\lambda_{i+1} > \lambda_i$ für i = x + 1, ..., n.

3. Dosenwand nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** $\lambda_i \cong d\ \lambda_{i+1}$ für i = 1, ... , x - 1 und $\lambda_{i+1} \cong c\ \lambda_i$ für i = x + 1, ..., n, wo d und c Faktoren sind, die von der Fluktuation der Anfälligkeit gegenüber Verformung durch die radiale Belastung über den Wulstteil i < x und i ≥ x bestimmt sind, wobei c ≅ d ≥ 1,05.

4. Dosenwand nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Extrema des Wulsttales und des Wulstgipfels ein Kreissegment mit einem Krümmungsradius R_i aufweisen, und daß wenigstens für b_x $R_x \cong (\lambda_x^2 + 4V_x^2)/16V_x$, wobei V_i die Wulsthöhe zwischen dem Oberteil des Wulstgipfels und dem Boden des Wulsttales ist.

5. Dosenwand nach Anspruch 4, **dadurch gekennzeichnet, daß** für jeden Wulst b_i gilt: $R_i \cong (\lambda_i^2 + 4V_i^2)/16V_i$.

6. Dose mit einer Dosenwand nach einem der vorhergehenden Ansprüche.

Revendications

1. Paroi de conteneur métallique comprenant, successivement, une première partir d'assemblage pour assembler avec une partie basale, une première partie sans bourrelets, une partie avec bourrelets, une seconde partie sans bourrelets et une seconde partie d'assemblage à assembler avec une partie formant couvercle, dans laquelle la partie à bourrelets comporte n bourrelets successivement numérotés b_i, i = 1, ..,x,..., n, chaque bourrelet comportant un creux de bourrelet et une crête de bourrelet qui s'étendent sur une longueur projetée λi, **caractérisée en ce que**, pour que le bourrelet b^x soit le plus susceptible de s'écraser, une longueur relativement petite des bourrelets est choisie et **en ce qu'**à la longueur des bourrelets, dépendant ailleurs de la moindre susceptibilité à l'écrasement, est donnée une plus grande longueur de bourrelets $\lambda_{i,i\neq x} > \lambda_x$.

2. Paroi de conteneur métallique selon la revendication 1, **caractérisée en ce que** λi > λi + 1 pour i = 1, ..., x-1 et λi + 1 > λi pour i = x + 1, ..., n.

3. Paroi de conteneur métallique selon la revendication 1 ou 2, **caractérisée en ce que** $\lambda i \cong d\ \lambda i+1$ pour i = 1, ..., x-1 et $\lambda i+1 \cong c\ \lambda i$ pour i = x + 1, ..., n, d et c étant des facteurs déterminés par la fluctuation de la tendance à la déformation par les contraintes radiales sur la partie filetée i < x et i ≥ x où c ≅ d ≥ 1,05.

4. Paroi de conteneur métallique selon l'une quelconque des revendications précédentes, **caractérisée en ce que** les extrémités du creux d'un bourrelet et de la crête d'un bourrelet constituent un segment de cercle à rayon de courbure R_i et **en ce que**, au moins pour le bourrelet bx, $Rx \cong (\lambda x^2 + 4Vx^2) / 16Vx$, où Vi désigne la hauteur des bourrelets entre le haut de la crête du bourrelet et le bas du fond du bourrelet.

5. Paroi de conteneur métallique selon la revendication 4, **caractérisée en ce que** pour chaque bourrelet bi s'applique la relation $Ri \cong (\lambda i^2 + 4Vi^2) / 16Vi$.

6. Conteneur métallique comprenant une paroi de container selon l'une quelconque des revendications précédentes.

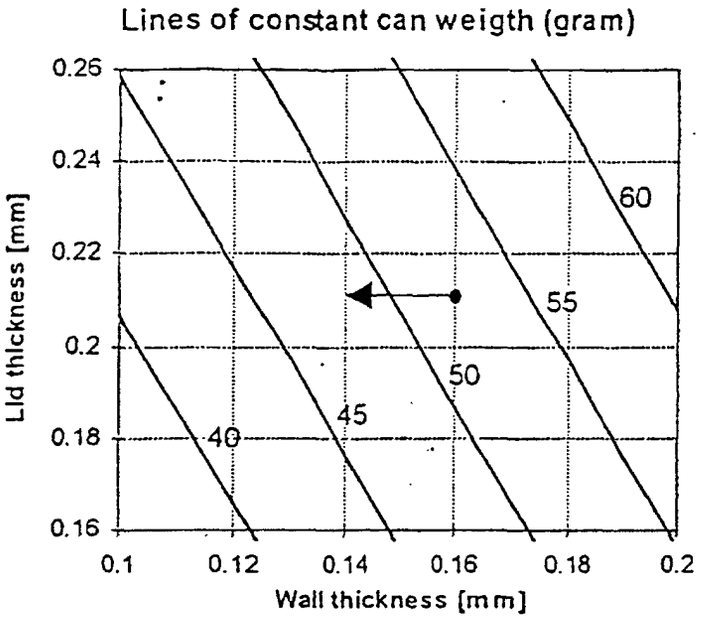

Lines of constant can weigth (gram)
Lid thickness [mm]
0.26
0.24
0.22
0.2
0.18
0.16
0.1
0.12
0.14
0.16
0.18
0.2
Wall thickness [mm]
40
45
50
55
60

Fig. 1

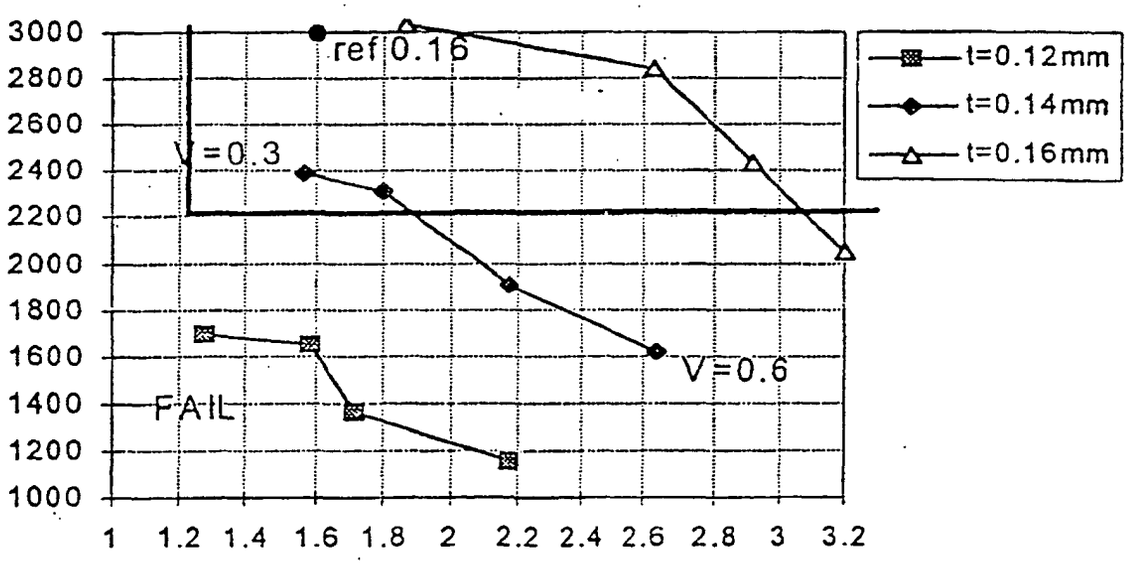

3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
ref 0.16
V=0.3
V=0.6
FAIL
t=0.12mm
t=0.14mm
t=0.16mm

Fig. 2

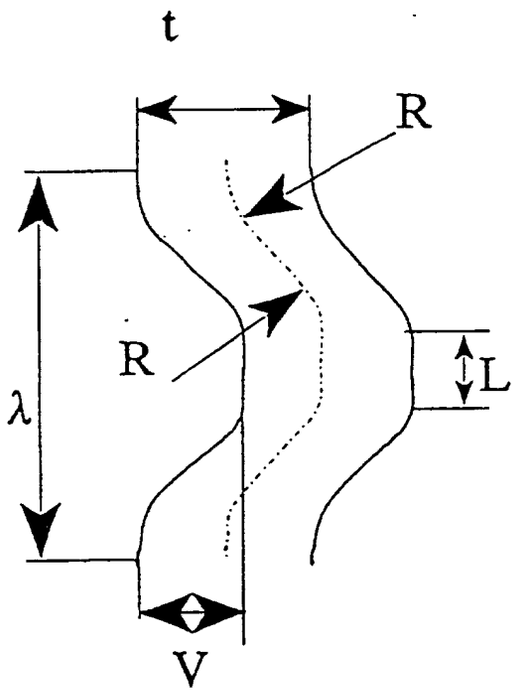


Fig. 3

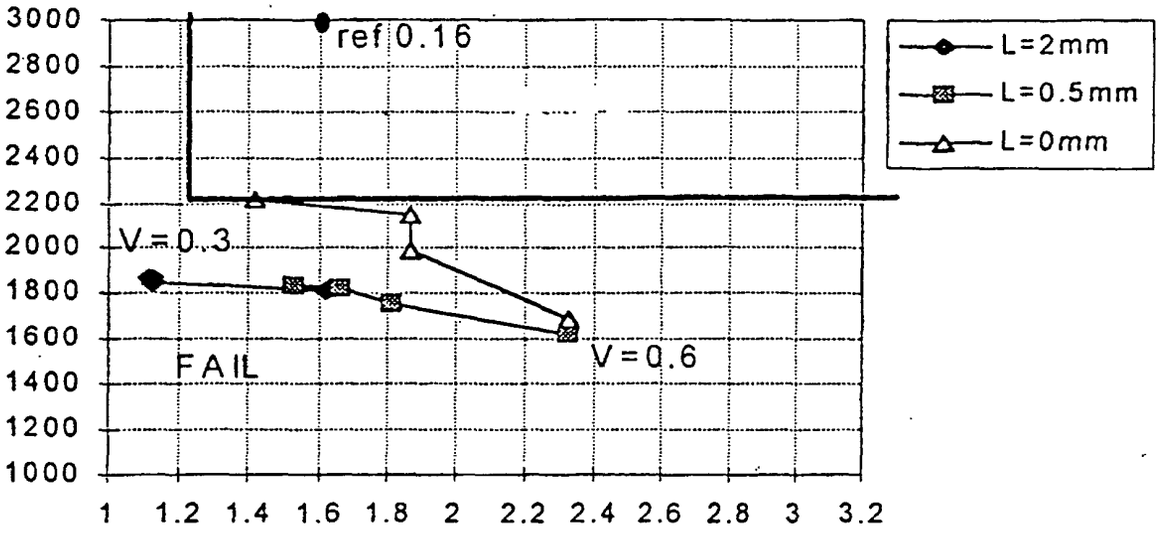

3000
2800
2600
2400
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2000
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1600
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1200
1000
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
ref 0.16
V=0.3
FAIL
V=0.6
L=2mm
L=0.5mm
L=0mm

Fig. 4

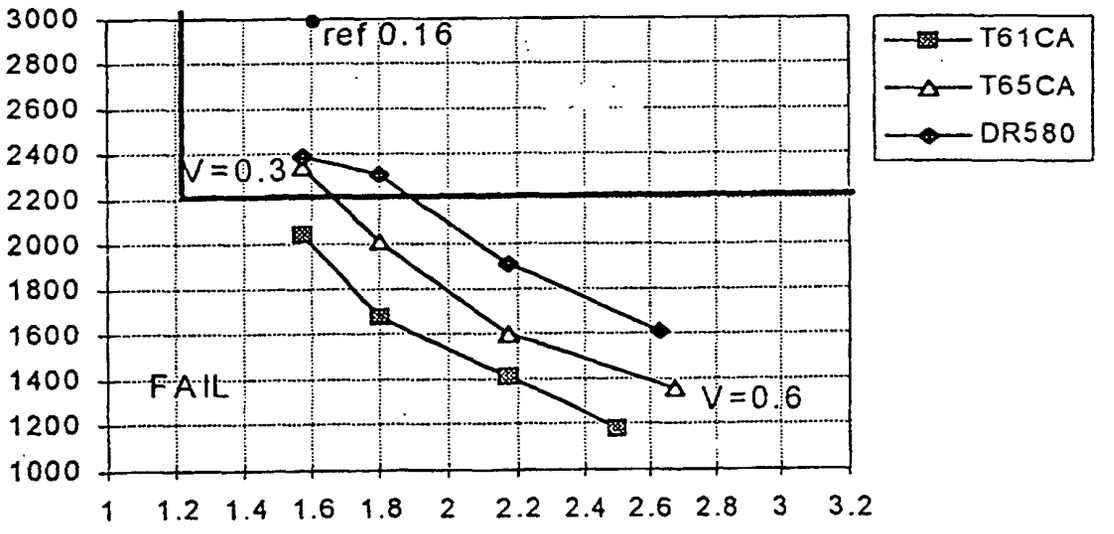

3000
2800
2600
2400
2200
2000
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1600
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1200
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1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
ref 0.16
V=0.3
FAIL
V=0.6
T61CA
T65CA
DR580

Fig. 5

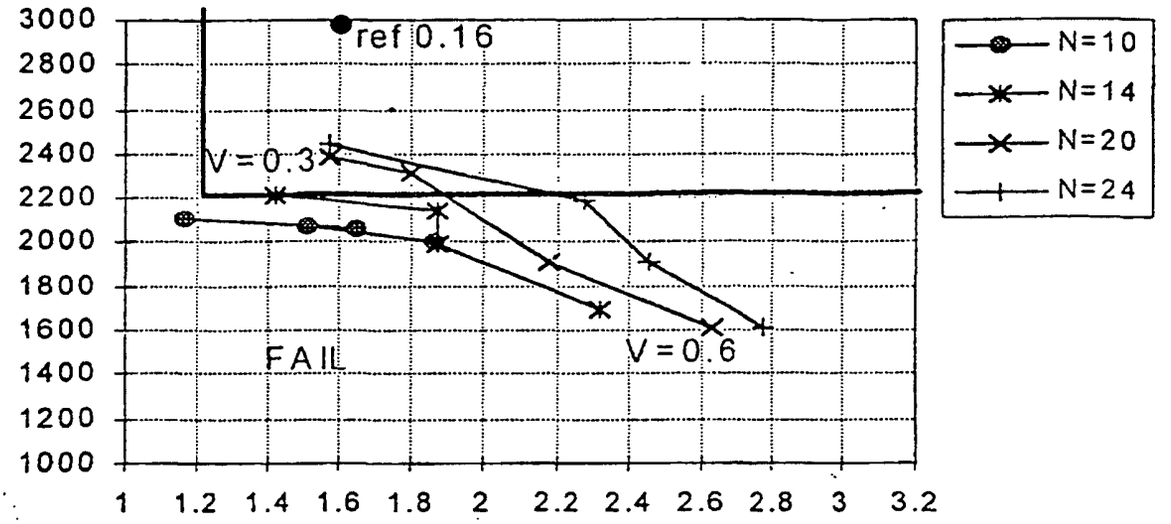

3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
ref 0.16
V = 0.3
FAIL
V = 0.6
N=10
N=14
N=20
N=24

Fig. 6

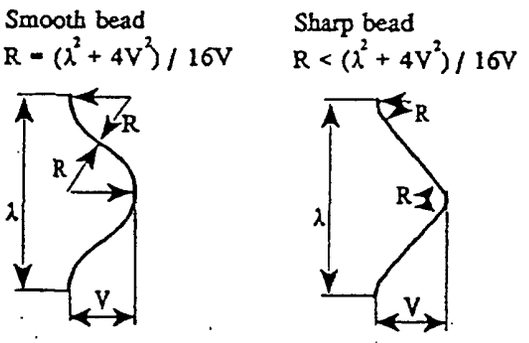

Smooth bead
R = (λ² + 4V²) / 16V
R
R
λ
V
Sharp bead
R < (λ² + 4V²) / 16V
R
R
λ
V

Fig. 7

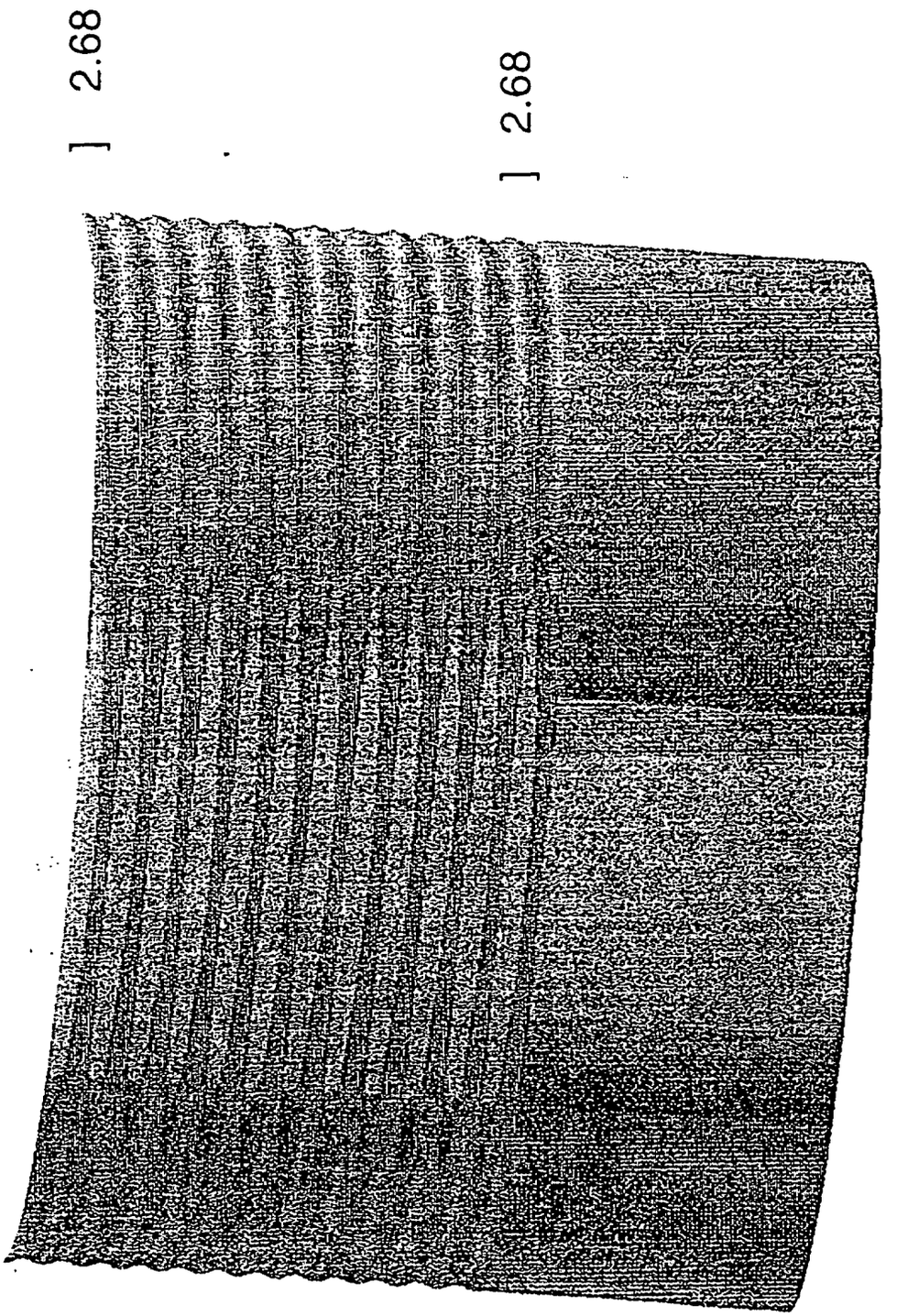


Fig. 8

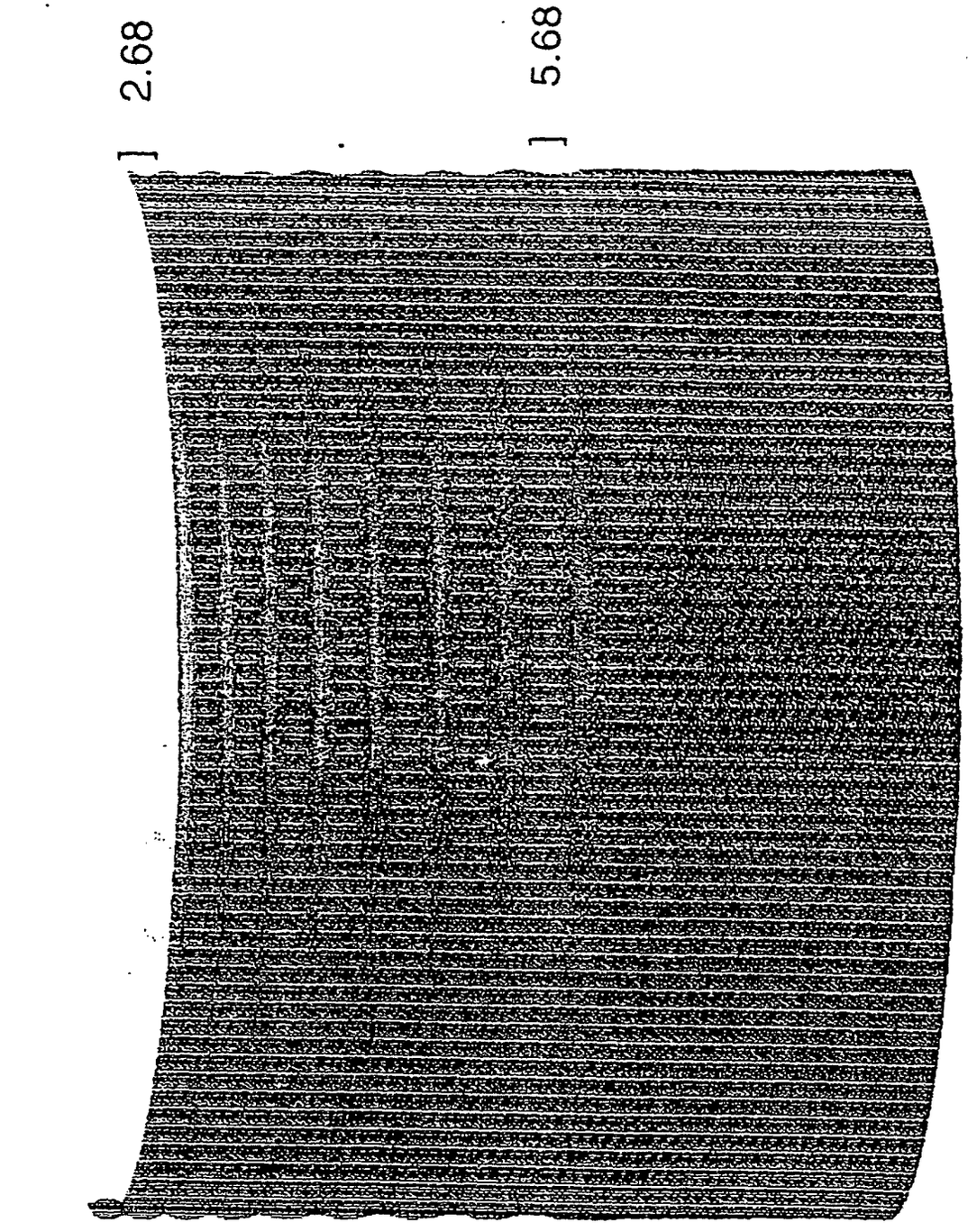


Fig. 9