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(54) **HYGIENIC SYSTEM FOR OPENING AND CLOSING CANS**

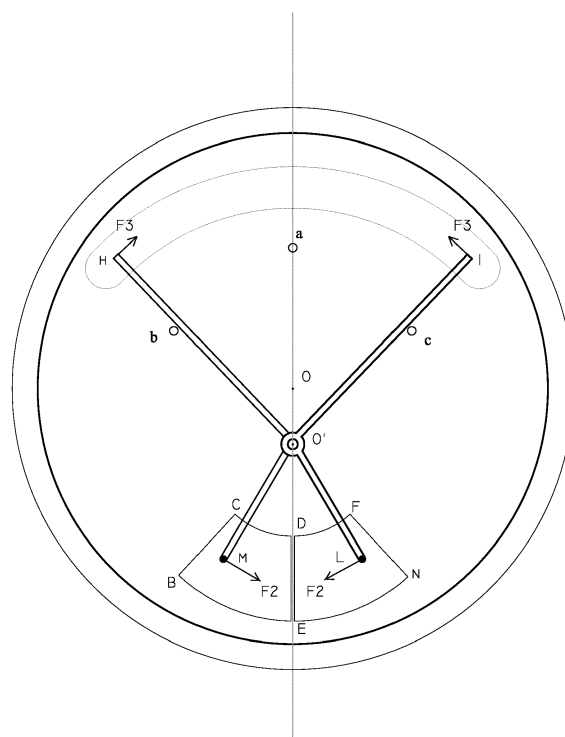
(57) A system for opening and closing tins and cans

(1) comprising:

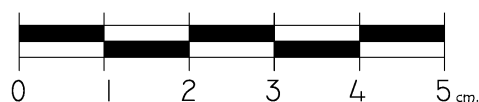
a lid (2) that covers a hollow and cylindrical body;
one or more levers (3) that move one or more portions (4) of said lid (2) over a plan parallel and adjacent to that of said lid (2);

said portions (4) of said lid (2) are delimited by score lines (5), are in relief with respect to said lid (2) and are connected to the resistance arm of the corresponding levers (3) such that the movement of the effort arm of the corresponding levers (3) moves laterally said portions (4) of said lid (2) externally to the tins and cans avoiding that said portions (4) come in touch with the content of the tins and cans.

FIGURE I



METRIC SCALE



Description

[0001] Can opening has undergone several transformations over the years. The first had a cone lid covered by a cap, but in around the 1960s the first can with a flat, non-machined lid was invented to replace the cone lid. This flat lid was perforated by a lever punch in two opposite points along the diameter: one for drinking and the other for letting air flow in. It was made of aluminium since it is more compatible with beverages than the tinplate used at the time for cans containing food products. Afterwards the pull-tab was introduced. Its name derives from its particular easy-pull shape. With this system, a ring and a zone previously scored to make detaching it easier, were riveted together in the centre of the lid to become a single body. When the ring was pulled upwards, the can could be opened by totally tearing off the pull-tab. This method was simple, convenient, low cost and hygienically correct, but it had one big defect: the pull-tabs with their sharp edges were dangerous and were often thrown into the environment.

[0002] This method was altered in around the year 2000 and is the one still in use today. The pull-tab is not scored along its entire perimeter. It is instead left intact around the riveted zone, while the metal ring serves as the lever. When raising the ring, downward pressure is exerted and the pull-tab is forced down into the liquid contained in the can. What results is that the microbes and bacteria on it are inevitably transferred to the beverage. This system has often been highly criticised owing to its lack of hygiene. The advantage of the invention presented here is that the hygienic risk is eliminated by using simple leverage that moves the pull-tab to the side so that contact with the beverage is prevented.

[0003] The current state of the art has not changed over the last 15 years, although a patent application (WO/2009/051409) for a new opening system was filed in 2009. This opening system makes use of a lever whose resistance arm sets a mechanism that pushes the pull-tab inside the can into motion with a rotary movement. Therefore, the pull-tab in any case dips into the liquid inside the can in this new opening system as well, without solving the problem of poor hygiene.

[0004] Unlike the opening, industry has never solved the problem of re-closing cans. That is perhaps because it is convinced that the beverage has to be drunk in a short while after it is opened. The invention proposes simple and hygienic opening and closing exploiting the gain of a lever. Once the part to which it is securely riveted is snipped off, the lever moves it to the side by sliding it along the exterior of the lid.

[0005] Beverage cans today consist of just two components: the body and the lid. The first is made by drawing, and the second by forming, which are then followed by special machining operations. The two components are assembled by folded seaming that makes the entire can watertight. Leaving aside the body, which is not altered by the invention, we can concentrate on the characteristics that are required of a lid:

1. Have an opening and re-closing that are simple and hygienic.
2. Withstand internal pressure.
3. Make the seam with the can body watertight until it is opened.
4. Contribute toward stiffening the structure of the can.

[0006] The first point is the objective of the invention presented herein. As for the second point, a few observations have to be made below because this aspect will condition the thicknesses of the lid and the strength needed to open it. As for the third and fourth points, the invention does not introduce any modification, so the solidity and coupling by folded seaming are not altered. However, if necessary, stiffening ribs can be made on the lid during forming.

[0007] The second point, to be analysed paying closer attention, particularly concerns beverages subject to fermentation. Taking, for example, beer as an example, this process converts carbohydrates into alcohol and carbon dioxide by using yeasts and bacteria. In particular conditions, fermentation might continue in the can (natural or intentional since the addition carbon dioxide that develops makes the beverage more agreeable), and this creates overpressure. For example, in its Dispatch no. 1/1/0714/COM dated 25/02/2000, the Italian Ministry of Defence issued the specifications for canned beer supplies to the Armed Forces. Among the other conditions, it ordered that the cans must withstand an internal overpressure of 6 atm. Further on we will see how we can allow for this value.

[0008] To explain how the system operates, we will consider the lever system shown in Figure 1 as an example. Here the pull-tab is scored in two symmetric parts during factory machining. The mechanism that moves the two half-pull-tabs to the side is a double class 1 lever with fulcrum not in centre O of the can, but in a centre O' so that the resistance arms are shorter than the effort arms. However, this system does not work like a pair of scissors (which are also a class 1 lever formed by joining two levers pivoted together). Instead, it works like pliers for external circlips, in which the resistance arms spread out when the effort arms close.

[0009] Again referring to Figure 1, note that the can is in the closing position and pull-tab CFNB is divided by the scoring into two identical parts, CDEB and DFNE, which must move - one to the right and one to the left - by levers HO'M and IO'L. The system is symmetric and affected by two measurements: the distance between O and O' and angle HO'O (equal to angle IOO'). Let's consider only the left part since its results are the same as those of the right part. Note the following:

1) Diameters being equal, the distance between O and O' determines lever gain G because it influences the ratio between the effort arm and resistance arm lengths. As the distance between O and O' increases, the length of the effort arm increases and the length of the resistance arm decreases, thus improving gain G.

2) In order to totally release the opening of the pull-tab, angle HO'O must be greater than angle CO'D, regardless of the position of the rivet in M that firmly connects the resistance arm to the half-pull-tab. To increase angle HO'O, it suffices to decrease angle HO'M.

[0010] As an example, further assumptions are made hereunder only in order to realize the forces explain the forces involved. It is emphasised that the invention is not bound to these dimensions, values and shapes selected only to simplify calculations. Please remember that the invention covers the concept, and not the specific forms for making it. Again referring to Figure 1, let us assume the following:

1) Pull-tab BCFN is formed by a 60° sector of the circular crown identified by radii O'D and O'E and falling between the two segments CB and FN. Moreover, the pull-tab is further divided into two parts, BCDE and EDFN, whose perimeters are marked by scoring that decreases the thickness up to a valued called s.

2) Half-pull-tab BCDE is moved laterally to the left by lever HO'M hinged in O'. H is the point where motive force F₃ (exerted by the fingers) is applied, while M is the point where resisting force F₂ (due to the resistance to shearing stress of the half-pull-tab) is applied.

3) The overpressure, Δp, is 6.00 atm, equivalent to 0.608 N/mm².

4) The material of the cans is 99.99% aluminium (even if this is not true since aluminium is used in an alloy). In any case, the choice of material does not greatly affect the results, as we will see further on. 99.99% aluminium has an ultimate tensile resistance, σ_r, of 58.9 N/mm² and a shear failure resistance, τ_r, of 47.1 N/mm², which is 80% of the tensile strength. The ratio τ_r/σ_r is a value that varies from one material to another, but that falls within the range of 0.6÷1.0 for the most widely used materials.

5) Aluminium cans have a mean thickness of 0.2÷0.3 mm. Furthermore, the thickness of the can is not uniform at every point of its surface. It is thicker where stresses are greater, such as the lid, and thinner where the stresses are lesser, such as in the body. The same is true for the aluminium alloys, tinplate and steel alloys.

[0011] To calculate the stress necessary to apply to each of the two levers, we have to follow the path below:

1) Calculate area and perimeter of the circular crown fraction BCDE (which we will call A_r and P_e).

2) Calculate the force, which we will call F₁, due to overpressure Δp on the area of the circular crown as stated in point 1. This force F₁ is perpendicular to the half-pull-tab.

3) Calculate the minimum thickness of the scored aluminium P_e long so that A_r can withstand F₁.

4) Based on the thickness found, calculate resisting force (which we will call F₂, as previously written) to remove perimeter P_e of BCDE by shearing. This force acts on the lid surface.

5) Calculate the mechanical gain of the lever (which we will call G) based on Figure 1, which represents the assumption considered.

6) Calculate the motive force (which we will call F₃, as previously written) that gives O' the same moment as that given by F₂. This force as well acts on the lid surface and represents the minimum value required to remove the half-pull-tab by shearing. The two forces F₂ and F₃ are basically perpendicular to their arms. This makes it possible to not consider the friction - however modest - of the fingertips on the arms of the levers in the calculations.

[0012] Referring to Figure 1, the following measurements can be assumed.

$$\begin{aligned}\overline{O'E} &= 20.0 \text{ mm} & \overline{O'D} &= 10.0 \text{ mm} & \overline{O'M} &= 15.0 \text{ mm} \\ \overline{HO'} &= 32.0 \text{ mm} & \widehat{CO'D} &= \pi/6\end{aligned}$$

[0013] The following is obtained for each step when following the path explained above.

$$\begin{aligned}1) \quad A_r &= \frac{1}{12} \pi (\overline{O'E}^2 - \overline{O'D}^2) & &= 78.5 \text{ mm}^2 \\ P_e &= \overline{BC} + \overline{CD} + \overline{DE} + \overline{EB} & &= 35.7 \text{ mm} \\ 2) \quad F_1 &= A_r \Delta p & &= 47.8 \text{ N}\end{aligned}$$

(continued)

$$\begin{array}{llll}
 3) & s & \approx F_1/(P_e \sigma_r) & = 0.0226 \text{ mm} \\
 4) & F_2 & \approx s P_e \tau_r & = 38.2 \text{ N} \\
 5) & G & = \overline{HO'}/\overline{O'M} & = 2.13 \\
 6) & F_3 & = F_2/G & = 17.9 \text{ N}
 \end{array}$$

[0014] The F_3 value is lower, or in any case comparable, to the values necessary today to open cans that are at about 20 N. Furthermore, it is not necessary to lift the lever ring with a fingernail like we have to do, somewhat inconveniently, today. The invention has an opening system simpler than the current one, and it becomes even more functional if a hollow is made in the forming under the circumference sector between points H and I that makes it easier for the fingertips to move the effort arms of the levers. In addition to this, the end profiles of the effort arms can be shaped to make it easier for the fingertips to grip them.

[0015] In going back to the formulas and following the path in reverse order, we can see the values that affect force F_3 :

$$\begin{aligned}
 F_3 &= \frac{\overline{O'M}}{\overline{HO'}} \cdot F_2 \\
 &= \frac{\overline{O'M}}{\overline{HO'}} \cdot s P_e \tau_r \\
 &= \frac{\overline{O'M}}{\overline{HO'}} \cdot P_e \tau_r \cdot \frac{F_1}{P_e \sigma_r} \\
 &= \frac{\overline{O'M}}{\overline{HO'}} \cdot P_e \tau_r \cdot \frac{1}{P_e \sigma_r} \cdot A_r \Delta p \\
 &= \left(\frac{\overline{O'M}}{\overline{HO'}} A_r \right) \cdot (\Delta p) \cdot \left(\frac{\tau_r}{\sigma_r} \right)
 \end{aligned}$$

[0016] In this last equation, the first term depends on the geometric configuration, the second on the overpressure, and the third is a ratio for every single material that, as stated previously, is usually between 0.6 and 1.0. The F_3 formula therefore demonstrates that the stress for opening the can is basically unrelated to the material used. Fewer stresses intervene when reclosing, so no issues emerge.

[0017] In addition to these results, we have to consider the following observations that further reassure:

- 1) The overpressure value Δp of 6 atm, found in the technical specifications of the Armed Forces, is a very safe value.
- 2) Many beverages do not ferment, so they do not generate overpressure.
- 3) The opening that forms can have a surface lower than the current ones so that the outgoing flow of beverage will not be disturbed by the immersed pull-tab. This is a benefit because the smaller the surface is to move by shearing, the fewer the stresses that come into play will be.
- 4) Can factories have reached automation and precision levels such as to remove any doubt that they follow the instructions given, in particular as far as scoring the half-pull-tabs along their perimeter is concerned. To remove them by shearing, it is necessary that the surface of the pull-tabs is slightly higher than the lid surface. Therefore, the scoring must be made on the inclined parts of a light profile obtained when forming the lid, as shown in Figure 4.

[0018] Similar to what we have seen for the leverage in Figure 1, systems of different forms that are however based on the same concept can be considered, as has already been stated. There is a single lever hinged again in O' in Figure 2. The system is simpler, but requires that gain G be increased in order that force F_3 is not too high. Then in Figure 3 we have a system that has no fixed fulcrum, which was represented by O' in the other two examples, but that instead varies as the spreading angle of the arms varies. This can be achieved by leaving the two levers free from each other and by designing a profile so that the fulcrum point moves toward the centre line of the arc starting from the upper perimeter of the pull-tab HI. In this variant gain G will be maximum at the beginning, in the shearing moment when maximum stress is required, to then diminish when there is only drag. In this case (illustrated in Figure 3), a bridge is

required to keep the levers parallel with the lid surface. In addition to replacing the two maximum divarication end stops of the effort arms in the opening moment, this riveted bridge in *b* and in *c* also serves to prevent the levers from slipping along the symmetry axis. This result can be achieved with a guide machined on the bridge, inside of which two rivets - *e* and *f* - that are integral with the levers are guided. Lastly, another two end stops - *a* and *d* are needed to force the ends of the arms to remain in their semicircles.

[0019] In this latter example, the two levers are completely free from each other and are more hypostatic than the two previous cases, in which the freedom is sufficient and necessary for the task they must perform. To this regard, a comment must be made, taking the opening and closing into consideration separately:

1) During opening, the forces involved tend to push the two levers against each other, so the possible slipping against each other can be avoided not only with the guide in the bridge, which is in any case necessary, but also with simple knurling.

2) When reclosing, the forces involved tend to move the levers apart, but they do not affect implementation as they are very moderate.

[0020] The example shown in Figure 3 was provided to demonstrate that the inventions can also reach high gains *G* (up to 10). Nevertheless, the example in Figure 1 is simpler to implement and, as we have seen, requires moderate forces for hygienically opening and closing the beverage cans.

[0021] Whatever leverage is selected, it is necessary to have end stops, which are marked on all the drawings with the letters *a*, *b*, *c*, *d*. They can be made using simple rivets protruding from the lid to restrict the angle of rotation of the levers. In fact, these arms must be able to rotate around *O'* only in the circular area assigned to them so that they are stopped both when completely open and when completely reclosed.

[0022] The invention was designed with the objective of resolving a hygienic deficiency for opening and closing cans in the food industry. However, the principle of operation can be extended to any can containing liquids (paints, oil, chemical products, etc.) and to those containers of solid products that flow easily (rice, sugar, cereals, etc.).

Claims

1. A system for opening and closing tins and cans (1) comprising:

- ❖ a lid (2) that covers a hollow and cylindrical body;
- ❖ one or more levers (3) that move one or more portions (4) of said lid (2) over a plan parallel and adjacent to that of said lid (2);

characterized in that said portions (4) of said lid (2) are delimited by score lines (5), are in relief with respect to said lid (2) and are connected to the resistance arm of the corresponding levers (3) such that the movement of the effort arm of the corresponding levers (3) moves laterally said portions (4) of said lid (2) externally to the tins and cans avoiding that said portions (4) come in touch with the content of the tins and cans.

2. A system for opening and closing tins and cans (1), as claimed in claim 1, the lever or the levers (3) of which are of the first class.

3. A system for opening and closing tins and cans (1), as claimed in claim 2, the lever or the levers (3) of which can rotate exclusively on limited circular sectors.

4. A system for opening and closing tins and cans (1), as claimed in claim 2, in which the fulcrum is fixed or mobile. If fixed, the fulcrum is a pin attached to said lid (2). If mobile, the fulcrum is the contact point between the arms of two levers (3).

5. A system for opening and closing tins and cans (1), as claimed in claims 2, in which every portion (4) to be moved is connected mechanically to the resistance arm of the corresponding lever (3).

6. A system for opening and closing tins and cans (1), as claimed in claim 1, in which the relief of the portion or of the portions (4) to be moved of said lid (2) can be realized by pressing.

7. A system for opening and closing tins and cans (1), as claimed in claim 3, in which the endstop of the limited circular sector or sectors can be realized by rivets.

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8. A system for opening and closing tins and cans (1), as claimed in claim 2, in which a shape can be pressed on said lid (2) in order to favor the grip by the fingers on the end or ends of the effort arms of the lever or the levers (3).

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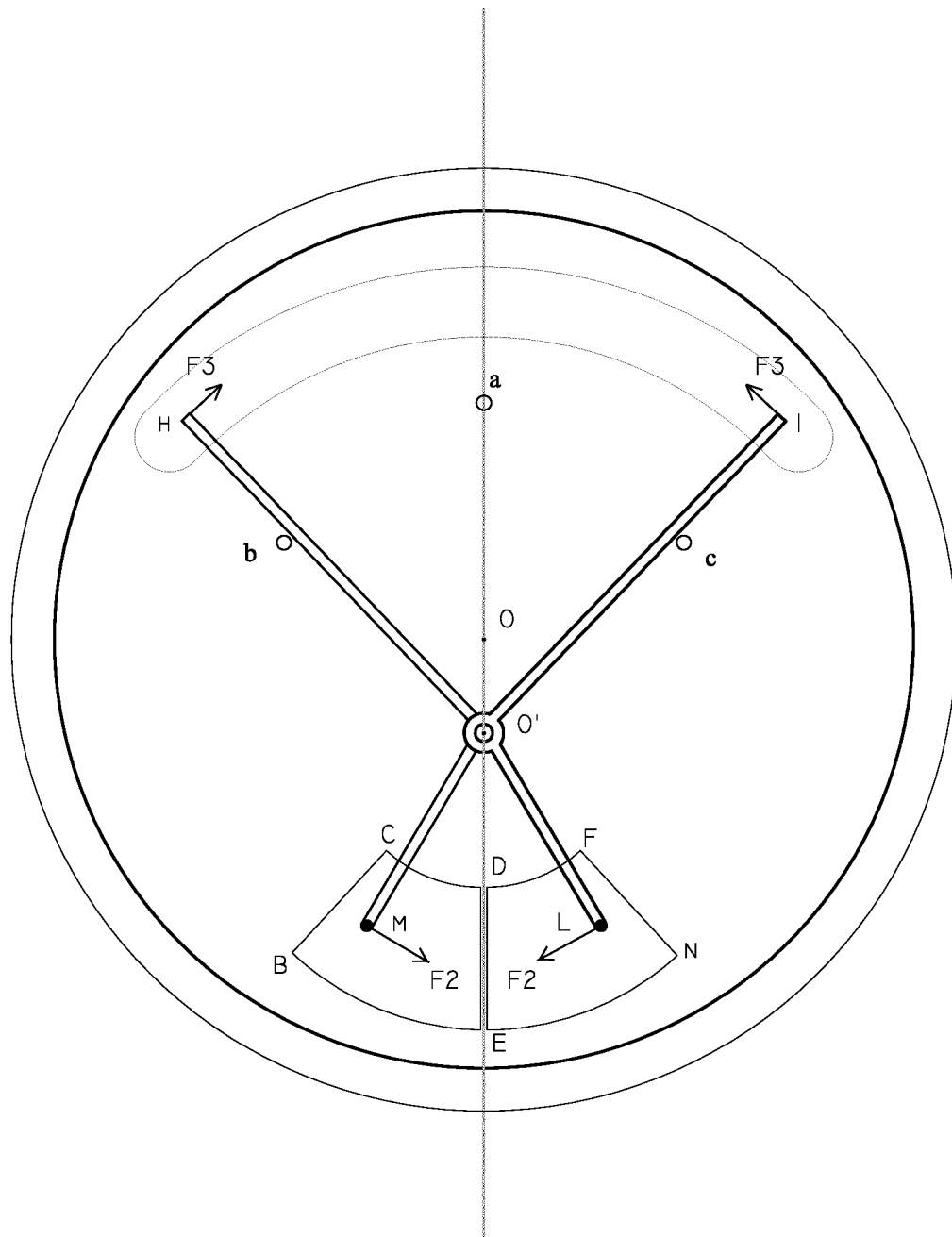
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FIGURE I



METRIC SCALE

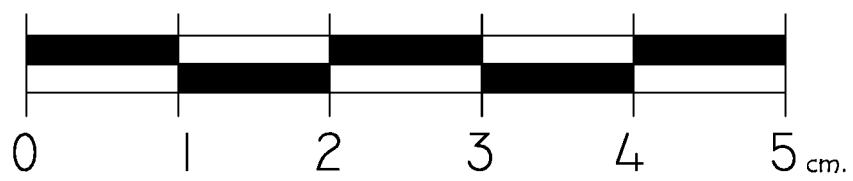
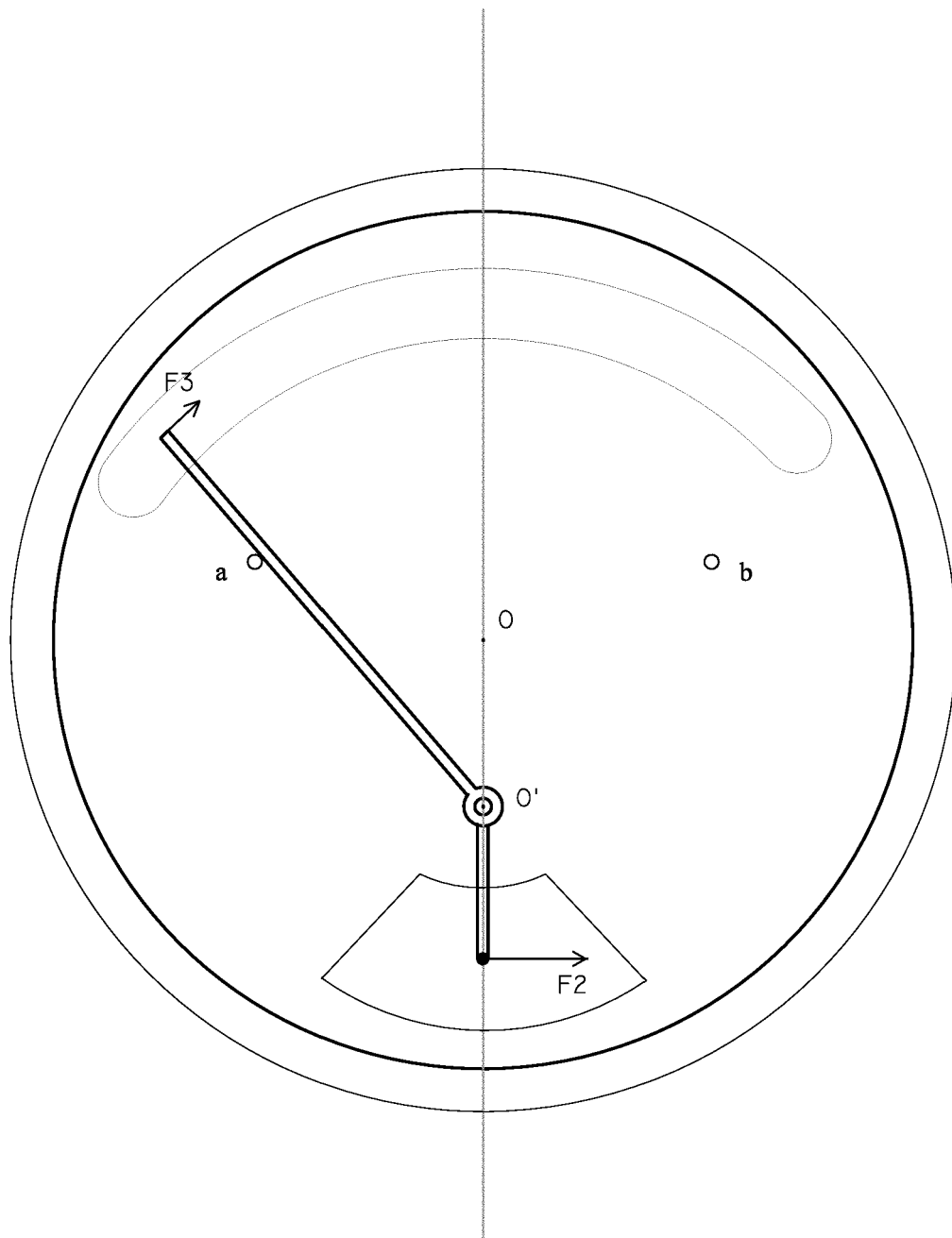


FIGURE 2



METRIC SCALE

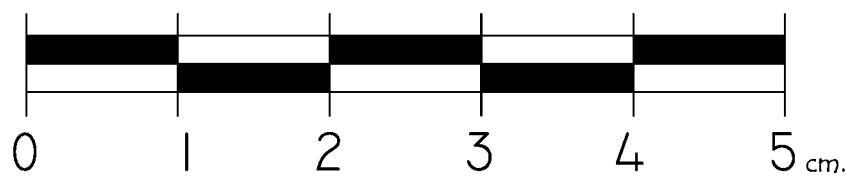
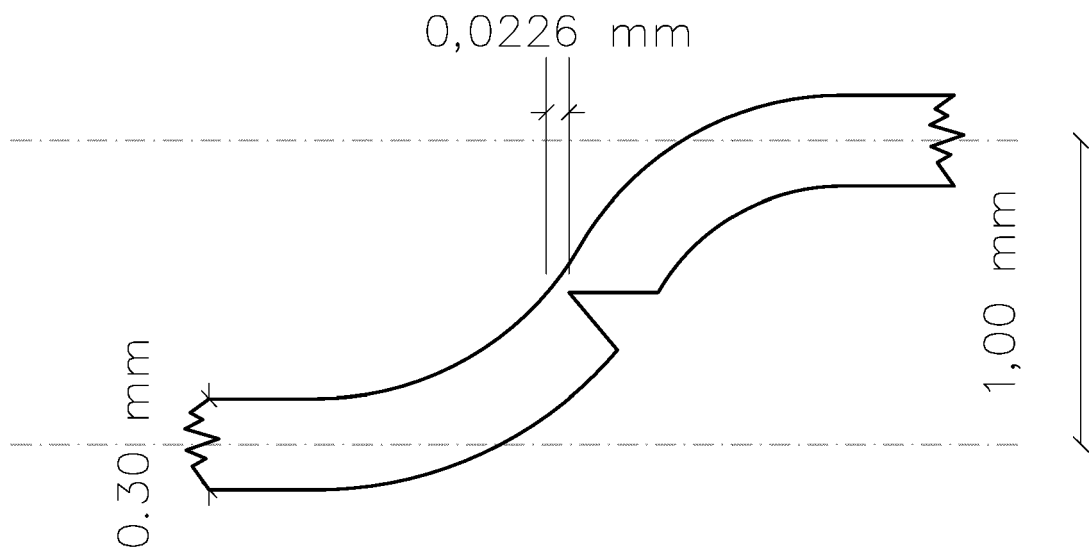
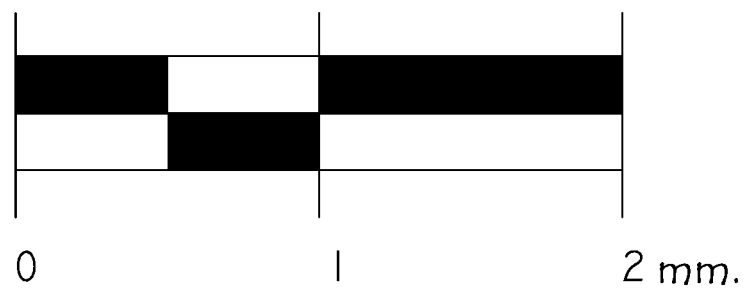


FIGURE 4



METRIC SCALE





EUROPEAN SEARCH REPORT

Application Number
EP 16 02 0435

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2009/051409 A2 (NA JONG-GAP [KR]) 23 April 2009 (2009-04-23) * paragraph [0073] - paragraph [0110]; figures 2, 15, 16 *	1	INV. B65D17/00
A	JP 2000 185736 A (MOTOTSU KAZUNORI; IMOARAI TAKESHI; MATSUI ATSUSHI) 4 July 2000 (2000-07-04) * figures *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 March 2017	Examiner Bridault, Alain
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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22-03-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009051409 A2	23-04-2009	NONE	
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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