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# (54) NIGHT COVER FOR REFRIGERATED DISPLAY CASE AND REFRIGERATED DISPLAY CASE

NACHTABDECKUNG FÜR KÜHLVITRINE UND KÜHLVITRINE

RIDEAU DE NUIT POUR VITRINE RÉFRIGÉRÉE ET VITRINE RÉFRIGÉRÉE

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(73) Proprietor: **Thermasolutions International Limited**
**Northamptonshire NN5 7UW (GB)**

(72) Inventor: **GREEN, Colin**
**London**
**Greater London (GB)**

(74) Representative: **London IP Ltd**
**100 High street**
**Milford on Sea**
**Lymington, Hampshire SO41 0QE (GB)**

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## Description

**[0001]** This invention relates to a night cover and to a refrigerated display case having an open front and such a night cover.

**[0002]** Refrigerated display cases of the open front type have a product display area where products are supported on shelves to be visible and accessible through an opening at the front of the case. Such display cases are used in, for example supermarkets and grocery stores, where consumables, such as food or drink, are to be held in a refrigerated condition.

**[0003]** The refrigeration system includes a compressor, a condenser and an evaporator which cools air that is pumped from a base of the display case up a rear channel, along a top panel toward the front of the display case where the air forms a cooling air curtain that is blown downwardly over the open front surface of the display case to be returned to the compressor for re-processing and re-circulation.

**[0004]** In order to reduce energy consumption it is known to fit such refrigerated display cases with a night cover formed by a retractable blind, for example a roller blind, in which fabric of the blind material may be deployed and re-deployed to a roller. Where the roller is manually deployed, so the roller is biased by a tension spring so that the blind is deployed against the bias of the tension spring and rewound, i.e. re-deployed, by virtue of the tension of the spring. Alternatively, the blind may be deployed and re-deployed by an electric motor actuating the roller.

**[0005]** The night cover is typically deployed at night to cover the open front of the display case to reduce heat ingress into the case and thereby reduce the load on the refrigeration system to reduce the amount of energy consumed. The night cover material may be that produced by Lenzing Plastics part number 7704284 if unperforated or 77048572 if perforated, or, preferably, a low emissivity aluminized polyethylene or polyester cross-weave fabric part number 77026928 for a perforated fabric or part number 77026929 for a non-perforated fabric. A perforated fabric having perforations of 1mm or less is often preferred to reduce condensation on product in the display case.

**[0006]** In a known open fronted multi-shelf display case, the known night cover may reduce energy consumption over an eight-hour period from a typical 14.4kWh to a typical 9.6kWh - an energy saving of up to one third.

**[0007]** EP-A-0630601 discloses a refrigerated display case having a night cover (blind). As stated in this application, due to constraints on the design and construction of the display case, the night cover blind is not guided or otherwise held tight against and along the two opposed vertical sides of the case. Thus, a gap between the vertical sides of the blind and the case occurs when the blind is deployed, and where two adjacent blinds are used there is a gap between the adjacent edges of the blinds. Warmer, moisture-laden air, ingresses around these gaps releasing content in the form of condensate onto products on the shelves of the display case and, on account of this, the shelves and products are found to be wet upon removal/re-deployment of the covering blind(s). This application also states that an outflow of denser cold air takes place from a lower portion of the display case and a corresponding inflow of warm air takes place into the upper portion of the display case. In order to limit the velocity of the air inflow, the solution proposed by this application is to promote non-turbulent circulation of ambient air between the cold air barrier, i.e. cold air curtain, and the night cover (blind) by utilising a plurality of rectangular apertures in rows in an upper portion of the night cover so as to slow down air flowing through the night cover and through the gaps between the night cover and the sides of the display case. Thus, the problem to be solved by this reference is the elimination of condensation within the display case.

**[0008]** EP-A-2850977 also discloses a display case having a night cover. This reference acknowledges that the ingress of ambient air into the product display area of the display case penetrates the cold air curtain and increases product temperatures in the case. This reference also discloses apertures in the night cover which are arrayed in an upper portion of the night cover, wherein the apertured section of the night cover has a surface area of between 1 to 7 and 1 to 18 of the non-apertured area. The apertures are stated to be between 38mm - 44mm in diameter or width, and in one embodiment the apertures are arranged to be two different diameters with the uppermost row of apertures being smaller than the lowermost row of apertures.

**[0009]** The larger diameter apertures of EP-A-0630601 and EP-A-2850977 have been found in experimentation to provide too high a desired velocity of air ingress and not a smooth spread of air ingress across the whole of the apertured section of the night cover resulting in perturbation of the air curtain. It has also been found that the larger apertures weaken the night cover, leading to distortion of the night cover.

**[0010]** Despite previous attempts to overcome problems associated with night covers, the present inventor has identified a problem of hot spots occurring from around a mid-point in height of a display case at locations on the shelves of the display case leading to a sometimes undesirable rise in temperature of product stored on the shelves, and these hot spots tend to be around the upper vertical edges of the night blind due to the ingress of ambient air. The production of these hot spots also tends to increase the power consumption of the refrigeration system to try and maintain the temperature within the display case stable.

**[0011]** The present invention seeks to at least partially mitigate the foregoing problems.

**[0012]** According to this invention there is provided a night cover as claimed in claim 1 herein.

**[0013]** The present inventor, after several years of ex-

perimentation, has found that such a selection of size and spacing of aperture and location of the apertures within the opening substantially eliminates hotspots and improves the efficiency of the refrigeration system leading to lower power consumption, i.e. improving power economy.

**[0014]** The apertures are sized and spaced to permit ambient air to flow therethrough to substantially prevent hotspots occurring in the refrigeration display case, whereby air lost from the refrigeration display case is substantially compensated without breaching the normally provided air curtain in the refrigerated display case.

**[0015]** Various features of the invention are defined in the claims appended to claim 1.

**[0016]** The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a known refrigeration display case having a known night cover,
Figure 2a shows airflow in a known display case when a night blind is not deployed,
Figure 2b shows airflow in a known display case when a known night cover is deployed,
Figure 2c shows the airflow of a display case having a night cover in accordance with this invention,
Figure 3a shows airflow ingress and leakage of a display case with a known night cover,
Figure 3b indicates the spread of hotspots in a known display case with a known night cover,
Figure 3c shows products affected by hotspots in a known display case having a known night cover,
Figure 4 shows, in graphical form, the effect of hotspots in a known display case having a known night cover, and the reduction in temperature with a night cover in accordance with this invention,
Figure 5 shows a perspective view of a refrigerated display case having a night cover in accordance with this invention,
Figure 6 shows a night cover in accordance with this invention,
Figures 7a - 7d show the apertured to non-apertured proportions of a night cover in accordance with this invention for different display cases,
Figure 8 shows, in graphical form, the refrigeration system energy improvement with the night cover of this invention, and
Figure 9 shows, in graphical form, the energy demand with no night cover, a known night cover and a night cover in accordance with the invention.

**[0017]** In the Figures like reference numerals denote like parts.

**[0018]** Figure 1 shows a refrigerated display case 1 having a base 2, side walls 3, a rear wall 4, a top cover 5 and adjustably locatable shelves 6 mounted on brackets 7. In the example shown, there are five shelves, but this number will vary upon the requirements of the merchandiser. Also, in the current example, the side wall is shown as being transparent plastics or glass, but may be metal or, if two display cases are joined together, open.

**[0019]** The display case is provided with a pair of unperforated night covers 40 which are each mounted on a respective roller having a spring biased mechanism against which the covers may be deployed to a position, as shown in Figure 1, where a handle 11 used for manual deployment and re-deployment is attached by a hook, not shown, to the base 2 so as to maintain the cover in a deployed position. The display case, when the covers are not deployed, has an aperture height h, known as the "throat" height of the display case.

**[0020]** The roller upon which the night cover 10 is wound is secured to the top cover 5 and located behind a valance 8.

**[0021]** Figure 2a shows airflow in a known display case having a riser 9 extending from the base 2. Located beneath the lowermost shelf 6 is a refrigeration system 20 comprising a compressor, condenser, and an evaporator, these items not being separately shown. The display case has an open front 21. The refrigeration system produces cooled air which is blown by a fan (not shown) through a channel 22 at the rear of the display case and through apertures in the rear wall 4 to spread over each of the shelves 6, the flow of cooled air being shown by arrow-headed lines 23. The cooled air travels along the underside of the top cover 5 and it is then directed downwardly as an air curtain 24 to the inner side of the riser 9, whereupon the air reenters the base to be re-cooled by the refrigeration system 20.

**[0022]** Ambient air 25, shown by arrow-headed broken lines, enters the front of the display case and mixes with, but does not penetrate, the air curtain 24, and a mixture of the cool, heavier, air from the air curtain 24 and the ambient air 25 spills out at the base of the display case over the riser 9.

**[0023]** When the night cover 40 is deployed, as shown in Figures 2b and 3a, it will be understood that because the night cover is not sealed to the display case, so ambient air passes between the upper outer vertical edge of the night cover and the side 4 of the display case and also between a vertical gap between each adjacent night cover 40, as shown by arrow-headed lines 26 in Figure 3a. Because the ambient air is travelling through a relatively narrow gap of approximately 10 mm between the outer vertical edge of the blind and the display case side and a gap of about 20 mm between adjacent edges of the night covers, so a positive air pressure is formed which, as shown by broken arrow-headed lines 27 in Figure 2b, penetrates the air curtain to cause hotspots, as will be described herein with reference to Figure 3b. The ambient air mixed with the air curtain reaches an equilibrium pressure around the centre, height-wise of the display case, and exits around the vertical edges of the night blind through negative pressure and the denser cooled air shown exiting the display case is shown by

arrow-headed lines 28 in Figures 2b and 3a.

**[0024]** The effect of the cool air 28 escaping towards the base of the display case results in more warm ambient air being drawn into the gap at the vertical edges of the blind which cause product temperatures to dramatically rise in hotspots.

**[0025]** The formation of hotspots is shown in Figure 3b. A median of the display case throat height is denoted by broken line M, and hotspot areas caused by a conventional night blind, as shown by cross-hatched areas S, increase in width with greater height extending from a point just below the median M. The effect of these hotspots upon products on the shelves within the display case is shown in Figure 3c, where product 50 is shown stacked on each of the shelves 6 and base 2 and the products 51 affected by the hotspots are shown to increase laterally of the display case with height with the possibility that products in the hotspots may exceed a desired temperature for life expectancy.

**[0026]** The effect of the known night cover upon temperature within the display case is graphically shown in Figure 4, which has temperature in degrees C as an ordinate and an abscissa of time in hours. The time at which the night cover is lowered is indicated by line 41 and the graphical representations are temperatures measured at the second shelf down from the top. Broken line 42 is the temperature measured by a heat probe located at the centre of shelf 2, i.e. between the two adjacent blinds 40;. Broken line 43 is the temperature measured by a heat probe located at the left hand side of shelf 2. Broken line 44 shows the temperature measured by a heat probe on the shelf 2 at the right hand side of shelf 2; changes in temperature over a sixteen-hour period are recorded.

**[0027]** Referring to Figure 5, a pair of night covers 50 in accordance with this invention are shown mounted over the open front of a display case 1. The open front of the display case has height h and the night cover of this invention has an uppermost apertured section 51 extending the width of each night cover and to a depth a from the top of the case opening to a distance d, and an unapertured section 52 extending from d to the lowermost part of the opening at the base of a distance u.

**[0028]** A top plan view of the night cover, before it is wound on a roller, is shown in Figure 6. In its unwound state from the top of the apertured section 51 to the lowermost end of the night cover is height h1. The length a1 of the apertured section 51 is in the range 30% - 40% of h1, in dependence upon the height of a display case and the size of the front opening of the display case, as will be described later herein with reference to Figure 7. The distance from distance d of the unapertured section 52 to the lowermost end of the night cover is u1. In general, distance a1, in a preferred embodiment, is one third h1, and distance u1 is two thirds h1.

**[0029]** An unapertured section 53 above the apertured section 51 is provided for securement about the roller and the section 53 is denoted by length r which has a length, typically, 0.1 of h1, i.e. approximately 10% of h1. In practice, however, in dependence upon the size of the display case, a portion of the section 51 may also be wrapped around the roller.

**[0030]** The night cover has a width w.

**[0031]** In one exemplary embodiment, length r is 150mm, length a is 870mm, distance u1 is 1,100mm so that h1 is 1,970mm. The lowermost 20mm of section 53 of the night cover is turned back on itself to form an envelope within which may be located a stiffening strip which, in one embodiment, is a magnetic strip for securing the night cover when deployed to a base of the refrigerated case.

**[0032]** The apertures 54 are each circular holes which have a constant hole diameter D in the chosen to be in the range 9mm - 11mm and, preferably, 10mm. The apertures are in a grid and have a hole centre spacing in the vertical direction y of 3D. The spacing between hole centres in the horizontal direction x is in the range 2D to 4D, preferably 3D.

**[0033]** By way of example, for a one metre wide night cover the percentage of aperture area to unapertured area ranges between 2.6% for a 450mm high night cover to 4.2% for a 870mm high night cover, so there is very little wasted material.

**[0034]** The distances x and y and the hole diameter D are particularly chosen so as not to weaken the night cover and to provide a cover avoiding hotspots. Similarly, the ratio of the apertured section51 to the unapertured section 52 is particularly chosen to provide non-turbulent airflow and to accomplish the avoidance of hotspots. Thus, the dimensions are a particular selection of dimensions.

**[0035]** Figure 2c shows the night cover of this invention deployed with the ingress of ambient air shown by broken lines 29 evenly spread through the apertured section 51, lowering the air velocity so it does not penetrate the air curtain and exiting near the base 2.

**[0036]** Figure 7 shows various height sizes of display case in which Figure 7a shows a display case having a height of 2m and the apertured section 51 is 540mm and the unapertured section 52 is 1,080mm, giving a one third to two thirds ratio of apertured to unapertured sections.

**[0037]** Figure 7b shows another display case having a height of 2m, but with a front riser 9. In this example, the apertured section 51 has a height of 450mm and the unapertured section 52 has a height of 1,080mm, giving a ratio of 30% - 70% apertured to unapertured sections.

**[0038]** Figure 7c shows a display case having a height of 2.2m with no riser and the apertured portion extends a distance of 735mm and the unapertured section extends a distance of 1,080mm, providing a ratio of apertured to non-apertured sections of about 40% to 60%.

**[0039]** Figure 7d shows another display case having a height of 2.2m with a riser 9. In this example, the apertured section 51 extends a distance of 630mm and the non-apertured section 52 extends a distance of 1,080mm, giving a ratio of apertured to non-apertured of approximately one third to two thirds.

**[0040]** Referring again to Figure 4, with a night cover in accordance with this invention a heat probe mounted at the centre of shelf 2 at the gap between adjacent night covers 50 recorded a curve as shown by line 47, a heat probe at the left hand side of the night cover recorded a temperature shown by curve 45, and a probe at the right hand side of the night cover recorded a temperature as shown by curve 46. From a comparison of curves 42 and 47, between curves 43 and 45, and between curves 44 and 46, it will be seen that a significant drop in temperature occurred with the night cover of this invention versus the known night cover.

**[0041]** Figure 8 shows curves of the energy drawn by the refrigeration system. The cycle is over a period of twenty four hours, with the night cover not deployed for sixteen hours and deployed for eight hours, the time at which the night cover was lowered being denoted by line 80. The power consumption is shown as the ordinate in kWh and the abscissa is time in hours. The known night cover power consumption is denoted by broken line 81 and the power consumption of the present invention is denoted by solid line 82. The power peaks and troughs with the night cover raised is caused by the refrigerator system cycling. It will be noted that with the night cover lowered, the energy consumption shows a difference of approximately 10% improvement.

**[0042]** The energy demand of the refrigeration system in various circumstances is shown in Figure 9. The curves shown in Figure 9 have an ordinate in kW and the abscissa is time in hours. The energy curve of the present invention is shown in section 91, the energy demand without a night cover is shown in section 92, and the energy demand with a known non-apertured night cover is shown in section 93. From these curves, the energy demand of the present invention versus a known night cover is seen to have a mean improvement of 0.25kW.

**[0043]** Thus, after several years experimentation, the present inventor has found that a particular aperture shape and size having a particular pitch in the x and y direction and spaced over a particularly defined portion of a night cover regulates and evenly diffuses air ingress to eliminate night hotspots and improve energy demand. The elimination of hotspots serves to improve product, e.g. food safety, and eliminate wastage through the temperature of product in a case rising unallowably. Further, by virtue of carefully balancing air ingress into the case when a night cover is deployed, so energy consumption is reduced, making a contribution to the reduction of global warming.

**[0044]** Thus, the invention, has apertures which are particularly sized and spaced to permit ambient air to flow therethrough to substantially prevent hotspots occurring in the refrigerator display case and which compensate for air lost from the refrigerated display case without breaking through the air curtain in the display case.

**[0045]** The night cover of this invention has the further advantages that:

It does not require extra parts and so may be readily retro-fitted to all case types.

**[0046]** It is inexpensive to produce.

**[0047]** It requires no changes to existing cases.

**[0048]** It requires no extra staff training.

## Claims

1. A night cover (50) for covering an opening in a front of a refrigerated display case (1), said night cover (50) being made from a flexible material having a first height (h1), and having a plurality of apertures (54) arranged in a vertical and horizontal grid in an upper first section (51), and a lower second section (52) which is unapertured, said upper first section (51) **characterised by** having a range of second heights (a) which is 30% - 40% of said first height (h1), said apertures (54) having a constant diameter (D) chosen to be a fixed dimension in the range 9mm - 11mm, the spacing between said aperture (54) centres in the vertical direction of said grid being 3D, and the spacing between aperture (54) centres in the horizontal direction of said grid being chosen to be in the range 2D to 4D.

2. A night cover as claimed in claim 1, wherein second height (a) is one of one third of the first height (h1), 30% of first height (h1), 40% of first height (h1) and 37% of first height (h1).

3. A night cover as claimed in claims 1 or 2, wherein the night cover has a further section (53) without apertures extending from a top edge of the first section (51) to 10% of first height (h1).

4. A night cover as claimed in any of claims 1 to 3 , wherein for a one metre wide night cover the percentage of aperture area to unapertured area ranges between 2.6% for a 450mm high night cover to 4.2% for a 870mm high night cover.

5. A night cover as claimed in any preceding claim, wherein the diameter (D) of the apertures is 10mm.

6. A night cover as claimed in any preceding claim, wherein the spacing of the aperture centres in the horizontal direction of said grid is 3D.

7. A night cover as claimed in any preceding claim, wherein the night cover has a further section (53) without apertures extending from a top edge of a first section (51) to 10% of the length of the first and second sections.

8. A night cover as claimed in any preceding claim, wherein in a manual version of the night cover, the lowermost end thereof is attached to a handle (11) for deploying the night cover.

**9.** A night cover as claimed in claim 8, wherein said handle (11) has a hook for securing the night cover to a base of a refrigerated display case.

**10.** A night cover as claimed in claims 1 to 8 inclusive, wherein the lowermost end of the night cover forms an envelope within which is located a magnetic strip for securing the night cover when deployed to a base of a refrigerated display case.

**11.** A refrigerated display case (1) with a night cover (50) as claimed in any preceding claim, the refrigerated display case (1) having a front opening and a roller having said further section of the night cover (50) wound thereabout, said night cover (50) being arranged to be in a non-deployed position when the refrigeration display case front opening is to be substantially open, and when in a deployed position said night cover (50) is arranged to substantially close said front opening.

**12.** A refrigerated display case (1) as claimed in claim 11, wherein the roller is electrically operated to deploy and rewind the night cover (50).

**Patentansprüche**

**1.** Eine Nachtabdeckung (50) zum Abdecken einer Öffnung auf der Vorderseite einer Kühltheke, die besagte Nachtabdeckung ist aus einem flexiblen Material hergestellt, mit einer ersten Höhe (h1) und mit einer Vielzahl von Öffnungen (54), die in einem vertikalen und horizontalen Gitter in einem oberen ersten Abschnitt (51) und einem unteren zweiten Abschnitt (52), der ungeöffnet ist, angeordnet sind, der besagte obere erste Abschnitt (51) ist **dadurch gekennzeichnet, dass** er einen Bereich von zweiten Höhen (a) hat, die 30 % - 40 % der besagten ersten Höhe (h1) umfassen, diese Öffnungen (54) haben einen konstanten Durchmesser (D), der mit einer festen Größe im Bereich von 9 mm - 11 mm festgelegt ist, der Abstand zwischen den Mittelpunkten dieser Öffnung (54) in vertikaler Richtung des besagten Gitters ist 3D, und der Abstand zwischen den Mittelpunkten der Öffnung (54) in horizontaler Richtung des besagten Gitters ist im Bereich 2D bis 4D festgelegt.

**2.** Eine Nachtabdeckung nach Anspruch 1, wobei die zweite Höhe (a) entweder ein Drittel der ersten Höhe (h1), 30 % der ersten Höhe (h1), 40 % der ersten Höhe (h1) oder 37 % der ersten Höhe (h1) umfasst.

**3.** Eine Nachtabdeckung nach Anspruch 1 oder 2, wobei die Nachtabdeckung einen weiteren Abschnitt (53) ohne Öffnungen hat, der sich von einem oberen Rand des ersten Abschnitts (51) bis 10 % der ersten Höhe (h1) erstreckt.

**4.** Eine Nachtabdeckung nach einem der Ansprüche 1 bis 3, wobei für einen Meter Breite der Nachtabdeckung das Verhältnis des Öffnungsbereichs zum nicht geöffneten Bereich zwischen 2,6 % bei einer Nachtabdeckung von 450 mm Höhe und 4,2 % für eine Nachtabdeckung mit 870 mm Höhe variiert.

**5.** Eine Nachtabdeckung nach einem der vorherigen Ansprüche, wobei der Durchmesser (D) der Öffnungen 10 mm beträgt.

**6.** Eine Nachtabdeckung nach einem der vorhergehenden Ansprüche, wobei der Abstand der Mittelpunkte der Öffnung in horizontaler Richtung des besagten Gitters 3D beträgt.

**7.** Eine Nachtabdeckung nach einem der vorhergehenden Ansprüche, wobei die Nachtabdeckung einen weiteren Abschnitt (53) ohne Öffnungen hat, der sich von einem oberen Rand des ersten Abschnitts (51) bis 10 % der Länge des ersten und zweiten Abschnitts erstreckt.

**8.** Eine Nachtabdeckung nach einem der vorhergehenden Ansprüche, wobei in einer manuellen Version der Nachtabdeckung dessen unteres Ende einen Griff (11) für das Herunterziehen der Nachtabdeckung aufweist.

**9.** Eine Nachtabdeckung nach Anspruch 8, wobei der besagte Griff (H) einen Haken aufweist, um die Nachtabdeckung an einem Unterteil der Kühltheke befestigen zu können.

**10.** Eine Nachtabdeckung nach einem der Ansprüche 1 bis 8 inklusive, wobei das untere Ende der Nachtabdeckung einen Umschlagbereich bildet, in dem ein Magnetstreifen untergebracht ist, mit dem die Nachtabdeckung befestigt wird, wenn sie zu einem Unterteil einer Kühltheke heruntergezogen wird.

**11.** Eine Kühltheke (1) mit einer Nachtabdeckung (50) nach einem der vorhergehenden Ansprüche, die Kühltheke (1) hat eine Öffnung an der Vorderseite und eine Rolle, um die der besagte weitere Abschnitt der Nachtabdeckung (50) herumgewickelt ist, die Nachtabdeckung (50) ist so angeordnet, dass sie in einer nicht-heruntergezogenen Position ist, wenn die Öffnung an der Vorderseite der Kühltheke im Wesentlichen offen ist, und in einer heruntergezogenen Position ist die Nachtabdeckung (50) so angeordnet, dass sie die Öffnung an der Vorderseite im Wesentlichen schließt.

**12.** Eine Kühltheke (1) nach einem der Ansprüche 11, wobei die Rolle elektrisch betrieben wird, um die

Nachtabdeckung (50) herunterziehen und wieder aufrollen zu können.

## Revendications

1. Couverture de nuit (50) destinée à couvrir une ouverture à l'avant d'une vitrine réfrigérée, ladite couverture de nuit étant fabriquée dans un matériau souple présentant une première hauteur (h1) et présentant une pluralité d'orifices (54) agencés dans une grille verticale et horizontale dans une première section supérieure (51) et une seconde section inférieure (52) qui n'a pas d'orifice, ladite première section supérieure (51) **caractérisée** en présentant une plage des secondes hauteurs (a) qui est de 30 % à 40 % de ladite première hauteur (h1), lesdits orifices (54)présentant un diamètre constant (D)choisi pour être une dimension fixe dans la plage de 9 mm à 11 mm, l'espacement entre lesdits centres des orifices (54) dans la direction verticale de ladite grille étant de 3D et l'espacement entre les centres des orifices (54) dans le sens horizontal de ladite grille choisi pour être dans la plage de 2D à 4D.

2. Couverture de nuit telle que revendiquée dans la revendication 1, dans laquelle la seconde hauteur (a) est parmi un tiers de la première hauteur (h1), 30 % de la première hauteur (h1) 40 % de la première hauteur (h1) et 37 % de la première hauteur (h1).

3. Couverture de nuit telle que revendiquée dans les revendications 1 ou 2, la couverture de nuit présentant une section supplémentaire (53) sans orifice s'étendant d'un bord supérieur de la première section (51) à 10 % de la première hauteur (h1).

4. Couverture de nuit telle que revendiquée dans l'une quelconque des revendications 1 à 3, dans laquelle pour une couverture de nuit d'un mètre de large, le pourcentage de surface des orifices par rapport à la surface sans orifice varie entre 2,6 % pour une couverture de nuit de 450 mm de haut à 4,2 % pour une couverture de nuit de 870 mm de haut.

5. Couverture de nuit telle que revendiquée dans une quelconque revendication précédente, dans laquelle le diamètre (D) des orifices est de 10 mm.

6. Couverture de nuit telle que revendiquée dans une quelconque revendication précédente, dans laquelle l'écartement des centres des orifices dans le sens horizontal de ladite grille est 3D.

7. Couverture de nuit telle que revendiquée dans une quelconque revendication précédente, la couverture de nuit présentant une section supplémentaire (53) sans orifice s'étendant d'un bord supérieur de la première section (51) à 10 % de la longueur des première et seconde sections.

8. Couverture de nuit telle que revendiquée dans une quelconque revendication précédente, dans laquelle dans une version manuelle de la couverture de nuit, l'extrémité la plus basse de celle-ci est fixée à une poignée (11) servant au déploiement de la couverture de nuit.

9. Couverture de nuit telle que revendiquée dans la revendication 8, dans laquelle ladite poignée (11) présente un crochet servant à sécuriser la couverture de nuit à une base d'une vitrine réfrigérée.

10. Couverture de nuit telle que revendiquée dans les revendications 1 à 8 inclusivement, dans laquelle l'extrémité la plus basse de la couverture de nuit forme une enveloppe à l'intérieur de laquelle se trouve une bande magnétique servant à sécuriser la couverture de nuit lorsqu'elle est déployée à une base d'une vitrine réfrigérée.

11. Vitrine réfrigérée (1) comportant une couverture de nuit (50) tel que revendiqué dans l'une quelconque des revendications précédentes, la vitrine réfrigérée (1) présentant une ouverture avant et un rouleau présentant ladite section supplémentaire de la couverture de nuit (50) enroulée autour de celui-ci, ladite couverture de nuit (50) étant agencée de manière à être dans une position non déployée lorsque l'ouverture avant de la vitrine réfrigérée est pratiquement ouverte et lorsqu'elle est en position déployée, ladite couverture de nuit (50) est agencée pour fermer pratiquement ladite ouverture avant.

12. Vitrine réfrigérée (1) telle que revendiquée dans la revendication 11, dans laquelle le rouleau est actionné électriquement pour déployer et rembobiner la couverture de nuit (50).

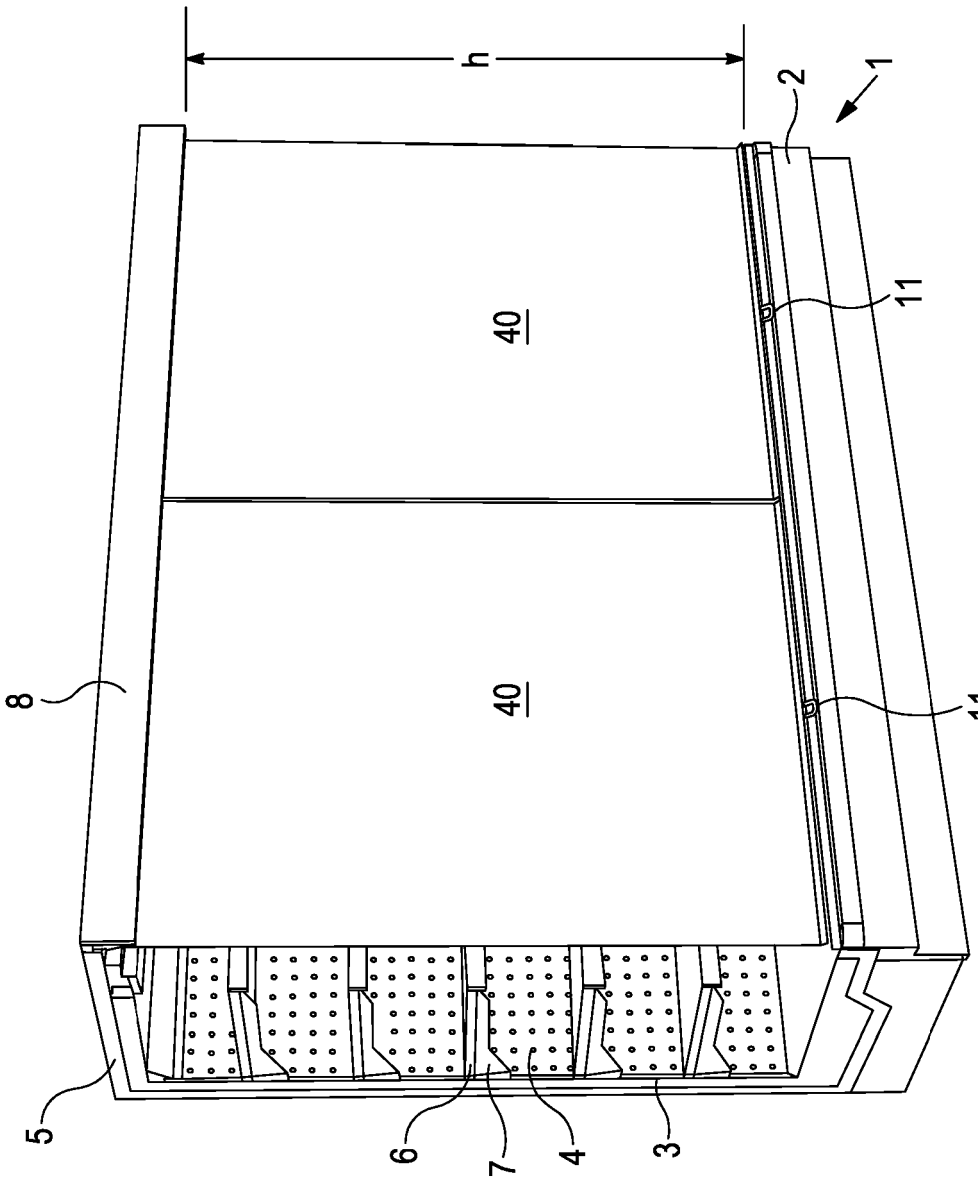


FIG. 1

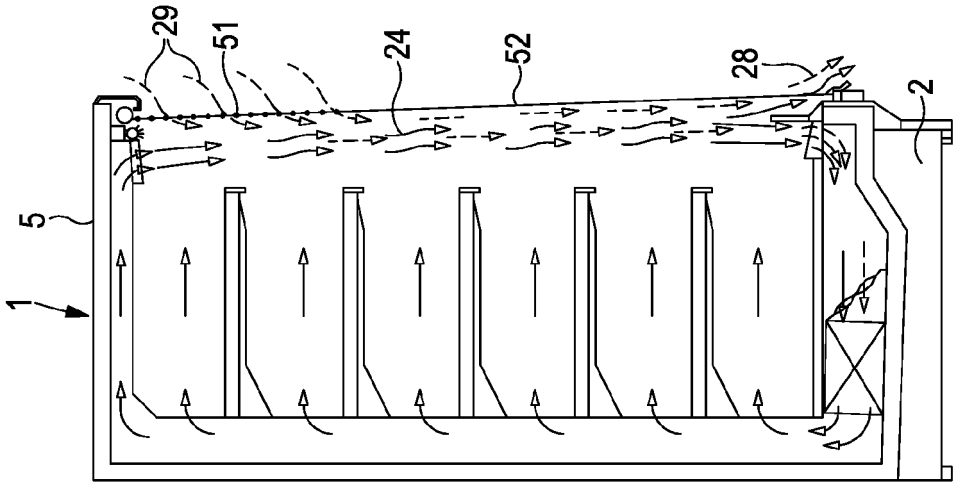


FIG. 2c

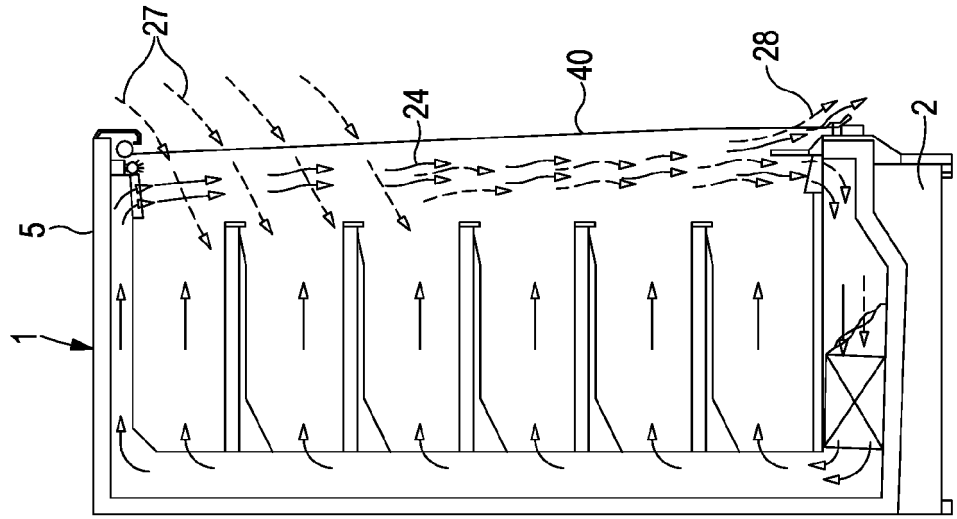


FIG. 2b

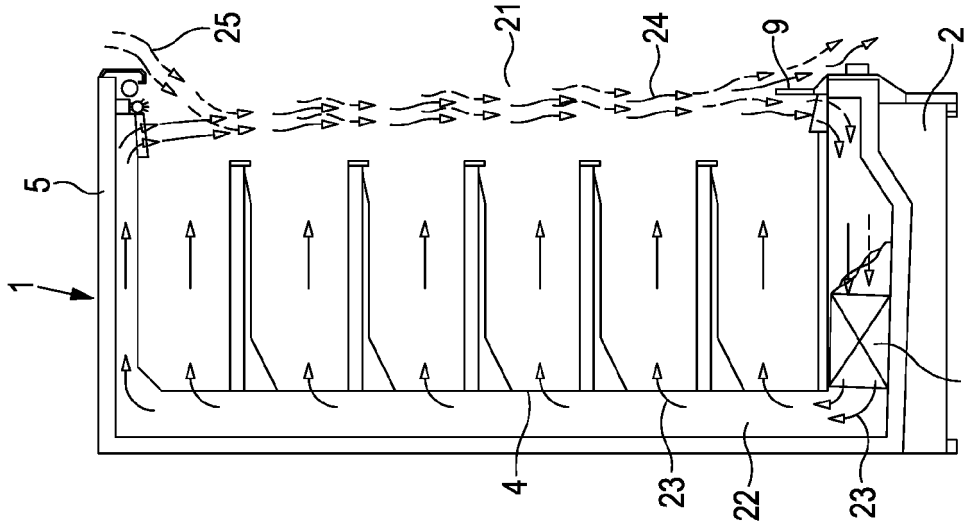


FIG. 2a

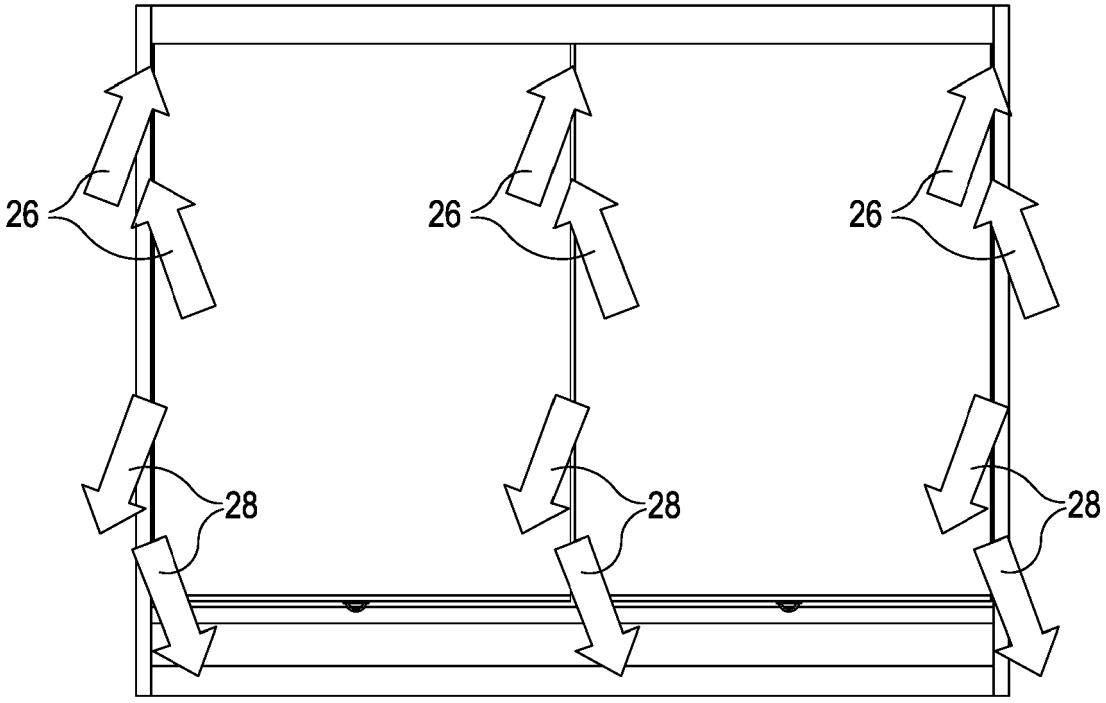


FIG. 3a

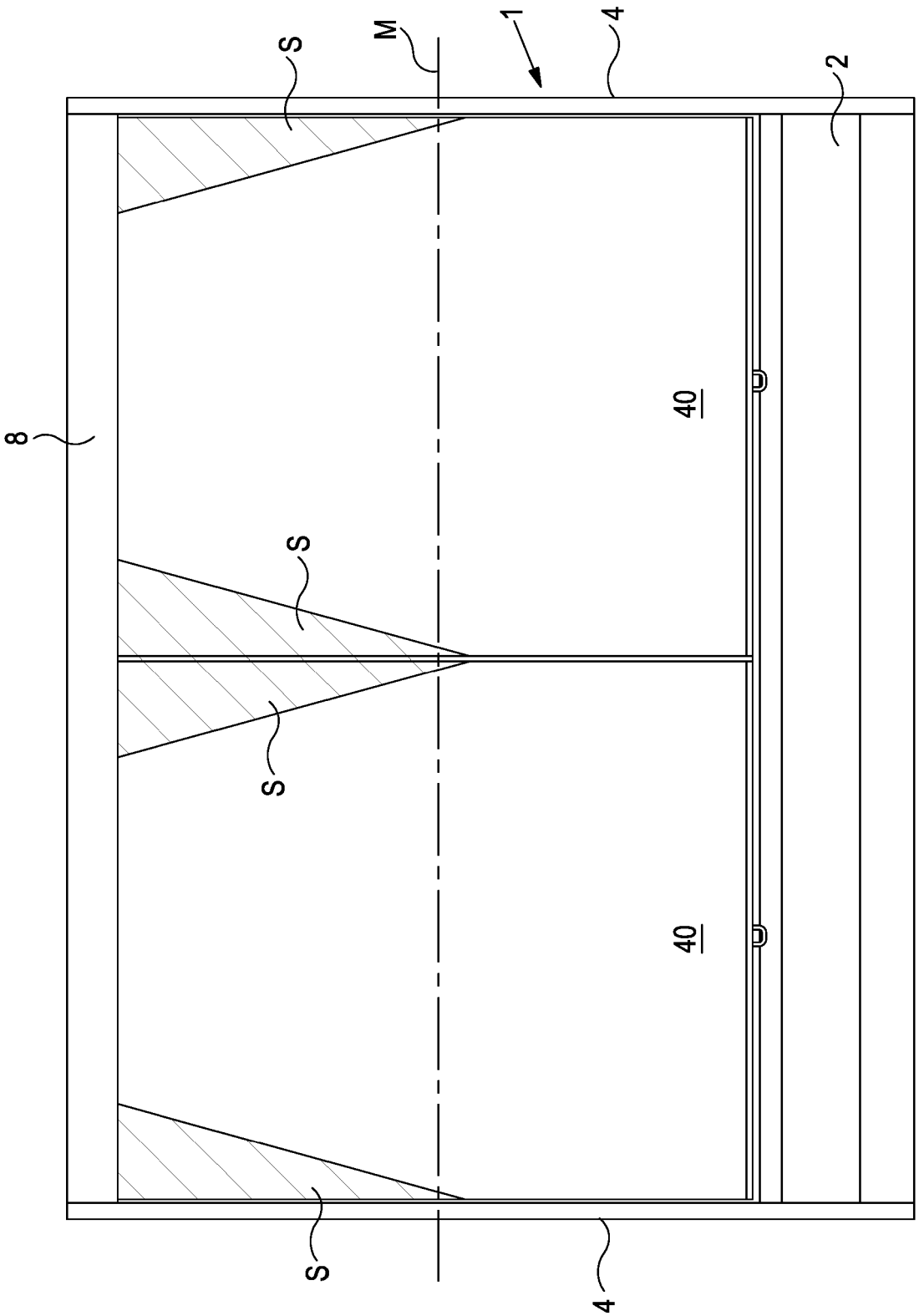


FIG. 3b

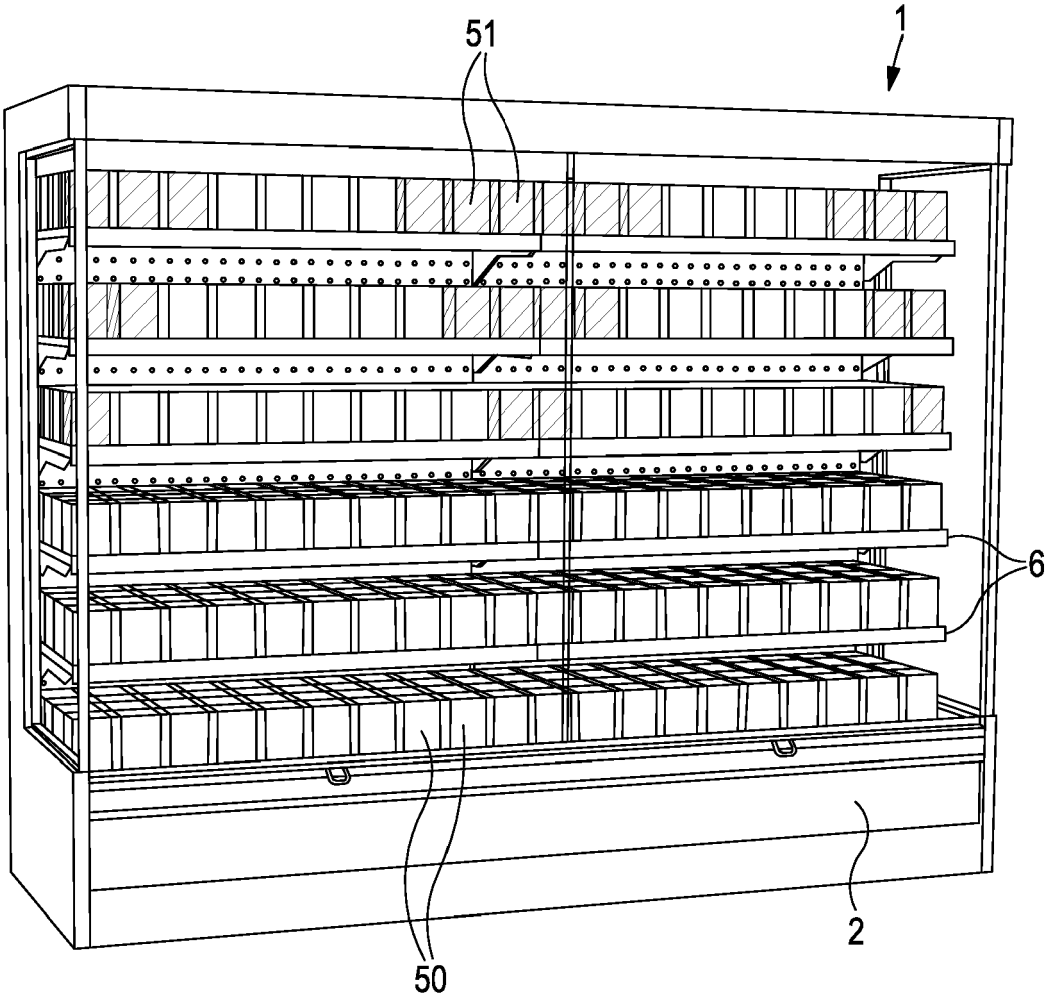


FIG. 3c

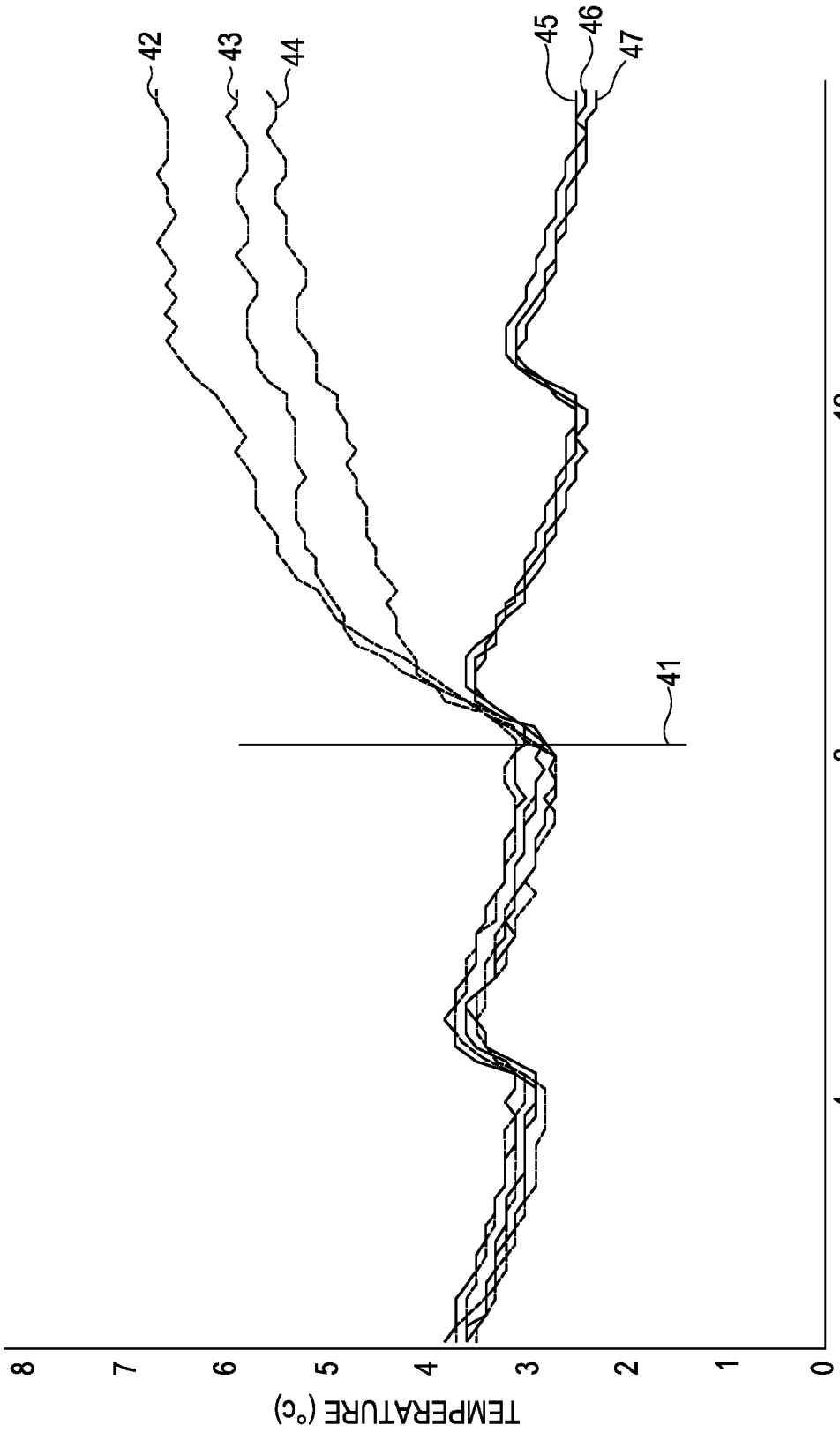


FIG. 4

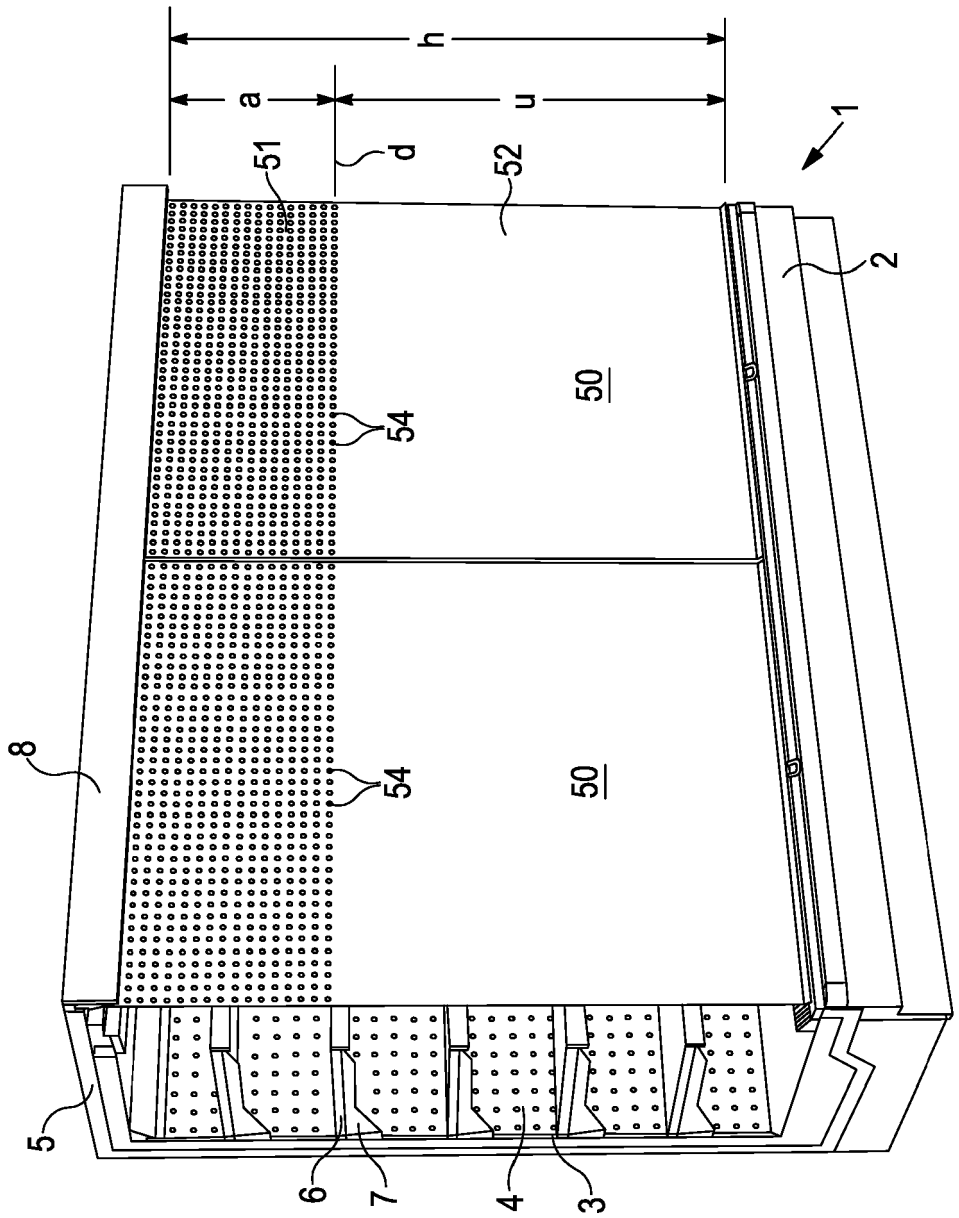


FIG. 5

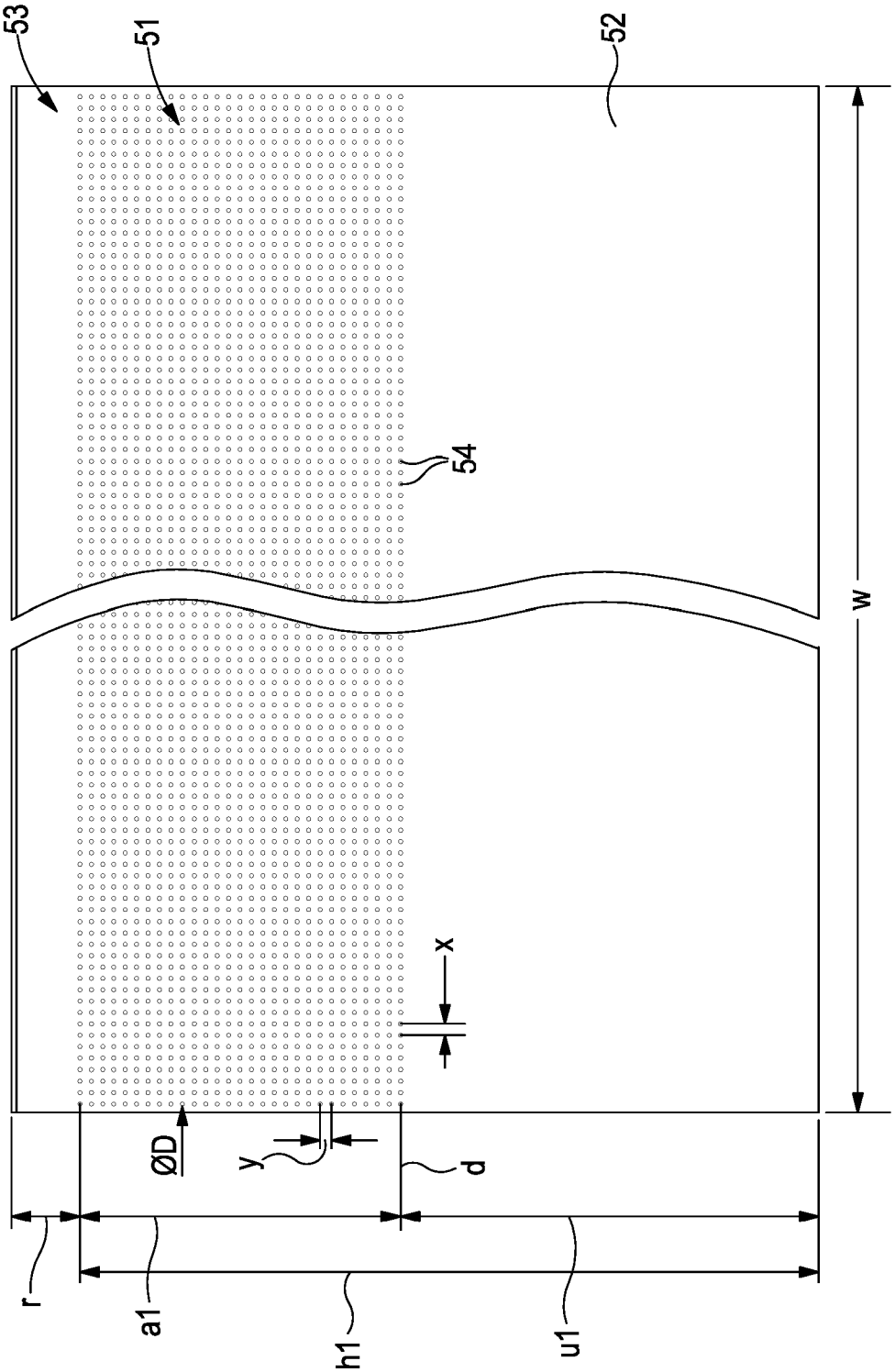


FIG. 6

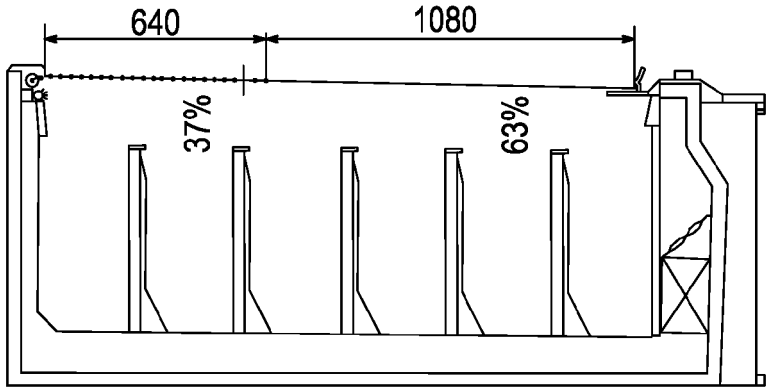


FIG. 7d

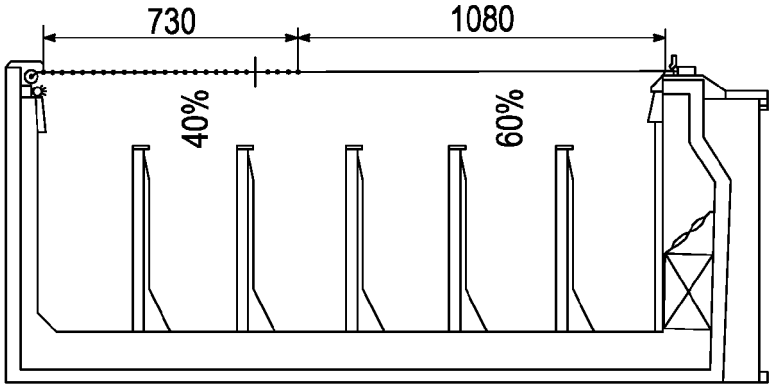


FIG. 7c

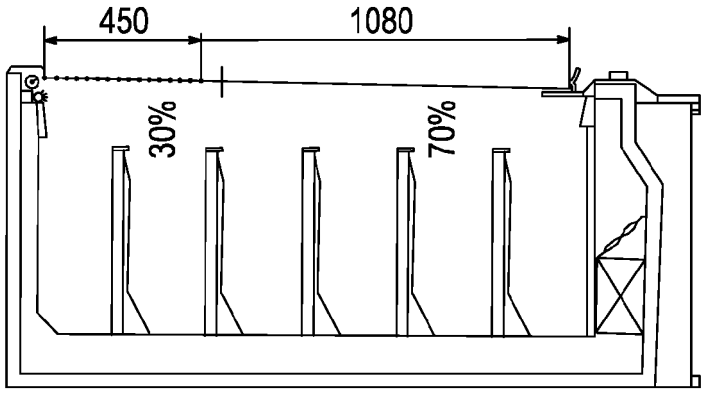


FIG. 7b

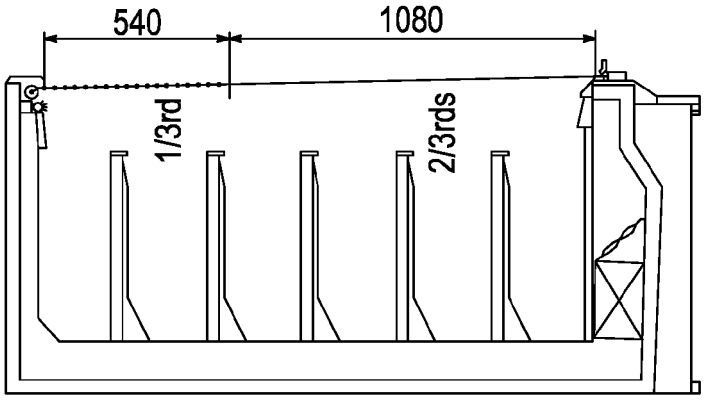


FIG. 7a

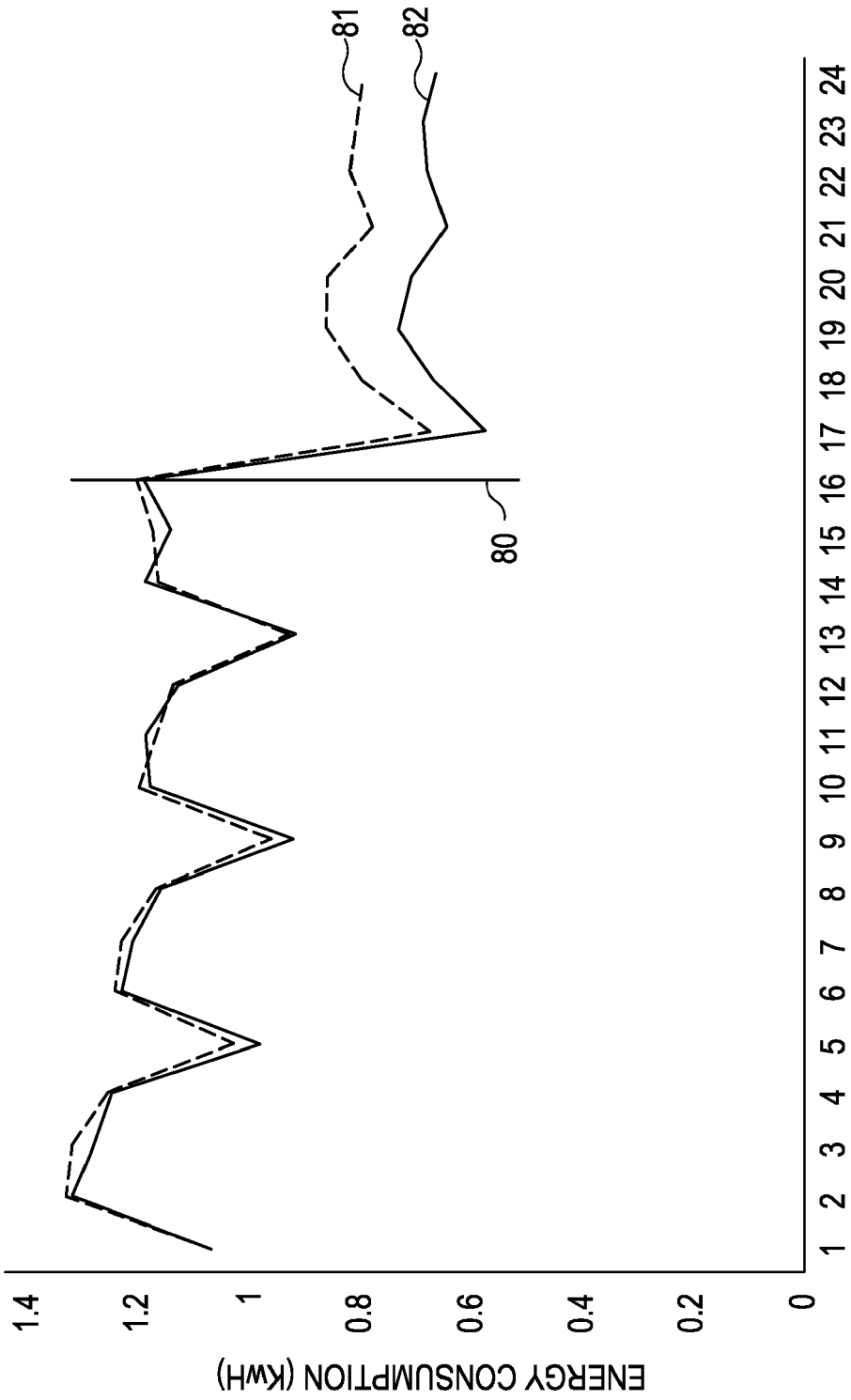
81
82
80
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
TIME (HOURS)
0 0.2 0.4 0.6 0.8 1 1.2 1.4
ENERGY CONSUMPTION (KWH)

FIG. 8

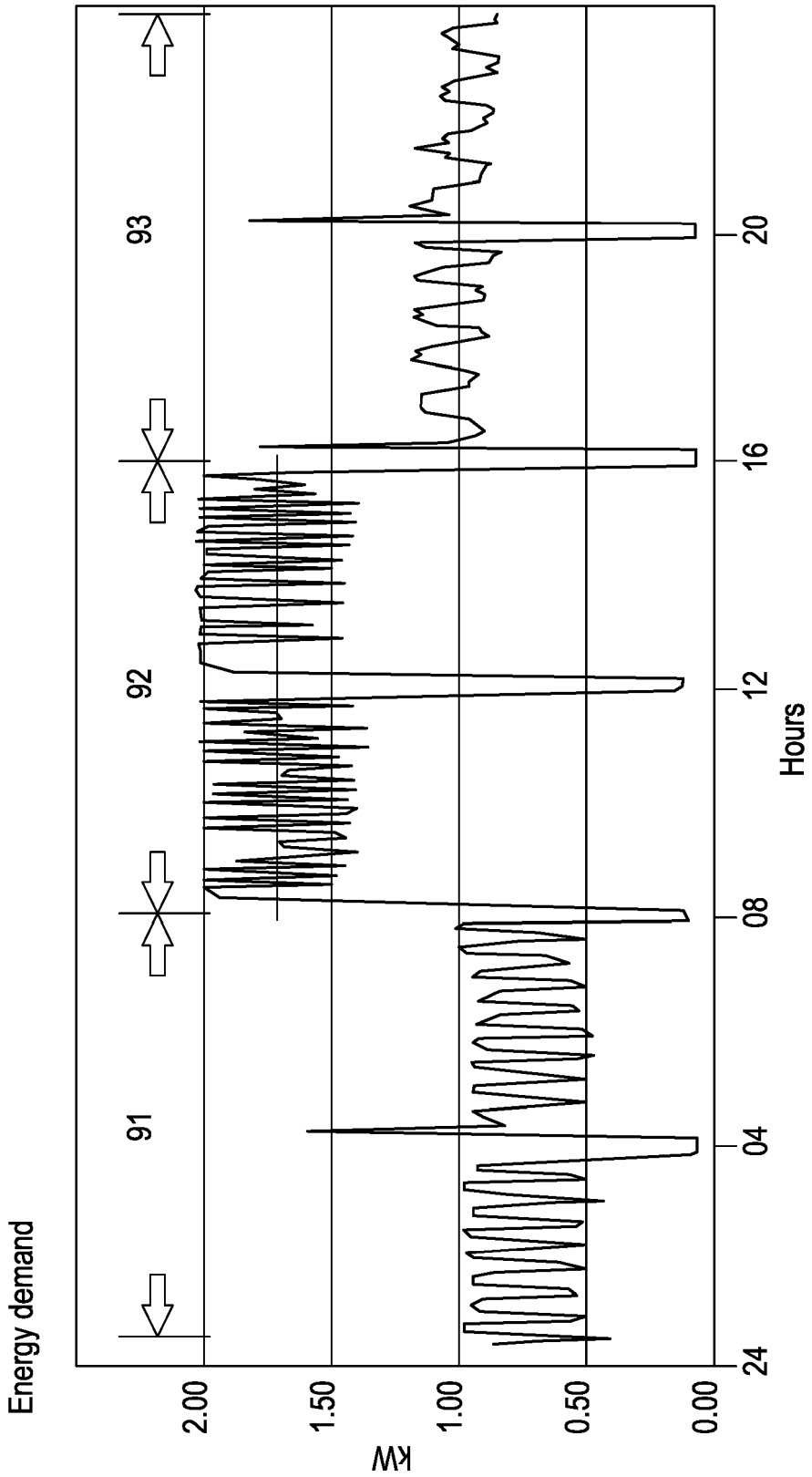
Energy demand
91
92
93
2.00
1.50
1.00
0.50
0.00
kW
24
04
08
12
16
20
Hours

FIG. 9

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- EP 0630601 A **[0007] [0009]**
- EP 2850977 A **[0008] [0009]**