A product vertical storage rack is provided for storing generally cylindrical shaped products, such as wine, in a generally horizontal orientation. The rack includes three parallel spaced sets of longitudinal continuous support elements defining support surfaces, each having a width to longitudinally accommodate one or more products of a pre-determined length. The sets of support elements are oriented such that the second and third sets of support elements intersect and engage the first set of support elements at spaced intervals to produce a lattice structure defining a plurality of multiple cylinder receiving regular hexagon prism shaped openings. A preferred embodiment is configured to hold 19 bottles in each regular hexagon prism shaped opening.
Fig. 9
Fig. 10
STORAGE RACK SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates to a cylinder product storage rack system and to various methods of making the same. The rack has been designed primarily as a storage rack for wine and other temperature sensitive bottled beverages and food products that can require long term storage, and will be described herein with reference to this preferred application. However, it will be appreciated that the invention is not limited to this particular field of use and may be used to advantage in the storage of other generally cylindrical products where weight bearing strength, space optimisation, packing density and/or a smoothing of temperature fluctuations are relevant considerations.

BACKGROUND OF THE INVENTION

[0002] The following discussion of the prior art is intended to place the invention in an appropriate technical context and enable the associated advantages to be fully understood. However, any discussion of the prior art throughout the specification should not be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

[0003] Storage is a particularly important consideration for wine, as it is a product which, in many instances, can improve significantly with age, but which can also deteriorate rapidly if the correct conditions are not maintained. In this regard the primary factors that have the strongest impact on a wines quality are usually temperature, light and humidity.

[0004] Wine producers invest a lot of time and capital in controlling these factors to provide the best possible environment in which to store the wine during the initial production process and post bottling commercial cellaring stage. The challenge to retailers and purchasers of wines for the purpose of aging and or simply storing for deferred consumption in the future is to find an economic means for maintaining the correct conditions in which the wines can retain and/or improve their quality with time.

[0005] While shielding from light and providing optimum humidity are independent environmental considerations, the appropriate selection of storage rack system can play an important role in relation to space optimisation, packing density and/or in terms of smoothing and reducing the effect of ambient temperature fluctuations.

[0006] In this regard, there are a huge number of different wine storage racks available. However, most of these have some form of limitation in terms of factors, such as the effective use of space in terms of storage capacity per unit area, and very few provide much in the way of inherent shielding from ambient temperature fluctuations. In addition, most wine storage racks do not provide for the housing of different bottle diameters, which can vary significantly depending on the wine style (e.g. Claret, Burgundy, Riesling, Champagne) and/or the bottle volume (e.g. standard 750 ml bottles, magnums, half-bottles). Furthermore, many do not have sufficient inherent strength for floor to ceiling applications without the need for additional structural supports.

[0007] It is an object of the present invention to provide a cylinder product storage system that overcomes or ameliorates one or more of the disadvantages of the prior art, or which at least offers a useful alternative.

SUMMARY OF THE INVENTION

[0008] According to the invention there is provided a cylinder product vertical storage rack for storing generally cylindrical shaped products in a generally horizontal orientation, the rack including:

[0009] three parallel equi-spaced sets of longitudinal continuous primary support elements each directly or indirectly defining surfaces capable of acting as support surfaces having an effective width selected to longitudinally accommodate one or more of cylindrical products of a pre-determined length,

[0010] the sets of primary support elements being oriented such that the second and third sets of support elements intersect and supportingly engage the first set of support elements at equi-spaced intervals at included angles with respect to the first support elements of +60 degrees and -60 degrees respectively, to produce a lattice structure defining a plurality of multiple cylinder receiving generally regular hexagon prism shaped openings between the primary support elements having sides of length x, each of the hexagonal prism shaped openings being in apex to apex contact, with a pair of opposed equilateral triangular prism shaped openings also having sides of length x disposed there between.

[0011] In one preferred form the primary support elements are in the form of sheets of suitable structural material such as plywood which directly define the support surfaces. In such instances the supporting intersection of each sheet set with the other sheet sets is preferably achieved by providing an appropriate arrangement of front to mid width slots and rear to mid width slots, each slot being appropriately sized and oriented to receive the intersecting sheet to thereby form the lattice structure defined above.

[0012] However, in other embodiments, one or more of the support elements or sets of support elements are comprised of other continuous support members of reduced width in the direction of the longitudinal axis of the cylinder products, such as a set of strip elements or groups of one or more rod elements spaced and supported to define at least a part of the relevant primary support surfaces.

[0013] In yet further embodiments, discrete secondary support elements may be provided which connect to some or all of the primary support elements to define parts of the support surfaces.

[0014] Preferably the first set of primary support elements are oriented horizontally such that each hexagon shaped opening has a flat horizontal surface defining its base onto which a plurality of cylinder products can be directly or indirectly supported in a first lower horizontal row.

[0015] Desirably, the dimension x is selected according to the diameter of the cylinder products to be stored. Preferably, x is selected to provide in the finished product a support surface sized to accommodate and support a total of three cylinder products adjacent each internal surface of each hexagon shaped opening which equates to a total of 19 cylinder products within each hexagon prism shaped opening, that is a first row of three cylinders, a second row of four cylinders, a third central row of five cylinders, a fourth row of four cylinders and a final fifth row of three cylinders. Alternatively this can be viewed as a peripheral hexagon of 12 cylinder products, a concentric inner hexagon of 6 cylinder products and a central single cylinder product. The dimension w is selected to provide complete containment of cylinder products within the rack. Preferably, w is selected to longitudinally accommodate a single set of 19 cylinders within each hexagon prism.
shaped opening, although it should be appreciated that w could alternatively be selected to allow for more than one set of 19 cylinders to be stored within each hexagon prism shaped opening in an end to end configuration.

[0016] In another embodiment, the dimension x is selected to support two outer rows of two cylinder products and an inner row of three cylinder products to thereby store a total of 7 cylinder products.

[0017] In an additional embodiment, the dimension x is selected to support two outer rows of four cylinders, a second row of five cylinders, a third central row of six cylinders, a fourth row of five cylinders and a final fifth row of four cylinders to give a total of 37 cylinder products within each hexagon prism shaped opening.

[0018] In yet further embodiments the dimension x can be selected to support a row of any other selected number of cylinder products greater than two, three or four as described above.

[0019] It will be appreciated that where the primary support elements directly define the support surfaces, dimension x will relate directly to the size of the cylinder products to be stored. However, in embodiments where the support surfaces are defined by secondary support elements that connect to the primary support elements, the dimension x will need to be larger to take into consideration reductions in the size of the openings arising from the degree by which the secondary support surfaces extend into the openings and thus reduce their cross sectional area.

[0020] In order to maximise packing density and stacking stability it is desirable that the dimensions be selected so that there is not excessive clearance around stacked cylinder products when the rack is fully loaded.

[0021] In the preferred form the cylinder product storage rack is a wine rack and the dimensions x is preferably selected to achieve the 19 bottle storage arrangement described above. For example, if storing Clarat-style bottles each of a 750 ml capacity which have a diameter of 74-77 mm, and the support surfaces are defined directly by the primary support elements, the length x is ideally 198-202 mm. Similarly, for the larger Burgundy style bottles each of a 750 ml capacity which typically have a diameter around 80-86 mm, x is ideally around 216-224 mm. In other embodiments that utilise secondary support elements as described above, where the size of the openings is determined by the degree the secondary elements extends into the openings defined by the primary support elements, the values of x provided above will need to be increased such that the support surfaces defined by the secondary support elements correspond to the figures above.

[0022] For wine racks of the invention with primary support elements being constructed partially or solely from plywood, a plywood thickness of around 12 mm is preferred in terms of providing adequate strength, bending resistance and aesthetic appearance, without adding excessive bulk. However, other materials and other thicknesses could be used.

[0023] Similarly, for wine rack embodiments utilising support rods in place of some or all of the primary support elements, a planar arrangement of three spaced 6.3 mm steel rods has also been found to work, although clearly other arrangements could clearly be used based on a variety of visually and materially different structural elements.

[0024] Reference throughout this specification to “one embodiment”, “some embodiments” or “an embodiment” means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases “in one embodiment”, “in some embodiments” or “in an embodiment” in various places throughout this specification are not necessarily all referring to the same embodiment, but may. Furthermore, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

[0026] FIG. 1 is a perspective view of a first embodiment rack system according to the invention using planar support elements;

[0027] FIG. 2 is a front view of the rack system shown in FIG. 1;

[0028] FIG. 3 illustrates the component blanks for producing the wine rack shown in FIGS. 1 and 2;

[0029] FIGS. 4(a)–(c) is a location guide for the three stage assembly of the components of FIG. 4;

[0030] FIG. 5 is a perspective view of a rack system similar to that shown in FIGS. 1 and 2 but with a different edge configuration;

[0031] FIG. 6 is a front perspective view of a second embodiment wine rack incorporating two support sets of support elements comprising rows of spaced rod elements;

[0032] FIG. 7 is a front perspective view of a third embodiment wine rack incorporating three support sets of support elements comprising rows of spaced rod elements joined by a set of spaced transversely extending rod elements and additionally comprising a set of discrete planar support elements to be supported by the rod elements.

[0033] FIG. 8 is a front view of a reduced area test sized wine storage rack according to the invention 8(a) disposed adjacent a selected conventional wine rack 8(b) during a temperature data logging trial;

[0034] FIG. 9 illustrates the component blanks for producing the wine rack according to the invention shown in FIG. 8; and

[0035] FIG. 10 is a graph depicting temperature of selected wine bottle positioned within the wine rack of the invention and the conventional wine rack of FIG. 8 in relation to ambient temperature over time.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0036] Referring firstly to FIGS. 1 and 2, there is shown a first embodiment cylinder product vertical storage rack 1 according to the invention. The rack includes three parallel equi-spaced sets of longitudinal continuous support elements identified as elements 2, 3 and 4 respectively. Each of the support elements 2, 3 and 4 have an effective width w selected to accommodate a pre-determined cylindrical product length.

[0037] The sets of support elements 2, 3 and 4 are oriented such that the second and third set of support elements each marked 3 and 4 respectively, intersect and supportingly engage the first set of support elements each marked 2 at spaced intervals x× the thickness of the support elements, at included angles with respect to the first support elements 2 of +60 degrees and -60 degrees respectively as shown in FIG. 2. As can be seen, this intersecting arrangement produces a
lattice structure defining a plurality of multiple cylinder receiving regular hexagonal prism shaped openings 6 having sides of length x in apex 7 to apex 7 contact, with a pair of opposed equilateral triangular prism shaped openings 8 also having sides of length x disposed there between. Length y is the distance between each of the horizontal planar support elements 2. It will be appreciated that for a given rack size with a fixed spacing between the centre lines of the horizontal support elements, the effective length of x will be influenced by the thickness of the support elements. The thicker the support, the smaller x and y will be.

In the embodiment illustrated in FIGS. 1, 2 and 5, the support elements 2, 3 and 4 are all in the form of sheets of suitable structural material such as plywood. As can be seen, the only differences between the first and second embodiments relate to the finishing of the top row of the rack. In this regard it will be appreciated that the finished structure can have a wide variety of edge configurations and can also be boxed in if required.

In the preferred embodiments, the first set of support elements 2 are oriented to extend in a horizontal plane such that each hexagonal prism shaped opening has a flat horizontal surface 9 defining its base onto which a plurality of cylinder shaped products can be supported in a first horizontal row.

In those embodiments constructed from sheet material, the supporting intersection of each set with the other sheet sets is preferably achieved by providing an appropriate arrangement of open ended slots extending from the front and/or rear edges of the sheets.

A specific example of this construction method for the rack of FIGS. 1 and 2 is shown in FIGS. 3 and 4. In this preferred form illustrated, the cylinder product storage rack is a wine rack and the dimension x is preferably selected to achieve a 19 bottle storage arrangement described in more detail below. For example, if storing Clarlet-style bottles each of a 750 ml capacity which have a diameter of 74-77 mm, the length x is ideally 198-202 mm and y is ideally around 340-352 mm. Similarly, for the larger Burgundy style bottles each of a 750 ml capacity which typically have a diameter around 80-86 mm, x is ideally around 216-224 mm and y is ideally around 385-405 mm. Dimension w is ideally around 340-360 mm to provide complete containment of a single set of 19 bottles Clarlet-style or Burgundy-style within the rack described above.

Using the calculations above, the planar support elements are first constructed as shown in FIG. 3. Firstly the panels of 12 mm ply having a width of 350 mm are cut to length. They are then marked up ready for the slots to be cut. The numerals indicated in the drawings show the length in millimetres from the left most edge of each panel to the centre of each slot. In this particular embodiment the slots are spaced at centre line spacing of 208 mm. Each of the slots extend from a longitudinal edge to just past the centre line of the panel, have a slot width of 14 mm (as measured across the uncut panel) and are cut at + or -60 degrees to the plane of the panels as shown by the circular direction indicators. As will be appreciated, the spacing of the slots needs to take into account the thickness of each panel such that the gap between adjacent slots is the desired length x.

For assembly of the embodiment illustrated in FIGS. 1 and 2, planar first support elements 2 are placed on a horizontal surface at an inter-element distance of y, each arranged parallel to each other 2a to 2e with the front to mid slots facing up as shown in FIG. 4(a). Elements can be maintaining in this position with the temporary use of heavy objects such as bricks (not shown) or a suitable jig arrangement until the assembly process affords the rack system achieves sufficient integral strength. Planar support elements 3 are then engaged with planar support elements 2 by sliding the rear to mid width slots of support elements 3 into the front to mid width slots of planar support elements 2 as per FIG. 4(b). Hence, element 3a engages with element 2a, element 3b engages with elements 2a-2e, element 3c engages with elements 2a-2e, element 3d engages with elements 2a-2e, element 3e engages with elements 2a-2e and element 3f engages with elements 2a-2e. Planar support elements 4 are then engaged with planar support elements 3 by sliding the rear to mid width slots of support elements 4 into the front to mid width slots of planar support elements 3 as shown in FIG. 4(c). Hence, element 4a engages with elements 2d-2e and element 3c, element 4b engages with elements 2b-2e and elements 3b-3d, element 4c engages with elements 2a-2e and elements 3b-3e, element 4d engages with elements 2a-2e and elements 3c-3f, element 4e engages with elements 2a-2e and elements 3d-3e and element 4f engages with element 2a. The system can then be rotated off the horizontal surface into a vertical position as shown in FIG. 1.

As can be seen from FIG. 5, the basic rack structure can be finished at the edges in a variety of different ways depending on the room dimensions into which it is to be installed and/or aesthetic requirements. In the illustrated variation, the upper edge terminates in closed uppermost triangular prism shaped openings 8.

Referring next to FIG. 6, there is shown a perspective view of a third embodiment wine rack made in accordance with the invention. In this particular embodiment, sheet material is once again used for the first set of horizontally extending support elements 2. However, the second and third sets of support elements have each been replaced by sets of support elements of reduced width which in the illustrated example are in the form of the spaced rod elements 9 illustrated. The rods are secured with the sheet material elements by passing through holes provided in the sheet, the geometry of the resulting cross braced structure acting to prevent relative movement between the sets of support element. However, if desired suitable additional fastening means could also be used.

Referring to FIG. 7, there is shown a perspective view of a fourth embodiment wine rack in accordance with the invention. In this particular embodiment, all longitudinal planar primary support elements are replaced with sets of spaced rod elements 9, secured in place by a further set of rod elements 9. For embodiments constructed from metal rods, the constituent rod elements are ideally interconnected by means of welding as per FIG. 7. However, other suitable fasteners could be used including specially configured bracket elements.

Added to the primary support structure are discrete planar support elements 10 which are employed to line at least the lower three surfaces of the hexagonal prism shaped openings and the base of the triangular prism shaped openings, onto which a plurality of cylinder shaped products can be supported as described above. Preferably, slots 10’ formed in the rear face of each discrete planar support element allows for engagement with spaced rod elements, as illustrated. In one particularly preferred form, the discrete planar support elements have slots 10’ which are deep enough to provide, on
installation, an opening configured for larger burgundy style bottles, but supplied with removable inserts, such that by retaining the inserts they can also be used to provide a smaller opening more ideally sized to receive smaller claret-style bottles.

[0048] It should be noted that in other variations alternative connection means could be provided for securing the discrete support elements to the primary structure including external brackets and/or providing through holes in the support elements through which the rods could be inserted during assembly.

[0049] Desirably, the dimension x is selected according to the diameter of the cylinder products to be stored. Preferably, x is selected to provide in the finished product a support surface sized to accommodate and support a total of three cylinder products adjacent each internal surface of each hexagon shaped opening which equates to a total of 19 cylinder products within each hexagon prism shaped opening, that is a first row of three cylinders, a second row of four cylinders, a third central row of five cylinders, a fourth row of four cylinders and a final fifth row of three cylinders. Alternatively this can be viewed as a peripheral hexagon of 12 cylinder products, a concentric inner hexagon of 6 cylinder products and a central single cylinder product. The dimension w is selected to provide complete containment of bottles within the rack. While the preferred embodiment described is sized to have a width corresponding to a single bottle, it should be appreciated that w could alternatively be selected to allow for more than one set of 19 cylinders to be stored longitudinally end to end within each hexagon prism shaped opening.

[0050] In another embodiment (not illustrated), the dimension x is selected to support two outer rows of two cylinder and an inner row of three cylinder products to thereby store a total of 7 cylinder products.

[0051] In an additional embodiment (also not illustrated), the dimension x is selected to support two outer rows of four cylinder, a second row of five cylinders, a third central row of six cylinders, a fourth row of five cylinders and a final fifth row of four cylinders to give a total of 37 cylinder products within each hexagon prism shaped opening.

[0052] For wine racks of the invention with primary support elements being constructed partially or solely from plywood, a plywood thickness of around 12 mm is preferred in terms of providing adequate strength, bending resistance and aesthetic appearance, without adding excessive bulk. However, other materials and other thicknesses could be used.

[0053] Similarly, for wine rack embodiments utilising support rods in place of some or all of the primary support elements, a planar arrangement of three spaced 6.3 mm steel rods has also been found to work, although clearly other arrangements could clearly be used based on a variety of visually and materially different structural elements. It will be appreciated that where the primary support elements directly define the support surfaces, dimension x will relate directly to the size of the cylinder products to be stored. However, in embodiments where the support surfaces are defined by secondary support elements that connect to the primary support elements, the dimension x will need to be larger to take into consideration reductions in the size of the openings arising from the degree by which the secondary support surfaces extend into the openings and thus reduce their cross sectional area.

Comparison of Wine Bottle Densities Achievable by Various Commercially Available Wine Rack Systems and an Embodiment of the Present Invention.

<table>
<thead>
<tr>
<th>Rack type</th>
<th>Max number of bottles per space*</th>
<th>Bottle density (bottles/m²)</th>
<th>% bottle density of Embodiment of PI c.f. other males</th>
</tr>
</thead>
<tbody>
<tr>
<td>CellarStak</td>
<td>225</td>
<td>88</td>
<td>+53</td>
</tr>
<tr>
<td>EnO Rake</td>
<td>192</td>
<td>75</td>
<td>+80</td>
</tr>
<tr>
<td>Borders</td>
<td>236</td>
<td>100</td>
<td>+35</td>
</tr>
<tr>
<td>Embodiment of PP*</td>
<td>346</td>
<td>135</td>
<td>—</td>
</tr>
</tbody>
</table>

*Calculations based on a 1600 mm high by 1600 mm wide space
**Embodiment of PI is one designed to hold 19 claret-style bottles (750 ml) in the hexagon prism shaped opening, where x = 220 mm (including 31 magnum-size (1500 ml) claret bottles)

Temperature Variability Comparison of Wine Bottles Stored in a Commercially Available Wine Rack System and an Embodiment of the Present Invention.

A pocket-style modular wine rack system constructed of ABS plastic (CellarStak®) with a 28-bottle capacity was purchased from The Wine Rack Shop (www.winerackshop.com.au). The CellarStak system was assembled in a 7 (high) by 4 (wide) array in accordance with the manufacturer’s instructions. Once assembled, the linear dimensions of the CellarStak system were 755 mm high by 420 mm wide by 240 mm deep as shown in FIG. 7(b).

An embodiment of the present invention was constructed as shown in FIG. 7(b) from the component elements shown in FIG. 8 for use as a “comparator rack” to the CellarStak rack. Plywood (Ecoply; 12 mm thickness) was cut into 325 mm strips and brush-coated with 2 applications of water-based polyurethane varnish (Cobalt’s Cabothane Clear). Horizontal (H), left-leaning (L) and right-leaning (R) support elements were cut from the above-mentioned plywood strips with a compound drop saw according to the production plan shown in FIG. 8. Half-width (162-163 mm) slots, each of a slot width of 14 mm were cut into the support elements according to the pattern shown in FIG. 8. As indicated by the symbols “/” or “/" in FIG. 8, slots were cut either at an angle of 30 degrees left of vertical or 30 degrees right of vertical, using the axis adjustment on the saw. Finally, the ends of each support element were cut at appropriate angles to allow for assembly of the embodiment, as described below. For assembly, the horizontal support elements (H1, H2) were arranged on a flat surface with the “slotted edges” facing up. The rear to mid width slots of the left-leaning support elements (L2, L1) were engaged with the (front to mid width) slots of H1, H2, respectively. The (rear to mid width) slots of the right-leaning support elements (R1, R2) were then engaged with the remaining slots of H1, H2 and the front to mid width slots of L2, L1, respectively. The above process resulted in two separate assemblies, the H1-L2-R1 assembly and the H2-L1-R2 assembly. The H2-L1-R2 assembly was first placed on its side, then the H1-L2-R1 assembly was placed on its side on top of the H2-L1-R2 assembly so that the inferior edges of support elements R1 and L2 rested on the superior edges of support elements L1 and R2, respectively as illustrated in FIG. 7(a). The assemblies were connected via 4
angle brackets secured with wood screws and the combined structure measured 735 mm high by 420 mm wide by 325 mm deep. Two additional pieces of plywood S (125 mm in length) were positioned under either end of H2 to provide support for the embodiment once filled with wine bottles.

[0057] Each rack was placed side by side on top of a 970 mm high plywood bench, located against the rear wall of a garage in Wollongong, Australia. The garage door is frequently opened and closed, resulting in fluctuations in the ambient room temperature of the garage.

[0058] Each rack was filled with a mixture of unopened 750 ml claret-style, burgundy style, riesling-style and champagne-style wine bottles 11. The CellarStak rack accommodated 28 bottles, while the comparator rack held 21 bottles, including 2 champagne-style wine bottles (100 mm maximum diameter) in each of the two triangular prism shaped openings.

[0059] Four identical temperature probes (Part #TMC6-HD; Onset, Cape Cod, Mass., USA) connected to a 4-input data logger (HOBOL12-008; Onset, Cape Cod, Mass., USA) were used to record the temperature of 3 test bottles at 10 minute intervals. Probe #1 was fitted to the side of the left-most bottle of the central 5-bottle row located in the hexagon prism shaped opening. Probe #2 was fitted to the side of the central bottle of the 19 bottles located in the hexagon prism shaped opening. Probe #3 located between the two rack systems to measure ambient room temperature. Probe #4 was fitted to a central bottle of the CellarStak rack, at the same height as the other probes. Probes #1, #2 and #4 were secured by gaffer tape in the same orientation length-wise along the upper left side of the bottle (each a claret style bottle) and 80 mm from the bottle base. The location of each probe on the various test bottles is marked with solid dots and the location of the ambient temperature probe is marked with a circled star in FIGS. 7(a) and 7(b).

[0060] Temperature plots were downloaded to a PC-computer loaded with HOBOLite software (Onset, Cape Cod, Mass., USA) and compared for temperature variation in relation to the ambient temperature (FIG. 9). As can be seen, the ambient temperature of the garage (dotted line; FIG. 9) underwent five distinct temperature decreases (depicted by star symbols in FIG. 9) over a 3 day test period from May 28, 2012 to May 31, 2012. In each of those instances, the magnitude of the temperature decrease of the test bottle in the CellarStak wine rack (Probe #4; upright triangles in FIG. 9) was greater than either that of the peripheral test bottle (Probe #1; inverted triangles in FIG. 9) or the central test bottle (Probe #2; circles in FIG. 9) of the embodiment of the present invention. Similarly, following the rebound of the ambient temperature throughout the latter part of May 28th after the initial temperature drop, the magnitude of the temperature increase of the test bottle in the CellarStak wine rack (Probe #4; upright triangles in FIG. 9) was greater than either that of the peripheral test bottle (Probe #1; inverted triangles in FIG. 9) or the central test bottle (Probe #2; circles in FIG. 9) of the embodiment of the present invention.

[0061] While various specific embodiments have been disclosed, it will be clear that many features can be varied, or the features of one embodiment combined with those of another embodiment and still fall within the invention. For example, the concept of providing discrete support elements could be used in any of the embodiments as a means of altering the size of selected storage openings to configure each opening to receive a particular range of cylinder or bottle size. Further this need not be done uniformly as shown in the fourth embodiment described in FIG. 7. Similarly, the discrete elements need not be planar and connected with the primary support elements, but could also include self-supporting slide in elements which could be shaped to define all or a part of the hexagon shaped opening.

[0062] It will also be appreciated from the foregoing description that the cylinder storage rack of the invention, particularly when used as rack for wine products and like, has significant advantages over the prior art.

[0063] Firstly, the structure is inherently extremely strong, despite the large openings that are provided. In this regard, the opposed angled intersection of the support elements prevents any relative sliding there between and is self-locking plus it resists macking forces as well as vertical loads. The structure is also significantly stronger than, for example, a diamond shaped opening lattice formation which does not have the bi-directional bracing of this particular structure. It is similarly much stronger than a honeycomb type structure, which does not have the advantage of continuously extending linear load bearing elements as in the present design.

[0064] Secondly, not only do the large hexagonal openings enable a high packing density of popular red and/or white wines as required, the equilateral triangular openings disposed between the hexagonal openings, are also extremely useful for storage non-standard sized bottles such as magnums and custom shaped champagne style bottles and the like. Furthermore, the high packing density translates to a high thermal mass which helps to limit temperature fluctuations of product stored within the rack when the rack is subjected to ambient temperature variations.

[0065] Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

1. A cylinder product vertical storage rack for storing generally cylindrical shaped products in a generally horizontal orientation, the rack including:

   three parallel equi-spaced sets of longitudinal continuous primary support elements each directly or indirectly defining surfaces capable of acting as support surfaces having an effective width selected to longitudinally accommodate one or more of cylindrical products of a pre-determined length.

   the sets of primary support elements being oriented such that the second and third sets of support elements intersect and supportingly engage the first set of support elements at equi-spaced intervals at included angles with respect to the first support elements of +60 degrees and −60 degrees respectively, to produce a lattice structure defining a plurality of multiple cylinder receiving generally regular hexagon prism shaped openings between the primary support elements having sides of length x, each of the hexagonal prism shaped openings being in apex to apex contact, with a pair of opposed equilateral triangular prism shaped openings also having sides of length x disposed there between.

2. A cylinder product vertical storage rack according to claim 1, wherein said first set of primary support elements are oriented horizontally such that each hexagon prism shaped opening has a flat horizontal support surface defining its base.

3. A cylinder product vertical storage rack according to claim 2, wherein at least one of said sets of primary support elements are in the form of sheets of a structural material.
4. A cylinder product vertical storage rack configured as a wine rack according to claim 3 wherein at least some of the primary support elements are made from plywood sheet having a thickness of around 12 mm.

5. A cylinder product vertical storage rack according to any one of claim 3, wherein at least two of the support elements are in the form of sheets of structural material, wherein the supporting intersection of each sheet set with the other sheet set or sets is achieved by providing an appropriate arrangement of open ended slots extending from the front and/or rear edge of each sheet, each slot being appropriately sized and oriented to receive the intersecting sheet to form the, or a part of, the lattice structure of claim 1.

6. A cylinder product vertical storage rack according to claim 3 wherein at least a portion of one of said sets of primary support elements are defined by elongate elements of reduced width.

7. A cylinder product vertical storage rack according to claim 6 wherein the elements of reduced width are each in the form of a rod or groups of spaced rods.

8. A cylinder product vertical storage rack according to claim 7 wherein the rods are metal rods.

9. A cylinder product vertical storage rack according to claim 1 further including discrete secondary support elements which define at least some of the support surfaces.

10. A cylinder product vertical storage rack according to claim 9 wherein the secondary support elements define the three lowermost support surfaces within each generally hexagon shaped opening.

11. A cylinder product vertical storage rack according to claim 1 configured as a wine rack, wherein the dimension x is selected to accommodate and support in the finished rack a total of three wine bottles adjacent each support surface within each generally hexagon prism shaped opening to accommodate a total of 19 wine bottles within each generally hexagon prism shaped opening.

12. A cylinder product vertical storage rack configured as a wine rack according to claim 11 designed to store claret style bottles having a diameter of about 74-76 mm wherein the support surface is defined directly by the primary support elements and x is approximately 198-202 mm.

13. A cylinder product vertical storage rack configured as a wine rack accordingly to claim 12 wherein the finished rack has a single depth bottle storage density of around 135 bottles per square metre.

14. A cylinder product vertical storage rack configured as a wine rack according to claim 11 designed to store Burgundy style bottles having a diameter of about 80-86 mm wherein the support surface is defined directly by the primary support elements and x is approximately 216-224 mm.

15. A cylinder product vertical storage rack according to any one of claim 1 configured as a wine rack, wherein the dimension x is selected to accommodate and support in the finished rack a total of two wine bottles adjacent each support surface within each hexagon prism shaped opening to accommodate a total of 7 wine bottles within each hexagon prism shaped opening.

16. A cylinder product vertical storage rack configured as a wine rack according to claim 1 wherein the width w is approximately 340-360 mm to accommodate a single bottle length.

17. A cylinder product vertical storage rack configured as a wine rack according to claim 1 wherein the width w is approximately 680-720 mm to accommodate two bottle lengths end to end.

18. A cylinder product vertical storage rack according to claim 1 wherein the temperature fluctuations experienced adjacent a mid portion of the majority of cylinder products within a rack loaded with cylinder products is less than the temperature fluctuations adjacent a mid portion of a majority of cylinder products loaded within a similar sized rack having discrete isolated openings for each cylinder product.

19. A cylinder product vertical storage rack substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying representations.

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