United States Patent

[11] 3,596,781

[72] Inventor **Jerry Fred Burton**
Box 198-A, Rte. 8, Lexington, N.C. 27292

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[45] Patented **Aug. 3, 1971**

[54] **METHOD AND APPARATUS FOR ASSEMBLING CYLINDERS IN A MINIMUM SPACE, AND PRODUCT OF THAT METHOD AND APPARATUS**
14 Claims, 15 Drawing Figs.

[52] **U.S. Cl.** ..... **214/10.5 R,** 105/367, 105/369 UL, 206/65 R, 214/152
[51] **Int. Cl.** **B65g 1/20**
[50] **Field of Search** ..... 214/152, 10.5, 6 M, 6 N, DIG 4, DIG. 3; 105/367, 369 U; 206/65

[56] **References Cited**

UNITED STATES PATENTS

1,833,764	11/1931	Tremblay et al.	214/ROLL HDCG DIGEST
2,218,316	10/1940	Moon	105/369 U
2,424,395	7/1947	Hedges	214/10.5 X
2,535,828	12/1950	Ardron	214/6 N UX
2,812,727	11/1957	Dorsey	105/367
3,434,602	3/1969	Vann	214/1 R

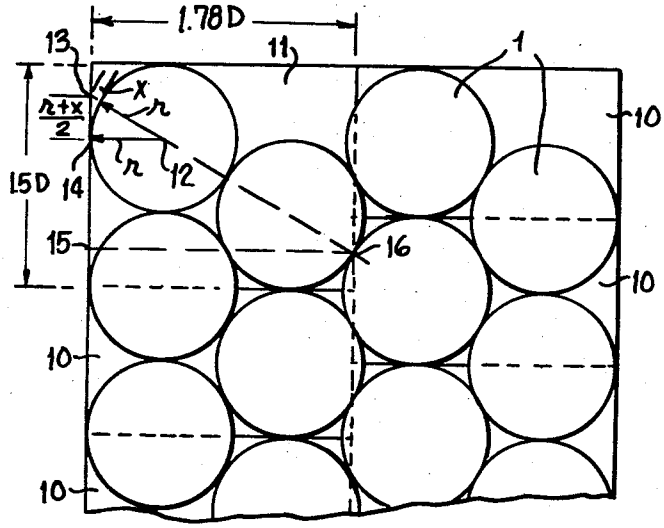
FOREIGN PATENTS

606,644	10/1960	Canada	214/152

Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Frank E. Werner
Attorneys—Robert S. Dunham, P. E. Henninger, Lester W. Clark, Thomas F. Moran, Gerald W. Griffin, R. Bradlee Boal, Christopher C. Dunham and Robert Scobey

ABSTRACT: The method and apparatus for assembling, e.g., for storage or for transportation, right circular cylinders, e.g., tobacco hogsheads, in a minimum space. The cylinders are placed on end and are aligned in adjacent rows so that each cylinder is tangent to two cylinders in each adjacent row. If so aligned, the horizontal lines connecting the cylinder axes of any three tangent cylinders intersect at angles of 60°.

Pallet structures are disclosed which assist in aligning the cylinders according to the invention, and which also assist in distributing the load between tiers of stacked cylinders, so as to make the stack more stable. Particular dimensions for the pallets, related to the cylinder diameters, are disclosed, together with particular methods of arranging the pallets under one or more tiers of cylinders.



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SHEET 1 OF 2

Fig. 2.

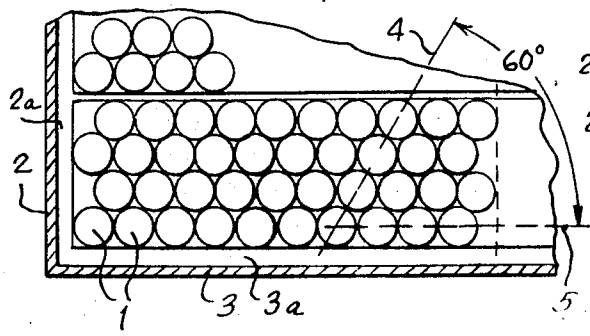


Fig. 1.
PRIOR ART

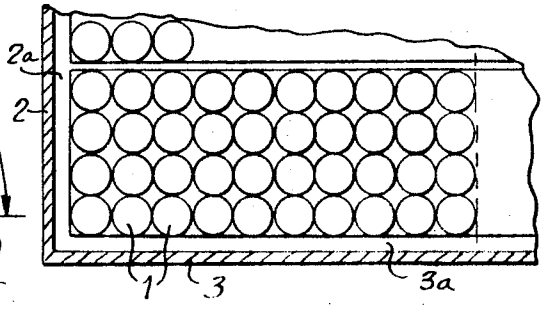


Fig. 3.

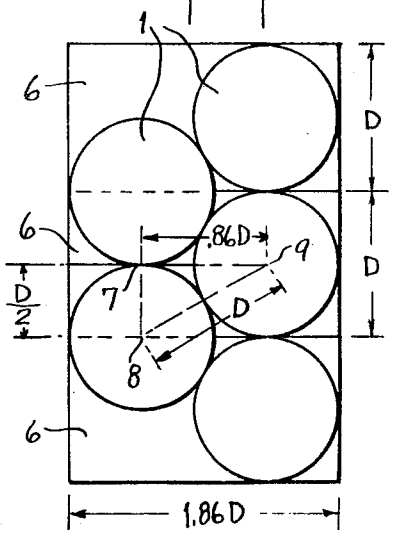


Fig. 4.

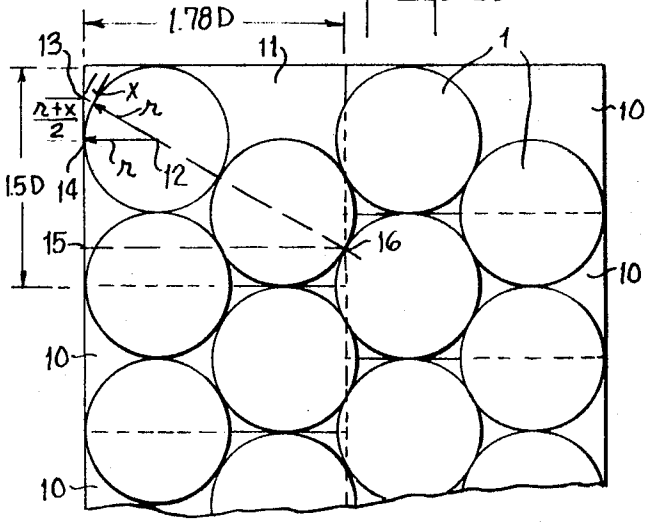
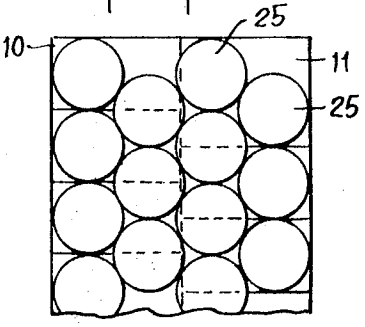


Fig. 14.



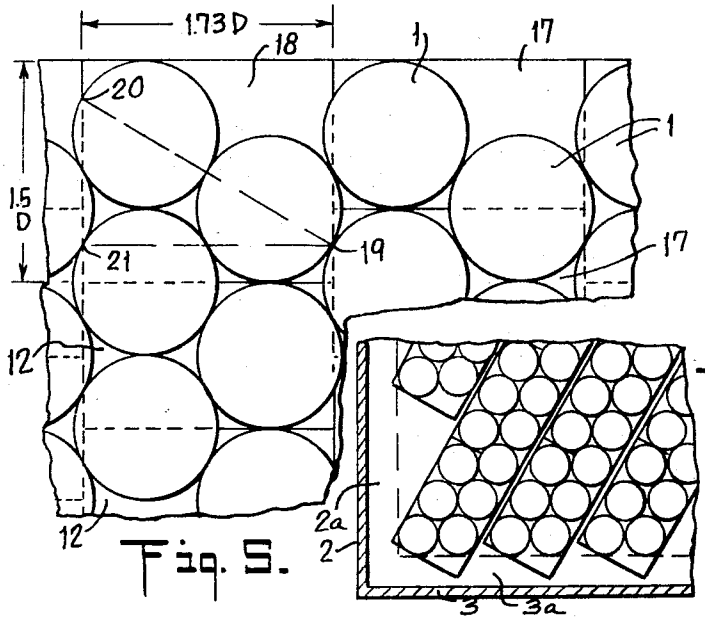


Fig. 5.

Fig. 15.

INVENTOR.
J. FRED BURTON
BY Lester W. Clark
ATTORNEY

Fig. 6.

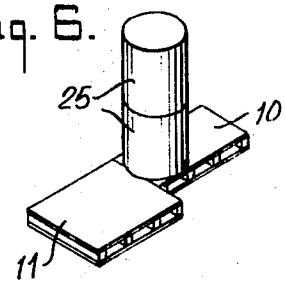


Fig. 7.

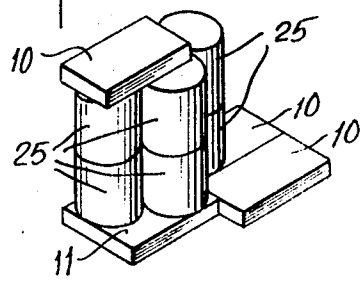


Fig. 8.

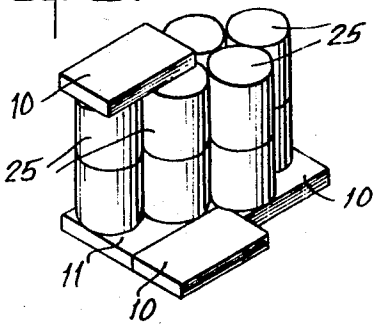


Fig. 9.

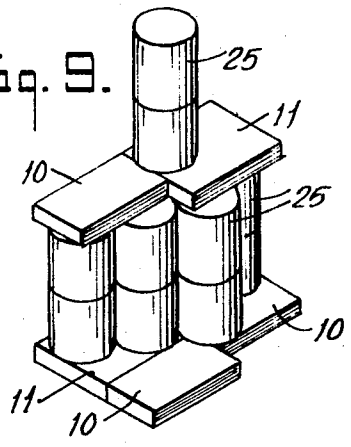


Fig. 10.

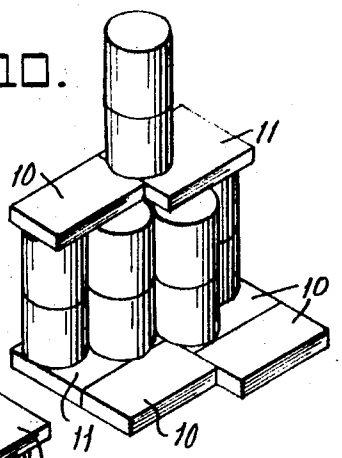


Fig. 11.

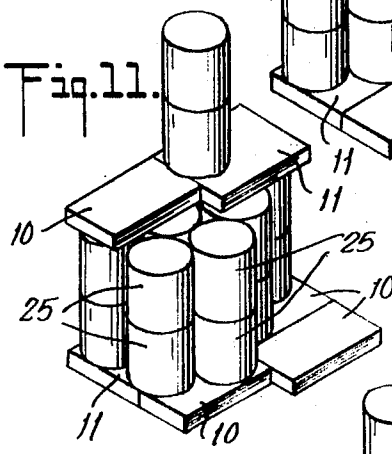


Fig. 12.

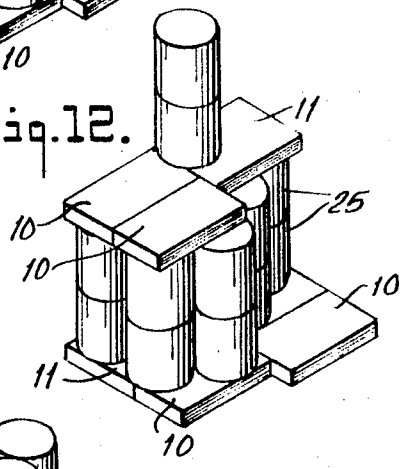
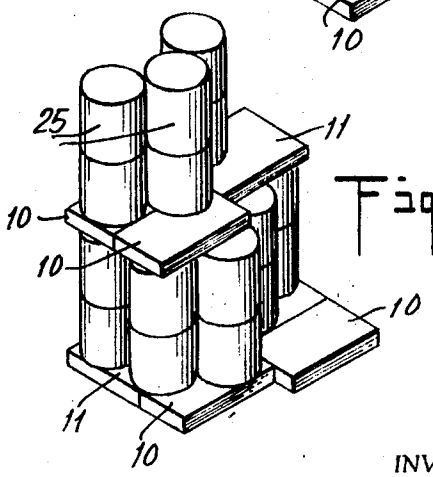


Fig. 13.



INVENTOR.
J. FRED BURTON
BY Lester N. Clark
ATTORNEY

METHOD AND APPARATUS FOR ASSEMBLING CYLINDERS IN A MINIMUM SPACE, AND PRODUCT OF THAT METHOD AND APPARATUS

CROSS-REFERENCE

My copending application, Ser. No. 797,186, filed Feb. 6, 1969, entitled "Lift Truck Apparatus for Manipulating Storage Drums" shows and claims a lift-truck attachment suitable for stacking cylinders according to the present invention.

BACKGROUND OF THE INVENTION

It has been observed, in connection with aligned right circular cylinders such as pipe sections, that they may be stored or packed for shipping in a minimum space by arranging the cylinders in rows so that each cylinder is tangent to two cylinders in each adjacent row and so that lines connecting the cylinder axes in any plane perpendicular to those axes intersect at angles of 60°.

Examples of the horizontal storage of cylinders in this fashion are shown in the U.S. Pat. No. 1,993,216 to Marshall, and U.S. Pat. No. 2,605,786 to Scott. However, it does not appear that this method of assembling cylinders for storage or shipment has ever been adapted to cylinders which have a relatively smaller length-to-width ratio than pipe sections, and which are stable when standing on end, i.e., with their axes vertical.

SUMMARY OF THE INVENTION

The present invention relates to a method for assembling right circular cylinders, such as drums, barrels, or tobacco hogshead, with a view to minimizing the space requirements for any particular number of cylinders. The cylinders are arranged standing on end and aligned in adjacent rows so that each cylinder is tangent to the cylinders in each adjacent row and horizontal lines connecting the cylinder axes intersect at angles of 60°. The method and apparatus of the invention are of particular utility in connection with cylinders of substantially equal diameter. It will readily be recognized that all such cylinders of equal nominal diameter are in fact subject to minor variations in size and shape, particularly after considerable use.

The cylinders may be arranged in a single tier or in multiple tiers. In either event, it is preferred to employ pallets having particular dimensions related to the diameters of the cylinders. The pallets serve to guide the placement of the cylinders as they are being stored or loaded. In multiple tiers, pallets between the tiers also serve to distribute the load of the cylinders above the pallets on the cylinders below, and thereby to avoid unstable stacks due to unequal dimensions of the cylinders or inaccurate placement thereof. Pallets are particularly desirable between tiers of cylinders with recessed ends, such as barrels or tobacco hogsheads.

In one embodiment of the invention, the pallets have a width equal to the cylinder diameter and a length of 1.86 times the cylinder diameter. A row of such pallets may be laid down with their long sides abutting. The cylinders are then placed on the pallets in two rows. Each cylinder in one row is tangent to one short edge and to both long edges of a pallet. Each cylinder in the other row has a diameter aligned with the abutting edges of two pallets and is tangent to the short edges of the two pallets at their point of abutment.

Another embodiment of the invention employs pallets having a width equal to the cylinder diameter and a length equal to about 1.78 times the cylinder diameter. These pallets are arranged in pairs of rows with their long sides abutting, with one set of aligned short sides of the pallets in one row abutting one set of aligned short sides of the adjacent row, and each pair of abutting long sides of each row displaced by about one-half the width of a pallet from a pair of abutting long sides of the adjacent row. In this embodiment, it is preferred to use special pallets at the opposite ends of adjacent rows. These special pallets have a width equal to about 1.5 times the cylinder diameter, so that the long sides of the pallets at the ends of the rows are aligned.

A third embodiment of the invention employs pallets having a width equal to the cylinder diameter and a length equal to 1.56 times the cylinder diameter. These pallets are grouped in rows, with more than two rows in each group. The cylinders necessarily overlap the short sides of the pallet on which they are placed, either being tangent or diametrically related only to the long side. As in the second embodiment mentioned above, the pallets at opposite ends of alternate rows have a width equal to 1.5 times the cylinder diameter so as to provide aligned long sides of the pallets at the ends of the rows.

Any of the three embodiments may be arranged in tiers, each tier comprising one layer of pallets and at least one layer of cylinders. Where multiple tiers are used in the second and third embodiments mentioned above, the wide pallet at the end of a row of pallets is in vertical alignment with a narrow pallet in the next adjacent tier.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a storage area having right circular cylinders stored therein according to the method conventionally used in the prior art;

FIG. 2 is a view similar to FIG. 1, but shows the cylinders stored in the area in accordance with the present invention;

FIG. 3 is a plan view on a larger scale showing one method of arranging right circular cylinders on pallets according to the invention;

FIG. 4 is a view similar to FIG. 3, illustrating a second embodiment of the invention;

FIG. 5 is another view similar to FIG. 3, illustrating a third embodiment of the invention;

FIGS. 6 to 13 illustrate the preferred sequence of building up a two-tiered stack of pallets and cylinders arranged in accordance with FIG. 4;

FIG. 14 is a plan view, on a smaller scale, showing the arrangement of the cylinders and pallets in the second tier of a stack whose first tier may be arranged according to FIG. 4;

FIG. 15 is a view similar to FIG. 2, illustrating a modified method of storing cylinders in accordance with the invention.

FIGS. 1-2

FIG. 1 shows the method conventionally used in the prior art for storing drums, barrels and the like. The word "storing" as used in this specification, is intended as a generic term inclusive of stationary storage, as in a warehouse or the like and moving storage, as in a freight car or the like.

FIG. 1 shows the space required for storing 40 cylinders 1 within a space defined by walls 2 and 3 intersecting at a right angle. In the arrangement shown, open spaces 2*a* and 3*a* are provided between the walls 2 and 3, respectively, and the stack of cylinders 1. Such open spaces are commonly provided, for example, in warehouses for storing tobacco in hogsheads, to allow ventilation of the stacked hogsheads, and to provide a walkway for inspection of the hogsheads.

Alternatively, where ventilation and inspection are not needed, as on a truck or freight car, the stacks of cylinders 1 may be placed directly against the walls.

It may be observed that the total storage space for 40 cylinders has a length equal to 10 times the diameter of one cylinder and a width equal to 4 times the diameter of one cylinder. Thus the total floor area required is 40 times the square of the cylinder diameter.

FIG. 2 illustrates the storage of the same number of cylinders of the same size in an area defined by the same walls 2 and 3 but arranged in accordance with the present invention. Note that the 40 cylinders are arranged in four horizontal rows, but that each cylinder is tangent to two cylinders in each adjacent row. Thus, the lines joining the axes of the cylinders intersect at 60° as indicated in the case of the angle between

the lines 4 and 5. The total length required for the storage of 40 cylinders is 10.5 times the cylinder diameter and the total width required may be computed to be 3.56 times the cylinder diameter. Thus, the total storage area required for the 40 cylinders is the product of 10.5×3.56, or 37.38 times the square of the cylinder diameter, whereas in FIG. 1, the floor area required is 40 times the square of the cylinder diameter. The percentage advantage in the storage area according to the present invention increases as the length of the rows increases, since the one-half cylinder diameter increase in row length is the same regardless of the number of cylinders in the row. Thus, in the example shown where there are 10 cylinders in the row, the percentage increase in the overall length is 5 percent. On the other hand, if there were 100 cylinders in a row, the percentage increase in the length would only be 0.5 percent.

The methods and apparatus of this invention are applicable to all types of cylindrical containers whether they be barrels, bales, cans, pipe sections, or some other specific structure. The particular apparatus and methods shown herein are more readily adaptable to cylinders which have a length to width ratio sufficiently small so that they are stable when stood on end, such as drums, as opposed to pipe sections having a diameter small as compared to their length, which are not stable when stood on end.

FIG. 3

It is desirable for the person directing the storage of cylinders according to the invention to have some way of guiding the arrangement of the cylinders so as to make sure that he is getting the cylinders in the proper 60° relationship with respect to their center lines. It appears to be quite easy and natural for a man to stack cylinders according to the prior art method with a 90° relationship between the centerlines, and to set these 90° relationships by eye, with no special measurement, and still come out with neat, rectangularly arranged stacks. However, where the 60° arrangement is used, as in the present invention, the 60° relationships seems to be less natural and more difficult to determine by eye. The stacks tend to become irregular and somewhat disarrayed with an attendant loss of valuable storage space, unless some means is provided for guiding the arrangement of the cylinders.

FIG. 3 shows an arrangement of pallets which provides that guiding function. Where the pallets are used directly on the floor, they also allow for ventilation around the bottom of the cylinders, which is desirable in the case of some stored products, e.g., tobacco in hogsheads. The ventilation so provided protects against the possibility of moisture damage to the tobacco. Each pallet generally is indicated by the numeral 6, and each has a width equal to the diameter D of a cylinder 1 and a length equal to about 1.86D.

The 1.86D dimension may be readily determined by applying the theorem of Pythagoras to the right angle triangle 7, 8, 9 whose hypotenuse is equal to the diameter D. Since this is a 30°, 60°, 90° triangle, it is known that the short side, 7—8, is one-half the hypotenuse or D/2. The remaining side 7—9, can then be determined to be 0.86D. The total length of the pallets is determined by adding one diameter to 0.86D, making a length of 1.86D.

This arrangement of the cylinders as shown in FIG. 3 is not the most efficient utilization of the available storage space, but it does allow for access to any of the rows, if adequate aisle space is provided between the rows. This arrangement is thus suitable for mixed storage, where the cylinders may contain different products, and it may be desirable to have access to the cylinders at random.

FIG. 4

This figure illustrates a somewhat more compact arrangement of pallets and cylinders. Here there are provided a plurality of pallets 10, arranged in two adjacent rows. Each pallet has a width equal to the cylinder diameter D and a length equal to 1.78D. At the upper end of the left-hand row, as it appears in the drawing, there is provided a pallet 11 having a width of 1.5D. It is intended that a similar wide pallet be provided at the opposite end of the adjacent right-hand row.

In this arrangement of the cylinders 1, the cylinders in each of the two tier rows are tangent to the short sides of the pallets at their points of abutment. The long sides of the pallets in each row abut each other, but the abutting long side of each pair of pallets are displaced by about one-half of a cylinder diameter from the abutting long sides of the pairs in the adjacent row of pallets. By staggering the pallets in this manner, and placing the pallets alternately in the two rows, each time an additional pallet is laid down in a row, there is provided a lateral guiding surface extending one-half the width of the pallet, so that the rows can be laid down in a more orderly fashion than if they were laid down with no lateral guidance between adjacent pallets. The inner rows of cylinders in this array necessarily overlap the abutting short sides of the pallets. Thus, in this array, each cylinder in an inner row rests on portions of three pallets, thereby distributing the load to accommodate any unevenness in the underlying surface.

In any storage method accessibility must always be considered in conjunction with economy of space. The arrangement of FIG. 4, which is the presently preferred embodiment of the invention, represents a compromise between accessibility and space economy. The two outer rows of cylinders are always accessible, assuming that suitable aisle space is provided between adjacent groups of rows of cylinders. Thus, in a situation where it is desired to be able to move a large number of cylinders rapidly, it is possible to bring more lift trucks into play on opposite sides of each group of rows of cylinders, than would be the case if the aisle space were farther apart, as in the embodiment described below in connection with FIG. 5.

The long dimension of the pallets 10 and 11 can be figured by applying the theorem of Pythagoras to the triangle 12, 13 and 14 in FIG. 4. There it is shown that in this 30°, 60°, 90° triangle, the long side is r, the hypotenuse is $r+x$ and the short side is $r+x/2$. It is known that r is equal to D/2. By solving this small triangle, it can be determined that $x=0.13r$. Considering then the larger triangle 13, 15, 16, it is now known that the hypotenuse is 2.065D and that the shorter side is one-half of that, or 0.032D. Solving that triangle produces the value for the long side 15, 16, which is the length of the pallet, as being equal to 1.78D.

Instead of using a wide pallets 11 at the end of one row, it is possible to use two narrow pallets 10, in which case the upper half of the uppermost of those two pallets, as viewed in FIG. 10, will perform no supporting function, but will simply project into a ventilation space, such as the walkaway 2*a* of FIG. 2.

FIG. 5

This figure illustrates an embodiment of the invention which arrives at an absolute minimum of storage space for a given number of cylinders, at some sacrifice of accessibility. Here pallets 17 are provided having a width equal to the cylinder diameter and a length equal to 1.56 times the cylinder diameter. These pallets are designed to be placed in adjacent staggered rows similar to the rows of FIG. 4, except that the number of rows of pallets between aisles is expected to be greater than two, preferably much greater. Each cylinder 1 is either tangent to two long sides of a pallet or has a diameter aligned with the abutting long sides of two pallets. Furthermore, each cylinder 1 overlaps the abutting short sides of pallets in two adjacent rows.

As in the case of FIG. 4, pallets 18, having a width of 1.5D are provided at alternate ends of adjacent rows so as to bring the long sides of the pallets at the ends of the rows into alignment.

The length of the pallets 17 and 18 may be determined from the triangle 19, 20, 21 in FIG. 5. Again, this is a 30°, 60°, 90° triangle. It is known that the hypotenuse is 2D and hence the

shorter side is D. It is therefore apparent that the long side, or length of the pallet, is equal to $\sqrt{3}D$, or 1.73D.

This arrangement has the further difficulty that the drum lift operator does not have an opportunity to observe the tangency of any drum at a short side of a pallet, and it must therefore be guided by the movement of the drums into tangent relationships. Since the drums have only nominally constant diameters, especially if they are old and somewhat battered, the stacking may not be completely regular where pallets of these dimensions are employed. It is therefore preferred to use the pallet arrangement of FIG. 4, which results in neater and more regular stacks. The theoretical gain in space between FIGS. 4 and 5 may be offset by losses due to irregular cylinder shapes and normal inaccuracies in cylinder placement.

FIGS. 6-13

These figures illustrate a series of steps in building up a stack of stored cylinders in accordance with the preferred embodiment of the invention, illustrated in plan view in FIG. 4. The finished stack is intended to consist of two tiers, each tier comprising the layer of pallets and two layers of cylinders stacked on the pallets.

The first step in assembling the stack is illustrated in FIG. 6, and shows the placement of a wide pallet 11 of the dimensions illustrated in FIG. 4 and a narrow pallet 10, also of the dimensions illustrated in FIG. 4. One short side of the pallet 10 abuts one short side of the pallet 11, with the rearmost long sides of those two pallets in alignment. Two cylinders 25 are stacked on the narrow pallet 10, one on top of the other. The bottom cylinder 25 is tangent to both long sides of the pallet 10 and overlap the pallet 11 slightly.

FIG. 7 indicates the next steps in assembling the stack of cylinders. A second narrow pallet 10 is placed beside the first pallet 10, with the long sides of the two pallets abutting. Two layers of cylinders 25 are then stacked on top of the pallet 11, with their edges tangent to the sides of the pallet 11, as illustrated in FIG. 4. Note that the open long side of the pallet 11 is aligned with the centerline of the second pallet 10, so that the abutting long sides of the two pallets 10 are displaced by one-half the width of a pallet 10 from the open long side of the pallet 11. The short side of the pallet 11 thus serves as a guide for placement of the second pallet 10.

While it might appear from the drawings that the two layers of cylinders on pallet 11 in FIG. 7 could be placed first, and the single stack of FIG. 6 placed later, that is not generally true in practice, because of lateral space limitations due to walls or other stacks of cylinders. Because of those space limitations, the gripping arms on the truck supporting the single stack would not have room to reach behind the double stack and set the stack shown in FIG. 6 in place.

It is practically necessary to place the second pallet 10 before the two layers of cylinders are stacked on pallet 11, since one of those stacks overlaps the second pallet 10 slightly (see FIG. 4). Otherwise, it would be necessary to force the pallet under the edge of the cylinder, which would be difficult, if not impossible to do without damage to the pallet.

Another narrow pallet 10 is then placed on top of the two layers of cylinders 25 which have just been stacked on the pallet 11.

It should be understood that all of the pallets are handled by a standard forklift truck, while the cylinders are handled by trucks equipped with clamping mechanisms for gripping cylinders. For example, the gripping mechanism may be that illustrated in my copending application Ser. No. 797,186, identified above, which is capable of grasping and lifting and/or turning either one, two or four cylinders at one time.

Since the immediately following step will be to place a narrow pallet 10 on the floor in front of and abutting the wide pallet 11, as shown in FIG. 8, it is necessary to place the narrow pallet 10 of the second tier before that narrow pallet 10 on the floor is put in place. Otherwise, a standard forklift truck could not reach the location of the second tier pallet 10 without running over the pallet on the floor. (It is assumed that lateral clearance at the left-hand side of the stack is limited.)

After the pallet 10 is placed adjacent the wide pallet 11, in the left-hand row, the bottom tier of pallets as it appears in FIG. 8, then two more stacks of cylinders 25 are placed on the pallets 10 in the right-hand row of pallets in FIG. 8.

The next steps are illustrated in FIG. 9. A second wide pallet 11 is placed on top of the stacks of cylinders 25 at the right-hand side of the array and another stack of cylinders 25 is placed on the inside back corner of the second wide pallet 11, overlapping the pallet 10 on the second tier.

FIGS. 10 to 14 illustrate a sequence of four steps which are repeatedly performed in continuing the buildup of a stack of cylinders in accordance with the invention. The first of this sequence of four steps is the placing of a narrow pallet 10 on the floor at the front of whichever row of pallets is at that time the shortest. See the foremost pallet 10 on the right-hand side of FIG. 10, which has been added to the right-hand row of pallets as they appear in FIG. 9.

The second step in the sequence of four is to place two stacks of two cylinders each on the opposite row of pallets from the one that has just been placed. See in FIG. 11 the four cylinders 25 appearing at the front of the figure supported by the left-hand row of pallets 11 and 10.

The third step in the sequence of four is the placing of another narrow pallet 10 on the top of the two stacks of cylinders which were placed in the immediately preceding step. See the front pallet 10 in the second tier in FIG. 12.

The fourth and final step in the sequence is the placing of two stacks of four cylinders on the top of the second tier pallet which was just placed and the pallet immediately behind it.

This sequence of steps is now repeated beginning first with one row of pallets and then with the other, to extend the stack of cylinders as far as may be convenient.

The arrangement shown in FIGS. 6—13 has been found to be particularly suitable for tobacco hogsheads, which are conventionally constructed with recessed ends encircled by peripherally projecting rims. Two layers of such hogsheads can be stably stacked end-on-end above one another without a layer of stress distributing pallets between them. If more than two layers of hogsheads is desired, then it is desirable to introduce a layer of pallets to distribute the loads and keep the stack substantially even and regular.

It is alternatively possible to place stress-distributing pallets between each pair of adjacent layers of cylinders.

With more stable individual cylinders, i.e., cylinders without recessed ends, it is possible to stack more than two layers of cylinders together without the use of stress-distributing pallets.

FIG. 14

This figure illustrates the array of pallets 10 and 11 in the second tier. Note that the wide pallet 11 in the second tier is above a narrow pallet 10 in the tier below. Note also that the abutting long sides of each pair of pallets in each row is located in alignment with the centerline of a pallet in the bottom tier. This staggering of the abutting sides of the pallets comes about because of the placing of the wide pallets alternately in opposite rows in the successive tiers. This staggering of the pallets in successive tiers is highly desirable to make the stack stable.

Note that in FIG. 14, as in FIG. 4, each cylinder in a center row rests upon portions of three pallets, so that any unevenness in the underlying support is accommodated.

FIG. 15

FIG. 15 shows a method for arranging pallets in rows which extend diagonally with respect to the walls 1 and 2 of the storage warehouse or other building in which they are located. Note that the pallet nearest the wall has an unoccupied portion which underlies a part of the walkway 2*a*, 3*a*, so that the ventilation and inspection facilities afforded by that walkway are not obstructed.

Obviously, the two tiers could alternatively be arranged with the bottom tier pallets and cylinders arrayed as in FIG. 14, and the upper tier as in FIG. 4. Note in this connection that the outer rows of cylinders in FIG. 4 are supported by two pallets, while in FIG. 14, they are supported only by one pallet. There is thus more stress distribution in a tier arrayed as in FIG. 4, and hence greater stability.

I claim:

1. The method of assembling right circular cylinders of equal diameter in a minimum space, comprising the steps of:

a. arranging a plurality of pallets, each having a width equal to the cylinder diameter and a length within the range from about 1.56 to about 1.89 times the cylinder diameter, in at least two adjacent rows, with the long sides of the pallets in each row abutting and the short sides aligned, with one set of the aligned short sides of one row abutting one set of the aligned short sides of the adjacent row, and with each pair of abutting long sides of each row displaced by about one-half the width of a pallet from a pair of abutting long sides of the adjacent row;

b. standing the cylinders on end on the rows of pallets so that, for each pallet, one cylinder rests on the pallet at one end thereof, with its bottom surface tangent to both long sides of the pallet, and two other cylinders rests on the other end of the pallet, both tangent to said one cylinder and overlapping the adjacent pallets, with said long sides of the pallet extending substantially diametrically of said two other cylinders; and

c. aligning the cylinders in adjacent rows so that each cylinder is tangent to two cylinders in each adjacent row and horizontal lines connecting the cylinder axes intersect at angles of 60°.

2. The method of claim 1, in which the cylinders overlap the aligned short sides at one side of each row of pallets, and are tangent to the aligned short sides at the other side of each row, and the pallet length is substantially 1.78 times the cylinder diameter.

3. The method of claim 2, in which there are only two rows of pallets, and four rows of cylinders, with the cylinders in the two inner rows overlapping the two rows of pallets and the cylinders in the two outer rows tangent to the outer edges of the pallets.

4. The method of claim 1, in which the cylinders overlap the aligned short sides at both sides of each row of pallets and the pallet length is substantially 1.56 times the cylinder diameter.

5. The method of claim 1, in which the pallets at opposite ends of adjacent rows have a width equal to about 1.5 times the cylinder diameter, so that the long sides of the pallets at the ends of the rows are aligned.

6. The method of claim 5, including the steps of:

a. arranging the pallets and cylinders in a plurality of tiers, each tier comprising one layer of pallets surmounted by at least one layer of cylinders;

b. placing the wide pallets (1.5 times cylinder diameter) at the end of each row of pallets in vertical alignment with a narrow pallet (= cylinder diameter) in the next adjacent tier.

7. The method of assembling right circular cylinders of equal diameter in a minimum space, comprising the steps of:

a. arranging a plurality of pallets, each having a width equal to the cylinder diameter and a length substantially 1.89 times the cylinder diameter in a row, with the long sides of the pallets abutting and the short sides aligned; and

b. standing the cylinders on end in two rows along the row of pallets, with the cylinders of one row being tangent to both long sides and one short side of a pallet and each cylinder of the other row having a diameter of the cylinder aligned with the abutting long sides of adjacent pallets, and each cylinder of each row is tangent to two cylinders of the other row, and horizontal lines connecting the cylinder axes intersect at angles of 60°.

8. An assemblage of right circular cylinders of equal diameter, occupying a minimum space, including two adjacent rows of cylinders standing on end, a single row of pallets supporting said two adjacent rows of cylinders, all said cylinders being tangent to the short sides of the pallets, with the cylinders of one row being tangent to the long sides of the pallets and the cylinders of the other row having diameters aligned with the long sides of the pallets, said pallets having a length about 1.89 times the cylinder diameters, and with each cylinder tangent to two cylinders in each adjacent row, so that horizontal lines connecting the cylinder axes intersect at angles of 60°.

9. An assemblage of right circular cylinders of equal diameter, occupying a minimum space, including:

a. two adjacent rows of pallets supporting four adjacent rows of cylinders, standing on end, and with each cylinder tangent to two cylinders in each adjacent row, so that horizontal lines connecting the cylinder axes intersect at 60°, each pallet having a width equal to the cylinder diameter and a length equal to about 1.78 times the cylinder diameter, the pallets of each row having their long sides abutting and their short sides aligned;

b. with one set of the aligned short sides of one row of pallets abutting one set of the aligned short sides of the adjacent row of pallets;

c. with each pair of abutting long sides of each row displaced by about one-half the width of a pallet from a pair of abutting long sides of the adjacent row;

d. with the two outer rows of cylinders tangent to the two outer sets of aligned short sides of the pallets; and

e. with the two inner rows of cylinders overlapping the abutting short sides of pallets in the two rows.

10. An assemblage of right circular cylinders of equal diameter, occupying a minimum space, including:

a. more than two adjacent rows of pallets, each providing the principal support for two adjacent rows of cylinders, standing on end, and with each cylinder tangent to two cylinders in each adjacent row, so that horizontal lines connecting the cylinder axes intersect at 60°, each pallet having a width equal to the cylinder diameter and a length equal to about 1.56 times the cylinder diameter, the pallets of each row having their long sides abutting and their short sides aligned;

b. with at least one set of the aligned short sides of each row of pallets abutting one set of the aligned short sides of the adjacent row of pallets;

c. with each pair of abutting long sides of each row displaced by about one-half the width of a pallet from a pair of abutting long sides of the adjacent row; and

d. with each inside row of cylinders overlapping the abutting short sides of pallets in two rows.

11. An assemblage of right circular cylinders of equal diameter, occupying a minimum space, including:

a. at least two adjacent rows of pallets supporting four adjacent rows of cylinders, standing on end, and with each cylinder tangent to two cylinders in each adjacent row, so that horizontal lines connecting the cylinder axes intersect at 60°, the pallets of each row having their long sides abutting and their short sides aligned;

b. with one set of the aligned short sides of one row of pallets abutting one set of the aligned short sides of the adjacent row of pallets;

c. with each pair of abutting long sides of each row displaced by about one-half the width of a pallet from a pair of abutting long sides of the adjacent row;

d. with each inside row of cylinders overlapping the abutting short sides of pallets in two rows; and

e. pallets at the opposite ends of adjacent rows having a width equal to about 1.5 times the cylinder diameter, so that the long pallet sides at the ends of the rows are aligned.

12. An assemblage as defined in claim 11, including:

a. a plurality of tiers of pallets and cylinders, each tier comprising one layer of pallets surmounted by at least one layer of cylinders;

b. with the wide pallet (1.5 times the cylinder diameter) at the end of each row of pallets in vertical alignment with a

narrow pallet (width equals cylinder diameter) in the next adjacent tier.

13. The method of claim 12, in which said stack is assembled in a plurality of tiers, each tier comprising a layer of pallets surmounted by at least one layer of cylinders, comprising the further steps of:

f. after each step (d), placing another pallet on the top of the cylinder tier and above said second and third cylinders;

g. after the second repetition of step (f), repeating step (b) by placing a cylinder on the second tier of pallets placed during the two repetitions of step (f);

h. after each subsequent repetition of step (f), repeating step (d) by placing at least two cylinders on said second tier of pallets.

14. The method of assembling in a space accessible from one end, a stable stack comprising a plurality of right circular cylinders of equal nominal diameter but subject to minor variations in size and shape, comprising the steps of:

a. placing on a supporting floor an initial array of elongated pallets, each having a width at least substantially equal to said cylinder diameter and a length equal to about 1.78 times said cylinder diameter, said array comprising two rows, each row comprising at least one pallet, with one short side of each pallet abutting a short side of a pallet in the other row, and one long side of a foremost pallet in one row spaced toward said accessible end of the space from the side of a pallet in the other row;

b. placing on the pallet in the other row a first one of said cylinders, standing on end, with its bottom end overlapping the abutting end of at least one pallet in said one row;

c. placing in said other row an additional pallet having a width substantially equal to the cylinder diameter and a length equal to about 1.78 times the cylinder diameter, with a long side of said additional pallet abutting a long side of the adjacent pallet in said other row and a short side of said additional pallet abutting a portion of a short side of the foremost pallet in said one row, so that the additional pallet becomes the foremost pallet in the two rows;

d. placing on the pallets in said one row second and third cylinders, standing on end, with their surfaces tangent and with the surface of one of said second and third cylinders tangent to said first cylinder, and so that a horizontal line drawn between the axes of the second and third cylinder intersects a horizontal line drawn between the axes of the first and third cylinders at an angle of 120°;

e. repeating steps (c) and (d), alternately beginning with a pallet in said one row, and then with a pallet in the other row.