Dec. 1, 1970 G. W. BAKER 3,543,369

METHOD FOR EXPANDING A CYLINDRICAL VACUUM COOLING CHAMBER

Filed July 9, 1968 2 Sheets-Sheet 1

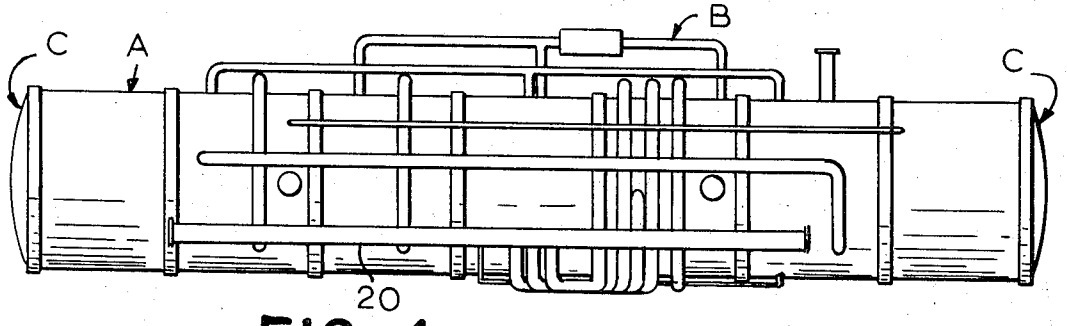


FIG_1

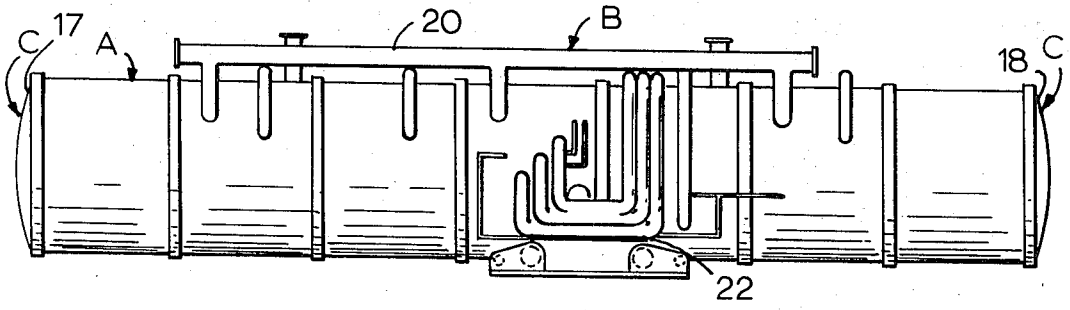


FIG_2

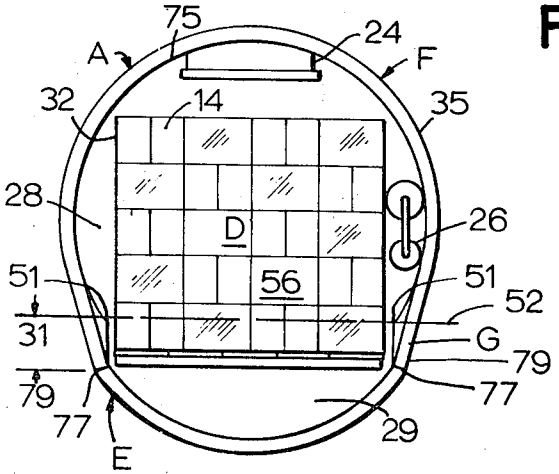


FIG_4

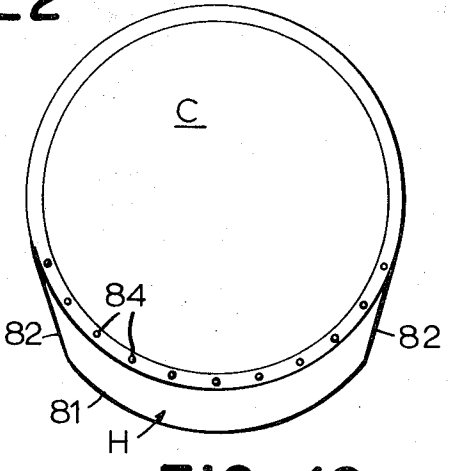


FIG_10

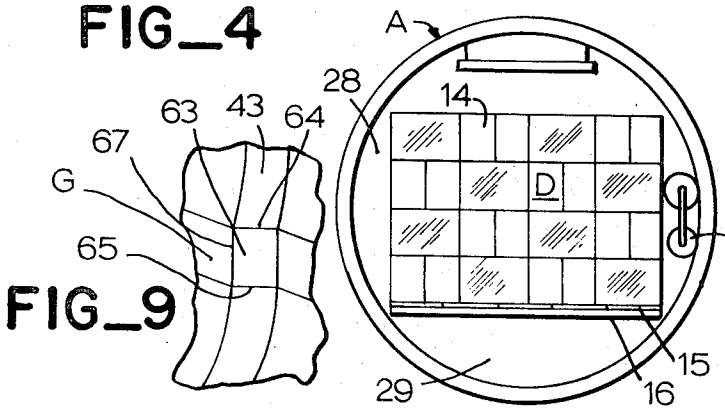


FIG_9

FIG_3

INVENTOR.
GEORGE WALTER BAKER
BY
Townsend & Townsend
ATTORNEYS

Dec. 1, 1970 G. W. BAKER 3,543,369

METHOD FOR EXPANDING A CYLINDRICAL VACUUM COOLING CHAMBER

Filed July 9, 1968 2 Sheets-Sheet 2

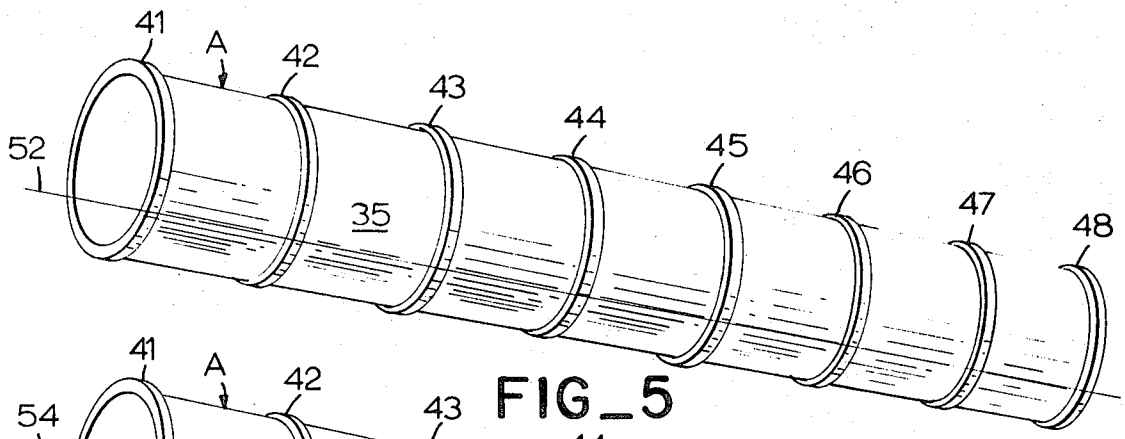


FIG_5

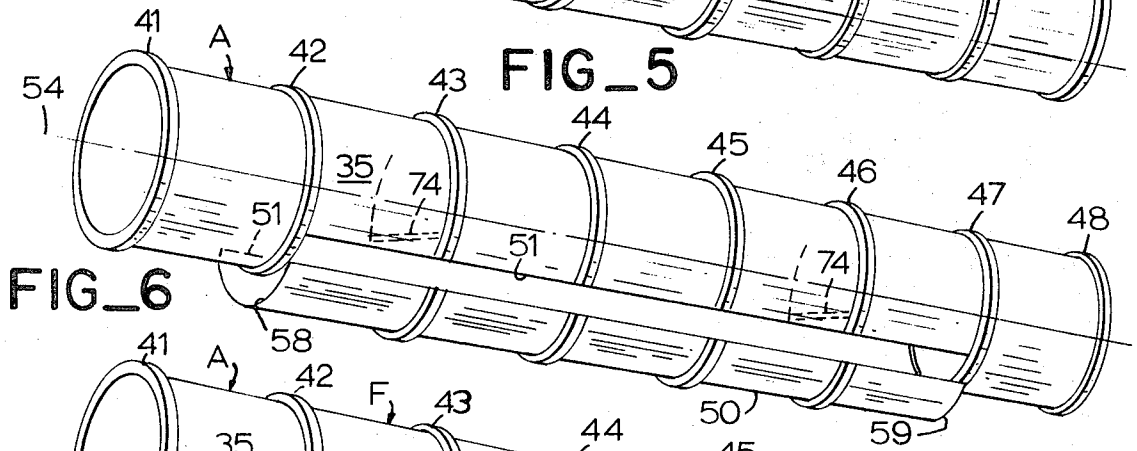


FIG_6

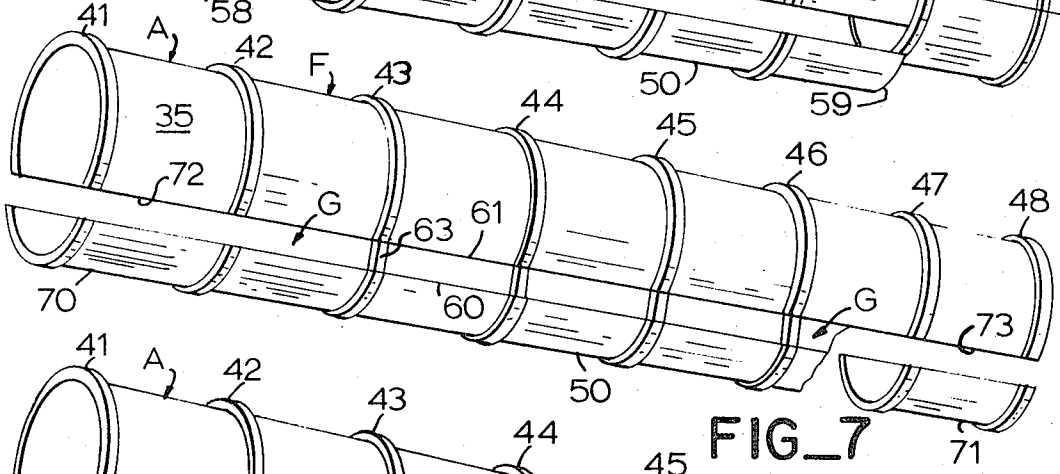


FIG_7

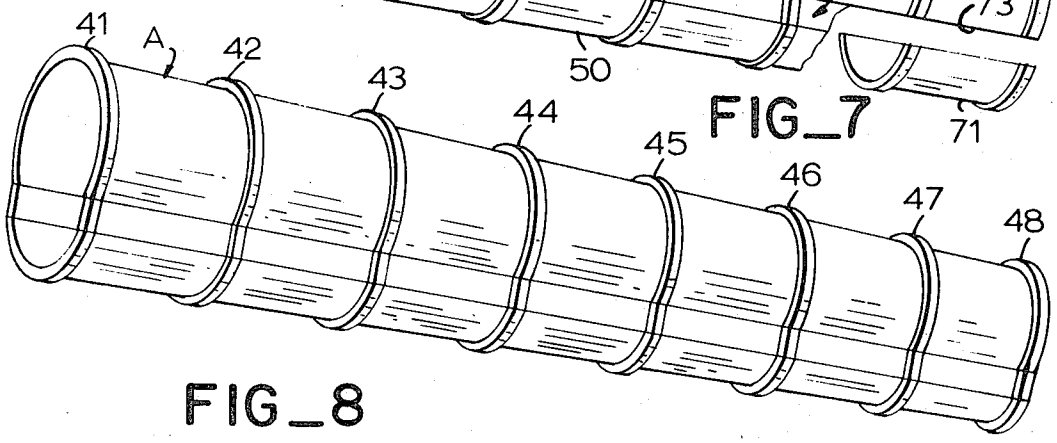


FIG_8

INVENTOR.
GEORGE WALTER BAKER
BY
Townsend and Townsend
ATTORNEYS

United States Patent Office 3,543,369 Patented Dec. 1, 1970

3,543,369

METHOD FOR EXPANDING A CYLINDRICAL VACUUM COOLING CHAMBER

George W. Baker, P.O. Box 1756,
El Centro, Calif. 92243

Filed July 9, 1968, Ser. No. 743,447
Int. Cl. B21d 53/00
U.S. Cl. 29—157 3 Claims

ABSTRACT OF THE DISCLOSURE

A method for converting and an apparatus comprising a cylindrical vacuum cooling chamber having an eccentric and increased overhead dimension. The cylinder as expanded provides substantially the strength of a cylindrical shell without elastic deformation of the cylinder or extensive piping reconnection during the expansion process.

This invention sets forth a method and apparatus for providing a cylindrical vacuum cooling cramber with an expanded vertical dimension of minimum volume.

Leafy fresh vegetable products are typically cooled for shipment in vacuum cooling chambers. These chambers have the product placed therein. Thereafter the vacuum chambers are sealed by airtight doors, typically at the chamber ends. When the product is completely sealed, the air within the chamber is evacuated, thereby causing the moisture within the packaged product to rapidly evaporate. This evaporation takes the ambient heat away from the product and produces rapid, uniform cooling throughout the contained product on a substantially instantaneous basis.

Existing vacuum coolers are fabricated from cylindrical chambers of circular cross section. These chambers have affixed thereto complex and extensive overhead and side-connected piping for the evacuation of the atmosphere and moisture during the cooling process. In the enlargement of such cylinders, considerable effort and expense can be avoided by preventing the relocation and refastening of such piping. Unfortunately, such relocation and refastening has heretofore been required because of the undesired elastic expansion and deformation of such cylinders upon their being cut for expansion.

This undesired elastic expansion and deformation of such cylinders is a product of their original fabrication process. Typically, such cylinders are originally fabricated from flat pieces of steel bent and joined to form cylindrical sidewalls of circular cross section. When such sidewalls are separated along a longitudinal seam, the sidewalls elastically tend to return to their original flat disposition. This expansion, if unrestrained, can completely destroy the complex and extensive overhead and side connected piping necessary for the operation of the vacuum cooling chamber. Furthermore, such expansion can complicate the desired vertical enlargement process by requiring that the separated cylinder segments be re-bent and reshaped to their original circular cross sections.

A principal object of this invention is to provide a simplified process for expanding existing vacuum cooling cylinders with no piping relocation and minimal cylinder deformation. The cylindrical chamber to be expanded has a medial segment corresponding to a fraction of the desired expansion cut out of the cylinder sidewalls. This cut segment is moved radially outward from the cylinder axis to the desired vertically expanded position and refastened to the cylinder by inserting vertical sidewalls. Thereafter, an adjoining segment of the desired vertical expansion is cut from the cylinder. This adjoining segment is similarly fastened to both the previously detached segment and the parent cylinder by inserting and fastening vertical sidewalls. Successive segments are cut, dropped and similarly fastened the entire length of the cylinder until the desired vertical expansion is attained. As each successive segment is cut, the intact portions of the cylinder in the expanded and unexpanded disposition, maintain the desired circular cross sections of the cooling cylinder and obviate the necessity of detaching and replacing the complex overhead and side connected piping or reforming the detached cylinder segments.

An advantage of this invention is that it provides a vacuum cooling chamber constructed from a cylindrical shell of circular cross section having minimal volumes unoccupied byproduct. Existing cylindrical cooling chambers are provided with circular cross sections to impart to the constructed cooling unit the necessary strength to resist collapse responsive to atmospheric pressure when the interior of the chamber is evacuated. These chambers, however, are typically loaded with vegetable products stacked in rectangular cross-sectional configurations. These rectangular cross-sectional configurations when placed within the cylindrical cooling section leaves volumes between the product and cylinder sidewalls unoccupied. As these unoccupied portions of the cylinder must be evacuated to produce the desired vacuum, unnecessary volumes of atmosphere must be evacuated to achieve the desired vacuum cooling. Such unnecessary atmospheric evacuation creates inefficiency in the cooling apparatus and unduly delays the time necessary to evacuate and cool a given volume of product.

Accordingly, it is an additional object of this invention to provide a vacuum-cooling cylinder having the overall strength of a cylindrical shell with minimal volumes of the cylinder therewithin unoccupied by the product to be cooled. To this end, the disclosed cooler has a cylindrical shape bifurcated longitudinally along first and second lines defined by the intersection of an imaginary plane with the cylinder sidewalls. This imaginary plane is taken parallel to the axis of the cylinder and lies below the axis a preselected distance so that the first and second lines are separated by a distance slightly larger than the anticipated width of the rectangularly loaded product. The lower bifurcated segment of the cylinder is located radially outward from the upper segment a distance corresponding to the desired increase in vertical dimension. These two separated segments are conjoined by vertical sidewalls extending therebetween to provide a chamber of expanded vertical dimension having minimal volumes thereof unoccupied by-product to be cooled.

Other objects, features and advantages of the present invention will be more apparent after referring to the following specification and attached drawings in which:

FIG. 1 is a plan view illustrating a conventional vacuum cooling apparatus of circular cross section having extensive side and overhead connected piping for vacuum cooling;

FIG. 2 is a side elevation of the cylinder of FIG. 1;

FIG. 3 is an end elevation illustrating the conventional loading of a vacuum cooling cylinder of circular cross section with stacked product of rectangular cross section;

FIG. 4 is an end elevation of a cylinder with an expanded vertical dimension in accordance with the present invention;

FIG. 5 is a perspective view of an unexpanded cylinder with the piping not shown, the view illustrating in broken lines the plane along which the cylinder is bifurcated;

FIG. 6 is a perspective view of the cylinder of FIG. 4 with a medial segment separated from the cylinder and dropped parallel to the cylinder axis to the expanded position;

FIG. 7 is a perspective view of the cylinder of FIG. 5 showing the medial segment fastened to the parent cylinder by vertical sidewalls and two end segments of the

cylinder adjoining the medial segment cut and dropped to the expanded position;

FIG. 8 illustrates the vacuum cylinder as finally completed according to the present invention;

FIG. 9 is an expanded perspective view of the inserted vertical sidewalls illustrating the attachment of such sidewalls and the configuration of the adjoined cylinder bracing; and

FIG. 10 illustrates an expanded door for enclosing the cylinder when expanded.

With reference to FIGS. 1–3, a vacuum cooling cylinder A is shown having overhead and side-connected evacuation piping B. Typically, load D of leafy vegetables contained within rectangularly shaped cartons **14** is placed on and rolled interior of cylinder A on conveyor rollers **16**. Thereafter, doors C are moved downwardly over the respective cylinder ends **17** and **18** so as to seal the cylinder ends. As sealed, evacuation piping B effects removal of the atmosphere and moisture, cooling contained load D.

Regarding the function of evacuation piping B, this piping comprises three separate systems. First, piping B includes an evacuation manifold **20** which withdraws the atmosphere from the interior of the cylinder so as to provide a vacuum of approximately three millimeters of mercury. Secondly, an ammonia refrigeration system **22**, including complementary compressors, ammonia pump, heat exchangers, storage tanks, and expansion valves cools air interior of the cylinder before it is evacuated. This cooling gives the atmosphere being evacuated a minimum volume and functions to remove contained water vapor in the form of ice. Thirdly, a drainage system including water removal piping **24** and manifold **26** permits accumulated water to drain from the interior of the cooler.

When load D within chamber A has been exposed to the required vacuum, the cylinder is flooded with air, and the load removed. Thereafter, load D is removed from cylinder A, and placed in refrigeration cargo containers for shipment.

Cylinders of circular cross section used in such coolers have the disadvantage of leaving large volumes interior thereof unoccupied by the rectangular load D. As can be seen in FIG. 3, load D as placed interior of cylinder A has a comparatively large and unoccupied spacial interval **28** to the side of load D and an unoccupied volume **29** at the bottom thereof. These comparatively large and unoccupied volumes require evacuation piping B to remove large quantities of atmosphere to effect the desired cooling of load D. As is apparent, if by the eccentric expansion of cylinder A, the vertical dimension of load D within cylinder A can be increased, a lesser volume of atmosphere within cylinder A need be unnecessarily evacuated to effect cooling of a vertically expanded load D.

With reference to FIG. 4, a cross-section configuration of a cylinder A expanded in accordance with this invention is illustrated. Generally described, the expanded cylinder of FIG. 4 has a bottom segment E cut from an upper segment F of cylinder A. Thereafter, segment E is dropped a predetermined distance **31** to permit at least an additional row **32** of cartons **14** to be inserted within the cylinder. As dropped, lower segment E is connected to upper segment F by insertion of vertical side walls G.

As expanded, it will be seen that unoccupied volumes **28'** and **29'** interior of cylinder A remain substantially unchanged. The expanded cylinder shown in FIG. 4, however, accommodates five rows of cartons whereas the unexpanded cylinder only accommodates four such rows. As accommodating five rows, the expanded cylinder of FIG. 4, requiring substantially the same unoccupied volumes **28** and **29** of air to be evacuated, includes a load D of approximately 25% greater capacity.

Unfortunately, such expansion of cylinders has heretofore been inhibited by the tendency of segments E and F to elastically expand upon being separated one from the other. Typically, cylinder A is originally fabricated from flat pieces of steel. These pieces of steel are bent and

joined to form the desired cylindrical sidewalls of circular cross section. When such sidewalls are separated along longitudinal seams so as to divide cylinder A into segments E and F, the sidewalls elastically return toward their original flat disposition. This expansion, if unrestrained, will destroy connected evacuation piping B and moreover will complicate the desired enlargement process by requiring that the separated cylinder segments be rebent and reshaped before inserted vertical sidewalls G fasten the cylinder segments one to the other. Accordingly, in the expansion of cylinder A, it is required that expansion of the respective segments be arrested to prevent the destruction of the cylindrical shape of the cylinder segments as well as to preserve evacuation piping B.

Referring to FIGS. 5–8, the expansion of a cylinder according to the present process is graphically illustrated. With reference to FIG. 5, a cylinder A is shown with the piping B and C removed for ease of understanding. Cylinder A comprises circular steel sidewalls **35** extending the entire length of cylinder A. These sidewalls are in turn reinforced by flanges **41–48** spaced at equal longitudinal intervals along the length of cylinder A. Flanges **41–48** impart to sidewalls **35** additional rigidity so that the sidewalls do not cave inwardly responsive to the ambient atmospheric pressure when cylinder A is evacuated interiorly.

Referring to FIG. 6, a first medial segment **50** is shown detached from cylinder A. Segment **50** is cut from cylinder A by cutting sidewalls **35** along lines **51**. Lines **51** are defined by the point of intersection of an imaginary plane **52** (shown in FIGS. 4 and 5) taken parallel to and below cylinder axis **54**. It will be noted that in defining this imaginary plane, the spacial separation of lines **51** on cylinder sidewalls **35** is chosen so as to slightly exceed the anticipated width **56** of load D.

After being cut along lines **51**, it is necessary that the cylinder segment be separated from the cylinder sidewalls at flanges **42** and **47**. Accordingly, two second cuts along arcs **58** and **59** adjoining flange **42** and flange **47**, respectively, are made. Thereafter, first medial segment **50** is dropped downwardly and radially outward from axis **54** the predetermined distance **31** (shown in FIG. 4) for vertical expansion of the cylinder.

It will be noted that when first medial segment **50** is separated from cylinder A, the cylinder remains substantially intact between flanges **41** and **42** at one end and flanges **47** and **48** at the opposite end. These intact portions of the cylinder sidewall and flanges prevent the undesired outward expansion of cylinder sidewalls **35**, which expansion would substantially destroy evacuation piping B and the shape of the respective cylinder segment sections E and F.

Referring to FIG. 7, segment **50** as cut and dropped is joined to upper segment F of cylinder A by inserted vertical sidewalls G. Sidewalls G are interconnected between flanges **42** and **47** and extend vertically between side boundaries **60** of first segment **50** and side boundaries **61** of upper segment F. Similarly, flanges **43** through **46** have flange segments **63** inserted so as to join two portions of the flanges attached to first segment **50** with those portions of the flanges remaining on upper segment F.

To assist in preventing elastic expansion of cylinder A, it has been found desirable in some instances to temporarily weld interior of cylinder A cross braces **74** (shown in broken lines in FIG. 6). These braces typically extend across the interior of upper braces F and are temporarily welded to the inside cylinder walls at bore ends. As temporarily placed within the cylinder, braces **74** assist in preventing the undesired elastic expansion of the cylinder during the enlargement process.

Regarding flange segments **63**, an expanded view of such a segment inserted in flange **43** is illustrated in FIG. 9. It will be noted, that flange **43** is cut parallel to imaginary plane **52** taken through cylinder A. As cut, flange

43 defines two horizontal seams 64 and 65, which horizontal seams may be conjoined by a rectangular flange segment 63. Retangular segment 63 is welded to the top of flange 43 at 64, the bottom of flange 43 at 65 and two inserted sidewalls G at seam 67 to conjoin the reinforcement flanges in an expanded disposition.

Once first segment 50 has been conjoined to cylinder A in its expanded disposition, the remaining portions of bottom cylinder segment E may be cut, dropped and attached by inserted sidewalls G to effect completion of the desired expansion. During such expansion medial segment 50, as attached to cylinder A in its expanded position, will arrest and prevent any undesired expansion of the cylinder which would destroy evacuation piping B or substantially alter the original shape of bottom segment E or upper segment F.

Accordingly, end segments 70 and 71 are first detached from the respective end portions of the cylinder by cutting cylinder sidewalls 35 and flanges 41 and 42, 47 and 48 at seams 72 and 73, respectively. Thereafter, segments 70 and 71 are dropped downwardly the predetermined distance 31 and fastened to upper segment F by inserting vertical sidewalls G between flanges 41 and 42 and 47 and 48. Thereater, flange segments G are inserted between the separated flanges 41, 42, 47 and 48 so as to complete the expansion. Finally, the respective segments 70 and 71 are welded to the first segment 50 at their abutting surfaces for completion of the desired, expanded and airtight cylinder as shown in FIG. 8.

Having completed the desired cylindrical expansion of cylinder A, it is necessary to conform the doors D to the new cross-sectional configuration of the cylinders at ends 17 and 18. Referring briefly to FIG. 4, it will be noted that cylinder A, as expanded, has the respective circular segments E and F interconnected by vertical sidewalls G. These circular segments at cylinder ends 17 and 18 are provided with a circular gasket 75 permitting door C to rest at the respective ends 17 and 18 of cylinder A in an air-sealed disposition.

It has been found, however, that if gasket 75 conforms to the vertical sidewalls G, passing upwardly at points 77 normally to plane 52 and thereafter curving arcuately conforming to the end of upper segment F, substantial gasket leaking in the vicinity of lines 51 (shown in FIG. 4) occurs. Accordingly, and to provide a gasket having no abrupt change of curvature, flanges 41 and 48 at the respective ends 17 and 18 of cylinder A are provided with members 79. Members 79 extend from the respective ends at point 77 of lowered segment E and fastened to sidewalls 35 of cylinder A at a point where they are tangent thereto. As fastened, members 79 provide a surface on which gasket 75 can be disposed without substantial or abrupt changes in curvature.

Referring to FIG. 10, a door C is shown having a lip H attached at the bottom portion thereof. Lip H has a circular lower boundary 81 conforming to the end section of segment E to side boundaries 32 spaced so as to overlie members 79. This lip H is attached to door C typically by bolts 84. As affixed to door C, lip H imparts a configuration thereto for sealing of the expanded end sections of container A.

It should be understood that as the tendency of the cylinder to elastically expand during the enlargement process increases the length of the respective segments detached during the enlargement process can be decreased to resist such expansion. Further, although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications can be practiced within the spirit of the invention as limited only by the scope of the appended claims.

What is claimed is:

1. A method for expanding a cylindrical vacuum cooling chamber for providing increased overhead dimension therein comprising the steps of: cutting a first and medial segment from said cylinder sidewalls, said segment having the longitudinal boundaries included within first and second lines defined by the intersection of a horizontal plane parallel to and below the cylinder axes with the cylinder sidewalls; dropping said detached medial segment radially outward from said cylinder axis; inserting and fastening planar sidewalls between said dropped medial segment and said cylinder; cutting a second segment from said cylinder sidewalls from a location on said cylinder adjoining said medial segment, said second segment having longitudinal seams included within said first and second line; dropping said adjoining segment radially outward from said cylinder axis; fastening said dropped adjoining segment to said medial segment along the adjoining boundary of said segments; inserting and fastening second planar sidewalls between said cylinder, said adjoining segment, and said first sidewalls and in a similar manner cutting, dropping, and fastening any and all remaining segments to provide a fluid impervious and enlarged cylinder to both of said cylinder ends.

2. A method for expanding a cylindrical vacuum cooling chamber according to claim 1 wherein: said cutting of said second segment includes cutting said cylinder to one of said cylinder ends.

3. A method for expanding a cylindrical vacuum cooling chamber according to claim 1 wherein said cylinder includes radially protruding encircling flanges spaced axially at preselected intervals along the length of said cylinder and including the steps of: cutting said encircling braces along lines intersected by said plane as said medial and adjoining segments are detached; inserting and fastening between said cut encircling braces on said cylinder and said segments interconnecting bracing for enlarging said peripheral braces to said expanded cylindrical dimension.

References Cited

UNITED STATES PATENTS

1,838,003	12/1931	Samuels	113—116 X
2,770,110	11/1956	Hibbs	62—270
3,282,228	11/1966	Spees	105—358
3,466,725	9/1969	Kock	29—425 X
3,475,809	11/1969	Brown	29—469 X

JOHN F. CAMPBELL, Primary Examiner

D. C. REILEY, Assistant Examiner

U.S. Cl. X.R.

29—401, 412, 425; 105—357, 358; 113—116