May 8, 1951 R. E. BLUDEAU 2,552,030

COLD TREATMENT APPARATUS AND METHOD

Filed July 26, 1946 3 Sheets-Sheet 1

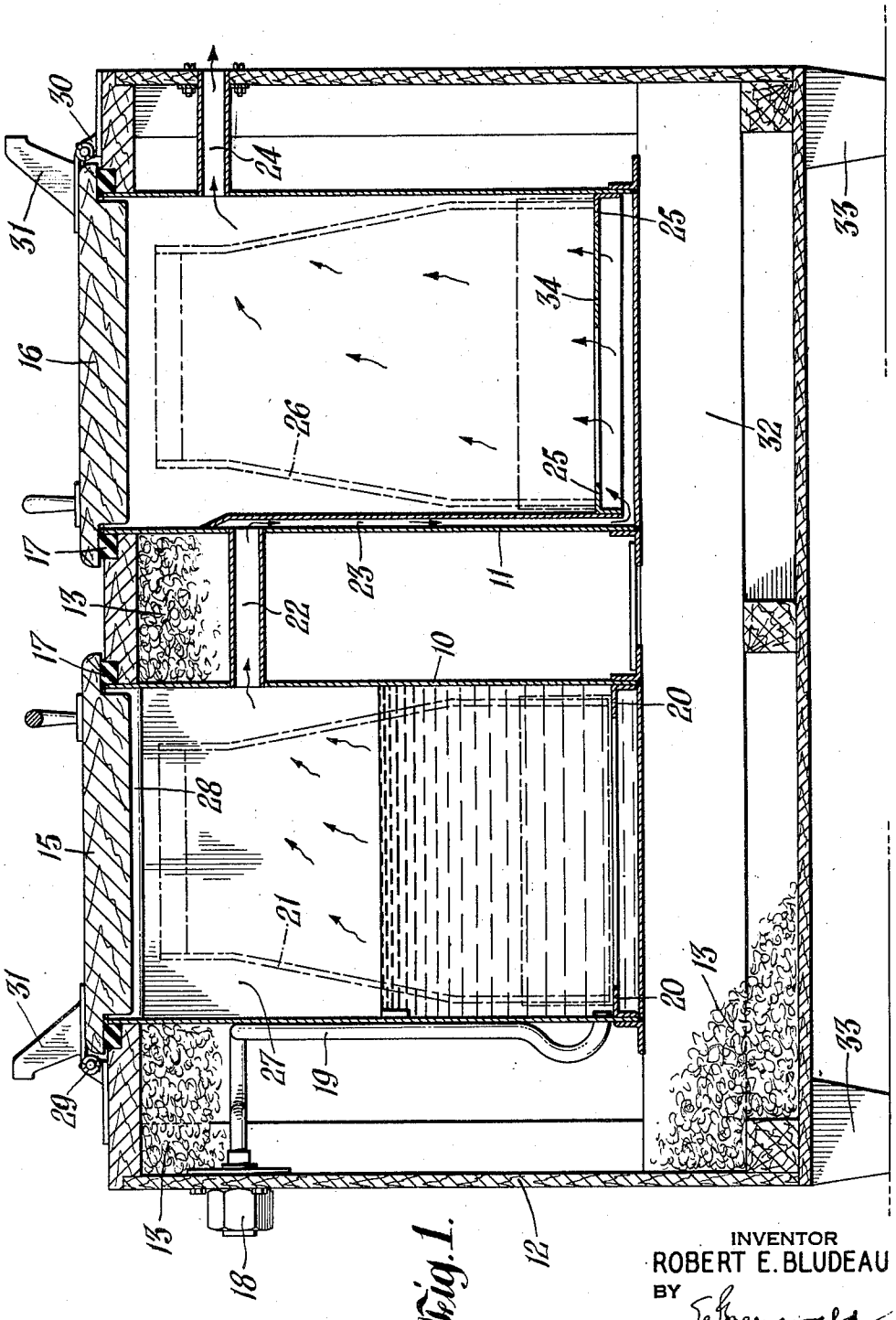


Fig. 1.

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COLD TREATMENT APPARATUS AND METHOD

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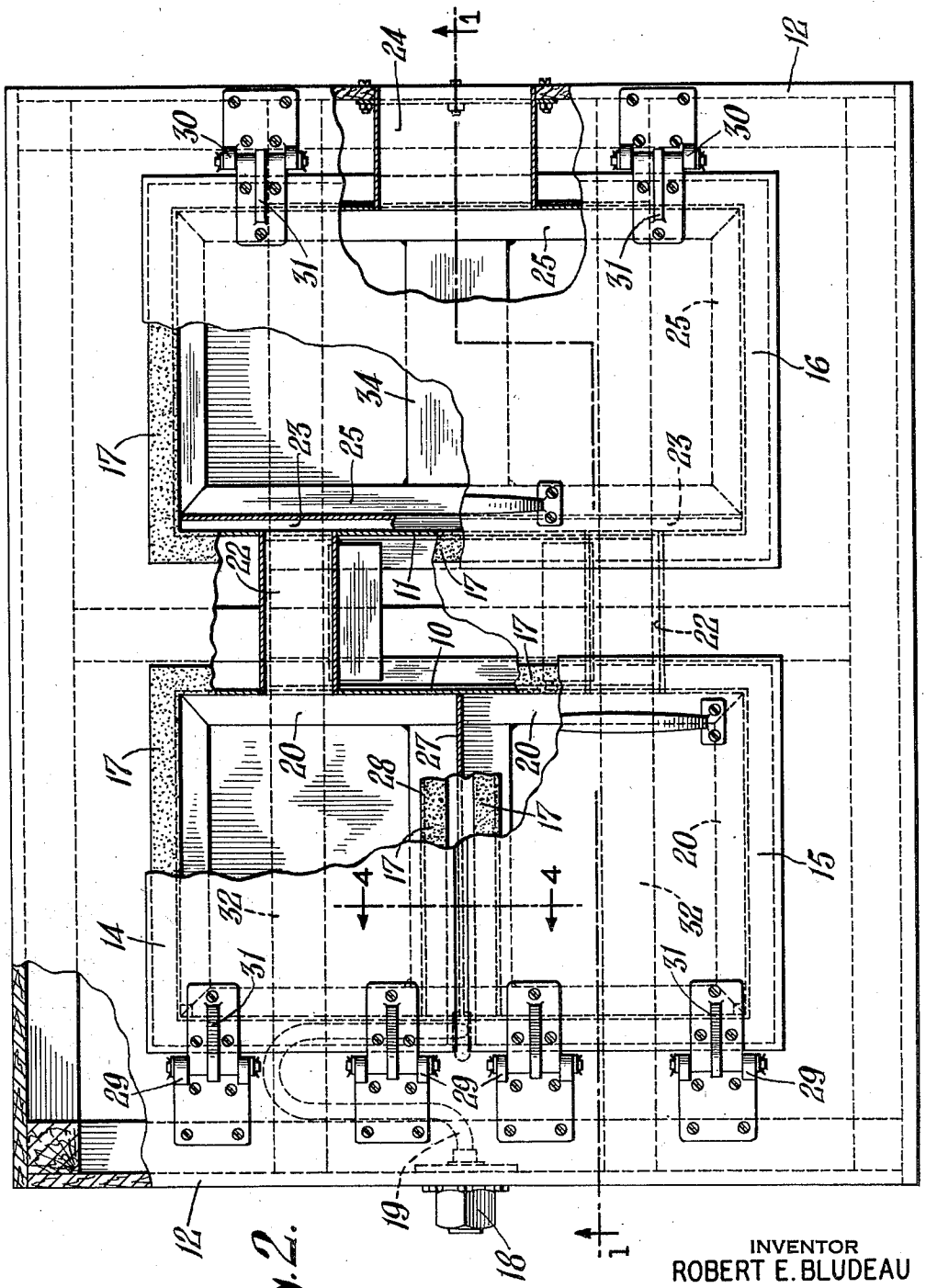


Fig. 2.

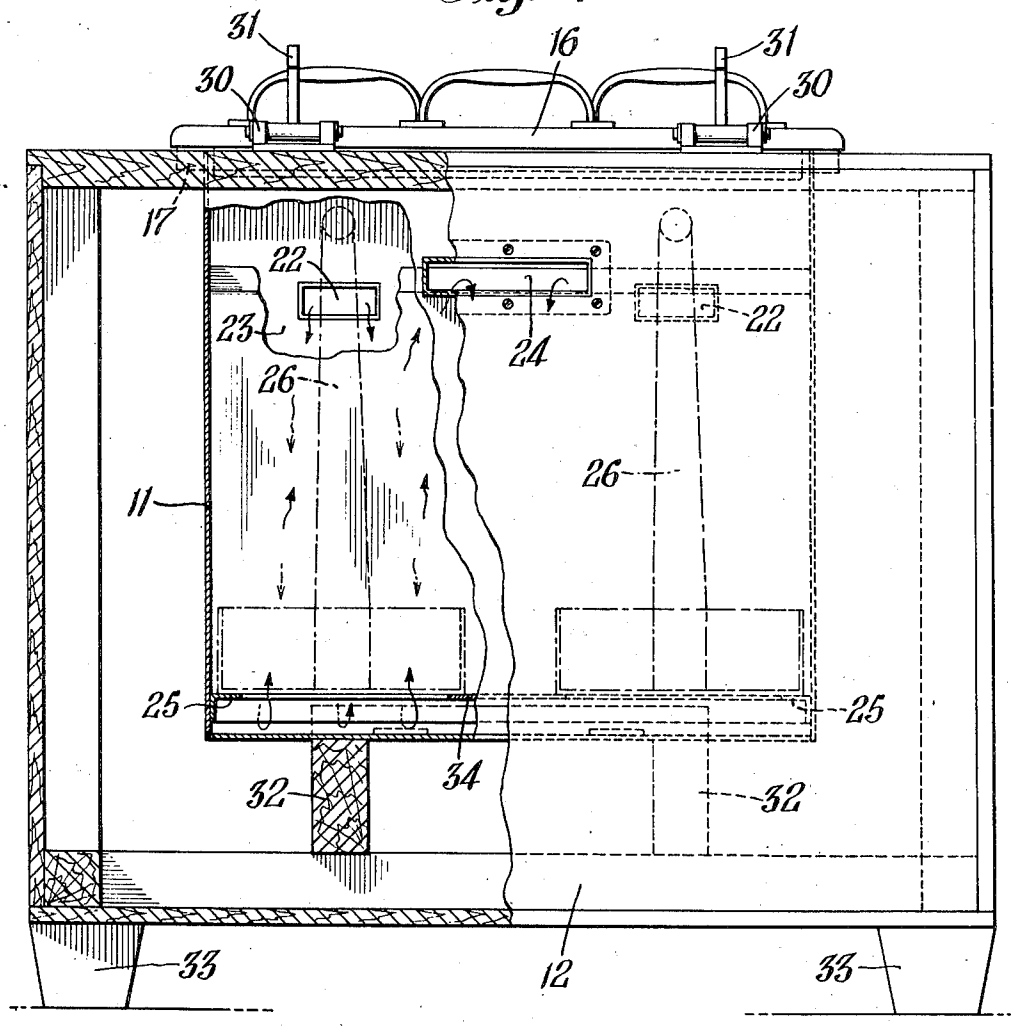
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COLD TREATMENT APPARATUS AND METHOD

Filed July 26, 1946 3 Sheets-Sheet 3

Fig. 3.



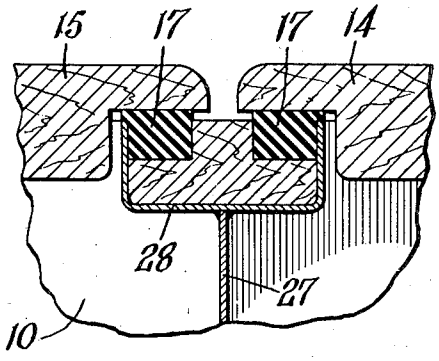


Fig. 4.

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UNITED STATES PATENT OFFICE

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COLD TREATMENT APPARATUS AND METHOD

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Application July 26, 1946, Serial No. 686,378

14 Claims. (Cl. 62—92)

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This invention relates to an improved cold treatment apparatus and method, and has for an object to increase the utility of such apparatus adapting it for a wide variety of sizes and shapes of articles to be cooled. Another object is to increase the degree of cooling to which various sizes and shapes of articles may be subjected. Yet another object is to provide a simple, efficient and inexpensive apparatus for accomplishing the previously mentioned purpose. A further object is to increase the facility with which apparatus of this character may be operated.

The desirability for chilling articles to a very low temperature has become recognized in shrink fitting and for other purposes. Liquid air, oxygen, nitrogen or other gases have been suggested as the refrigerant for cooling the article by direct immersion. Likewise precooling of an article by flowing vaporized refrigerant over it prior to this immersion has been suggested. However, such prior suggestions have not had the preliminary cooling chamber so independent of the immersion tank of liquid refrigerant that either may be used alone or both used together efficiently and for different sizes and shapes of articles without undue moisture deposition on them. It has been discovered that most efficient operation is possible when losses in temperature on transferring of an article from the precooling chamber to the liquid refrigerant tank are a minimum and each is exposed to the atmosphere for a minimum time. To this end the chamber and tank are located close together and the closures to each open in opposite directions so that not only may such transfer occur quickly but the loss of vaporized refrigerant through diffusion of the cold gas with warm air at room temperature be lessened by keeping the closures of the chamber and tank in closed position except during actual transfer. With small articles and holders these closures need not be open all the way to get the article holders in and out of the tank and chamber.

Referring to the drawing:

Fig. 1 is a sectional elevation of one embodiment of this invention taken on the line 1—1 of Fig. 2;

Fig. 2 is a top plan view of the device of Fig. 1 with parts broken away;

Fig. 3 is a right end view of the device of Fig. 2 with part of the housing broken away;

Fig. 4 is a section on the line 4—4 of Fig. 2.

A tank 10 for vaporized liquid refrigerant such as nitrogen, liquid air, or the like is located adjacent the precooling chamber 11, both being located within the casing or housing 12. Thermal insulating material 13 is placed between the tank and chamber and between each and the casing. The tank 10 preferably is provided with two closures 14 and 15 while the cooling chamber 11 preferably has one closure 16. Surrounding the upper openings of the tank and chamber are packing strips 17 cooperating with the closures in providing a fairly tight fit to guard against undue leakage of vaporized refrigerant around the edges of the closures.

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A filling connection 18 is located on the outside of the housing as shown in Figs. 1 and 2, the filling pipe 19 leading from this connection 18 into the bottom portion of the tank 10. As shown in Fig. 2 this filling pipe 19 has a bend in it to decrease expansion and contraction between occasions when the tank is empty and free of refrigerant and times when it is filled.

Adjacent the bottom of the tank 10 is located an inwardly projecting flange 20 for supporting an object or article holder 21. The type of article holder and the number of shelves it may carry depends on the size and shape of the articles to be cooled. Vaporized refrigerant coming from the liquid refrigerant in the tank 10 passes as indicated by arrows through two gas passages 22, down a passageway 23 formed in a side wall of the precooling chamber 11 to the lower portion of the latter, thence upward through the chamber 11 in contact with any objects therein, and out a vent passage 24 to the atmosphere. The entrance of the vent passage 24 is near the upper end of the chamber 11 but below the closure 16. The chamber 11, adjacent its bottom and above the outlet of passage 23, has an inwardly projecting flange 25 for supporting the work holder 26. Ordinarily two work holders are adapted to support articles to be cooled in the precooling chamber. When filled to the desired degree and exposed to cold gas for a prescribed period the holders may be removed from the precooling chamber and placed in the liquid refrigerant tank. For chilling small articles four or more work holders will ordinarily be needed. As one is removed from the immersion tank it is unloaded and then reloaded with articles to be cooled. Before the newly loaded holder is placed in the chamber 11 a holder which has been in the cooling chamber a longer time is placed in the immersion tank to make room for the newly loaded article holder.

The liquid tank 10 contains a partition 27, shown in Figs. 2 and 4, extending from the closures 14 and 15 in contact with opposite sides of

the tank and downwardly to well below the normal liquid level and adjacent the bottom of the tank or to the top of the supporting flange 20. Such a construction enables the liquid level on each side of the partition to be equalized by static pressure transmitted below the partition 27. An advantage however for the partition is that it tends to localize the vapors of refrigerant where relatively warm objects are being immersed in only one side of the tank. As shown in Fig. 4 the upper edge of the partition 27 is welded or otherwise secured to a channel member 28 containing a block and the packing strips 17 for cooperation with each closure 14 and 15.

The closures 14 and 15 are provided with hinges 29 adjacent one end of the housing 12 while the closure 16 for the precooling chamber has hinges 30 adjacent the opposite end of the housing. These closures are so hinged that they will swing open in opposite directions making it possible for the operator to transfer an article holder from the chamber 11 to the tank 10 without having to lift the holder over either closure when open. As shown in Fig. 1 each closure is provided with a stop 31 to limit the degree of opening and to assure each closure opening less than 90°, or in other words to insure that each closure automatically falls to its closed position when no longer held open.

Among the advantages of this invention may be mentioned the fact that the cooling chamber and immersion tank are functionally and structurally more nearly independent of one another than has heretofore been the custom, wherefore each is capable of separate use or both may be used together, or one half of the tank 10 may be used with the chamber 11. Having the covers open oppositely facilitates the transfer of the article holders from the chamber 11 into the tank 10 without having to lift them higher than enough to clear the top of the housing. The partition 27 makes the two parts of the tank more nearly separate functionally as to vapors. The apparatus illustrated is intended to use liquid nitrogen as the refrigerant, the spent gas for passing through the precooling chamber 11 is discharged to the atmosphere through the vent 24. Such a practice makes unnecessary the provision of any heating or diluting apparatus such as has been proposed where liquid oxygen is used as the liquid refrigerant. The work holders are of course of a size adapted to fit within the openings in the top of the chamber 11 and the tank 10 when the covers are raised. As illustrated this means that there may be some space in the precooling chamber 11 between and not occupied by the work holders. When this is so this space may be filled with a stationary shelf 34 or removable shelves for supporting objects independently of the work holders. One purpose for such shelving is to retain special work which may be metallurgically changed with the use of the low temperature encountered. Having the covers in unstable equilibrium when not held open insures their being closed against inefficient loss of vaporized refrigerant. The housing contains wooden beams 32 on which the tank 10 and chamber 11 are mounted, the entire cabinet preferably being supported off the floor by legs 33.

While the principles and apparatus of this invention may be utilized in various ways for cold treating metal and other articles, the particular apparatus disclosed herein has special advantages when the cold treating operation is performed in the following manner. At the start of an operating period, two workpiece holders, containing one or more workpieces, are placed in the precooling chamber 11. After the elapse of a sufficient time for the workpieces to precool, these carriers are transferred to the tank 10 and are severally immersed in the liquid refrigerant below the two gas spaces separated by the partition 27, and two "fresh" workpiece holders are then placed in the precooling chamber 11 to replace those transferred to the tank 10. After a sufficient cooling period has elapsed, one of the holders in the liquid is removed to utilize the cold workpieces in such holder, and this holder is replaced by a workpiece holder transferred from the precooling chamber 11. Then the other of the first holders in the liquid is removed therefrom to utilize the cold workpieces in such holder, and this holder is replaced by the workpiece holder that has been in the precooling chamber the longer time. Meanwhile "fresh" workpiece holders are successively placed in the precooling chamber to replace those successively transferred to the tank. Thus, during normal operation, both sections of the liquid tank and the precooling chamber are loaded with workpiece holders (four altogether in this arrangement), and the holders are transferred and withdrawn in the order of their coldness or the length of their cooling periods, and they are replaced in similar sequence in the precooling chamber, so that the operating cycle, once it has been initiated, will be continuous.

This invention is better adapted for cooling larger objects than is the apparatus disclosed in the application of Bludeau and Buckman, Serial No. 661,029, filed April 10, 1946, for "Cold Treating Machine."

I claim:

1. A cold treatment apparatus comprising, in combination, a tank for a vaporizable liquid refrigerant, a cooling chamber outside of and laterally displaced from said tank, said tank and chamber each having an opening through which an article may be inserted and withdrawn, a movable closure for each opening, a passage for vaporized refrigerant leading from an upper portion of said tank above a normal liquid level therein into an end portion of said chamber, and a vent for an end portion of said chamber remote from that into which said passage leads whereby vaporized refrigerant under slight pressure in said tank may pass through said chamber in contact with an article therein and out said vent into the atmosphere.

2. A cold treatment apparatus comprising, in combination, a tank for a vaporizable liquid refrigerant, a cooling chamber beside said tank, a housing enclosing both the tank and chamber, thermal insulation between the housing and tank and between the housing and chamber, a closure for said tank and a closure for said chamber to allow insertion and withdrawal of work into and from the chamber and the tank, a passage for vaporized refrigerant leading from an upper portion of said tank above a normal liquid level therein and through such thermal insulation into a lower portion of said chamber below any work therein being cooled, and a vent in the upper portion of said chamber below the closure therefor for venting spent vaporized refrigerant into the atmosphere.

3. Apparatus according to claim 2 in which each closure moves away from the other in opening.

4. Apparatus according to claim 2 in which a

bent filling pipe extends from said tank through said insulation to the outside of said housing whereby the bent portion of said pipe is adapted to flex to compensate for differences in length of the pipe between periods of its use and non-use.

5. Apparatus according to claim 2 in which said insulation is on at least the sides and bottom of said tank and chamber.

6. A cold treatment apparatus according to claim 2 in which a portion of said passage is substantially parallel to and within an upstanding wall of said chamber and constituted in part by such wall.

7. Apparatus according to claim 2 in which said tank is provided with two spaced and independently operable closures and said chamber with only one closure.

8. A cold treating apparatus, comprising a tank for liquid refrigerant in which an article to be cooled may be immersed in the liquid, said tank having an opening above the liquid level through which said article may enter the liquid refrigerant, a removable cover for said opening, a cooling chamber outside said tank having an opening through which an article may be inserted for cooling, a removable cover for the chamber opening, a passage for vaporized refrigerant leading from said tank above the liquid level to a lower end portion of the chamber and another passage for vaporized refigerant leading from the opposite end portion of said chamber to that into which the vaporized refrigerant enters, whereby a slight pressure in said tank may suffice to circulate cold gas through and out of the chamber.

9. A cold treating apparatus, comprising a tank for liquid refrigerant in which an article to be cooled may be immersed in the liquid, said tank having an opening above the liquid level through which said article may enter the liquid refrigerant, a removable cover for said opening, a cooling chamber outside said tank having an opening through which an article may be inserted for cooling, a removable cover for the chamber opening, a passage for vaporized refrigerant leading from said tank above the liquid level to an end portion of the chamber and another passage for vaporized refrigerant leading from the opposite end portion of said chamber to that into which the vaporized refrigerant enters, whereby a slight pressure in said tank may suffice to circulate cold gas through and out of the chamber said chamber being of larger volume than said tank below the liquid level, whereby an article may be removed from said chamber into said tank for immersion while a second article may be retained in said chamber with the first but not removed with said first article.

10. A cold treatment apparatus comprising, in combination, a tank for a vaporizable liquid refrigerant, a cooling chamber, a partition in said tank open adjacent the bottom of the tank and dividing the portion of the tank above the normal liquid level into separate gas spaces, a closure for each gas space, a closure for the chamber, a passage from each gas space in the tank into an end portion of the chamber, and a vent passage from the end portion of the chamber opposite that into which vaporized refrigerant is supplied.

11. A cold treating apparatus comprising, in combination, two separate vertical chambers arranged adjacent to but outside of one another and each having an opening at its top end through which articles may be inserted into and removed from said chambers, one of said chambers constituting a precooling chamber and the other chamber constituting a tank for holding vaporizable refrigerant into which articles are adapted to be transferred after they have been precooled in said precooling chamber; a conduit for conducting vaporized refrigerant from an upper portion of said tank into a lower portion of said precooling chamber; and means for closing and uncovering the opening at the top end of each of said chambers.

12. A cold treating apparatus comprising, in combination, two separate vertical chambers arranged adjacent to but outside of one another and each having a closed bottom but having an opening at its top end through which articles may be inserted into and removed from said chambers, one of said chambers constituting a precooling chamber and the other chamber constituting a tank for holding vaporizable liquid refrigerant into which articles are adapted to be transferred and immersed for further cooling after they have been precooled in said precooling chamber; a conduit leading from the space above the liquid refrigerant level in said tank into the lower part of said precooling chamber, to conduct vaporized refrigerant from said space into said precooling chamber near its bottom; a vent adjacent the top end of said precooling chamber for discharging vaporized refrigerant from said precooling chamber; and movable closure means operable to close and to uncover the opening at the top end of each of said chambers.

13. A cold treatment apparatus comprising a tank for refrigerant, a chamber adjacent to but outside of said tank, an outlet passage for vaporized refrigerant leading from an upper portion of said tank into a lower portion of said chamber for discharge of such refrigerant into a lower portion of said chamber, and an outlet passage for said refrigerant leading from an upper portion of said chamber into the atmosphere, said outlet passage from said tank extending downward for a substantial distance within said chamber.

14. A cold treatment apparatus comprising a tank for refrigerant, a chamber adjacent said tank, an outlet passage for vaporized refrigerant leading from an upper portion of said tank into a lower portion of said chamber for discharge of such refrigerant into a lower portion of said chamber, an outlet passage for said refrigerant leading from an upper portion of said chamber into the atmosphere, a pivotal closure for each of the tank and chamber, at least said tank closure being located above the tank and provided with a stop to prevent said closure being opened through more than an acute angle to insure said closure closing upon its release.

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