Sept. 3, 1940. H. P. CULVER 2,213,206

COATING APPARATUS

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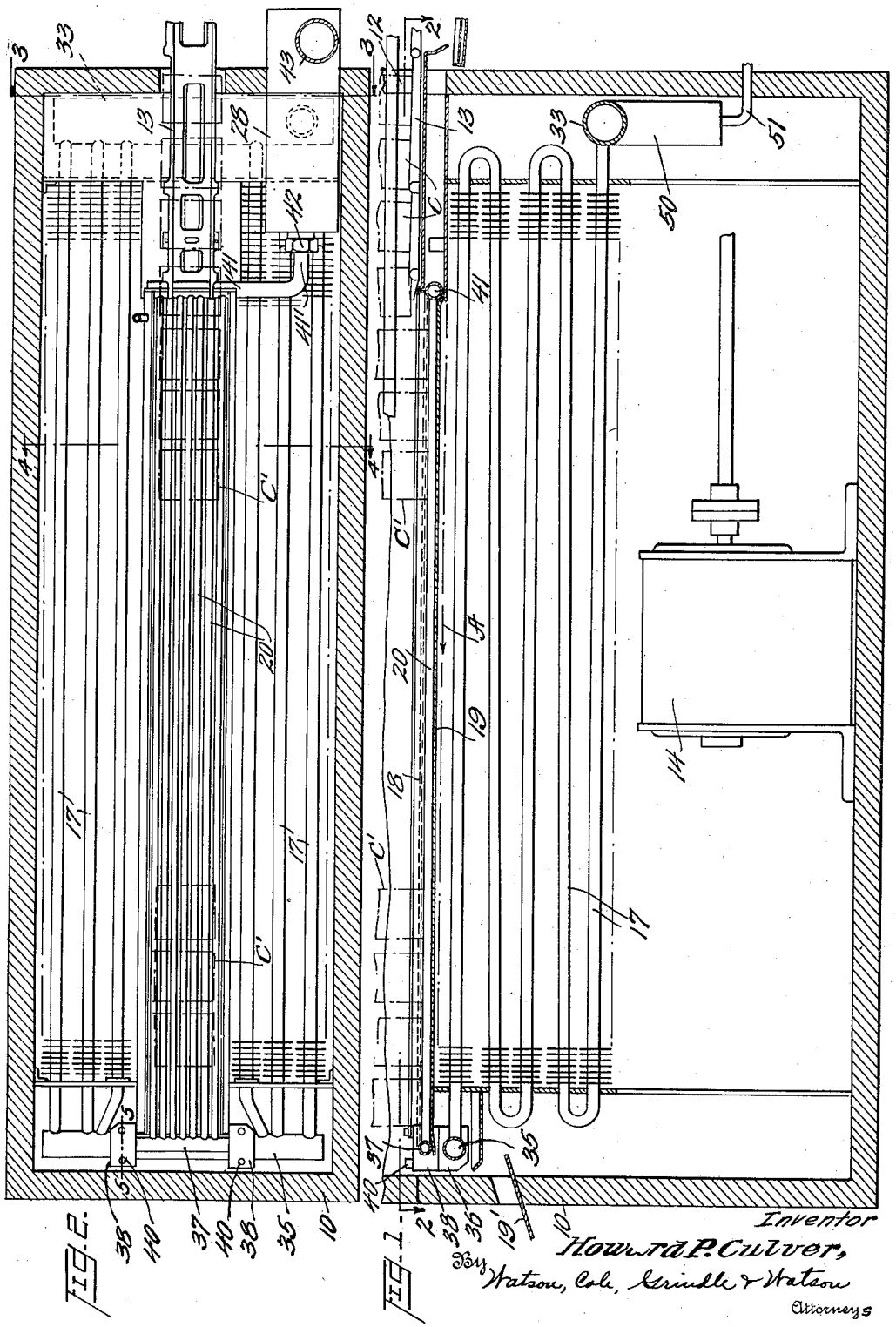


FIG. 2.

FIG. 1.

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COATING APPARATUS

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FIG. 5.

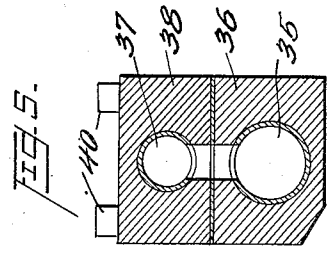


FIG. 4.

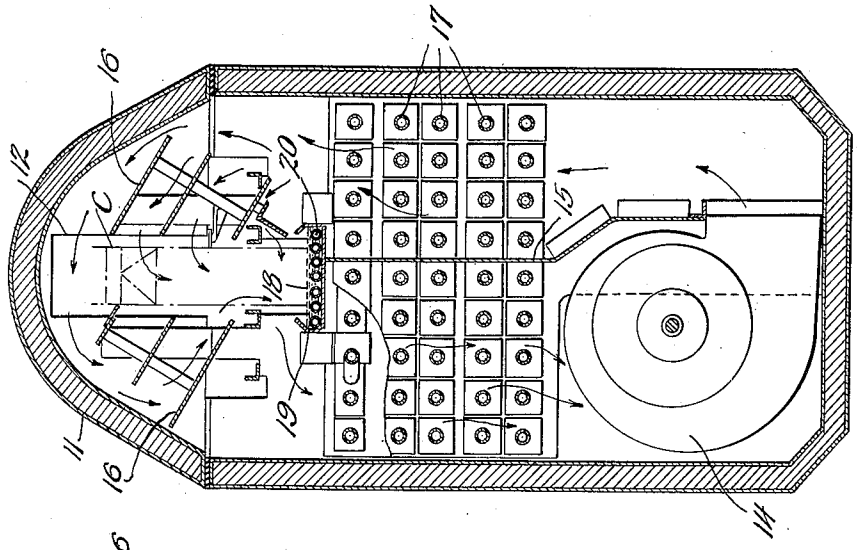
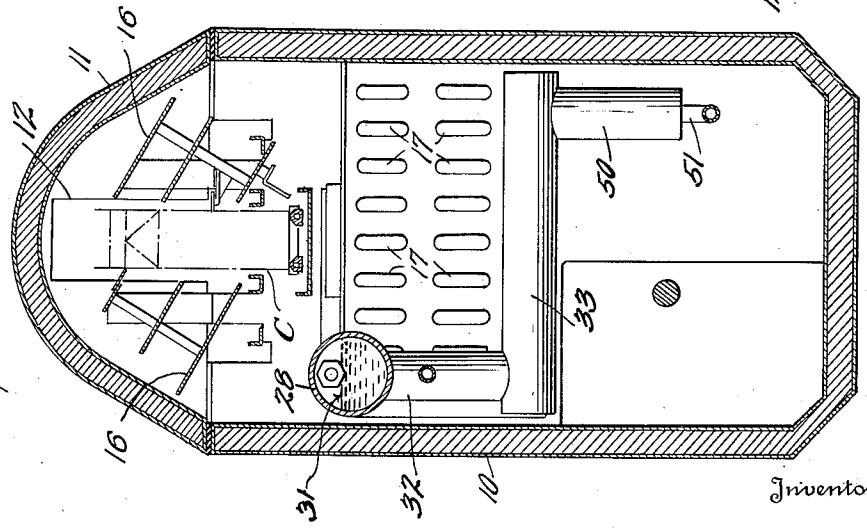


FIG. 3.



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COATING APPARATUS

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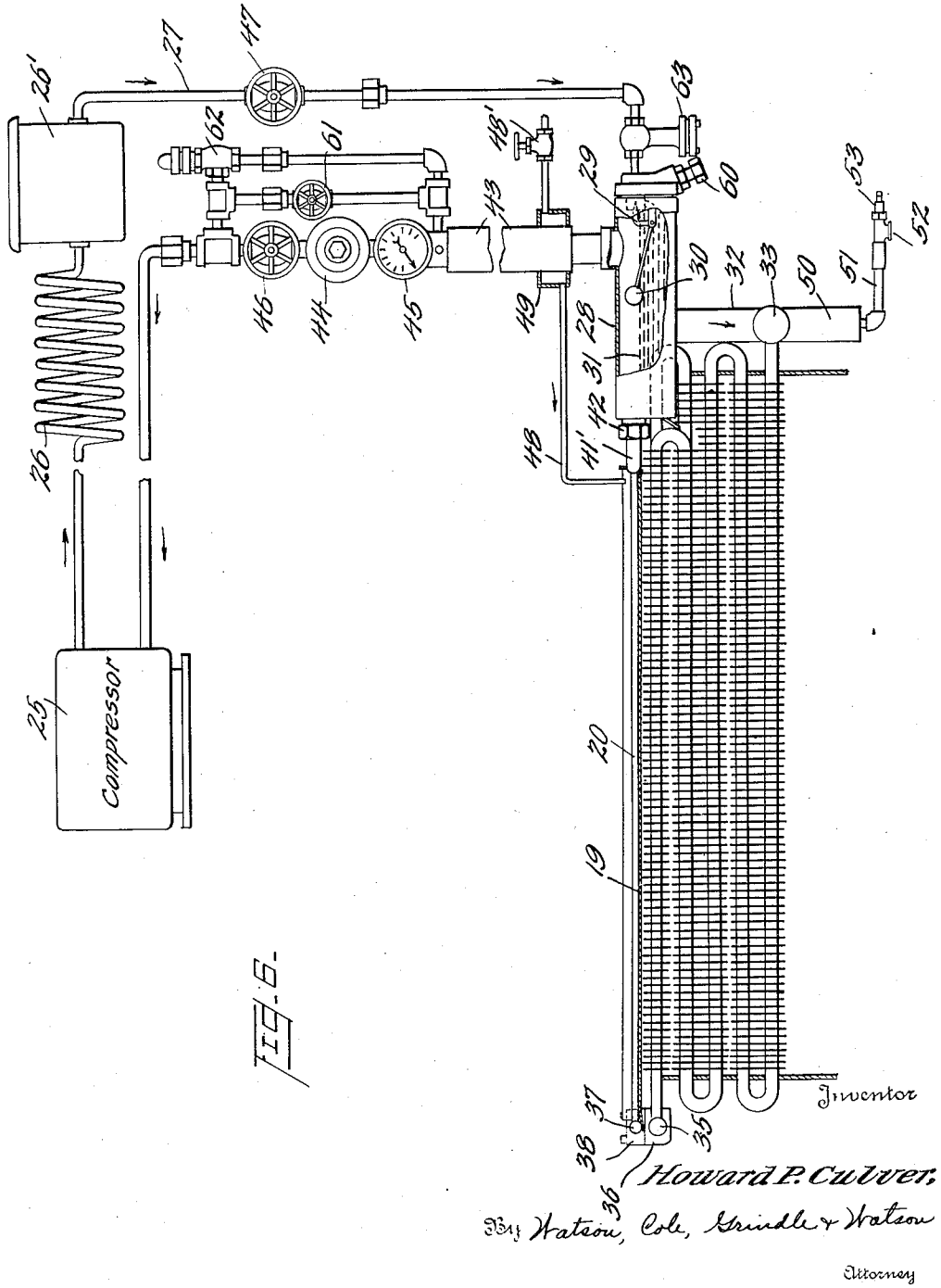


FIG. 5.

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UNITED STATES PATENT OFFICE

2,213,206

COATING APPARATUS

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Application August 24, 1938, Serial No. 226,536

4 Claims. (Cl. 62—102)

This invention relates to apparatus for cooling containers and like articles, and particularly to apparatus for rapidly cooling and solidifying coatings applied in molten condition to the walls of empty paper containers.

In application 172,025, filed October 30, 1937, in the names of Ira J. Snader and James E. Earp, there is disclosed a method of and apparatus for applying to all wall surfaces of an empty paper container a coating of a substance, such as paraffin, in molten condition, which substance solidifies or sets upon cooling. In accordance with the method therein set forth an empty paper container, one end of which is closed, is immersed in a bath of molten paraffin or paraffin containing substance, or some other substance which is liquid when at elevated temperatures and which solidifies upon cooling to room or ordinary temperatures, the purpose being to provide the container with a smooth, homogeneous, liquid-repellent coating, which will eliminate the possibility of contact of any liquid subsequently introduced into the container with the fibrous walls of the container. The said apparatus embodies means for subjecting different portions of the freshly coated container to the cooling action of different media, the upper portion, which is only one ply in thickness, and hence comparatively easily cooled, being subjected to the cooling action of a stream of air which has itself been previously reduced in temperature by refrigerating means, and the lower portion or bottom of the container, which is several plies in thickness and also is more heavily coated, being subjected to the action of a body of liquid, for instance water, which liquid body is likewise maintained at a low temperature by cooling or refrigerating means.

The cooling operation is carried out within a casing or housing having an aperture for the introduction of freshly coated containers and a second aperture for the discharge of such containers after the coatings have solidified and, in the operation of the mechanism, containers are introduced rapidly in succession through the inlet aperture and withdrawn at the same rate through the outlet aperture. In the case of the apparatus disclosed in the aforementioned application the means employed for effecting cooling of the circulated air stream and cooling of the body of liquid within the housing comprises a refrigerating mechanism primarily designed and intended for use with brine as a circulating refrigerant medium, the brine being cooled to the desired temperature by means located without the housing, circulated through the housing, and thence returned to the cooling apparatus for re-cooling or removal of the heat absorbed thereby during its passage through the housing.

In its general features the present invention is quite similar to that disclosed in the application referred to and above briefly described. However, instead of the cooling mechanism provided by the prior inventors to effect the cooling of the air and liquid for the purposes specified, a specially designed refrigeration apparatus of the compression-expansion type is provided. Thus, in accordance with the present invention, a refrigeration apparatus is employed in which the refrigerant used may exist in gaseous or in liquid form, depending upon the temperatures and pressures to which it is subjected. A refrigerating apparatus of this character necessarily includes a compressor, a condenser, a closed circuit which includes the compressor, the condenser, the work circuit or cooling coil, and various control instrumentalities. In general refrigerating apparatus of this type is old and well-known and no broad claim of novelty is made therefor. However, in adapting this type of refrigerating mechanism specifically to the cooling of freshly coated containers or like objects, numerous changes have been made which greatly facilitate the operation of the apparatus in the performance of its intended functions. These novel features will be hereinafter specifically pointed out and claimed.

One embodiment of the invention is illustrated in the accompanying drawings but it will be appreciated by those skilled in the art that this is set forth by way of example only and that, within the import of the invention, numerous minor changes in the design and arrangement of its component elements may be effected.

In the drawings:

Figure 1 is a longitudinal vertical section taken through the lower portion of the housing for the container cooling mechanism, showing certain elements of the refrigerating apparatus employed;

Figure 2 is a horizontal section through the housing taken on the line 2—2 of Figure 1;

Figures 3 and 4 are transverse sections through the housing, taken respectively on lines 3—3 and 4—4 of Figure 2;

Figure 5 is a section on line 5—5 of Figure 2, the parts shown, however, being illustrated upon a somewhat larger scale; and

Figure 6 is a side elevation of the refrigerating apparatus employed, portion of this apparatus being diagrammatically illustrated and the housing being omitted.

The means for circulating a gaseous stream, for instance a stream of air, through the housing, cooling it at one point, and passing it over the coated containers at another point, comprises no portion of the present invention in and of itself, being fully disclosed in the prior application above mentioned. Likewise the broad concept of subjecting the bases of the containers to the action of a liquid comprises no portion of the present invention. For a full and complete description of the air circulating means reference may be had to the application previously referred to, and a brief description only of the housing and air circulating means need here be given.

As readily perceived from an inspection of Figures 1 to 4, inclusive, the housing comprises an elongated box-like body portion **10** and a top **11** which preferably is readily removable to permit access to the interior of the housing. At the ends of the housing, and formed partly in the body **10** and partly in the top **11**, are aligned rectangular apertures, one of which is indicated at **12** in Figures 3 and 4, for the introduction of containers which have been freshly coated and the discharge of completely cooled containers, respectively. A series of containers passing through the housing is indicated in Figures 1 and 2, these containers being moved in the direction of the arrow A (Figure 1) by conveyor means which is not illustrated. The entering containers, indicated at C, are shown to be resting upon a heated trackway **13** and the containers indicated at C' are shown with their lower ends immersed in a body of liquid which is artificially cooled. During the time that each container is passing through the housing practically all portions of the walls thereof, both exterior and interior surfaces, are subjected to the action of a cool stream of air the effect of which is to solidify or harden the molten paraffin or other molten coating substance which has been applied thereto just prior to introduction of the container into the cooling chamber. A fan for the circulation of this stream of air is indicated at **14**, this fan causing air to circulate in a closed circuit, in the direction indicated by the small arrows in Figure 4. The details of the air circulating means need not be here described, and it is only necessary to say that the air delivered by the fan passes upwardly on the right-hand side of the longitudinally extending substantially vertical division plate **15**, thence transversely and downwardly, as directed by the inclined vanes **16** and the undersurface of the cover **11**, so as to sweep over the surfaces of the line of containers C and C', and to some extent into the interiors of these containers, thence downwardly on the left-hand side of the central partition **15** to the intake ports of the fan.

As this air stream passes upwardly toward the containers, and again as it passes downwardly from the containers to the fan, it passes through banks of finned tubes, indicated at **17**, so that the air stream is cooled both as it approaches the containers and as it leaves the containers. The bottoms of the containers C' are immersed in a body of water indicated at **18**, this water being contained in a longitudinally extending horizontally disposed pan **19**. Extending through the pan in a longitudinal direction are a plurality of tubular ducts **20** through which is passed a refrigerant, this nest of tubes **20** comprising portion of the cooling system to be hereinafter more fully described. In the operation of the apparatus the body of water **18** is maintained at a temperature slightly above freezing, in order that this body may exert the maximum cooling effect upon the bottoms of the containers.

In Figure 6 of the drawings the mechanism for cooling the circulating air and cooling the water in the pan **19** is most clearly illustrated. This cooling system is of the compression-expansion type, embodying a compressor diagrammatically indicated at **25**, a condenser diagrammatically indicated at **26**, and a closed circuit which includes both compressor and condenser, as well as the work performing conduits or pipes, and the various control instrumentalities commonly used in association with such circuits. The refrigerant used may for example be ammonia, which exists as a gas at certain temperatures and pressures, and as a liquid at lower temperatures and higher pressures. The refrigerant passes through this circuit in the direction of the arrows shown, being forced by the compressor **25** into the condenser **26** and issuing from the condenser into receiving tank **26'**, from which tank it passes into conduit **27** and then downwardly through this conduit to the horizontally disposed chamber **28** which is so designed, and is so positioned in the system, that it accommodates the refrigerant in both its liquid and gaseous forms.

The refrigerant in liquid form will pass into conduit **27** under relatively high pressure, for instance a pressure of approximately 165 pounds per square inch. At the discharge end of this conduit, however, there is positioned valve means for controlling the flow of liquid refrigerant to the chamber **28**, this control means being diagrammatically shown in Figure 6. Thus a float controlled valve is indicated at **29** and a float operatively connected thereto is indicated at **30**. This float controlled valve may be of any desired construction and it functions to maintain the level of the liquid refrigerant within the chamber **28** at approximately that which is indicated in Figure 6 by the dotted line **31**. When the liquid level falls, the float **30** descends and the valve device **29** opens to permit the inflow of liquid refrigerant, but when the liquid level **31** is restored, the valve device **29** is closed in the usual manner to prevent further inflow.

From the bottom of the chamber **29** there projects downwardly a tube or conduit **32** which is in communication with a header **33** extending transversely of the housing **10**. Communicating with the header **33** are the inlet ends of the transversely extending series of tubes or conduits **17** which pass forwardly and rearwardly in a serpentine manner and have their discharge ends in communication with a header **35** upon which is mounted spaced blocks **35** having flat horizontal upper faces. Each horizontal reach of each tube **35** is slightly inclined to the horizontal so that gas bubbles, which may form for instance in the lowest reach, may work their way upwardly to the header **36**. Communicating with the header **36** is a relatively short second header **37** upon which are mounted spaced blocks **38**, the vertical passages indicated at **39** (Figure 5) formed in these blocks serving to bring into communication the parallel headers **35** and **37**. The blocks **38** are rigidly secured to the blocks **36** by bolts or screws, the heads of two of which are indicated at **40** in Figure 5.

Communicating with the duct **37** and header **38** are the plurality of tubes **20'** which pass through the water pan **19** adjacent the bottom thereof, these tubes being disposed in close relationship and extending horizontally from the

header 38 to the header 41, into which all of the tubes 20 discharge. One end of header 41 is extended laterally and terminates in a longitudinally extending portion 41' which is connected to chamber 28 by detachable coupling 42, the point of discharge of the refrigerant passing from the header 41 into the chamber 28 being located above the level of the liquid 31 in that chamber.

Rising from chamber 28 is an uptake 43 of relatively large diameter which constitutes a portion of the conduit for leading gaseous refrigerant to the intake side of the compressor 25, the uptake 43 being of relatively large diameter in order that it may comprise, in effect, a separating chamber for gas and liquid. In the gaseous refrigerant return line, beyond the uptake 43, is a pressure regulator 44 and this regulator is so adjusted that the pressure of the gaseous refrigerant in uptake 43 and in chamber 28 will approximate, where ammonia is employed as a refrigerant, 50 pounds per square inch, which pressure will ensure maintenance of the desired temperatures in the various parts of the work circuit. The pressure indicators and cut-off valves illustrated in the drawing are of conventional form and need not be described in detail, the pressure indicator being indicated at 45 and cut-off valves at 46 and 47.

Water is supplied to the pan 19 through a water pipe or duct 48, having an adjustable metering valve 48; from a suitable source of supply, this water passing through a chamber 49 which encircles the gas refrigerant uptake 43 and being cooled while in said chamber to a low temperature. It will be appreciated that each container passing through the water in the pan 19 will, when removed, carry some small drops of water with it, hence the necessity for maintaining an inflow. The inflow of water will likewise cause the pan to quickly fill in the event that all containers are removed therefrom, at the termination of a run, and hence insure that a satisfactory body of water is in the pan at the beginning of a further run. Any excess water flowing into the pan will escape from its left-hand end (Figure 1) and will fall onto the return flow trough 19' and thus be conducted from the housing.

Extending downwardly from the header 33 is a downtake 50 and communicating with the bottom of this downtake is a horizontally extending drain pipe 51 having a discharge orifice 52 controlled by a valve 53. By opening the valve from time to time oil which collects in the sump or downtake 50 can be removed, such oil being introduced into the refrigerant by the compressor and, being heavier than the refrigerant, settling to the lowest point in the system.

It will be observed that the pan 19 and the series of horizontally extending pipes 20, together with the headers 37 and 41, lie above the level 31 of the liquid within the chamber 28. Ordinarily therefore liquid refrigerant will not rise from the header 35 into the header 37 and hence will not fill the pipes or ducts 20. In the operation of the apparatus, however, small bodies of liquid refrigerant are entrained by the gases which are generated in the various ducts 17 for the liquid refrigerant, these bodies passing upwardly from the header 35 to the header 37, together with the rising gas, and being conducted through the tubes 20 to the header 41 and thence back to the gas and liquid chamber 28. The effect of the refrigerant passing through tubes 20 is to maintain the temperature of the water body in the pan 19 at approximately 33° F., or just above freezing, so that the cooling effect of the liquid on the container bottoms is as great as possible. The ends of pan 19 are attached to the headers 37 and 41, respectively, and as these headers are detachably connected to the headers 35 and the chamber 28, respectively, it follows that the pan 19 and the associated tubes 20 and headers 37 and 41 comprise a unit which may be readily removed from the apparatus for cleaning and repair, a very desirable feature of such an apparatus.

The refrigerant circulatory system described is provided with several features which safeguard it and prevent damage under unusual conditions. Thus it may happen that automatic control valve 44 fails while the machine is in operation. In order to prevent loss of bottles or containers upon such an occurrence a by-pass around the valve 44 is provided, which by-pass is equipped with a manually operable needle valve 61. When automatic valve 44 fails valve 61 may be opened and manually adjusted to maintain the desired temperatures until such time as the machine can be stopped and valve 44 repaired. A conduit controlled by a needle valve 60 is provided to permit the introduction of refrigerant into chamber 28 in the event that valve 29 fails to open. This valve may likewise be manually controlled to regulate the temperature in the cooling system until such time as valve 29 can be repaired.

A second by-pass around valve 44 is provided, the pressure in which is controlled by a safety valve 62. This valve will open when, due to failure of automatic valve 44, an excessive pressure builds up in the uptake 43. The system is also provided with a trap 63 in which scale and other solids may collect and from which such substances may, from time to time, be removed.

In the event that it is desired to remove the refrigerant from the machine this can easily be accomplished by closing valve 47 and operating the compressor, whereupon the gas is gradually withdrawn from the cooling coils, condensed and stored. This process can be expedited, if desired, by heating the cooling coils, for instance with steam or hot water.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. The combination with a container cooling mechanism of the type including a casing having means therein for circulating a stream of air over the walls of a container passing therethrough, a body of liquid in which containers may be successively partially immersed and a conduit for a refrigerant having a portion disposed in the path of the stream of air and a second portion, in series with the first portion, disposed in heat exchanging relationship with said body of liquid, of a chamber for a refrigerant to which the ends of said conduit are connected, means for maintaining within said chamber a body of liquid refrigerant of predetermined depth, and means for withdrawing gaseous refrigerant from the upper portion of said chamber, the arrangement being such that liquid refrigerant passes from the chamber into one end of said conduit and gaseous refrigerant passes from said conduit into the chamber.

2. The combination with a container cooling mechanism of the type including a casing having means therein for circulating a stream of air

over the walls of a container passing therethrough, a body of liquid in which containers may be successively partially immersed and a conduit for a refrigerant having a portion disposed in the path of the stream of air and a second portion, in series with the first portion, disposed in heat exchanging relationship with said body of liquid, of a chamber for a refrigerant to which the ends of said conduit are connected, means for maintaining within said chamber a body of liquid refrigerant of predetermined depth, and means for withdrawing gaseous refrigerant from the upper portion of said chamber, the arrangement being such that that portion of the conduit which is disposed in heat exchanging relationship to the body of liquid normally contains gaseous refrigerant and that portion over which the cooling air passes normally contains liquid refrigerant.

3. The combination with a container cooling mechanism of the type including a casing having means therein for circulating a stream of air over the walls of a container passing therethrough, a body of liquid in which containers may be successively partially immersed and a conduit for a refrigerant having a portion disposed in the path of the stream of air and a second portion, in series with the first portion, disposed in heat exchanging relationship with said body of liquid, of a chamber for a refrigerant to which the ends of said conduit are connected, means for maintaining within said chamber a body of liquid refrigerant of predetermined depth, and means for withdrawing gaseous refrigerant from the upper portion of said chamber, the arrangement being such that that portion of the conduit which is disposed in heat exchanging relationship to the body of liquid is of less cross-sectional area than that portion over which the cooling air passes, for the purpose set forth.

4. The combination with a container cooling mechanism of the type including a casing having means therein for circulating a stream of air over the walls of a container passing therethrough, a body of liquid in which containers may be successively partially immersed and a conduit for a refrigerant having a portion disposed in the path of the stream of air and a second portion, in series with the first portion, disposed in heat exchanging relationship with said body of liquid, of a chamber for a refrigerant to which the ends of said conduit are connected, means for maintaining within said chamber a body of liquid refrigerant of predetermined depth, and means for withdrawing gaseous refrigerant from the upper portion of said chamber, the arrangement being such that portion of the conduit which is disposed in heat exchanging relationship to the body of liquid has its ends connected to headers, one such header being detachably connected to the discharge end of the other portion of the conduit and the second header to the said chamber.

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