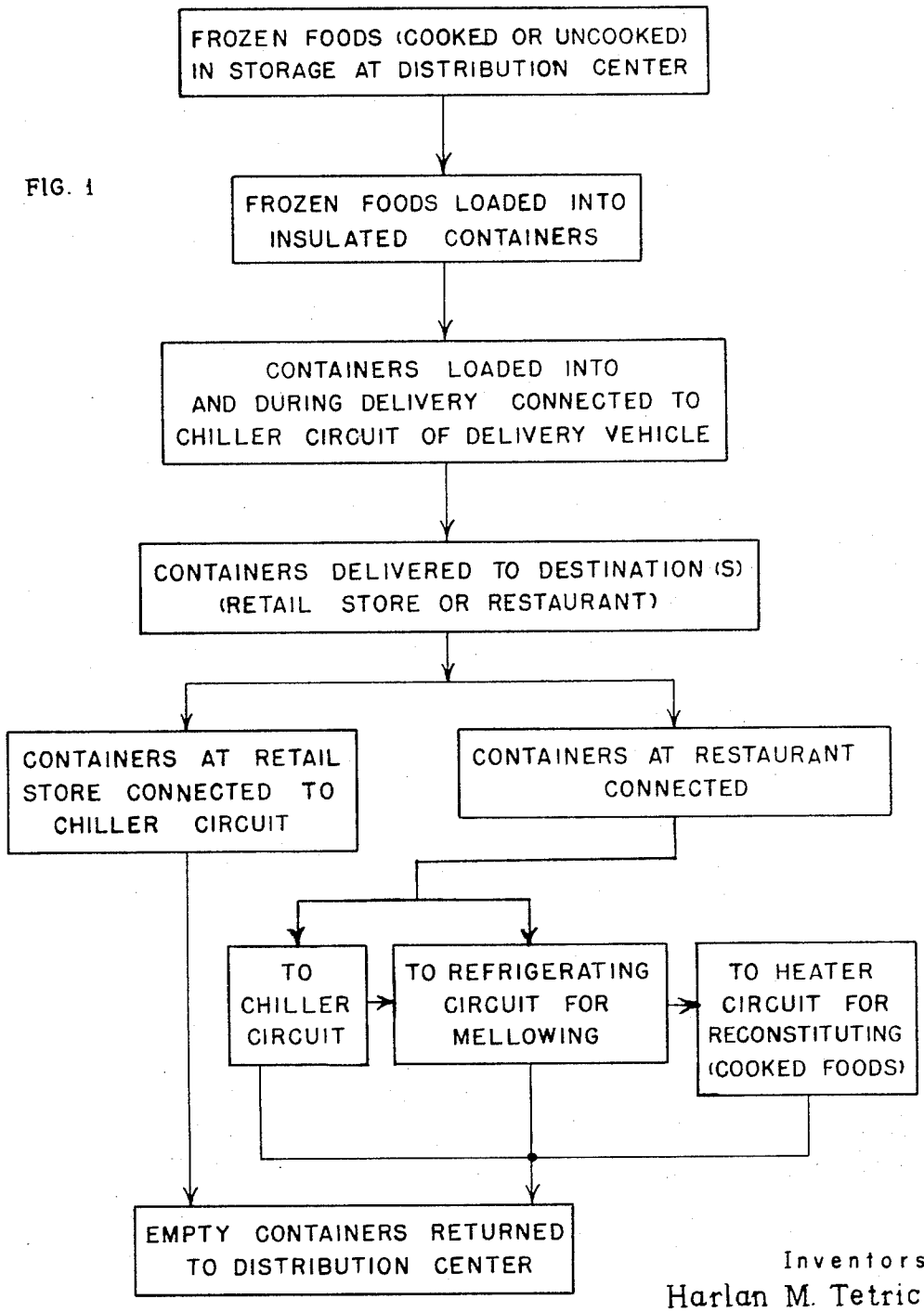
Sept. 23, 1969 H. M. TETRICK ET AL 3,468,369

PROCESS AND APPARATUS FOR HANDLING PERISHABLE MATERIALS

Filed April 10, 1967 4 Sheets-Sheet 1

FIG. 1



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PROCESS AND APPARATUS FOR HANDLING PERISHABLE MATERIALS

Filed April 10, 1967 4 Sheets-Sheet 2

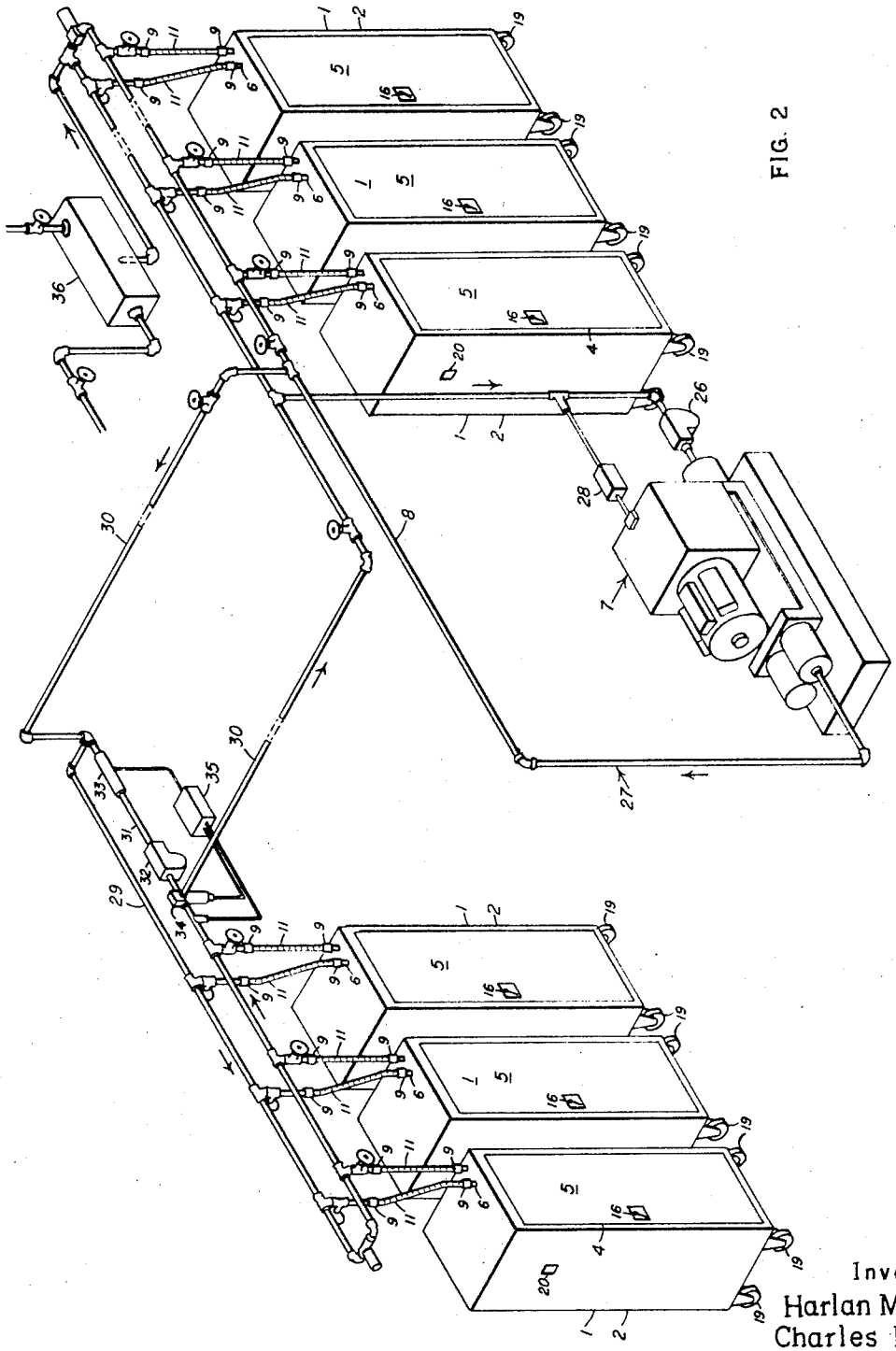


FIG. 2

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PROCESS AND APPARATUS FOR HANDLING PERISHABLE MATERIALS

Filed April 10, 1967 4 Sheets-Sheet 3

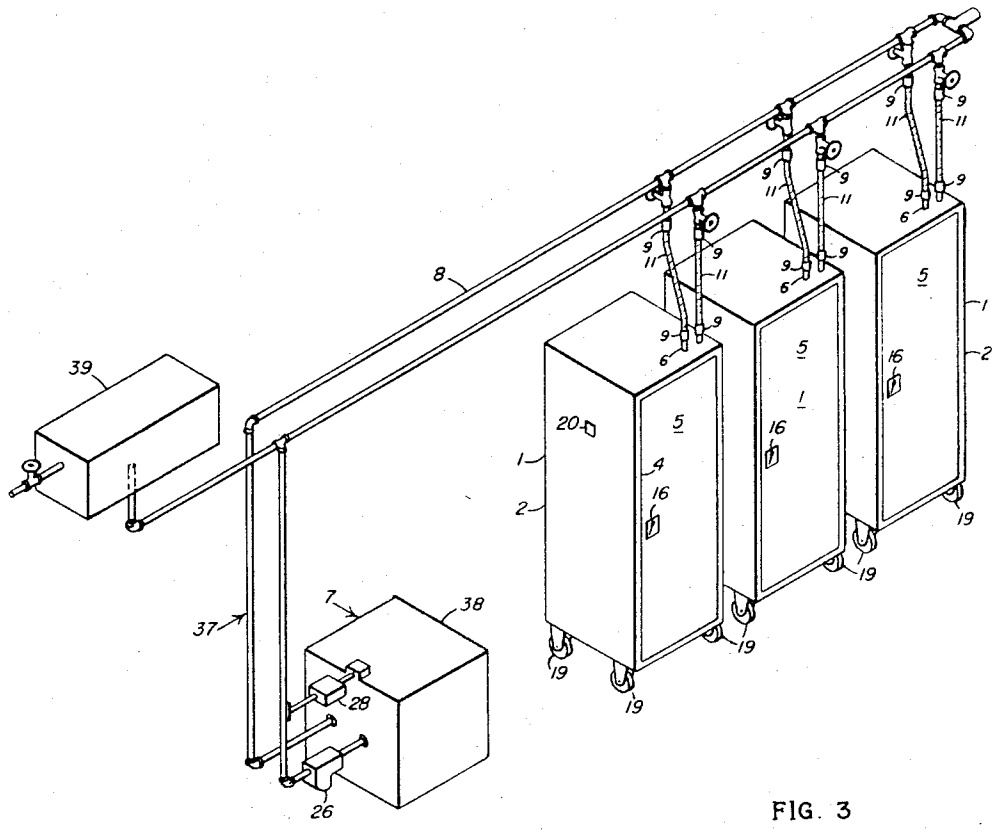


FIG. 3

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PROCESS AND APPARATUS FOR HANDLING PERISHABLE MATERIALS

Filed April 10, 1967 4 Sheets-Sheet 4

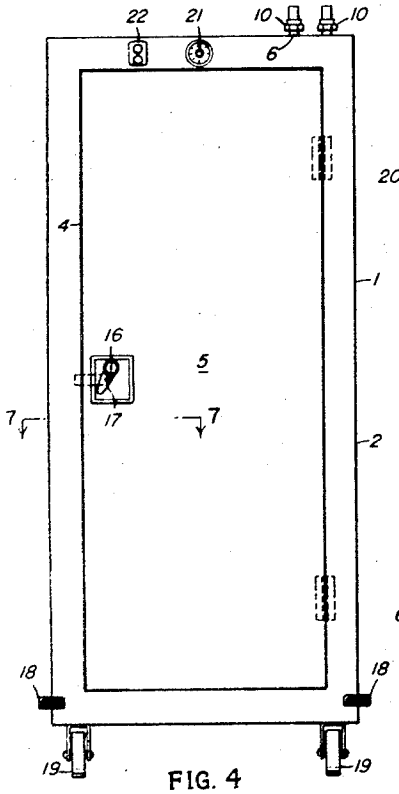


FIG. 4

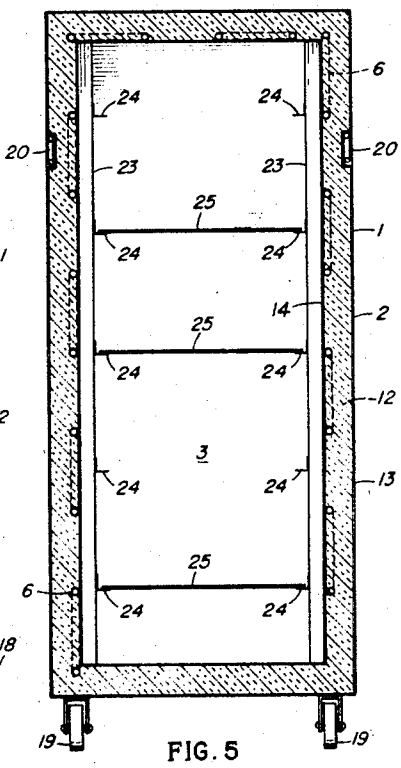


FIG. 5

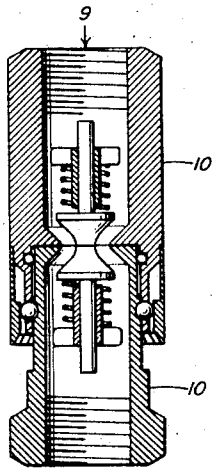


FIG. 10

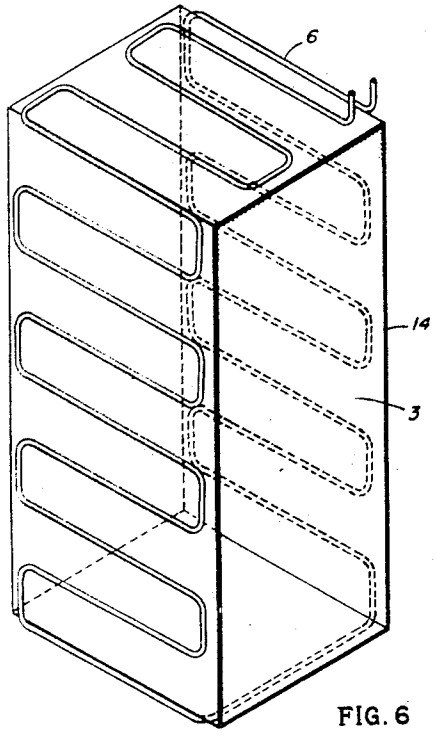


FIG. 6

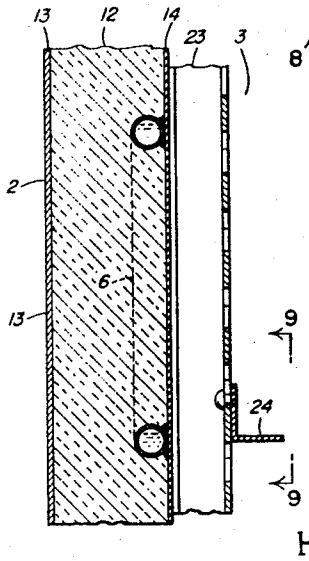


FIG. 8

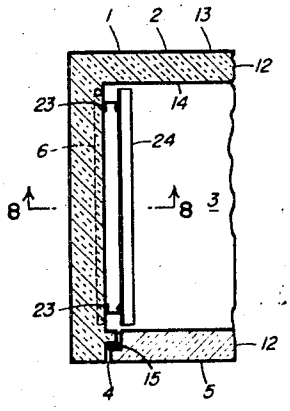
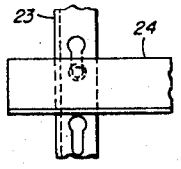


FIG. 7

FIG. 9



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United States Patent Office 3,468,369
Patented Sept. 23, 1969

3,468,369

PROCESS AND APPARATUS FOR HANDLING PERISHABLE MATERIALS

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Filed Apr. 10, 1967, Ser. No. 629,653
Int. Cl. F25b *13/00, 29/00;* F28d *15/00*
U.S. Cl. 165—2 9 Claims

ABSTRACT OF THE DISCLOSURE

A process and apparatus for handling frozen foods or other perishable materials under controlled temperature conditions in which the perishable materials required at any given destination are delivered thereto from a distribution center in one or more portable, insulated containers, individually piped for circulation therethrough of a liquid heat transfer medium for controlling their internal temperatures but unequipped with individual primary heat exchangers, the materials are loaded into the containers at the distribution center and remain therein until removed at the destination, the containers when empty are returned to the center for reuse, and the piping of each container is quick connectible to any of a plurality of conveniently located primary heat exchangers, each adapted to supply the liquid medium at a selected temperature to a plurality of containers for producing in the containers the internal temperatures required at source, destination or during delivery.

Background of the invention

In the distribution of frozen foods or other perishable materials from freezing plants, warehouses or other distribution centers to restaurants, retail grocery stores or other destinations which they are sold or otherwise used, it is customary to insulate the compartment of the vehicle in which the materials are shipped. If the delivery time is short, the compartment may simply be insulated against loss of cold to ambient air, but, more usually, the compartment is refrigerated for controlling its temperature by charging it with a suitable solid or liquid refrigerating medium or connecting it to a mechanical chiller. Whether the perishable materials are loaded into the insulated compartment in the shipping vehicle individually, in packages or in cartons containing several packages, cold from the compartment inevitably is lost to ambient air during loading and, if there is partial unloading at each of several destinations, there cannot but be at least a temporary rise in the compartment's temperature at each, with consequent impairment of control of the temperature of the materials. This impairment would be much the greater were it attempted to ship in the same compartment materials at different temperatures, such as frozen and unfrozen foods. As a result, frozen and unfrozen foods, even if for delivery to the same destination, commonly are shipped in separate vehicles or at least in separate compartments.

A proposal for reducing the dependence for the control of the temperature of frozen foods during delivery upon the temperature in the shipping compartment in which they are delivered, is to pack frozen foods in insulated cartons which are sealed and individually charged with a

suitable refrigerant, such as liquid nitrogen. Even in cases in which the expense is not prohibitive, the charge dissipates rather rapidly, thus practically limiting this expedient to deliveries of short duration.

It is with these and other problems in handling perishable materials both during and before and after delivery from a distribution center to any of a number of destinations, that the present invention is concerned.

Summary of the invention

The present invention provides an improved process and apparatus for handling perishable foods or other perishable materials requiring controlled temperature conditions in which the materials for a given destination are loaded at a distribution center into and until used at the destination remain in one or more insulated containers, the internal temperature of which is controlled by circulating through piping thereof a liquid heat transfer medium suppliable as any stage by a primary heat exchanger for the stage to which a plurality of containers is attachable at the same time, thereby enabling the temperature to which the perishable materials in any container are exposed to be controlled at all times without dependence upon refrigeration of the air surrounding the container or the introduction of a temporary charge of refrigerant into the container.

The primary heat exchangers of the invention may be fixed, portable or mobile units, each is adapted to supply a plurality of containers and the primary exchangers required for a particular application of the invention are of such number and capacity and so located as to provide the desired control of the temperature of the foods in the containers from loading therein to removal therefrom. Each primary exchanger has pipes through which it supplies the liquid medium and those pipes and the piping of each container are fitted with compatible, quick connectible elements of fluid quick couplings for enabling any container to be connected and disconnected at will to an adjoining heat exchanger without significant loss of the liquid medium.

The improved shipping and storage containers of the invention are essentially refrigerators stripped of the weight and expense of individual chillers or other primary heat exchangers, each having an insulated shell, an access opening therein normally closed by a hinged or other suitable door, suitably arranged piping for the liquid heat transfer medium, and an interior that, as desired, is fixed or variable in its compartmentation. Wheeled or otherwise rendered mobile, if need be, the improved containers in any case are portable and, by return when empty to a distribution center for further use, reusable over long periods. If desired, the containers are readily adaptable for use at a store or other destination as temporary dispensing cabinets replaceable when empty by loaded containers delivered from the distribution center. As applied to perishable materials and depending on the liquid heat transfer medium used, it also is feasible at a restaurant or like destination to hold the foods in a container frozen for an indefinite period, raise their temperature to a mellowing or thawing range to shorten the time required for preparing them for consumption, or, by using a heater rather than a chiller as the primary heat exchanger, even reconstitute the foods for consumption direct from the container.

While the foregoing are its principal objectives, other objects and advantages of the invention will appear here-

inafter in the detailed description, be particularly pointed out in the appended claims, and be illustrated in the accompanying drawings, in which:

Figure description

FIGURE 1 is a flow sheet of a preferred embodiment of the improved perishable materials handling process of the present invention;

FIGURE 2 is an isometric view of a chiller circuit, including a mellowing branch, of a preferred embodiment of the improved apparatus of the present invention;

FIGURE 3 is an isometric view of a heater circuit of the preferred apparatus;

FIGURE 4 is a front elevational view on an enlarged scale of a preferred embodiment of the improved insulated container of the present invention;

FIGURE 5 is a central vertical sectional view of the container of FIGURE 4 taken parallel to the plane of that figure;

FIGURE 6 is an isometric view of the casing of the container of FIGURE 4 with the coating and insulation removed;

FIGURE 7 is a fragmentary horizontal sectional view taken along lines 7—7 of FIGURE 4;

FIGURE 8 is a fragmentary vertical sectional view on an enlarged scale taken along lines 8—8 of FIGURE 7;

FIGURE 9 is a fragmentary elevational view taken along lines 9—9 of FIGURE 8; and

FIGURE 10 is a central longitudinal sectional view of a preferred quick coupling.

Detailed description

Referring now in detail to the drawings in which like reference characters designate like parts, the improved process and apparatus of the present invention, while capable of storing or otherwise handling perishable materials under controlled temperature conditions at one location foods requiring refrigeration, are particularly adapted for handling perishable materials, such as previously refrigerated or frozen foods which in the course of handling require shipment or transportation from one location to another. In such handling the source or starting location may be a freezing plant, warehouse or other distribution center and the end location one or more retail grocery stores, restaurants, or other destinations whose requirements of the materials are supplied in whole or in part from the particular center.

The materials designed to be handled according to this invention may be any perishable materials, such as perishable foods which in shipment from a source to a destination require a controlled temperature environment for their preservation. However, the primary need is in the handling of frozen foods that are frozen at one location and shipped for sale, consumption or other use at one or more other locations. It therefore is with reference to such food handling that the improved process and apparatus will be described as exemplary of the invention.

The apparatus essential to the invention is comprised of a plurality of cabinets or other containers **1**, each having an insulated casing or shell **2**, the hollow interior **3** of which is accessible for loading and unloading through an access opening **4** normally closed by an insulated door or other closure member **5**. Each container has in it copper or other suitably heat conductive piping, tubing or coils **6** for transferring heat between its interior **3** and a liquid heat transfer medium circulated through the piping. Unlike the usual refrigerators or freezers, the containers **1** are not self-contained heat transfer units equipped with individual chillers or heaters and, instead, are dependent for supply of the liquid heat transfer medium at the desired temperature upon separate chillers or heaters, herein termed generally "primary heat exchangers" and designated as **7**, each of a capacity to supply and adapted for connection to a plurality of containers.

All in the same application, installation or system supplying the same liquid heat transfer medium, the primary heat exchangers **7** are located or positioned along the route or routes of the containers as necessary to provide the desired control of the containers' internal or interior temperatures. Thus, in a typical application in which the containers are loaded at a distribution center and transported in trucks or other suitable vehicles or shipping devices to a plurality of destinations, there ordinarily will be one or more primary heat exchangers at the distribution center, on each vehicle and at each destination. Each such heat exchanger will have supply and return lines or pipes **8** to which a plurality of containers will be connectible, ordinarily in parallel. To enable a container to be plugged or tapped, both readily and interchangeably, into any primary heat exchanger in a particular system or installation, the connections between the containers and the lines **8** of the primary exchangers are push-pull or other suitable quick connectible or disconnect fluid couplings **9**, the compatible, interfittable or mateable coupling elements or couplers **10** of each of which are valved for closing themselves when uncoupled and opening automatically on coupling. Conveniently, each container **1** may have the ends of its piping **6** projecting above its casing **2** with each end fitted with one element **10** of the coupling **9** common to the particular system. In turn, the lines **8** of each primary exchanger **7** may be fitted at intervals with coupling elements **10** mateable or couplable with those on each container. To compensate for manufacturing and installation tolerances, there usually should be some flexibility in the connections between the container pipings **6** and primary exchanger lines **8**. This is readily providable by making the connections through flexible hoses or leads **11** which may be permanently attached to the lines with coupling elements at their free ends compatible with those on the containers, or, and preferably, have coupling elements at both ends for coupling with mating elements on the lines and pipings.

While its basic components are the insulated casing **2**, insulated door **5** normally closing the access opening **4** to its interior **3** and heat transfer piping **6** fitted at its projecting ends with elements **10** of the couplings **9**, and its size and shape may be those best suited for the particular system in which it is to be used, the preferred container **1** is further refined in the several respects illustrated. Of box or regular hexahedral-shape, the preferred container is both permanent and rigid. Its insulated casing **2** and door **5** both are of the thin, lightweight sandwich construction now usual in refrigerators, with a layer of pored polyurethane or like suitable insulation **12** sheathed in and sandwiched between a covering **13** and lining **14** of sheet aluminum or like suitable material. Conveniently hinged at one side to and flush with the front of the casing **2**, the door **5** has between it and the casing **2** about the opening **4** a suitable sealing gasket **15**. The door may be held closed by any suitable lock **16**, that illustrated being a mechanical lock operated by a handle **17** recessed in the door and lockable against turning, as by a key (not shown), for preventing pilfering of the contents of the container. Also provided as desirable conveniences on the exterior of the box are corner bumpers **18**, bottom casters **19**, recessed side handles **20**, and, on the face of the casing **2** above the door, a thermometer **21** showing the temperature of the interior **3** and an alarm **22** of the warning light or other suitable type for indicating a failure in the container's operation. The interior **3** may be divided or compartmentalized as desired, that of the illustrated container having fixed side brackets **23** adjustably mounting slides **24** for supporting shelves **25** at any desired vertical spacing. In the illustrated container the piping **6** is embedded in the casing **2** against the concealed side of the lining **14** and fixed, as by welding, to that side to hold it in place, thus requiring the lining to have good heat conductivity, as does aluminum, for transferring heat between the piping and the interior.

The primary heat exchangers **7** may be fixed, portable

or mobile, depending on the need of the particular system. When chillers, they preferably will be self-contained units, depending for chilling on the alternate compression and expansion of Freon or other suitable primary refrigerant and including suitable means for transferring heat between that refrigerant and the relatively secondary liquid refrigerant or heat transfer medium used for controlling the temperature in the containers **1**. Equipped at a suitable point in its lines **8** with a circulating pump **26** for circulating the secondary liquid refrigerant through the lines and the piping **6** of the containers **1** connected thereto at a particular time, and forming with its pump and lines a chiller circuit **27**, the chiller will be controlled by a thermostat **28** for maintaining the interiors **3** of the connected containers within the temperature range desired.

At the distribution center in which the containers in the typical system are loaded with prefrozen foods and in the vehicle or vehicles in which the loaded containers are transported to fill the food requirements of one or more destinations, the task of the primary heat exchangers **7** usually will be to hold the foods in the containers frozen and thus at a temperature not exceeding 32° F. and in such case the thermostats **28** of the one or more chillers at the center and on or in each vehicle will be set to maintain the internal temperatures of any containers connected thereto within the required range, such as from −20° to 10° F. On the other hand, at a restaurant or like destination it may be desired to hold the foods in some container or containers frozen, while mellowing or thawing in one or more other containers foods that are shortly to be consumed to reduce the time of preparation. The mellowing can be produced by a separate mellowing circuit adapted to supply the secondary liquid refrigerant in the required temperature range. However, a chiller circuit **27** is readily adaptable to both purposes by connecting across its main lines **8** a branch or mellowing line or circuit **29** suitably fitted for raising the temperature of the secondary liquid refrigerant from the main lines to the desired higher level.

In the exemplary adaptation shown in FIG. 2, the branch line **29** is connected at spaced points to a pair of connecting lines **30** each connected to one of the main lines **8** and also is connected between those points by a bypass **31**. In the bypass are a circulating pump **32** and an electric heater **33** and at the junction of the branch line, the bypass and the connecting line **30** at bypass' inlet end is a motorized or other suitable automatic three-way modulating valve **34**. The pump **32** preferably runs constantly, as does the main pump **26**, but the heater **33** and three-way valve **34** are thermostatically controlled, conveniently by a common thermostat **35** sensing the temperature in the branch line immediately in advance of the junction. Under this control, the valve **34** will be set automatically to connect either the bypass **31** or the connecting line **30** at the bypass' inlet end in the branch line **29** or to regulate the division of flow from the branch line between the bypass and that connecting line. The heater **33** in turn will be energized whenever the valve **34** connects only the bypass **31** in the branch line. With this arrangement the branch line **29** will circulate refrigerant within itself until the internal temperature of the one or more containers connected to it is raised to the desired level and thereafter will alternately connect and disconnect the branch line partly or fully to and from the main lines **8** as needed to maintain that level, which, depending on the foods involved, will usually be within a range of from 10° to 50° F. This arrangement also permits the branch line **29**, when not needed for mellowing, to be used for supplying refrigerant at the same temperature as the main lines **8** by so setting its thermostat **35** as to cut out the bypass **31** and shut off the heater **33** and at such time the pump **32** also should be shut off. Whether or not provided with a branch line, the chiller circuit **27** ordinarily will have a reservoir **36** connected to its main lines **8** for automatically compensating for any loss of the secondary liquid refrigerant.

If in the particular system the foods in any container are to be held frozen or mellowed, the primary heat exchangers **7** will all be chillers. However, if, as in supplying a restaurant chain, it is desired to cook foods completely in a central kitchen, freeze the cooked foods for storage until needed and at restaurant simply heat or reconstitute the foods for consumption, the containers **1** lend themselves to such heating. In this case, given a suitable liquid heat transfer medium, no change is needed in the containers and the only change required is in the substitution of a heater for a chiller in a primary heat exchanger circuit. In the exemplary heater circuit **37** shown in FIG. 3, the heater serving as the primary heat exchanger **7** has a closed boiler-type vessel or tank **38** in which the medium is heated under the control of the associated, in this case high temperature range thermostat **28** by electrical or other suitable heating means (not shown), either directly or through a primary heat transfer medium, such as water. The secondray or, if heated directly, sole liquid heat transfer medium is circulated through the vessel **38**, lines **8** and any container **1** attached thereto by the circulating pump **26** and, to compensate for expansion of the circulated medium, the circuit should include an expansion tank **39**. While the temperature to which the foods in any container attached in the heater circuit **38** are subjected may be varied as desired, the usual range will be from 120° to 212° F.

The heat transfer medium used in this invention is a liquid and properly classifiable, at least when used as a refrigerant, as a secondary heat transfer medium. While such media are generally termed "brines," the corrosiveness of a true brine or saline solution renders its use in this invention impractical. There are, however, numerous liquids that are suited for use, as both non-corrosive and having liquidus ranges encompassing or bracketing the overall temperature range required in a system of this invention. Ideally, the liquid should be non-toxic and have a specific heat, specific gravity and viscosity approaching that of water, with freezing and boiling points bracketing the range of temperatures to which it will be subjected. Thus, if the particular system is not to include any heater circuits **38** and involves at most the low freezing range and the middle mellowing or refrigerating range, with overall limits on the order of −20° and 50° F., the medium may be a liquid such as methyl or ethyl alcohol. For a system including heater circuits, the boiling points of the alcohols are too low but liquids, such as ethylene glycol, are suitable, as are a number of the silicones. The liquid presently preferred, as combining practical economy with a close approximation of the ideal properties, is a silicone fluid now marketed by the General Electric Company under the designation S.F. 96–5. While, as polymers, silicones generally do not have definite freezing and boiling points, the liquidus range of this silicone extends from around −120° F. to around 275° F. and at 77° F. its viscosity is 5 centistokes, specific gravity 0.916 and specific heat 0.36.

Using the above preferred apparatus, the improved process of this invention is depicted in flow sheet form in FIG. 1. The process is concerned with the handling of foods that have previously been frozen and suitably packaged. Assuming, as indicated on the first block of the flow sheet, that the frozen foods, either cooked or uncooked, are stored in suitable facilities at the distribution center at the temperature range in which they are held frozen, the requirements of any destination supplied by the center, on computerized or other mode of demand, are loaded into one or more of the insulated containers **1** in an assembly area. Thereafter, the containers are moved for shipment to a dock or like area at the center for loading into a truck, trailer or other suitable vehicle and, depending upon the time intervals and ambient temperatures, each may be plugged into a chiller circuit **27** in

one or both areas. Again depending on the ambient temperature and the time required for delivery, the containers, as necessary, may be plugged into a chiller circuit in the vehicle. Since, so plugged, the containers are independent in their internal temperatures of the temperature of the compartment of the vehicle in which they are loaded, the compartment requires no insulation or refrigeration and its load can be a mixture of the containerized frozen foods and any non-refrigerating branch **29** of a chiller circuit **27** or a separate refrigerating circuit, the mixed load can be extended to include one or more of the improved containers loaded with refrigerated goods or intended to mellow frozen foods along the route.

Upon arrival of the vehicle at a destination, any of the insulated containers and other goods consigned thereto are unloaded, the containers after unplugging from the circuit or circuits in the vehicle. After unloading, the containers are moved to the area or areas and plugged into the circuit or circuits appropriate for their intended use. In a retail store the usual alternatives will be storage and use as a dispensing cabinet in place of an empty container, the containers for such use ordinarily being so constructed and so loaded as to display their contents with their doors open or removed and resting on their backs to minimize loss of cold. These alternatives also are possible in a restaurant in which food is both consumed on the premises and sold for consumption elsewhere, although the more usual alternative uses at such a destination will be storing frozen foods or mellowing or thawing frozen foods to shorten the time of preparation for consumption. Also, if the foods in it were fully cooked before freezing and have been mellowed or thawed, a container can be plugged into a heater circuit **38** for reconstituting the foods for consumption without intervening cooking.

In whatever system the insulated containers are used, their insulation and the liquid medium filling their pipings **6** enable them to hold their internal temperatures for considerable periods, which not only are adequate to span the times required for loading and unloading, but, if the delivery time is short, can even enable them to be delivered from the distribution center to a destination without connection to a heat exchanger circuit on the transporting vehicle. The lack of need for insulation or refrigeration of the vehicle itself also enables any vehicle to be adapted temporarily for transporting the loaded containers simply by equipping it with one or more portable, if necessary, self-powered primary heat exchanger circuits. The same expedient or the use of mobile heat exchanger circuits can be resorted to at a distribution center or destination. A system according to the present invention, using the improved containers and, as desired or necessary, permanently installed portable or mobile primary heat exchanger circuits, therefore can be adapted for use at any time and place and can fulfill any requirements imposed upon it in handling frozen foods from loading at a distribution center to use at a destination. Handling frozen foods in lightweight permanent containers, that when empty are returned for reuse to the distribution center, adapted to supply a liquid heat transfer medium at a controlled temperature to a plurality of containers from any one of the plurality of primary heat exchangers to which all of the containers are interchangeable and eliminating direct handling of the foods between initial loading and ultimate use, the process and apparatus of the present invention combine efficiency and flexibility with a cost in equipment and use far less than their capabilities would indicate.

From the above detailed description, it will be apparent that there has been provided a process and apparatus for handling perishable materials from loading at a distribution center to use at one or more destinations which improve in numerous ways upon those heretofore employed. It should be understood that the described and disclosed embodiments of the process and apparatus are merely exemplary of the invention and that all modifications are intended to be included that do not depart from the spirit of the invention and the scope of the appended claims.

Having now described our invention, we claim:

1. A process for handling perishable materials under controlled temperature conditions in shipment by shipping means between and storage at a distribution center and any of a plurality of destinations, comprising selectively equipping said shipping means, distribution center and destinations with any of a plurality of primary heat exchanger circuits all adapted in a given application of the process to supply at selected temperatures the same liquid heat transfer medium having a liquidus range extending below —20° F. and above 50° F. and beyond any minimum and maximum required for particular materials being handled, maintaining at said center a supply of portable insulated containers each equipped for heat transfer only with coils for receiving said liquid medium and releasably fluid-connectable in plural to any of said circuits for supply in common thereby with said liquid medium, loading perishable materials into any of said containers at said center, shipping each loaded container from said center to one of said destinations by selected of said shipping means, and, without intervening unloading of each loaded container and by selective connection thereof to and control of the temperature range within said liquidus range at which said liquid medium is supplied thereto by any of said circuits between loading and unloading, at said center and in shipment maintaining the materials in said loaded container in a preselected temperature range within said liquidus range and not extending above 32° F., and at the destination of said loaded container regulating within said liquidus range the temperature range of the materials therein including for certain materials raising the temperature thereof prior to unloading above said preseletced temperature range to a required maximum for a particular use upon unloading.

2. A process according to claim **1**, wherein the perishable materials loaded into the containers are frozen foods.

3. A process according to claim **1**, wherein each container between loading and unloading is successively connected to primary heat exchanger circuits at different locations.

4. A process according to claim **3**, wherein the containers are returned when empty to the distribution center.

5. A process according to claim **4**, wherein the containers are interchangeably connectible to the heat exchanger circuits by fitting opposite ends of the piping with a pair of quick-coupling elements of fluid quick couplings, and having in each primary heat exchanger circuit pipes fitted at intervals with pairs of quick coupling elements each mateable with the pair of quick coupling elements of any of the containers.

6. A process according to claim **2**, wherein all of the primary heat exchanger circuits supply the same liquid heat transfer medium and the heat exchangers therein are all chillers for supplying the medium to the containers at each location in a temperature range for holding frozen the foods therein.

7. A process according to claim **2**, wherein the primary heat exchanger circuits include chiller and refrigerating circuits for supplying the medium to any containers connected thereto at temperatures in the freezing and refrigerating ranges, respectively, of the foods therein.

8. A process according to claim **7**, wherein each refrigerating circuit is a branch of a chiller circuit.

9. A process according to claim **2**, wherein the frozen foods with which certain of the containers are loaded were fully cooked prior to freezing, each destination is an eating establishment, and the heat exchanger circuits include at each establishment to which containers with cooked foods are consigned at least one heater circuit for reconstituting for consumption the cooked foods in any container connected thereto by supplying the medium

thereto at an elevated temperature in a range suitable for such consumption.

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