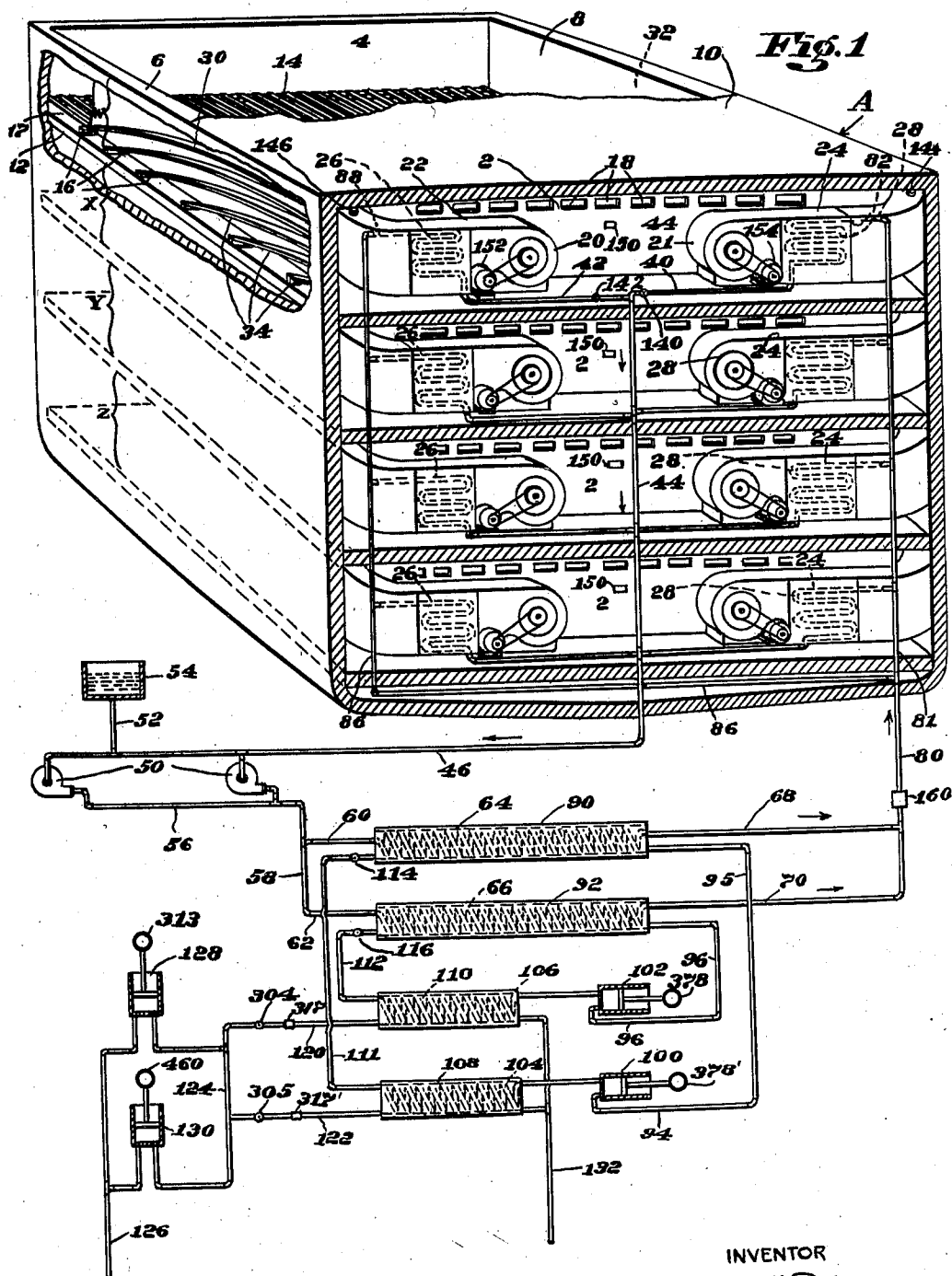


March 30, 1943.

H. H. ROBSON
PRESERVING PERISHABLES
Filed Sept. 17, 1941

2,315,379

5 Sheets-Sheet 1



INVENTOR
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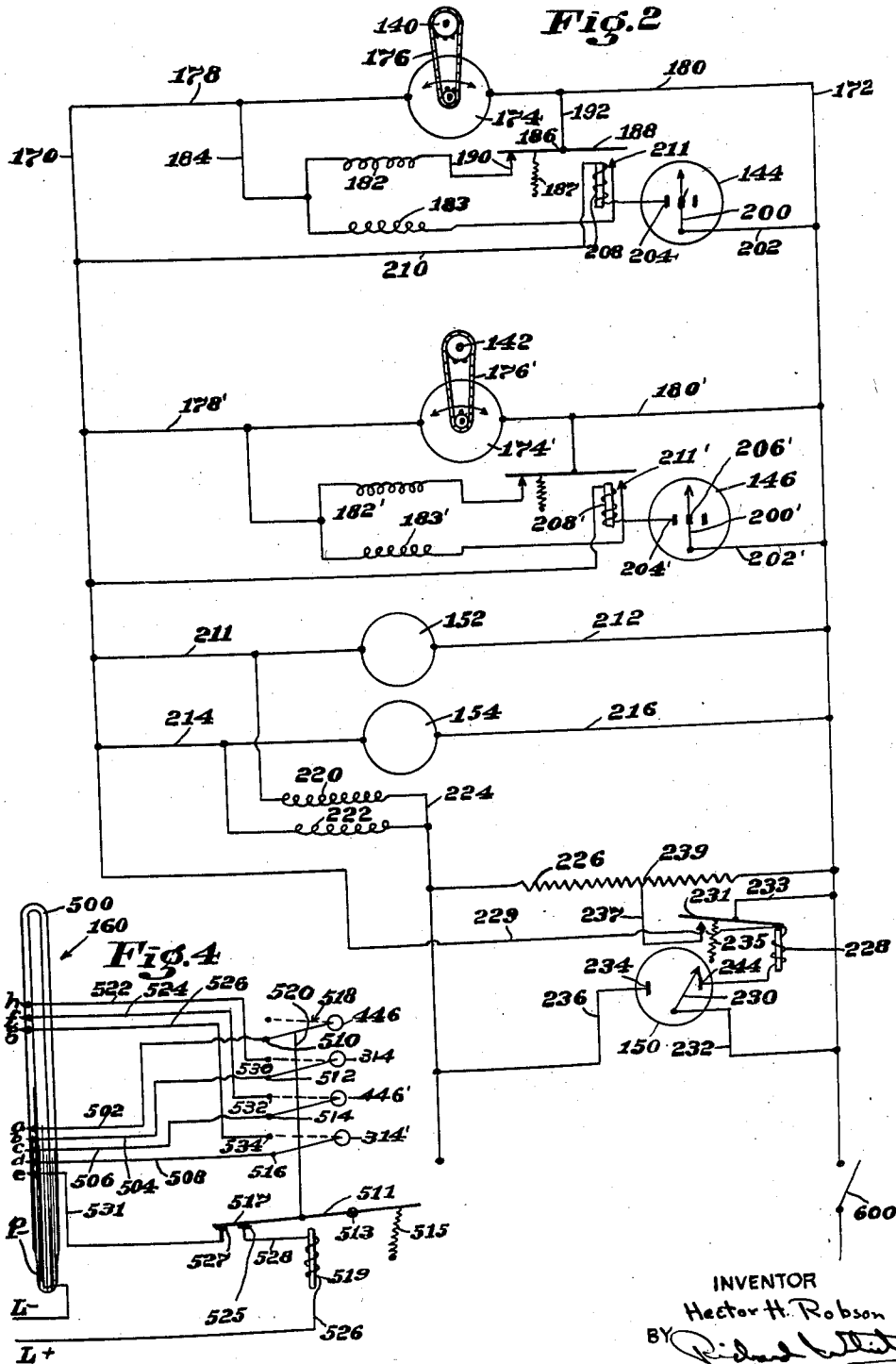
March 30, 1943.

H. H. ROBSON
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2,315,379

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March 30, 1943.

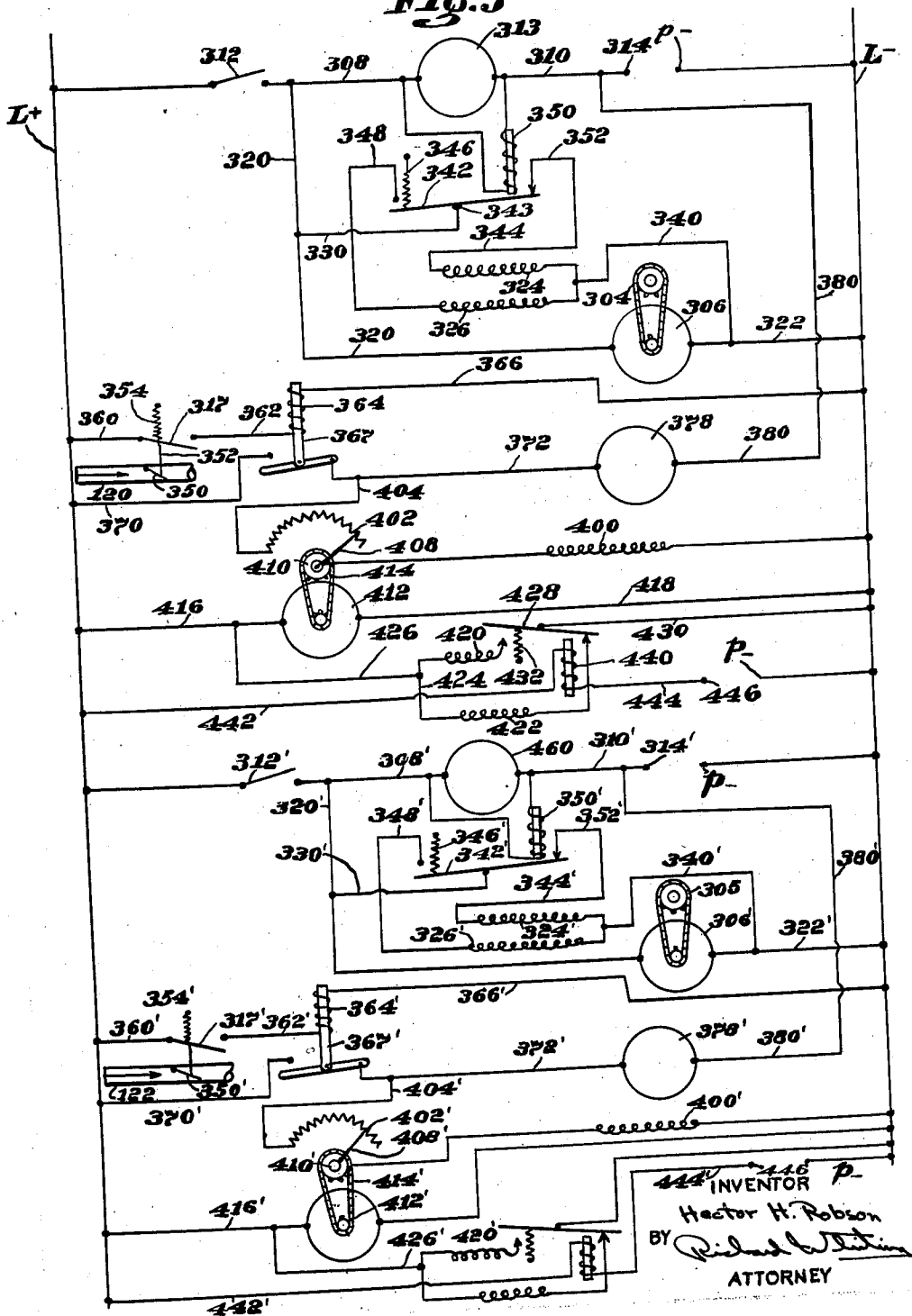
H. H. ROBSON
PRESERVING PERISHABLES

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Fig. 3



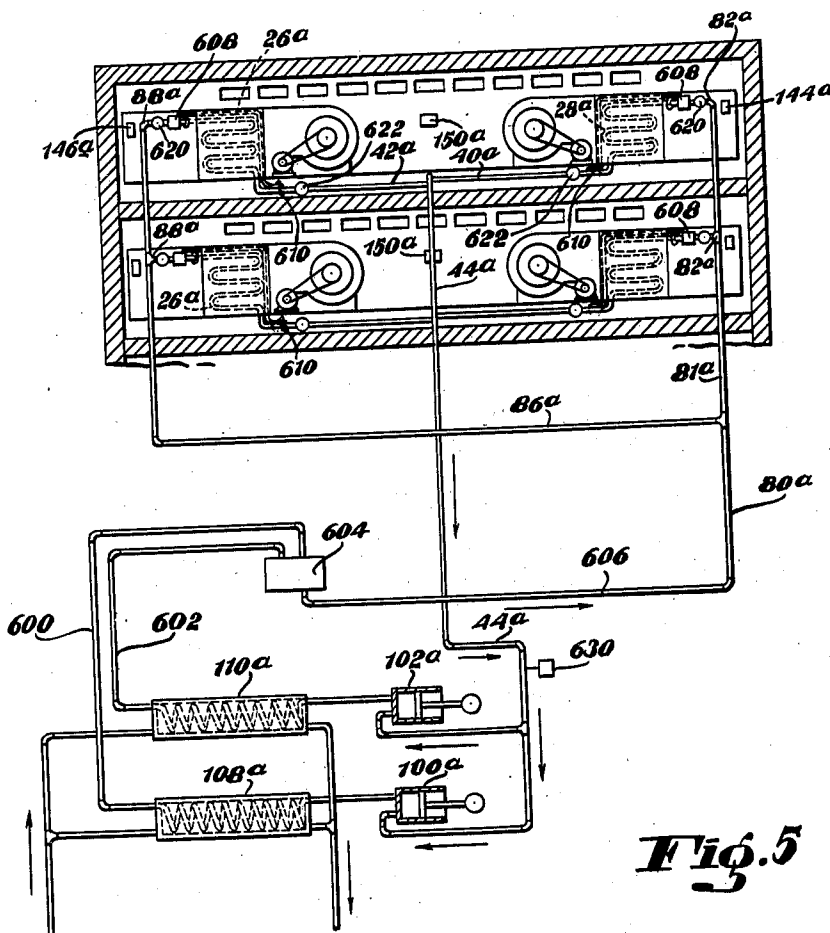
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2,315,379

5 Sheets-Sheet 4



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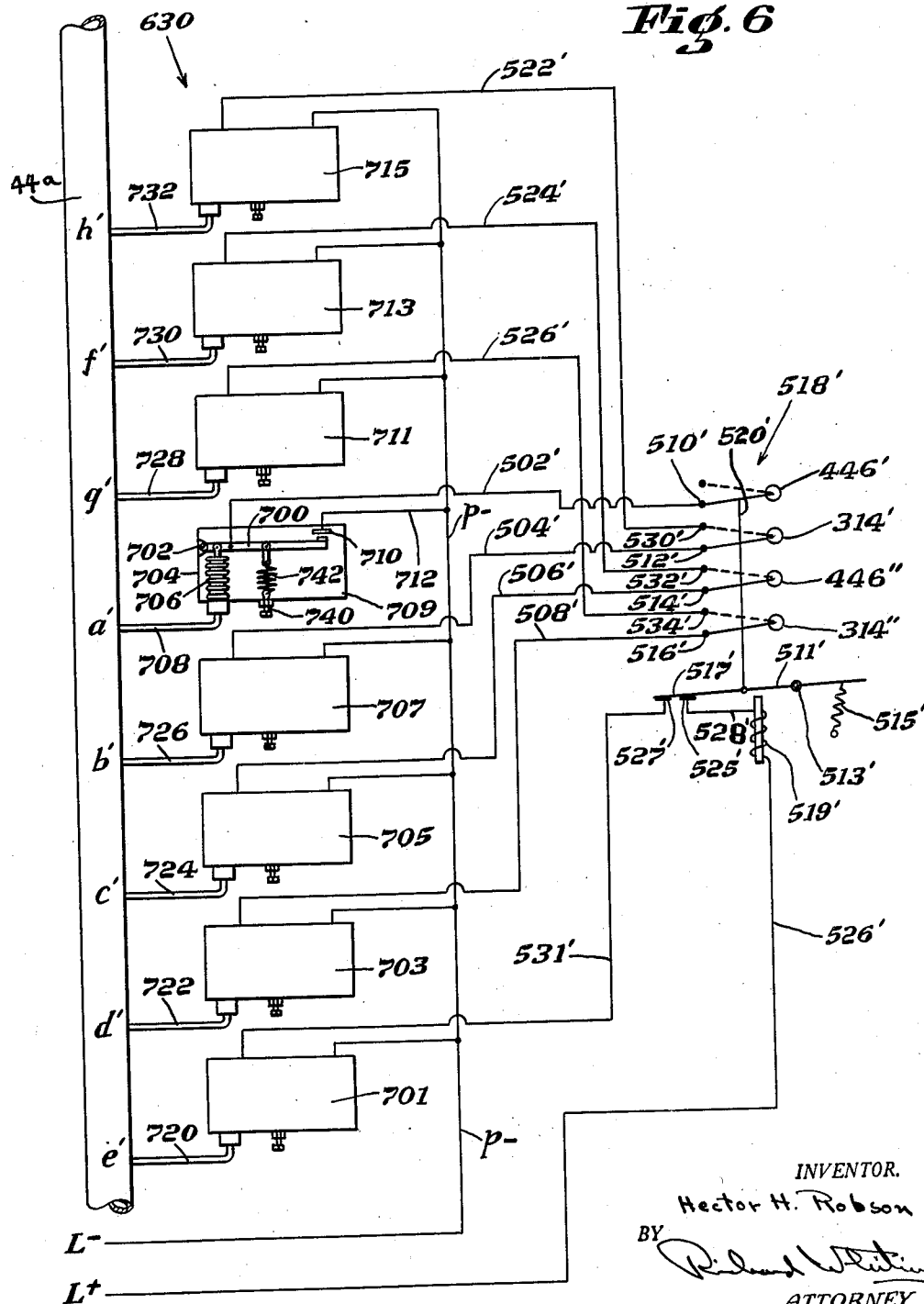
March 30, 1943.

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PRESERVING PERISHABLES
Filed Sept. 17, 1941

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Fig. 6



UNITED STATES PATENT OFFICE

2,315,379

PRESERVING PERISHABLES

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to United Fruit Company, Boston, Mass., a cor-
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Application September 17, 1941, Serial No. 411,240

22 Claims. (Cl. 62—6)

This invention relates to refrigerating systems for preserving perishables such as vegetables and fruit, and particularly bananas, during shipment, and its object is to provide an improved refrigerating system of the type in which air is withdrawn from the cargo compartment, cooled by being passed in contact with air cooling apparatus, and then returned to the cargo compartment and preferably passed generally vertically through the cargo. By my invention I have improved on such systems by minimizing the tendency of the air to dry the perishable cargo during refrigeration and by effectively controlling the amount of ripening of the fruit during the voyage.

This application is a continuation in part of my prior application Serial No. 296,080, filed September 22, 1939.

In the drawings:

Fig. 1 is a diagrammatic view, partly in perspective, showing a portion of a cargo carrying ship equipped with a refrigerating system embodying my invention;

Fig. 2 is a diagram of electrically operated apparatus provided in each cargo compartment for controlling the rate of refrigerant flow and the fan speeds;

Fig. 3 is a diagram of an electric circuit showing apparatus for controlling the capacity of the central refrigerating plant in response to predetermined temperatures of the refrigerant in the system;

Fig. 4 is a detail of a portion of the circuit of Fig. 3;

Fig. 5 is a diagrammatic elevation view of a modification, and

Fig. 6 is a diagram of an electric circuit showing in detail the pressure responsive element 630 shown in Fig. 5.

In Fig. 1 I have indicated generally at A a section of a ship having any desired number of cargo compartments, in this instance four, designated W, X, Y and Z. Each of these compartments, as illustrated by compartment W, is bounded by end partitions 2 and 4, side partitions 6 and 8, and by upper and lower decks 10 and 12.

Each of the cargo compartments is provided with a suitable system for circulating air, preferably, although not necessarily, of the type noted in my prior Patents Nos. 1,835,085 and 2,111,938. As described in those patents in detail, such a system preferably embodies a perforate floor grating 14 resting on risers 16 or the like, to form an air receiving space 17 between the grating and the under deck 12. The cargo rests on the floor

grating. Air is withdrawn from the interior of the compartment through suitable openings 18 in the end partition 2 by means of fans 20 and 21 which force the air to port and starboard through ducts 22 and 24 containing cooling coils 26 and 28 for lowering its temperature. The cooled air is forced lengthwise of the compartment through side ducts 30 and 32, each of which contains a plurality of air directors 34. The directors 34 curve downwardly to direct air forced through the side ducts to various predetermined portions of the bottom of the compartment from whence it passes athwartship through the space 17 beneath the floor grating. From space 17 the air passes upwardly through the grating and through the cargo resting thereon and is withdrawn to complete the cycle of air circulation. Suitable provision may, of course, be made for removing stale air and admitting fresh air in a conventional manner. For further details of this system, reference should be made to my prior patents above noted. It is to be understood that each of the compartments W, X, Y and Z is equipped with a system of air circulation and distribution of whatever type employed.

A system embodying my invention preferably includes apparatus for continually withdrawing the refrigerant from the coils 26 and 28 of each compartment, cooling it and returning it to the coils. The refrigerant flowing through the coils may be of the so-called non-volatile type, of which brine is typical, or it may be of the volatile type such as ammonia, Freon carbon dioxide, etc. and in the latter event the cooling system would be the direct expansion type. Any suitable system is within the scope of my invention, as will be described, and I shall first describe a system employing a non-volatile cooling medium which for brevity I shall refer to as brine, it being understood that any of the well known equivalents for brine may be used as well.

The coil 28 in each compartment has an outlet 40 and the coil 26 in each compartment has an outlet 42 which lead to a common outlet header 44 connected by pipe 46 to pumps 50 for circulating the brine through the system. The pipe 46 communicates by stand pipe 52 with a reservoir 64 adapted to compensate for expansion and contraction of the brine incident to changes in its temperature.

From the pumps 50 the brine flows through a further header having a branch 56 and a branch 58 from the latter of which the brine is conducted by pipes 60 and 62 through the coils 64 and 66 of cooling apparatus to be described, for reduc-

ing its temperature. The cooled brine is conducted by pipes 68 and 70 to a delivery header 80 from which it is conducted through pipes 81 and 82 to the coil 28 in each compartment and by pipes 85 and 88 to the coil 26 in each compartment.

As will be described, a feature of my invention resides in its ability accurately to control the temperature of the surface of the brine coils. This control, furthermore, is automatic upon a variation in certain conditions within the system to be described. For that purpose the system which I have herein disclosed embodies cooling apparatus preferably having a plurality of automatically controlled brine cooling units, each consisting of a compressor, a condenser and an evaporator, of which I have shown two for purposes of illustration, but it will be understood that a larger or smaller number may be employed in practice. The evaporators indicated at 90 and 92 enclose the aforesaid coils 64 and 66 respectively. These evaporators contain any suitable volatile refrigerant, such as ammonia, Freon carbon dioxide or the like. They are exhausted through pipes 94 and 96 by means of the compressors 100 and 102. The compressed refrigerant passes through the coils 104 and 106 of condensers 108 and 110 and thence through pipes 111 and 112 back to the evaporators 90 and 92 being expanded through suitable valves 114 and 116. The coils 104 and 106 within the condensers may be cooled by sea water introduced through pipes 120 and 122 from header 124 being pumped from the ocean through pipes 126 by means of pumps 128 and 130. From the condensers the sea water exhausts overboard through header 132.

To control automatically the operation of the system under the varying conditions prevailing in practice I provide cooperating controls automatically actuated in response to the temperatures of the air delivered to the cargo, of the air withdrawn from the cargo and of the brine delivered to the cooling coils. Thus, located within each of the air delivery ducts 30 and 32 of each compartment is a thermostat 146 and 144 respectively and the brine return pipes 40 and 42 returning from the coils 28 and 26 respectively in each compartment contain valves 140 and 142 which are automatically operated in response to temperatures registered by said thermostats 144 and 146. Disposed in the path of the air withdrawn from the compartment through the apertures 18 is a thermostat 150 connected in the circuit that drives electric motors 152 and 154 which operate fans 20 and 21 respectively. In the brine delivery header 80 is a thermostat 160 which regulates the capacity of the cooling plant compressors. This control system will now be described in detail.

In Fig. 2 I have illustrated an electric circuit which automatically operates the valves 140 and 142 and controls the speed of fans 20 and 21 in each compartment. The electric circuit illustrated in Fig. 2 is duplicated for each of the compartments W, X, Y and Z. The valve 140 in each compartment is opened and closed mechanically by a reversible electric motor 174 connected to the valve by a suitable drive indicated at 176. The motor is connected across the power lines 170 and 172 by leads 178 and 180. Motor 174 is a reversing shunt wound motor and its field windings 182 and 183 are connected in parallel by line 184 to line 178 as indicated. Winding 182 is normally energized to rotate motor 174

in a direction to open the valve by a circuit which includes armature 188 pivoted at 186 and spring pressed downwardly at 187 to close contact at 190, thus completing the circuit through lead 182 to line 180 and thence to power source 172. Thermostat 144 which, as above stated, is located in the air delivery duct 32, has a temperature indicating lever 200 electrically connected at 202 to line 172 and it has a terminal 204 against which lever 200 moves when a predetermined low temperature is reached. This circuit is then closed through solenoid 208 connected by lead 210 to line 170, energizing the solenoid and attracting armature 183 to break the circuit through winding 182 and to complete the circuit through contact 211 and winding 183. When winding 183 is energized motor 174 rotates in a direction to close valve 140. The valve 140 moves very slowly in either direction and is provided with the usual circuit interrupters (not shown) for automatically breaking the circuit when the extreme open or closed positions of the valve are reached. Preferably the valve takes about $\frac{1}{2}$ minute to close from full open position and vice versa.

Similarly, valve 142 is operated by a reversible shunt wound motor 174' and is automatically opened and closed in response to the temperature at thermostat 146. The circuit operating motor 174' from thermostat 146 is identical to that above described for operating motor 174 from thermostat 144 and accordingly need not be further described. The corresponding parts are indicated by the primes of the numerals above recited.

The aforesaid motors 152 and 154 for operating fans 20 and 21 respectively are connected across mains 170 and 172 by lines 211, 212, 214 and 216. Thermostat 150 disposed in the path of the return air automatically regulates the speed of both fans to vary the number of air changes per hour with reference to predetermined temperatures of the return air. Motors 152 and 154 have shunt field windings 220 and 222 respectively, connected in parallel by line 224. Resistance 226 connects line 224 with power source 172. Thermostat 150 has an indicating lever 230 connected by line 232 to line 172. A terminal 244, with which lever 230 closes contact when the temperature is high, is connected to solenoid 228 which is connected at 229 with line 170. Solenoid 228 rotates an armature 231 in circuit with line 172 through line 233. The armature is spring retracted at 235 against the attraction of solenoid 228 to close circuit through line 237 connected at 239 with resistance 226. On thermostat 150 is also a terminal 234 connected by line 236 to line 224.

The speeds of fan driving motors 152 and 154 are automatically simultaneously regulated by introducing in series with their field windings 220 and 222 different amounts of resistance depending upon the temperature registered at 150, it being understood that the greater the resistance in series with the shunt field, the higher the fan speed. When the return air is at its highest temperature, lever 230 of thermostat 150 is against stop 244 so that solenoid 228 is energized and the full value of resistance 226 is in series with the windings 220 and 222 so that the fans run at full speed. When the return air drops to a predetermined temperature needle 230 moves from contact 244 so that circuit is made through armature 231 and line 237 thereby cutting out a portion of resistance 226 and slowing down the

fans. As the temperature of the return air continues to drop needle 230 contacts terminal 234 to decrease further the resistance and again to slow the fans.

The cooling capacity of the brine cooling apparatus is automatically varied in response to different brine temperatures registered by the thermostat 160 (Fig. 1) in the brine delivery line. The circuit is indicated in Fig. 3 in which L+ and L- indicate two leads from a suitable power source, not shown. Connected across these leads by lines 308 and 310 is a motor 313 adapted to drive the sea water pump 128 (Fig. 1). The line 308 contains a starting switch 312 and line 310 includes points 314 and p- of the thermostat 160 as will be described. It will be apparent that seat pump 128 (Fig. 1) will be started when switch 312 is closed provided contact is then made across points 314 and p- of the thermostat 160. Within pipe 120 leading from pump 128 to condenser 110 is a valve 304 which is automatically opened when the pump is operated and closed when the pump stops. For that purpose the valve is electrically actuated by reversible shunt wound motor 306 connected to the power source by wires 322 and 320 when switch 312 is closed. The reversing field windings 324 and 326 of the motor are connected in parallel to line 322 by line 340. Selective energizing of the windings is effected by armature 342 pivoted at 343 and connected by line 330 to line 320 and through switch 312 to L+. Armature 342 is spring drawn upwardly at 345 to close contact with wire 348 to energize winding 326. Solenoid 350, connected across lines 308 and 310 may be energized to attract the armature and break circuit through line 348 and make circuit through line 352 and winding 324. Valve 304 is opened when winding 324 is energized and is closed when current flows through winding 326. Thus, when switch 312 is closed and sea pump motor 313 is operated, solenoid 350 is energized and current flows from line 330 through the armature in a direction to open the valve. When the sea pump motor 313 is stopped, through breaking circuit across thermostat points 314 and p-, valve 304 is automatically rotated to closed position.

The motor 378 driving compressor 102 is automatically started when sea water flows through pipe 120 as a result of sea pump 128 being started and valve 304 being opened. For that purpose I attach to pipe 120 (Fig. 1) leading from the sea pumps to condenser 110 a switch designated 317 closed as the result of passage of sea water through pipe 120. Diagrammatically, I have illustrated a suitable arrangement in Fig. 3 wherein is shown the pipe 120 containing a pivoted diaphragm 350 linked by rod 352 to switch 317 spring pressed at 354 to open position and closed by movement of diaphragm 350 upwardly upon passage of sea water through pipe 120. In this fashion, upon starting of pump 128 and opening of valve 304, circuit is automatically completed across lines 360 and 362 to energize solenoid 364 connected by line 366 to power main L-. Core 367 of the solenoid is thereby attracted closing circuit across lines 370 and 372 to start motor 378 connected by line 380 to line 310 and thence through thermostat terminals 314 and p- to the power source L-. For ease in starting I preferably employ starting resistance of conventional character not shown, which is gradually cut out as full speed is assumed.

To slow down compressor driving motor 378 under certain conditions which will appear, I 75

provide in series with its shunt field winding 400, resistance 402 connected by line 404 to line 372. Electrically conducting lever 408 pivoted at 410 to which pivot the winding 400 is also connected and contacting the resistance effects a change in the amount of resistance in series with the winding 400. When lever 408 is in its clockwise position indicated full resistance is in series with winding 400 and motor 378 rotates at maximum speed. Lever 408 is rotated counterclockwise to cut out resistance and hence to retard motor 378 by reversible shunt wound motor 412 suitably connected by drive 414 to the shaft on which lever 408 is mounted. Motor 412 is connected by lead 416 to power source L+ and by lead 418 to power main L-. Its shunt field windings 420 and 422 are connected in parallel at 434 and by line 426 to line 416. Selective energizing of windings 420 and 422 is effected by pivoted armature 428 connected by line 430 to source L-. Spring 432 rotates armature 428 in a direction to close circuit through winding 420, under which condition motor 412 moves switch lever 408 to its extreme counterclockwise position. To cut in resistance 402, armature 428 is attracted by solenoid 440 to close circuit through winding 422. Solenoid 440 is connected by line 442 to line L+ and by line 444 to two terminals 446 and p-, also forming a part of thermostat 160, as will be described.

By this construction compressor driving motor 378 is automatically started when sea water flows through pipe 120 and runs at full speed as long as contact is made across terminals 446 and p- which cuts in all of resistance 402. When circuit is broken across terminals 446 and p- resistance 402 is cut out, thereby automatically reducing the compressor speed. The compressor automatically stops when circuit is broken across terminals 314 and p-. Motor 412 is, of course, provided with the usual circuit interrupters (not shown) to prevent rotation of the motor beyond the extreme positions of lever 408.

Sea pump 130 (Fig. 1) is driven by motor 460 operated by a circuit which is precisely like that above described and in which the corresponding elements have been marked by the primes of the numbers above described. Similarly, valve 305 is automatically opened and closed by motor 306'. Compressor 100 is likewise driven by a motor 378' started when switch 317' is closed as a result of sea water flowing through pipe 122, slowed when circuit is broken through thermostat 446' and p-, and stopped when circuit is broken through thermostat points 314' and p-.

In Fig. 4 I have illustrated the details of the thermostat 160 in brine line 60 (Fig. 1). It includes suitable temperature indicating means, such as a thermometer 500 exposed to the brine delivered to the cooling coils 28 and 28'. Lead L- is electrically connected to the mercury in the bulb of the thermometer at p-. At four predetermined, comparatively low temperatures designated a, b, c and d, are leads 502, 504, 506 and 508 which make electrical contact with the mercury when it has risen above the respective temperatures, a, b, c and d, and these leads terminate at switch points 510, 512, 514 and 516 respectively. A four pole switch designated generally at 518 has four switch arms pivoted at terminals 446, 314, 446' and 314' and has an insulated switch bar handle 520 by which the four switch arms may be rotated as a unit from their positions shown, contacting the points 510 to 516 inclusive, to a second position, as indicated

in dotted lines. Disposed at higher temperatures *h*, *f* and *g* are three further contacts having leads 522, 524 and 526 respectively connected to the three terminals 530, 532 and 534. When the switch is in full line position circuit is completed from *p*— to terminals 446, 314, 446' and 314' in the event that the mercury covers contacts *a*, *b*, *c* and *d*. When the switch is moved to its dotted line position circuit is completed from *p*— to terminals 314, 446' and 314' (but not to 446) provided the mercury has risen above temperatures *h*, *f* and *g*. As will be apparent, the individual circuits above described are cut out as the mercury falls below the individual temperatures indicated. The circuits that are thereby interrupted are indicated in Fig. 3 where the terminal points 446, 314, 446' and 314' are shown.

To effect automatic movement of switch arm 520 from its full line to its dotted line position at a predetermined temperature I pivot the arm to a lever 511 which is pivoted at 513 and is adapted to be rotated clockwise about its pivot to move the switch to its dotted line position by spring 515. The switch is moved manually to its full line position by depressing end 517 of lever 511 and to hold the lever down against the action of spring 515 I provide a solenoid 519 connected by lead 526 to power source L+ and by line 528 through contact points 525 and 527 to lead 531 which makes contact with the mercury at temperature *e*. Thus, if the temperature is higher than *e* and end 517 is depressed, circuit will be closed through solenoid 519 since end 517 of lever 511 bridges contacts 525 and 527 and the switch will be held in its full line position against the action of spring 515. However, as soon as the mercury falls below temperature *e* circuit is interrupted and switch 518 is moved by spring 515 to its dotted line position. Even though the temperature again rises above *e*, switch 518 will remain in dotted line position until it is manually moved to full line position.

For simplicity I have shown in Fig. 4 an electric circuit in which current going through the mercury in thermometer 500 is employed directly to operate the apparatus in the circuits of Fig. 3, although in an obvious manner relay circuits can be employed if it is desired to use a weaker current through the thermometer 500 than would be required to operate that apparatus.

When the cooling apparatus of Figs. 3 and 4 is started in operation to cool warm brine, switch 518 (Fig. 4) is set to its full line position and magnetically held as above described. Since the temperature of the brine at thermostat 160 is now well above *a*, contact is made from point *p*— to points 446, 314, 446' and 314'. Accordingly, the circuits across these points in Fig. 3 are now closed.

Switch 312 is then closed, completing the circuit to sea pump driving motor 313 and to motor 306 opening valve 304. Consequently, sea water will flow through pipe 120 (Fig. 1) to condenser 110 and as it deflects diaphragm 350 within pipe 120 (Fig. 3) switch 317 will close to complete the relay circuit through lines 370, 372 and 380 to start the compressor driving motor 378. The compressor will rotate at maximum speed since all of resistance 432 is in series with field winding 400 of motor 378 as the result of motor 412 being energized in its field winding 422.

Similarly, when switch 312' is closed sea pump motor 460 rotates, valve 305 opens and compressor motor 378' operates at full speed.

As the mercury drops in thermometer 500 as the result of brine cooling, the first thermostatic contact to be broken is from *p*— to point 446 which automatically retards the speed of compressor 102. This is effected by the resultant releasing of armature 428 to energize field winding 420 of motor 412 rotating the latter in a direction to cut out resistance 432 in series with field winding 400 of compressor driving motor 378.

Should the mercury again momentarily rise over point *a* full speed of compressor 102 will be resumed momentarily in an obvious manner.

As the mercury recedes below point *b* interrupting circuit between *p*— and 314, sea pump driving motor 313 will stop, as will compressor driving motor 378. Valve 304 will now close automatically since circuit is still made to motor 306 and its field winding 326 will now be energized as the result of contact of armature 342 with line 348.

Should this result in the mercury rising to close again contact from 314 to *p*—, compressor driving motor 378 will not immediately start again since switch 317 has automatically been opened by spring 354 when sea water ceased to flow through pipe 120 as the result of the stopping of sea pump motor 313 and the closing of valve 304. However, the compressor will be started automatically as soon as switch 317 is again closed as the result of passage of sea water through pipe 120.

In similar fashion, recession of mercury below point *c*, breaking circuit across points *p*— and 446' retards compressor driving motor 378' and further recession below point *d* stops that compressor and sea pump driving motor 460 and closes valve 305. The temporary rising of the mercury above those points causes the reverse effect as indicated above for the points *b* and *a*.

When the mercury drops below the temperature *e*, the holding circuit to switch 518 is interrupted releasing it for movement by spring 515 to dotted line position. Although I have shown temperature *e* as being lower than *d*, in practice it will not, of course, be lower than the mercury will go when the last cooling unit has automatically been shut down. As soon as switch 518 has thus been released, the mercury will gradually rise until temperature *g* is reached, at approximately which temperature I wish to hold the brine during the remainder of the voyage, for a purpose which will appear. At temperature *g* contact is made from *p*— to 314', starting sea pump motor 460, opening valve 305 and driving compressor operating motor 378' at slow speed. Should the mercury continue to rise until temperature *f* is reached, full speed of compressor driving motor 378' will be attained by the closing of circuit from *p*— to 446'. This will usually be effective to cause the brine temperature again to drop to *g*, but should it rise to the point *h* circuit will be completed from *p*— to 314 which will start sea pump 313, open valve 304 and start compressor driving motor 378 rotating slowly.

The operation of a refrigerating system embodying my invention to refrigerate perishable cargo automatically in such a way as to minimize cargo spoilage and drying and effectively to retard ripening will now be described.

After each cargo compartment has been loaded the apparatus specifically described with reference to Fig. 2, and duplicated in each compartment, is started in operation by closing a switch 600 for each compartment. Fan driving motors 152 and 154 in each compartment will thereby be rotated at maximum speed since the temperature

of the air withdrawn from the compartment and passing thermostat 150 is now high and pointer 230 will accordingly contact terminal 244 establishing all of the resistance 226 in series with field windings 220 and 222 of the motors. Valves 140 and 142 in the brine return line from coils 28 and 26 will now open automatically since circuit is completed to the valve opening motors 174 and 174' and also through their field windings 182 and 182'.

Brine pumps 50 (Fig. 1) are started and to cool the brine the cooling apparatus of Fig. 3 is started in operation by closing switches 312 and 312' as above described. The thermostat 160 in the brine delivery line will now have its switch 518 magnetically held in full line position.

Perishable cargo has a certain definite temperature at which it should be carried for best preservation. This temperature differs not only with different sorts of fruit and vegetables, but also with other factors such as the degree of ripening desired at the destination, and the proper temperature required for carrying specific cargo under prescribed conditions is a matter of common knowledge to shippers. By my invention I am able to reduce the temperature of the cargo to its prescribed carrying temperature quickly, thereby minimizing spoilage, and yet without undue absorption of moisture from the cargo. After the carrying temperature has been reached, I am able to maintain it constant within very narrow limits, and I thereby not only eliminate chilling and spoiling, but I effect a more accurate control of the desired amount of ripening during the voyage.

The setting of the thermostat 150 controlling the fan speeds and hence the number of air changes in the cargo compartment per unit of time, is such that the maximum rate of air change is automatically maintained until the cargo has nearly reached its carrying temperature. Thereby I effectively guard against moisture absorption from the cargo by the air while effecting a rapid reduction in cargo temperature. That is, the high rate of air flow past the cooling coils and through the cargo insures a small temperature difference between the air and the cargo so that the air, in cooling the first portion of cargo which it contacts, does not undergo such an abrupt rise in temperature as to enhance materially its ability to absorb moisture from portions of the cargo subsequently contacted by the air before it leaves the compartment. Furthermore, the temperature difference between the air withdrawn from the compartment and the cooling coils is also small so that there is little tendency to precipitate moisture on the coils and thereby unduly to dry the air before it is returned to the cargo.

As the extraction of heat from the cargo continues the temperatures gradually drop at the air delivery thermostats 144 and 146, at the air return thermostat 150 and in the brine flowing through coils 26 and 28. The thermostats 144 and 146 are so adjusted as to temperature that when the delivered air contacting them reaches a temperature of no more than a degree F. or so below the desired cargo carrying temperature, contact is made at terminals 204 and 204' respectively to close down slightly the valves 140 and 142 by energizing the field coils 182 and 182' of the valve operating motors 174 and 174'. This diminishes the flow of brine through the coils and insures against harmful cargo chilling. In the event of over adjustment indicated by a rise

in air temperature above that at which the thermostats make the contacts above described, the valves will again automatically move slowly toward open position until the over adjustment is corrected.

During this process of diminishing brine flow through the cooling coils of each compartment, the temperature of the brine will drop rapidly since the rate of flow of brine through the evaporators 90 and 92 is also now decreased. When any of brine temperatures *a*, *b*, *c* or *d* is reached, the capacity of the cooling apparatus will be reduced automatically in the manner above described.

The cooling continues with the delivery air maintained at or very slightly below the desired cargo carrying temperature and as the cargo also nears that temperature, the temperature of the air withdrawn, registered by the thermostat 150 in each compartment, gradually approaches the temperature of the air delivered. When the cargo has reached its carrying temperature, the temperature of the air withdrawn will be only a fraction of a degree F. or so above the desired carrying temperature of the cargo, particularly if, as is preferred, the fruit is cooled by streams of air distributed uniformly through the compartment (as by the side air directors 34 and air space 17 beneath grating 14) and directed generally vertically through the entire volume of cargo. Having predetermined this difference, I utilize the temperature of the withdrawn air to indicate when the carrying temperature of the cargo has been reached. Thermostat 150 is set so that as that predetermined temperature of the withdrawn air is approached the rate of air change is gradually reduced. This reduction is effected by lever 230 first breaking contact at 244 to cut out a portion of resistance 226 in series with field windings 220 and 222 of the fan driving motors 152 and 154 and subsequently making contact at 234 further to reduce that resistance and again decrease the fan speeds to effect the low rate of air change at which the cargo is to be carried for the remainder of the voyage. Although drying of the cargo is minimized, as above described, by employing a high rate of air change during initial cooling of the cargo, drying is also reduced by using a low rate of air change to hold the cargo at its carrying temperature after it has been reached.

As a further safeguard against drying the cargo, my invention effects maintenance of the delivered air at the temperature necessary to hold the cargo at its carrying temperature by the use of a comparatively high rate of brine flow at moderate temperature, through the brine coils 26 and 28, rather than a lower rate of flow of colder brine. Thereby I insure that the surface temperature of the coils is more nearly uniform throughout their entire exposed area with no portions so low in temperature as to cause excessive moisture precipitation and hence drying of the air delivered to the cargo. Furthermore, I thereby enhance the efficiency of the compressors.

To that end when the brine temperature falls below *e* (Fig. 4) switch 518 will be released to move to its dotted line position, with the result that the temperature of the brine will rise, without starting the compressors, until it reaches temperature *g*. As described above, the brine temperature approximating *g* is automatically maintained thereafter.

As soon as the brine temperature rises the temperature of the delivered air also begins to

rise. Any slight rise in air temperature is felt at thermostats 144 and 146, causing contact to be broken at terminals 204 and 204' (Fig. 2) which effects energizing of field coils 182 and 182' of valve operating motors 174 and 174'. Consequently the valves 140 and 142 now open fully admitting more brine and thereby checking further rise in delivered air temperature. The brine temperature *g* is such with relation to the capacity of the cooling system and the load impressed on it by the cargo that for the remainder of the voyage the cargo will be kept at its desired carrying temperature with the brine valves 140 and 142 fully open, or nearly so, and the fan speeds throttled to a minimum. Of course, this relationship may be disturbed, but it is automatically restored by the apparatus provided by my invention.

By insuring uniformity in the temperature at which the cargo is carried, my invention eliminates the spoilage incident to temperature fluctuations of the order commonly occurring in the conventional refrigerating system. Drying of the cargo is minimized by utilizing the temperature of the air withdrawn from the compartment as the factor controlling the rate of air change and this temperature as above described influences and cooperates with the entire system of controls since it influences the rate of brine flow through its effect on the temperature of the air delivered and since it thereby also affects the load on the cooling apparatus.

As stated above, other refrigerants than brine may be used and they may be either of the non-volatile type, like brine, or the volatile type in which event the system would be of the direct expansion variety. In such a system the compressors or equivalent pressure applying means well known in the art would be retained, as I have shown at 100a and 102a in Fig. 5, as would the condensers 108a and 110a. Preferably the cooling coils 26a and 28a function as evaporators. The volatile refrigerant that has been compressed and condensed flows from the condensers, as by pipes 600 and 602, to a receiver 604 from which it passes through line 606 to header 80a and thence through pipes 81a and 82a to the coil 28a in each compartment and by pipes 86a and 88a to the coils 26a in each compartment. At the entrance end of each coil is an expansion valve 608 automatically actuated in response to the temperature at a thermostat 610 at the outlet of the coil to effect admission of the proper quantity of refrigerant for efficient operation of the evaporator as is well known.

Thermostat 144a in one air delivery duct and thermostat 146a in the other are connected to solenoid operated valves 620 on the inlet side and 622 on the outlet side of the coils 28a and 26a respectively.

The refrigerant returns from the coils 26a and 28a through pipes 42a and 40a which join at a header 44a returning directly to the compressors. In the header 44a is an automatic pressure switch 630 responsive to the pressure in the header 44a and connected to the motors which drive the compressors.

With such a system when the delivered air passing thermostat 144a or 146a reaches a predetermined low temperature, the valves 620 and 622 on opposite ends of the coil controlled by that thermostat automatically close simultaneously to stop further flow of refrigerant through the coil until a rise in temperature of the air acting on the thermostat 144a or 146a causes the valves

again to open. By providing for simultaneous closing of valves on opposite ends of each coil I insure that the coils retain the proper amount of refrigerant and are ready to start functioning immediately when their corresponding air delivery thermostats indicate the need for further air cooling.

The pressure responsive element 630 is preferably constructed to operate in precisely the same way as the temperature responsive element 160 illustrated in detail in Fig. 4 except that the former operates in response to pressure rather than temperature. That is, the mechanism of Fig. 3 is duplicated and automatically operated by a device such as is illustrated in Fig. 4 suitably modified to act in response to varying pressures in the line 44a. Essentially the modification may employ pressurestats of usual sort instead of the thermometer used in the embodiment of Fig. 4. Thus the pressure responsive element indicated generally at 630 in Fig. 5 could, as shown in Fig. 6, include a series of pressurestats 701, 703, 705, 707, 709, 711, 713, and 715. Each of these pressurestats may be of conventional construction and, as indicated by pressurestat 709, may have a lever 700 pivoted at 702 to the enclosing box 704 and connected to a bellows 706 communicating by a tube 708 with pipe 44a (see also Fig. 5) so that pressure in the line 44a causes expansion of bellows 706 and counterclockwise movement of the lever 700 around its pivot 702. Lever 700 is electrically conducting and makes contact with terminal 710 electrically connected by line 712 with common terminal *p*— to which is connected lead *L*— from a suitable power source, not shown. Lever 700 is also electrically connected by line 502' with switch 518'.

In like manner the other pressurestats 701, 703, 705, 707, 711, 713, and 715 are connected by tubing 720, 722, 724, 726, 728, 730, and 732, respectively, with the pipe 44a and each pressurestat has a pivoted lever which, like lever 700 of pressurestat 709, is operated in response to pressure in the pipe 44a to close circuit between line *p*— and switch 518' through lines 531', 533', 536', 504', 526', 524' and 522', respectively.

Each of the pressurestats has an adjustment of the conventional sort shown at 740 for pressurestat 709, for changing the tension in spring 742 which pulls downwardly on lever 700 so that the amount of pressure in bellows 706 from pipe 44a required to make contact at 710 can be regulated. Just as the Fig. 4 embodiment operates in response to varying temperatures *a*, *b*, *c*, *d*, *e*, *f*, *g* and *h*, so the individual pressurestats are regulated by their adjustments 740 to complete electric circuit from *p*— to switch 518' at corresponding varying pressures which I have indicated at *a'*, *b'*, *c'*, *d'*, *e'*, *f'*, *g'* and *h'*.

The switch 518' to which each pressurestat is connected may be and preferably is in all respects identical in construction and mode of operation with switch 518 of Fig. 4 and the corresponding parts in Fig. 6 have been indicated by the primes of the reference characters employed in Fig. 4. Thereby the circuits of Fig. 3 would be selectively established and broken in response to changes in pressure in pipe 44a rather than in response to changes in temperature at thermometer 160. Like switch 518, switch 518' has a holding circuit employing lever 511' and associated parts including a pressurestat operating at a minimum pressure *e'*. The pressure at *e'*, of course will not in practice be lower than the pressure in the pipe

44a when the last cooling unit has automatically been shut down.

The direct expansion system above described, like the non-volatile system first described, controls the rate of working of the compressors in response to the temperature of the refrigerant in the cooling coils, although in the direct expansion system the apparatus works indirectly through the pressure in the coil outlet corresponding to the temperature within the coil. Furthermore, the cooling effect of the refrigerant on the air is regulated in both systems by varying the rate of flow of the refrigerant through the coil, although in the direct expansion system the reduction in rate of flow is not gradual as in the non-volatile system, but amounts to complete cessation or to alternate, intermittent flowing and stopping.

It is to be understood that the embodiments of my apparatus above described may be varied considerably without departing from the spirit of my invention which is to be limited only as indicated in the appended claims. Thus, I have specifically described in detail the use of direct current apparatus because that source of power is more commonly available on board ship. However, A. C. equipment may, of course, be used or the motivating power may be steam, hydraulic, pneumatic or otherwise. The capacity of the cooling apparatus, of which there may be any desired number of units, may be varied otherwise than by varying the speeds of the compressors, as other throttling instrumentalities well known in the art may be employed. Similarly, the rate of air change may be varied otherwise than by varying the speed of the fans, such as by employing dampers automatically controlled by the thermostats 150. The variation in cooling effect of the refrigerant on the air can be varied without changing the rate of flow of the refrigerant such as by by-passing a portion of the air around the coils, or otherwise. Although I have shown the use of coils for cooling the air, such cooling may be effected by spraying the air, employing cooling apparatus of the well known air washer type but regulated automatically in accordance with the principle of my invention. All such modifications are to be included within the scope of my invention in so far as the claims permit.

I claim:

1. Apparatus for preserving perishables in a cargo compartment comprising the combination of means for changing the air in the compartment by withdrawing it therefrom and returning it thereto through the cargo, cooling apparatus for lowering the temperature of the air delivered to the cargo, a refrigerant flowing through said apparatus, means for cooling said refrigerant, means responsive to the temperature of air delivered to the cargo for regulating the rate of flow of the refrigerant through said apparatus, means responsive to the temperature of air withdrawn from the compartment for regulating the rate of air change in the compartment, and means responsive to the temperature of the refrigerant for regulating the capacity of said refrigerant cooling means.

2. In a refrigerating system for preserving perishables in a cargo compartment, apparatus for establishing and maintaining a predetermined carrying temperature in said compartment including a cooling unit, means for recirculating air over said cooling unit and through said compartment, means for supplying refrigerant to said cooling unit, and means responsive to the temperature of the refrigerant delivered by said sup-

ply means for controlling said supply means to supply refrigerant to said cooling unit at a temperature which automatically decreases to a predetermined low for establishing said carrying temperature in the compartment and which thereafter automatically increases to and substantially stabilizes at a point between said low temperature and the carrying temperature of the compartment for maintaining said carrying temperature in the compartment.

3. In a refrigerating system for preserving perishables in a cargo compartment, apparatus for establishing and maintaining a predetermined carrying temperature in said compartment including a cooling unit, means for recirculating air over said cooling unit and through said compartment, means for supplying refrigerant to said cooling unit, and means controlling said supply means to supply refrigerant to said cooling unit at a temperature which automatically decreases to a predetermined low for establishing said carrying temperature in the compartment and which thereafter automatically increases to and substantially stabilizes at a point between said low temperature and the carrying temperature of the compartment for maintaining said carrying temperature in the compartment, said last named means including means responsive to the temperature of the air delivered to said compartment from said unit for decreasing the rate of flow of refrigerant through said unit when the temperature of the delivered air reaches a predetermined low and for again increasing the rate of flow of refrigerant through said unit when the temperature reaches a predetermined high.

4. In a refrigerating system for preserving perishables in a cargo compartment, apparatus for establishing and maintaining a predetermined carrying temperature in said compartment including a cooling unit, means for recirculating air over said cooling unit and through said compartment, means for supplying refrigerant to said cooling unit, means responsive to the temperature of the air delivered to said compartment from said unit for automatically retarding the rate of flow of refrigerant through said unit while the temperature of said delivered air is at or below a predetermined low temperature below said carrying temperature, and means responsive to the temperature of the refrigerant delivered by said supply means for controlling said supply means to supply refrigerant to said cooling unit at a temperature which automatically decreases to a predetermined low for establishing said carrying temperature in the compartment and which thereafter automatically increases to and substantially stabilizes at a point between said low temperature and the carrying temperature of the compartment for maintaining said carrying temperature in the compartment.

5. In a refrigerating system for preserving perishables in a cargo compartment, apparatus for establishing and maintaining a predetermined carrying temperature in said compartment including a cooling unit, means for recirculating air over said cooling unit and through said compartment, means for supplying refrigerant to said cooling unit, temperature responsive means controlling said supply means to supply refrigerant to said cooling unit at a temperature which automatically decreases to a predetermined low for establishing said carrying temperature in the compartment and which thereafter automatically increases to and substantially stabilizes at a point between said low temperature and the car-

rying temperature of the compartment for maintaining said carrying temperature in the compartment, and temperature responsive means controlling said air recirculating means to recirculate the air automatically at a high rate for establishing said carrying temperature in the compartment and at a lower rate while the temperature of the compartment is substantially at the carrying temperature.

6. In a refrigerating system for preserving perishables in a cargo compartment, apparatus for establishing and maintaining a predetermined carrying temperature in said compartment including a cooling unit, means for recirculating air over said cooling unit and through said compartment, means for supplying refrigerant to said cooling unit, temperature responsive means controlling said supply means to supply refrigerant to said cooling unit at a temperature which automatically decreases to a predetermined low for establishing said carrying temperature in the compartment and which thereafter automatically increases to and substantially stabilizes at a point between said low temperature and the carrying temperature of the compartment for maintaining said carrying temperature in the compartment, and means responsive to the temperature of the air withdrawn from said compartment for controlling said air recirculating means automatically to recirculate the air at a high rate while the temperature of said withdrawn air is substantially above said carrying temperature and at a lower rate while the temperature of said withdrawn air is substantially at said carrying temperature.

7. Apparatus for preserving perishables in a cargo compartment including an air cooler through which flows a refrigerant, means for withdrawing air from the compartment, passing it adjacent said cooler to lower its temperature and delivering it to the cargo, an element responsive to the temperature of the delivered air passing from cooler to cargo, refrigerating means operable to extract heat from the refrigerant at a rate to lower the temperature of the delivered air gradually to reduce the temperature of the cargo from a comparatively warm temperature to a lower carrying temperature, means actuated by the element to decrease the flow of refrigerant through the cooler when the temperature of the delivered air falls below a delivered air carrying temperature necessary to maintain said cargo carrying temperature, and means responsive to the temperature of the refrigerant to stop the extraction of heat from the refrigerant after its flow has so been decreased and to allow its temperature to rise and become substantially stabilized at a temperature effective to establish and to maintain said delivered air carrying temperature when the flow of refrigerant through the cooler is again increased.

8. Apparatus for preserving perishables in a cargo compartment including an air cooler through which flows a volatile refrigerant, means for withdrawing air from the compartment passing it adjacent said cooler to lower its temperature and delivering it to the cargo, an element responsive to the temperature of the delivered air passing from cooler to cargo, refrigerating means operable to extract heat from the volatile refrigerant at a rate to lower the temperature of the delivered air gradually to reduce the temperature of the cargo from a comparatively warm temperature to a lower carrying temperature, means actuated by the element to stop the flow of

refrigerant through the cooler when the temperature of the delivered air falls below a delivered air carrying temperature necessary to maintain said cargo carrying temperature, and means responsive to the pressure of the refrigerant to stop the extraction of heat from the refrigerant after its flow has so been stopped and to allow its pressure to rise and become substantially stabilized at a pressure and temperature effective to establish and to maintain said delivered air carrying temperature when the flow of refrigerant through the cooler is again commenced.

9. The method of preserving perishable cargo by quickly reducing its temperature to a predetermined carrying temperature without excessively drying it, which consists in passing air in proximity to cooling apparatus through which flows a cooling refrigerant, gradually lowering the temperature of the air by extracting heat from the refrigerant in an amount to maintain the temperature of the refrigerant only slightly below that of the air so that extraction of moisture from the air while it is so cooled is minimized, and delivering to and through the cargo streams of air so cooled to reduce the temperature of the cargo by air at a temperature maintained only slightly below that of the cargo and continually decreased as the temperature of the cargo is decreased to effect said lowering in temperature of the cargo without unduly absorbing moisture from it.

10. The method of preserving perishable cargo by lowering the temperature of warm cargo to a predetermined carrying temperature, which consists in passing air in proximity to cooling apparatus through which flows a cooling refrigerant, gradually lowering the temperature of the air by extracting heat from the refrigerant in an amount to maintain the temperature of the refrigerant only slightly below that of the air while maintaining the rate of flow of the refrigerant through said apparatus at a predetermined maximum so that extraction of moisture from the air while it is so cooled is minimized, and delivering to and through the cargo streams of air so cooled to reduce the temperature of the cargo by air at a temperature maintained only slightly below that of the cargo and continually decreased as the temperature of the cargo decreases to effect said lowering in temperature of the cargo without unduly absorbing moisture from it and restraining reduction in temperature of the cargo below said predetermined carrying temperature by reducing the rate of flow of said refrigerant through said apparatus as the temperature of the delivered air approaches that required to maintain said carrying temperature.

11. The method of preserving perishable cargo by lowering the temperature of warm cargo to a predetermined carrying temperature and thereafter maintaining said carrying temperature, which consists in passing air in proximity to cooling apparatus through which flows a cooling refrigerant, gradually lowering the temperature of the air by extracting heat from the refrigerant in an amount to cool the refrigerant gradually and maintain the temperature of the refrigerant only slightly below that of the air while maintaining the rate of flow of the refrigerant through said apparatus at a predetermined maximum so that extraction of moisture from the air while it is so cooled is minimized, and delivering to and through the cargo streams of air so cooled to reduce the temperature of the cargo by air at a temperature maintained only slightly

below that of the cargo and continually decreased as the temperature of the cargo decreases to effect said lowering in temperature of the cargo without unduly absorbing moisture from it, restraining reduction in temperature of the cargo below said predetermined carrying temperature by reducing the rate of flow of said refrigerant through said apparatus as the temperature of the delivered air approaches that required to maintain said carrying temperature, and thereafter maintaining the delivered air at said required temperature by again increasing the rate of flow of the refrigerant and allowing the temperature of the refrigerant to rise to a temperature sufficient to hold said required delivered air temperature at said increased rate of flow of the refrigerant.

12. The method of preserving perishable cargo by lowering the temperature of warm cargo to a predetermined carrying temperature and thereafter maintaining said carrying temperature, which consists in passing air in proximity to cooling apparatus through which flows a cooling refrigerant, gradually lowering the temperature of the air by extracting heat from the refrigerant in an amount to cool the refrigerant gradually and maintain the temperature of the refrigerant only slightly below that of the air while maintaining the rate of flow of the refrigerant through said apparatus at a predetermined maximum so that extraction of moisture from the air while it is so cooled is minimized, and delivering at a predetermined maximum velocity to and through the cargo streams of air so cooled to reduce the temperature of the cargo by air at a temperature maintained only slightly below that of the cargo and continually decreased as the temperature of the cargo decreases to effect said lowering in temperature of the cargo without unduly absorbing moisture from it, restraining reduction in temperature of the cargo below said predetermined carrying temperature by reducing the rate of flow of said refrigerant through said apparatus as the temperature of the delivered air approaches that required to maintain said carrying temperature, and thereafter maintaining the cargo at its said carrying temperature by again increasing the rate of flow of the refrigerant, allowing the temperature of the refrigerant to rise to a temperature sufficient to hold said required delivered air temperature at said increased rate of flow of the refrigerant and finally reducing to substantially below said maximum the velocity of air delivered to the cargo.

13. In a system for preserving perishables in a cargo compartment the combination with cooling apparatus, refrigerating means supplying refrigerant to the cooling apparatus, means for changing the air in the compartment by withdrawing it therefrom, cooling it by passing it adjacent said cooling apparatus and delivering it through the perishables in the compartment, of means maintaining a maximum rate of work of the refrigerating means and means maintaining a maximum of flow of the refrigerant through the cooling apparatus while the temperature of the refrigerant in the cooling apparatus and the temperature of the air delivered through the perishables are falling, means reducing the rate of flow of the refrigerant when the temperature of the delivered air reaches a predetermined low and for again increasing the rate of flow of the refrigerant when the temperature of the delivered air rises a predetermined amount, means reducing the rate of work of the refrigerating

means when the temperature of the refrigerant in the cooling apparatus reaches a predetermined low and for holding it reduced until the temperature of the refrigerant rises a predetermined amount from said low whereby to effect said rise in temperature of the delivered air said predetermined amount to effect said increase in rate of flow of the refrigerant.

14. The method of refrigerating perishable cargo which consists in initially extracting the heat from the warm cargo by passing air through the cargo at a predetermined high rate of flow while lowering the temperature of the air by passing it over cooling apparatus containing a circulating refrigerant, reducing both the rate of flow and the temperature of the refrigerant while maintaining the said high rate of air flow until the temperature of the cargo reaches the desired carrying temperature, and holding the cargo at said carrying temperature by restoring, at least in part, the initial rate of flow of the refrigerant, increasing the temperature of the refrigerant and reducing the rate of air flow.

15. In a system for preserving perishables in a cargo compartment, including cooling apparatus, refrigerating means supplying a refrigerant to the apparatus, means for changing the air in the compartment by withdrawing it therefrom, cooling it by passing it adjacent said cooling apparatus and delivering it to and through the perishables in the compartment, the combination therewith of valve means for controlling the flow of refrigerant through the cooling apparatus, an element responsive to the temperature of the delivered air operatively connected to said valve means for maintaining a high rate of refrigerant flow while the temperature of the delivered air is falling, reducing the rate of refrigerant flow when the temperature of the delivered air reaches a predetermined low and again increasing the rate of refrigerant flow when the temperature of the delivered air rises a small amount above said predetermined low, and means including an element responsive to the temperature of the refrigerant for controlling the rate of work of the refrigerating means by reducing it when the temperature of the refrigerant reaches a predetermined low, holding it reduced until the temperature of the refrigerant rises sufficiently to allow said rise in temperature of the delivered air which effects said increase in rate of refrigerant flow and thereafter increasing it in the amount necessary to inhibit further rise in delivered air temperature substantially above said small amount.

16. In a system for preserving perishables in a cargo compartment including cooling apparatus, refrigerating means supplying a volatile refrigerant to the apparatus, means for changing the air in the compartment by withdrawing it therefrom, cooling it by passing it adjacent said cooling apparatus and delivering it to and through the perishables in the compartment, the combination therewith of valve means for controlling the flow of refrigerant through the cooling apparatus, an element responsive to the temperature of the delivered air operatively connected to said valve means for admitting refrigerant through the cooling apparatus while the temperature and pressure of the refrigerant are falling, stopping the refrigerant flow when the temperature of the delivered air reaches a predetermined low and again starting the refrigerant flow when the temperature of the delivered air rises a small amount above said predetermined low, and means in-

cluding an element responsive to the pressure of the refrigerant for controlling the rate of work of the refrigerating means by reducing it when the pressure of the refrigerant reaches a predetermined low, holding it reduced until the pressure of the refrigerant rises sufficiently to allow said rise in temperature of the delivered air which again starts said refrigerant flow and thereafter increasing it in the amount necessary to inhibit further rise in delivered air temperature substantially above said small amount.

17. The system as defined in claim 15 in which said means for controlling the rate of work of said refrigerating means includes apparatus for supplying refrigerant to said cooling apparatus at a temperature which decreases to a predetermined low for establishing a carrying temperature in the compartment and which thereafter automatically increases to and substantially stabilizes at a point between said low temperature and the corresponding temperature of the compartment for maintaining said carrying temperature.

18. The system as defined in claim 16 in which said means for controlling the rate of work of said refrigerating means includes means for supplying refrigerant to said cooling apparatus at a pressure which decreases to a predetermined low for establishing a carrying temperature in the compartment and which thereafter increases to and substantially stabilizes at a higher pressure for maintaining said carrying temperature.

19. In a system for preserving perishables in a cargo compartment, including air cooling apparatus and refrigerating means supplying refrigerant to the apparatus, the combination therewith of mechanism responsive to a low refrigerant temperature operative to reduce the rate of work of the refrigerating means when said low temperature is reached, mechanism responsive to a higher refrigerant temperature operative to control the rate of work of the refrigerating means substantially to stabilize the temperature of the refrigerant at such higher temperature, a control member adapted selectively to render either of said mechanisms operative and the other inoperative, and an element responsive to a predetermined temperature of the refrigerant and connected to said control member to operate it so that said first mechanism is rendered inoperative and said second mechanism is rendered operative automatically when said predetermined temperature is reached.

20. In a system for preserving perishables in a cargo compartment, including air cooling apparatus and refrigerating means supplying refrigerant to the apparatus, the combination therewith of mechanism responsive to a low refrigerant pressure operative to reduce the rate of work of the refrigerating means when said low pressure is reached, mechanism responsive to a higher

refrigerant pressure operative to control the rate of work of the refrigerating means substantially to stabilize the pressure of the refrigerant at such higher pressure, a control member adapted selectively to render either of said mechanisms operative and the other inoperative, and an element responsive to a predetermined pressure of the refrigerant and connected to said control member to operate it so that said first mechanism is rendered inoperative and said second mechanism is rendered operative automatically when said predetermined pressure is reached.

21. In a system for preserving perishables in a cargo compartment, including air cooling apparatus and refrigerating means supplying refrigerant to the apparatus, the combination therewith of mechanism responsive to a plurality of successive low temperatures of the refrigerant operative to reduce the rate of work of the refrigerating means in stages as those successive temperatures of the refrigerant are reached, mechanism responsive to a plurality of successive higher refrigerant temperatures operative to control the rate of work of the refrigerating means substantially to stabilize the temperature of the refrigerant in the region of said higher temperatures, a control member adapted selectively to render either of said mechanisms operative and the other inoperative and an element responsive to a predetermined low temperature of the refrigerant and connected to said control member to operate it so that said first mechanism is rendered inoperative and said second mechanism is rendered operative automatically when said predetermined low temperature is reached.

22. In a system for preserving perishables in a cargo compartment, including air cooling apparatus and refrigerating means supplying refrigerant to the apparatus, the combination therewith of mechanism responsive to a plurality of successive low pressures of the refrigerant operative to reduce the rate of work of the refrigerating means in stages as those successive pressures of the refrigerant are reached, mechanism responsive to a plurality of successive higher refrigerant pressures operative to control the rate of work of the refrigerating means substantially to stabilize the pressure of the refrigerant in the region of said higher pressures, a control member adapted selectively to render either of said mechanisms operative and the other inoperative and an element responsive to a predetermined low pressure of the refrigerant connected to said control member to operate it so that said first mechanism is rendered inoperative and said second mechanism is rendered operative automatically when said predetermined low pressure is reached.

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