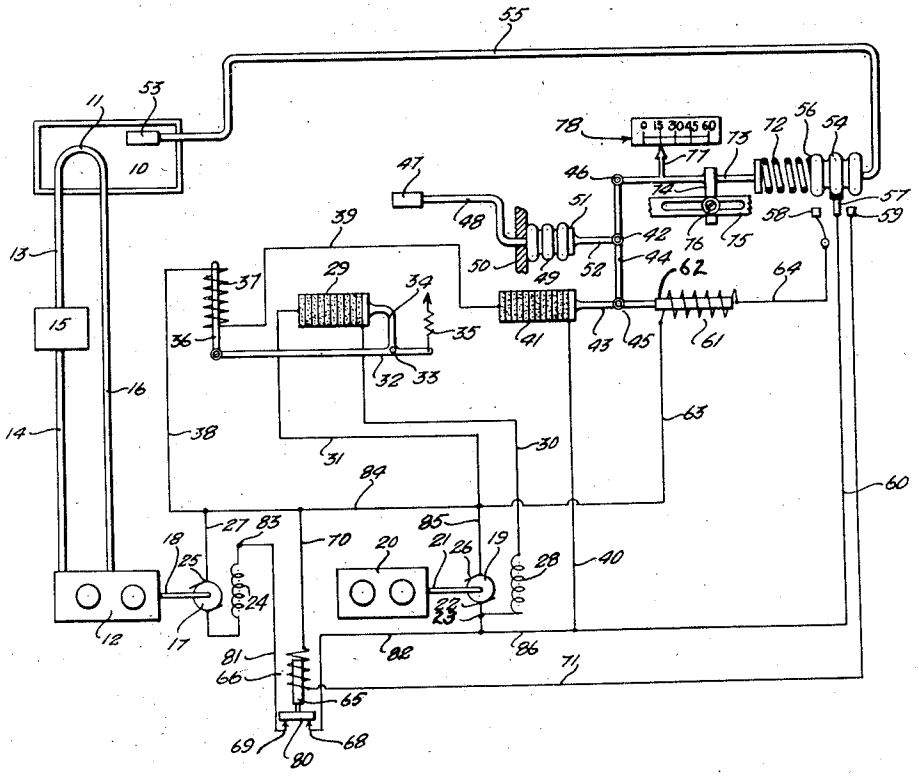
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REFRIGERATION SYSTEM AND APPARATUS

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George E. Hulse INVENTOR

BY

Janney, Blair & Curtis ATTORNEYS

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## REFRIGERATION SYSTEM AND APPARATUS

George E. Hulse, New Haven, Conn., assignor to The Safety Car Heating & Lighting Company, a corporation of New Jersey

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This invention relates to refrigeration systems and apparatus.

One of the objects of this invention is to provide a refrigeration apparatus and system of durable and simple construction. Another object is to provide a system and apparatus of the above character which will be highly efficient in operation while reliably meeting certain peculiar conditions met with in practical use. Another object is to provide a system and apparatus of the above character in which a wide range of rates or characters of action may be achieved automatically in accordance with the possible widely varying requirements met with in practice. Another object is to provide an apparatus of the above character that will be of easy and inexpensive manufacture and of economical construction and action. Another object is to provide an apparatus of the above character which may be operated by unskilled attendants without the danger of a subsequent breakdown, and which will require a minimum amount of attention while in operation. Other objects will be in part obvious and in part pointed out hereinafter.

This invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, in which is shown one of the various possible embodiments of the several features of this invention, the single figure is a diagrammatic showing of a preferred embodiment of my invention.

Referring now to the drawing in detail, there is shown a space 10, which may take any form such as the interior of a refrigerator car, a chamber or room, whose temperature is to be regulated. A refrigeration unit, employing preferably a gaseous refrigerant, has an expansion or evaporator device 11 disposed within space 10. Thus when liquefied gas, such as sulphur dioxide, evaporates in expansion device 11, it absorbs heat from the compartment 10 and the temperature of compartment 10 may be regulated by controlling the rate of evaporation of this gas taking place therein.

The refrigeration unit is preferably of the compression-expansion type and includes a compressor 12 discharging compressed gaseous refrigerant, through pipe 14, to other parts, generally indicated at 15, of the unit. These parts may include a condenser, receiver, and a suitably controlled expansion valve, whence pipe 13 leads liquefied refrigerant to evaporator 11. The expanded gas is returned to the intake of compressor 12 by a pipe 16. The rate of absorption of heat in compartment 10 is proportional to the amount of liquefied gas being supplied to expansion device 11 and its subsequent evaporation. This in turn depends upon the efficiency of compressor 12, so compartment 10 is refrigerated at a greater speed when compressor 12 is being driven at proportionately greater speed.

A series motor 17 drives compressor 12 by a shaft 18 and current for this motor is supplied by a generator 19. Generator 19 is driven by an engine 20, connected thereto by a shaft 21. Engine 20 may be of any desired construction but is preferably of the internal combustion type and adapted to run continuously for substantial periods of time. Any suitable means may be employed for maintaining the engine at a constant speed even though its power output may vary. One brush 22 of generator 19 is connected by lines 23 and 82 to a contact 68 of a switch 80 and a contact 69 of this switch is connected by a line 81 to one terminal 83 of motor 17. The other side 25 of the motor is connected by lines 27, 84 and 85 to brush 26 of the generator. Thus when switch 80 is closed to connect contacts 68 and 69, a circuit is completed between the motor and the generator.

Generator 19, as above described, is preferably of the shunt wound type and is provided with a field winding 28 connected across the terminals thereof through a variable resistance preferably taking the form of a carbon pile 29. The field circuit will thus be seen to extend from terminal 22 of generator 19, through field winding 28, conductor 30, through carbon pile 29, line 31, and by way of conductor 85 back to the other terminal 26 of the generator. The pressure on the carbon pile may be varied by any suitable form of mechanical device, and as illustrative of the latter, I have shown a bell crank lever 32 pivoted at 33 and having its one arm 34 in engagement with the unanchored end of the carbon pile. A spring 35 is connected to lever 32 and acts to swing the latter in such a direction as to compress the carbon pile. At the other end of the lever 32 is connected the core 36 of a solenoid whose winding is indicated at 37. Thus this solenoid acts against spring 35 for, when suitably energized, it exerts a pull on core 36 to relieve the pressure of arm 34 on carbon pile 29 and does so in opposition to the effect of spring 35. Subsequent de-energization or diminution of the energization of solenoid 37 lessens this pull and

allows spring 35 to compress carbon pile 29 in the above described manner. The solenoid 36–37, acting in this manner against the action of spring 35, controls the resistance in the shunt field circuit of generator 19 and thus controls the output of the generator.

In accordance with certain features of my invention, I control the energization of winding 37 in accordance with certain conditions to be met. Winding 37 is connected in circuit with a variable resistance preferably taking the form of a carbon pile 41, and this circuit will be seen to extend as follows: from terminal 26 of generator 19, conductors 84 and 38, winding 37, conductor 39, carbon pile 41, and by way of conductors 40, 86 and 23, back to the remaining terminal 22 of generator 19. In this manner energizing current is supplied by generator 19 to the winding 37, but the magnitude of this current is controlled by carbon pile 41. The greater the effective resistance of carbon pile 41, the less current passes to solenoid 37, and this resistance depends upon the amount of pressure with which carbon pile 41 is compressed.

An arm 43 is in engagement with free or unanchored end of carbon pile 41, and a lever 44 is pivotally connected to arm 43 at 45. Lever 44 is in turn pivoted at 46 to a member 73 mounted to be capable of adjustment in a horizontal direction, in a manner to be described hereinafter. A bulb 47 is positioned outside of compartment 10 and contains a suitable volatile liquid having the property of relatively quick evaporation upon a rise in temperature and relatively rapid condensation upon the fall in temperature. The vapor pressures created by this liquid are transmitted by a pipe 48 to a bellows 49 anchored at 50. Thus a rise in temperature, causing evaporation of the liquid contained in bulb 47, increases the pressure applied to the unanchored end 51 of bellows 49 to move this end and a decrease in temperature diminishes the pressure inside of bellows 49 to cause a contraction thereof. The unanchored end 51 of the bellows is pivotally connected at 42 by a rod 52 to lever 44. Thus an increase in temperature outside of space 10 forces rod 52 toward the right, causing lever 44 to swing in counterclockwise direction, as viewed in the drawing, about pivot 46; this action relieves the pressure applied to carbon pile 41. A subsequent decrease of temperature causes contraction of bellows 49 to swing lever 44 in a clockwise direction about pivot 46, thereby increasing the pressure on carbon pile 41.

Increase in the outside temperature thus reduces the pressure on carbon pile 41, lessening the energization of winding 37, with the result that resistance of carbon pile 29 is decreased and the output of generator 19 increased; this increased output increases the speed of motor 17 and of the refrigeration unit to supply greater refrigeration to compartment 10. On the other hand a decrease in the outside temperature causes the pressure applied to carbon pile 41 to be increased, thus to increase the energization of winding 37 which therefore acts to decrease the output of generator 19; this decreased output, supplied to motor 17, decreases the rate of refrigeration taking place in compartment 10. Thus the speed of motor 17, and consequently the rate of refrigeration taking place in compartment 10, is controlled by the temperature outside this compartment.

A bulb 53 is disposed within the compartment 10 and is connected to a bellows 54 by a pipe 55 Within this bulb is a suitable volatile liquid having properties substantially similar to those of the liquid contained in bulb 47. Thus variations in temperature within compartment 10 cause variations in pressure within bellows 54 and corresponding changes in the position of unanchored end 56 of bellows 54.

A contact 57 is secured to, and preferably insulated from, a movable portion of bellows 54, and is adapted to coact with spaced contacts 58 and 59 which may be adjustable. Contacts 57 and 58 control the energization of a winding 61 of a solenoid whose core 62 is connected to arm 43 so that energization of this solenoid exerts a pull on arm 43 to relieve the pressure, preferably entirely, that is applied to carbon pile 41. This solenoid is, therefore, of sufficient strength, when energized, to act against bellows 49 regardless of the latter's position. Solenoid 61 is energized by a generator 19 under control of contacts 57–58, and its circuit extends from terminal 22 of generator 19, conductors 23, 86, and 60, contact 57, contact 58, conductor 64, winding 61, conductors 63 and 85 to terminal 26 of generator 19. Closure of this circuit at contacts 57 and 58, when the temperature within space 10 reaches a certain maximum, causes solenoid 61—62 to entirely relieve the pressure on pile 41, practically de-energizing winding 37 and causing spring 35 to maintain maximum compression and minimum resistance of pile 29; thus the output of generator 19 is a maximum and motor 17 is driven at high speed.

Contacts 57—59 control the switch 80 between generator 19 and motor 17, and are in circuit with winding 66 whose core 65 is secured to switch 80 which bridges contacts 68 and 69 when solenoid 66 is de-energized; the weight of the movable parts or a spring holding the switch in circuit-closing position. When winding 66 is energized, switch 80 is out of engagement with contacts 68 and 69, and the circuit between the generator 19 and the motor 17 (described above) is broken to stop the motor and refrigeration unit.

Solenoid 66 is energized by generator 19 and its circuit extends from terminal 22 of generator 19, conductors 23, 86, 60, contact 57, contact 59, conductor 71, winding 66, conductors 70, 84 and 85 to the other terminal 26 of generator 19. When bellows 54 contracts because the temperature of compartment 10 is at or below that preferred, contact 57 engages contact 59 to energize solenoid 66 and switch 80 is lifted out of contact with contacts 68 and 69 to stop the motor and refrigeration unit.

If this system is installed on a railroad car or used for refrigerating a compartment in which a variety of perishable articles are to be refrigerated at different times, it becomes desirable to have means of adjusting the system to maintain the compartment at different temperatures according to the peculiar needs of the respective articles to be stored. Thus one kind of vegetable might be most efficiently stored at a temperature of 30–35°, while certain fresh fish, which might be stored at a later time within the compartment, would require a lower temperature for most effective preservation. While the vegetables are being stored in the compartment, the refrigerating needs thereof will thus be far less than they may be at a later time when, for example, fish is stored in the compartment.

To cause the system to meet the particular situation for which it is to be adapted for a period of time, I arrange to predetermine the action of

bellows 54 and 49. I provide a spring 72 acting against the unanchored end 56 of bellows 54. Spring 72 is seated against a rod 73, the remote end of which forms pivot 46 for lever 44. Thus the amount of interior pressure required to actuate bellows 54 and move contact 57 out of engagement with contact 59 and ultimately into engagement with contact 58, is made dependent upon the amount of pressure applied to unanchored end 56 of the bellows by spring 72. The amount of pressure applied to the bellows by spring 72 is in turn determined by the lateral position of arm 73 forming the seat therefor. To secure rod 73 against transverse motion I provide an arm 74 rigidly connected to rod 73 and extending under a slotted stationary member 75. Connected to arm 74 and extending through the slot in member 75 is a suitable thumb-screw 76 so that arm 74 may be clamped to stationary member 75 at any position above the slot. A pointer 77 is attached to arm 73 in registry with a temperature scale generally indicated at 78 and bearing suitable temperature indications. Thus the position of arm 73, and consequently the pressure applied by spring 72 to bellows 54, is indicated on this scale. The particular temperature at which compartment 10 is to be maintained may thus be indicated on this scale by a suitable graduation thereof prepared in accordance with the ratio between the pressure applied by spring 72 on bellows 74 and the vapor pressure exerted by the volatile liquid in bulb 53 for a certain rise of temperature in compartment 10.

The lateral position of rod 73 also affects the action of bellows 49 in that it affects the position of pivot 46. If pivot 46 is moved in a right-hand direction and then fixed in that position, bellows 49 must exert a greater pressure on arm 44 to lessen the pressure of arm 43 on carbon pile 41. As described above, the lessening of pressure from carbon pile 41 speeds up motor 17 and refrigeration unit, and increases refrigeration. Thus it will require a higher temperature outside the compartment to lessen the pressure applied to carbon pile 41 and speed up refrigeration, since bellows 49 must now expand a greater distance to bring about the same effect that it formerly did. It will be noted that moving of the arm 73 in a right-hand direction also increases the pressure opposing bellows 54 so that a higher temperature within compartment 10 to produce greater evaporation of the volatile liquid contained in bulb 53 is required to move contact 57 into engagement with contact 58 to speed up refrigeration, as described above. Conversely, moving arm 73 in a left-hand direction as viewed in the drawing, has the opposite effects on the actions of bellows 49 and bellows 54 so that a lower temperature is insured in compartment 10. Thus the lateral position of rod 73 determines the temperature at which compartment 10 is to be maintained. If rod 73 is moved to the right, spring 72 exerts a greater pressure on bellows 54 so that the vapor of the volatile liquid contained in bulb 53 must exert a greater pressure within bellows 54 to engage contacts 57 and 58 and provide maximum refrigeration. Conversely, if rod 73 is moved in a left-hand direction, less pressure is required to move contact 57 into engagement with contact 58 to produce the same effect.

Considering now the action of this system, let it be assumed that the space 10 is the interior of a railroad refrigerator car and that this car has been loaded with perishable goods to be in transit over a considerable period of time. Furthermore, let it be assumed that these goods must be maintained below a certain definite temperature limit and that while in transportation the car is to pass through various terrain in which there are changes in climate and especially in temperature. The temperature required for most efficient maintenance of the goods in their proper condition has been determined, and accordingly rod 73 has been moved to the proper position in accordance with scale 78 and clamped in this position by thumb-screw 76. Let it be assumed that 15° F. is the temperature to be maintained in space 10, as is indicated by indicator 77. Thus rod 73 is so positioned that indicator 77 is at the 15° position, but the parts are preferably so related that, with this adjustment of rod 73, the pressure exerted by spring 72 on bellows 54 is sufficient to disengage contact 57 from contact 58 when the temperature in space 10 has almost reached 15° F., for example, when it reaches a temperature of 17° F. Further, let it be assumed that engine 20 has been started to drive generator 19, thus furnishing current for the system, and that compressor 12 and its associated parts forming the refrigeration unit for compartment 10 have been suitably conditioned for operation. Finally, let it be assumed that the car has been loaded in a warm climate so that after the completion of the loading, the temperature of the interior 10 is far above that preferred, requiring a high rate of refrigeration immediately.

As the outside temperature has been assumed to be far above that preferred within space 10, the vapor pressure of the volatile liquid contained in bulb 47 is correspondingly high, and this high pressure is exerted on the unanchored end 51 of bellows 49. Bellows 49 moves arm 52 and swings lever 44 in a counter-clockwise direction to greatly lessen, and preferably to remove, the pressure on carbon pile 41. At the same time, however, the vapor pressure of the volatile liquid contained in bulb 53 in compartment 10 is relatively high, and this high pressure is exerted against unanchored end 56 of bellows 54, being sufficient to cause contact 57 to engage contact 58, completing the circuit between generator 19 and solenoid 61. Solenoid 61 is energized and removes all pressure from carbon pile 41 if this has not been completely removed by the action of bellows 49 as described above.

The removal of pressure from carbon pile 41 brings its resistance to a maximum, and consequently little or no current passes through the circuit of solenoid winding 37. Thus solenoid 37 is practically de-energized and exerts substantially no opposition to spring 35 which, secured to the opposite end of the lever 32, therefore exerts maximum pressure on carbon pile 29. In this manner the resistance of the circuit of the shunt field 28 of generator 19 is reduced to a minimum, and the output of generator 19 is a maximum so motor 17 and the refrigeration unit are operating at high speed.

As motor 17 is now running at maximum speed, compressor 12 and its associated parts are running at a comparatively great speed, and, coacting with parts 15, the compressor supplies a greater amount of liquid refrigerant to expansion device 11, also facilitating rapid evaporation thereof due to the greater action on the suction side (pipe 16) of compressor 12. The quick evaporation of the refrigerant in expansion device 11 serves to absorb rapidly large quantities of heat

from compartment 10, and, as this action continues, with the refrigerating unit operating at substantially full capacity, the temperature of compartment 10 is brought down to approximately that preferred (17° F. as above assumed) in a comparatively short period of time.

Before the preferred temperature is reached within space 10, and when the temperature of the compartment is about 17° F., a sufficient portion of the gas contained in bulb 53, pipe 55, and bellows 54, the result of the evaporation of the volatile liquid contained therein, condenses to reduce the pressure on the unanchored end of the bellows 54 and allows spring 72 to push the bellows and consequently contact 57 out of engagement with contact 58. This action breaks the circuit between generator 19 and solenoid 61 to de-energize the solenoid. The de-energization of this solenoid releases the tension on core 62, and thus leaves the pressure on carbon pile 41 to be determined by bellows 49. If the temperature outside of space 10 is relatively low, let us say, at or about the temperature preferred inside of space 10, the period of maximum rate of refrigeration definitely ceases, and bellows 49 insures a low rate of speed of motor 25 and hence a low rate of refrigerating action inside space 10. However, if the temperature outside the interior 10 is substantially above that preferred within the compartment 10, bellows 49 may remain correspondingly expanded to relieve a substantial portion or all of the pressure on carbon pile 41; carbon pile 29 remains compressed, and the motor speed is still relatively high but less than it was formerly. In either case, as the outside temperature changes so as correspondingly to change the rate of heat leakage from the outside to the inside of space 10, bellows 49 insures corresponding changes in the rate of drive of the refrigeration unit. Thus the rate of heat leakage into compartment 10 is automatically met by a corresponding and compensative rate of refrigeration supplied to space 10.

As above pointed out, the termination of the period during which maximum rate of refrigeration takes place in the space 10 occurs when the temperature in space 10 has reached about 17° F.; thereafter, the bellows 49 determines the rate of drive of the refrigeration unit and for any given expansion or contraction of bellows 49, the corresponding rate of refrigeration is preferably just somewhat more than that required simply to compensate for heat leakage into the space 10. This preferred action takes place in order to assure meeting various otherwise uncontrollable factors. Hence, after the temperature of 17° F. has been achieved inside space 10, the rate of refrigeration varies if the outside temperature varies and hence if the rate of heat leakage varies, thus to provide refrigeration at a rate not only varying with the demand but also slightly greater than the demand. Gradually, therefore, the inside temperature of 15° F. is reached, though the reduction from 17° F. to 15° F. may require a substantial period of time during which, however, compensation for varying heat leakage into space 10 is achieved. During this period of time, the compressor 12 and associated refrigeration apparatus are operating at lower speeds or rates, though variable, and continue so to operate to compensate for heat leakage.

Since, however, it is preferred, as above noted, to over-compensate somewhat, a point may be reached where too great a reduction in temperature inside space 10 takes place. Should, therefore, the temperature inside space 10 fall below 15° F., bellows 54 contracts sufficiently to cause contact 57 to engage contact 59, thus closing the circuit of solenoid winding 66 to open switch 80 and stop the motor 17. Thus the over-compensation for heat leakage and for possible other factors, such as the speed-output characteristic of the refrigeration unit, are prevented from depressing the temperature in space 10 too greatly.

Should thereafter the temperature of space 10 increase above 15° F., due, for example, to continued heat leakage, bellows 54 expands to open the circuit of solenoid coil 66 at contacts 57 and 59 and a low but varying rate of refrigeration ensues and may continue for a substantial period until the effect of over-compensation again depresses the temperature below that preferred.

It is to be understood that the above described over-compensation is intended to be a safety measure, and that, for example, if it is practicable to cause the refrigerating action of the unit to vary identically with, or as a straight-line function of the speed of drive of the unit, no over-compensation is necessary.

The mechanical and electrical action of the system after the completion of the period of maximum rate of initial refrigeration may be clear in view of all of the foregoing, but it may nevertheless be pointed out that, should bellows 49 still exert a partial pressure on carbon pile 41 through rod 43, this partial pressure on carbon pile 41 reduces the resistance thereof and allows some current to pass through solenoid 37. This diminished energization of winding 37 causes it to exert some tension on lever 32 against spring 35, and consequently the pressure on carbon pile 29 is partially reduced and the resistance thereof is increased. Now the resistance of shunt field 28 of generator 19 is increased and the total output of the generator is reduced to reduce the speed of motor 17. The reduction of the speed of motor 17 decreases the rate of refrigeration supplied to compartment 10 in the manner described above. Subsequent changes in outside temperature affect correspondingly the expansion or contraction of bellows 49, and correspondingly the latter fixes the speed of drive of the compressor 12 and hence the rate of refrigeration taking place in space 10. These actions take place, it will now be clear, after the initial refrigerating action at maximum rate has been completed and hence, in the above assumed example, after a temperature of about 17° F. has been achieved. Thus when the temperature of the interior of compartment 10 is above that preferred, various rates of refrigeration are attained in this manner in accordance with the rate of heat leakage through the walls into the interior, such heat leakage being a function of the outside temperature, and departures from the preferred temperature within space 10 due to heat leakage are prevented. When, however, the temperature within compartment 10 has reached that preferred (above assumed to be 15° F.) and no refrigeration is required, bellows 54 closes contacts 57 and 59, switch 80 is opened and compressor 12 stops, and with this action, refrigeration ceases.

Let it be assumed, however, that the articles contained in the interior 10 are of such a character that they may be efficiently stored at a comparatively high temperature, for example, about 50° F. I have, in accordance with certain features of my invention, caused such a widely different condition to affect the standard of

operation of the system and apparatus in a unique way. Assuming that the outside temperature is of the same order of magnitude as existed when, in the earlier assumed and above described set of conditions, an inside temperature of 15° F. was to be maintained, it is first to be noted that therefore the rate of heat leakage will now be much less, because the difference between the outside temperature and the inside temperature is now much less (in general terms, is now 50°—15° or 35° less). I now cause the compensation for heat leakage to be correspondingly less in amount.

First, I reset rod 73 by moving it to the right until pointer 77 indicates 50° on scale 78. Now spring 72 exerts a greater pressure on the free end of bellows 54 and a greater pressure (corresponding to a greater temperature in bulb 53) must be exerted therein to move contact 57 into engagement with contact 58. At the same time, however, pivot point 46 connecting lever 44 to rod 73 is moved to the right, effecting a change in standard of operation of bellows 49 and outside bulb 47; in effect, this change in position of pivot point 46 causes lever 44 to be swung in clockwise direction, and carbon pile 41 is then compressed to a greater extent for a given temperature affecting outside thermostatic bulb 47 than was formerly the case.

The same maximum rate of refrigeration takes place initially as before but it is now of a shorter length of time, since the inside temperature is to be brought down to 50° F. Initially, therefore, bellows 54 causes contacts 57 and 58 to be in engagement, coil 61 is energized, carbon pile 41 is of minimum resistance, coil 37 is of minimum energization, carbon pile 29 is of maximum compression, the output of the constant speed generator 19 is a maximum, speed of motor 17 is maximum, and the rate of refrigeration of space 10 and its contents is a maximum.

As the inside temperature is brought down to about 52° F. by this highest rate of refrigeration, bellows 54 moves contact 57 away from contact 58, and coil 61 is now open-circuited; the carbon pile 41 is now under control of bellows 49, which, as above noted, must now operate at a different standard. When pile 41 comes under the control of bellows 49, it is, as above pointed out, in a state of greater compression than was the case when it came under the control of bellows 49 in the earlier assumed state of conditions when a temperature of about 17° F. had been achieved inside space 10. Consequently, coil 37 is more intensely energized, carbon pile 29 is under less compression, the output of generator 19 is less and the speed of motor 17 and the rate of refrigeration correspondingly less. In fact this rate of speed or of refrigeration is less than was formerly the case by an amount substantially equivalent to the now lesser rate of heat leakage for, assuming an outside temperature of 80° F. for both cases, the heat leakage is now proportional to 80° F.—52° F. whereas formerly it was proportional to 80° F.—17° F.

From this point on, variations in this new rate of heat leakage are compensated for by corresponding changes in resistance of carbon pile 41 and in speed or rate of refrigeration, under the control of bulb 47 and bellows 49. Preferably, as before, a slight over-compensation is achieved, as will be clear from the above described action of the system under the first above assumed conditions. Should this over-compensation cause depression of the inside temperature below 50° F., bellows 54 causes contact 57 to engage contact 59 to cut off motor 17 at switch 80 and halt refrigeration until these contacts are disengaged upon a subsequent rise in inside temperature to start the refrigeration unit, but at a relatively low rate proportional to heat leakage by bellows 49 and outside bulb 47.

Under any conditions, should the outside temperature fall below that preferred inside space 10, making refrigeration unnecessary, bellows 49 contracts to increase the pressure on and the current through solenoid 37 to greatly diminish the speed of the motor 17, but stoppage of refrigeration is made to take place when bellows 54 responds to the intended inside temperature whereupon contacts 57 and 59 effect opening of the circuit of motor 17. This feature of coaction is important particularly where material, such as certain fruits, that generate heat, is stored in space 10. Thus dependable refrigeration is achieved. Should heat generation within space 10 take place to raise the temperature above that preferred, even though the outside temperature is below that preferred inside space 10, bellows 54 starts the refrigeration unit by disengaging contact 57 from contact 59, a low rate of refrigeration following, due to the low speed of drive set by outside bellows 49.

From the foregoing description of the action of my invention, it will be apparent that the entire system is capable of operating with maximum efficiency for any set of temperature values. Interior 10 may be maintained at any practical temperature by an adjustment of rod 73 to the proper position in accordance with scale 78. After this adjustment and the subsequent starting of constant speed engine 20, the system operates automatically to adjust itself to any climatic or temperature condition to which it may be subjected. Moreover, the rate of supply of refrigeration to interior 10 is not only variable but is automatically suited to the particular condition to be met, and more particularly is automatically suited to changes in heat leakage caused by changing the standard of temperature to be maintained, and this condition will be seen, in view of the few illustrative examples above described, to be one of many falling in a wide range of differing conditions.

It will thus be seen that there has been provided in this invention an apparatus in which the various objects above noted together with many practical advantages are successfully achieved.

As many possible embodiments may be made in the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a refrigeration system, in combination, a chamber whose temperature is to be regulated, a refrigeration unit for said chamber, an electric motor for driving an element of said refrigeration unit, motive means adapted to run continuously for substantial periods of time, generator means driven by said motive means for supplying current to said motor, and means responsive to varying needs for refrigeration in said chamber adapted to affect the operative standard of said generator means to change the rate of drive of said refrigerating unit.

2. In a refrigeration system, in combination,

means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor driving an element of said refrigeration unit, motive means adapted to run continuously for substantial periods of time, a generator driven by said motive means for supplying current to said motor, a resistance for said generator and said motor, and temperature responsive means for varying the amount of said resistance.

3. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, a variable resistance for controlling the speed of said motive means, means for controlling the effectiveness of said resistance, a second resistance for controlling the effectiveness of said last-mentioned means, and thermostatic means for controlling the effectiveness of said second resistance.

4. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, a carbon pile for regulating the speed of said motive means, means adapted to exert pressure on said carbon pile to reduce its effective resistance, means adapted to act in opposition to said last-mentioned means, and thermostatic means for controlling one of said last two mentioned means.

5. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, a variable resistance for regulating the speed of said motive means according to pressure applied thereto, means adapted to exert pressure on said resistance to reduce its effectiveness, means adapted to act in opposition to said last-mentioned means, a second pressure-responsive variable resistance for controlling said last-mentioned means, and thermostatic means for controlling the pressure on said second resistance in accordance with temperature changes.

6. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, a carbon pile for regulating the speed of said motive means, means adapted to control the pressure on said carbon pile to control its resistance, a second carbon pile for regulating the actuation of said last-mentioned means, thermostatic means for controlling the pressure on said second carbon pile to vary the resistance thereof, and thermostatic means inside said space for limiting the action of said first-mentioned thermostatic means.

7. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a generator for supplying current to said motor, a carbon pile for controlling the output of said generator to said motor, and means for affecting the pressure on said carbon pile according to changes in temperature.

8. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a carbon pile for controlling the speed of said motor, and means for varying the pressure on said carbon pile according to the temperature within said space and outside of said space.

9. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a variable resistance for affecting the speed of drive of said motor, electromagnetic means for controlling said resistance, a second variable resistance for controlling the effectiveness of said electromagnetic means and means for affecting said second resistance according to the temperature outside said space.

10. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a carbon pile disposed within the circuit of said motor and said source of current, means for exerting a certain pressure on said carbon pile, a solenoid acting against said last-mentioned means to reduce said pressure, a second carbon pile controlling the effectiveness of said solenoid, means for exerting pressure on said second carbon pile according to the temperature outside said space, and means for limiting the action of said last-mentioned means responsive to the temperature inside said space.

11. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, means responsive to the temperature outside said space for controlling the speed of said motive means, and means responsive to the temperature inside said space for controlling the actuation of said motive means.

12. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a variable resistance for controlling the speed and the actuation of said motive means, means responsive to the temperature outside said space for controlling the effectiveness of said resistance between certain temperature limits, and means responsive to the temperature inside said space for controlling the actuation of said motive means through said resistance above and below said limits.

13. In a refrigeration system, in combination, means forming a space whose temperature is to be controlled, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a carbon pile for controlling the speed of said motive means according to the pressure applied thereto, means responsive to the temperature outside said space for applying various pressures to said carbon pile to regulate the speed of said motive means, and means responsive to the temperature inside said space for controlling the actuation of said motive means.

14. In a refrigeration system, in combination, means forming a space whose temperature is to be controlled, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a variable resistance for controlling the actuation for affecting the speed of said motive means, and means responsive to the temperature inside said space for controlling the effectiveness of said resistance.

15. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space

motive means for actuating an element of said refrigeration unit, a variable resistance for controlling the speed of said motive means, thermostatic means responsive to temperature outside of said space for varying said resistance, and means responsive to the temperature inside of said space for affecting said resistance to modify the action of said thermostatic means.

16. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a variable pressure-responsive resistance for controlling the speed of said motive means, and means responsive to the difference in temperature inside said space and outside said space for controlling the pressure applied to said variable resistance.

17. In a refrigeration system, in combination, a chamber whose temperature is to be regulated, a refrigeration unit for said chamber, a prime mover for actuating an element of said refrigeration unit, variable resistance means for controlling the speed of drive of said element, means for starting and stopping the drive of said element, a thermostatic element responsive to the temperature outside said space for controlling one of said means, and a thermostatic element responsive to the temperature inside said space for controlling the other of said means.

18. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a variable resistance for controlling the speed of said motive means, means responsive to the temperature outside said space for controlling said resistance, means responsive to the temperature inside said space for controlling said resistance and acting independently of said outside temperature responsive means, and means for regulating the effectiveness of said inside temperature-responsive means.

19. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a variable resistance for controlling the speed of said motive means, electromagnetic means for controlling said resistance, a second variable resistance for controlling the effectiveness of said electromagnetic means, and means responsive to the temperature inside said space for varying said second resistance when the temperature of said space is above that preferred and for stopping said motive means when the temperature of said space is at or below that preferred.

20. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, a variable resistance for controlling the speed of said motive means according to pressure applied thereto, means for varying the pressure applied to said resistance, a second variable resistance for controlling the effectiveness of said last-mentioned means, means for controlling the actuation of said motive means, means for varying said second resistance to vary the effectiveness of said pressure-varying means in one direction upon a decrease in outside temperature and to vary its effectiveness in opposite direction upon an increase in outside temperature, and means operating independently of said last-mentioned means for affecting the pressure on said second resistance to effect a maximum speed of said motive means when the temperature of said space is above that preferred and for actuating said controlling means when the temperature is at or below that preferred.

21. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for actuating an element of said refrigeration unit, means responsive to the temperature inside said space for starting and stopping said motive means, and means responsive to temperature outside of said space for varying the speed of drive of said motive means.

22. In a refrigeration system, in combination, means forming a space whose temperature is to be controlled, means for abstracting heat from the interior of said space, means responsive to the temperature inside of said space for initiating and stopping the heat-abstracting action of said second-mentioned means, and means affected by temperature outside of said space for controlling the rate of action of said heat-abstracting means.

23. In a refrigeration system, in combination, means forming a space whose temperature is to be controlled, means for abstracting heat from the interior of said space, means for preventing said heat-abstracting means from depressing the temperature inside said space below a certain value, means causing said heat-abstracting means to operate at a rate that varies substantially with the rate of heat leakage from the exterior of said space into the interior thereof, means for changing the value of temperature at which said third-mentioned means function to prevent further depression of the temperature inside said space, and means responsive to actuation of said changing means for causing said rate-varying means to operate at a different standard.

24. In a refrigeration system, in combination, means forming a space whose temperature is to be controlled, means for abstracting heat from the interior of said space, means causing said heat-abstracting means to operate at a relatively high rate when the temperature inside said space is above a certain value, means causing said heat-abstracting means to operate at a lower rate and for varying the rate of refrigeration in accordance substantially with varying heat leakage into said space as the outside temperature varies and operative after said value of temperature inside said space has been reached, means for changing the temperature value before which high rate of refrigeration is achieved and after which varying rate of refrigeration is achieved, and means responsive to the actuation of said changing means for changing the standard of operation of said rate-varying means.

25. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, electric motive means for driving an element of said refrigeration unit, a source of current for said motive means, a variable resistance in the circuit of said source of current and said motive means, thermostatic means outside said space for regulating said resistance in accordance with the amount of heat leakage to the interior of said space, and thermostatic means inside said space for making and breaking said circuit in accordance with the temperature of said space.

26. In a refrigeration system, in combination,

means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving parts of said refrigeration unit, means for controlling the speed of said motive means in accordance with the temperature outside said space between predetermined maximum and minimum speeds, and means for controlling the actuation of said motive means in response to the temperature inside said space and independently of said last-mentioned means.

27. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, speed control means for said motive means, thermostatic means outside said space adapted to act upon said speed control means, and thermostatic means inside said space adapted to act upon said speed control means.

28. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for driving an element of said refrigeration unit, speed controlling means for said motive means, means responsive to the temperature outside said space for regulating said last-mentioned means, and means responsive to the temperature inside said space for modifying the action of said last-mentioned means and controlling the starting and stopping of said motive means.

29. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, electric motive means for driving an element of said refrigeration unit, a variable resistance for controlling the speed of said motive means, means for regulating the effectiveness of said resistance in response to the temperature outside said space, means for regulating the operative effectiveness of said last-mentioned means, means for modifying the action of said last two mentioned means in response to the temperature inside said space, and means controlling the starting and stopping of said motive means in response to the action of said last-mentioned means.

30. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving parts of said refrigeration unit, a generator for supplying current to said motor, a variable resistance in the field of said generator, means for regulating said resistance in response to the temperature outside said space, and means for modifying the action of said last-mentioned means in response to the temperature inside said space.

31. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a generator for supplying current to said motor, a variable resistance in the field of said generator, means for regulating said resistance in response to the temperature outside said space, means for modifying the action of said last-mentioned means in response to the temperature inside said space, and means responsive to the temperature inside said space for controlling the starting and stopping of said motor.

32. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving parts of said refrigeration unit, a generator for supplying current to said motor, a variable resistance in the field of said generator, means for regulating said resistance in response to the temperature outside said space, a switch in the circuit of said motor and said generator, and a thermostat responsive to the temperature inside said space for controlling the actuation of said switch.

33. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving parts of said refrigeration unit, a generator for supplying current to said motor, a pressure-responsive resistance in the field of said generator, electro-responsive means for applying pressure to said resistance, and means for varying the current flowing to said electro-responsive means in response to the temperature changes.

34. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving parts of said refrigeration unit, a generator for supplying current to said motor, a pressure-responsive resistance in the field of said generator, electro-responsive means for applying pressure to said resistance, means for varying the current flowing to said electro-responsive means in response to the temperature outside said space, and means for making and breaking the circuit between said motor and said generator in response to the temperature inside said space.

35. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving parts of said refrigeration unit, a generator for supplying current to said motor, a pressure-responsive resistance in the field of said generator, electro-responsive means for applying pressure to said resistance, means for varying the current flowing to said electro-responsive means in response to the temperature outside said space, and means responsive to the temperature inside said space for modifying the action of said last-mentioned means and making and breaking the circuit between said generator and said motor.

36. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving parts of said refrigeration unit, a generator for supplying current to said motor, a pressure-responsive resistance adapted to control the output of said generator, electro-responsive means for applying pressure to said resistance, means for varying the current flowing to said electro-responsive means in response to temperature changes, means for making and breaking the circuit between said motor and said generator in response to temperature changes, and manually operable means for adjusting the operative standard of said last two mentioned means.

37. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for driving an element of said refrigeration unit, a generator, driving means for said generator, a pressure-responsive resistance in the field of said generator, electro-responsive means for varying the pressure on said resistance, an electro-responsive switch in the circuit of said motor and said generator, and means

for controlling the action of said electro-responsive means and said electro-responsive switch in accordance with the temperatures within said space and outside said space.

38. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, means for abstracting heat from said space, a motor for driving an element of said heat abstracting means, a generator for supplying current to said motor, driving means for said generator, a pressure-responsive resistance for controlling the output of said generator, electro-responsive means for varying the pressure on said resistance, said generator being in a circuit with said electro-responsive means, means for varying the amount of current passing through said last-mentioned circuit in response to the temperature outside said space, and means for making and breaking said first-mentioned circuit in response to the temperature inside said space.

39. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, means for abstracting heat from said space, a motor for driving an element of said heat abstracting means, a generator for supplying current to said motor, motive means for said generator, a pressure-responsive resistance in the field of said generator, electro-responsive means for varying the pressure on said resistance, means for varying the amount of current passing through said last-mentioned circuit in response to the temperature outside said space, and means responsive to the temperature inside said space for modifying the action of said last-mentioned means.

40. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for driving an element of said refrigeration unit, a source of current for said electric motor, a pressure-responsive variable resistance for regulating the effectiveness of said source of current, electro-responsive means for applying pressure to said resistance, a variable resistance in the circuit of said electro-responsive means, and means responsive to temperature changes for varying said last-mentioned resistance.

41. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for driving an element of said refrigeration unit, a source of current for said electric motor, a pressure-responsive variable resistance for regulating the effectiveness of said source of current, electro-responsive means for varying the amount of pressure on said resistance, a variable resistance in the circuit of said electro-responsive means, means responsive to the temperature outside said space for varying said last-mentioned resistance, and means responsive to the temperature inside said space for modifying the action of said last-mentioned means.

42. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for driving an element of said refrigeration unit, a source of current for said electric motor, a pressure-responsive variable resistance for changing the effectiveness of said source of current, electro-responsive means for controlling the pressure on said resistance, a variable resistance in the circuit of said electro-responsive means, means responsive to the temperature outside said space for regulating said last-mentioned resistance, means responsive to the temperature inside said space for modifying the action of said last-mentioned means, and means for adjusting the operative standard of said last two mentioned means.

43. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for driving an element of said refrigeration unit, a source of current for said electric motor, a pressure-responsive variable resistance for regulating the effectiveness of said source of current, electro-responsive means for regulating the pressure on said resistance, a variable resistance, said last-mentioned resistance and said electro-responsive means being in a circuit with said generator, and means for regulating the effectiveness of said last-mentioned variable resistance in response to temperature changes.

44. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for motivating a part of said refrigeration unit, a source of current for said electric motor, a variable resistance for regulating the effectiveness of said source of current, control means for increasing and diminishing said resistance, a variable resistance, said last-mentioned resistance and said control means being in a circuit with said generator, and means responsive to the temperatures inside said space and outside said space for increasing and decreasing said last-mentioned resistance in accordance with changes in said temperatures.

45. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, an electric motor for driving an element of said refrigeration unit, a source of current for said electric motor, a pressure-responsive variable resistance for regulating the effectiveness of said source of current, electro-responsive means for regulating the pressure on said resistance, a variable resistance in the circuit of said electro-responsive means, electro-responsive means for regulating said last-mentioned resistance, and temperature responsive means adapted to coact with said last-mentioned electro-responsive means and for controlling the operation of said last-mentioned electro-responsive means.

46. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, electric means for operating an element of said refrigeration unit, a pressure-responsive variable resistance for regulating the speed of said electric means, means for applying varying amounts of pressure to said resistance in accordance with the temperature outside said space, means connected with said last-mentioned means and adapted to modify the action thereof, and means responsive to the temperature inside said space for controlling the operation of said last-mentioned means and said electric means.

47. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a pressure-responsive resistance for controlling the speed of operation of said unit, means for applying various amounts of pressure to said resistance, means responsive to the temperature outside said space connected with and adapted to operate said last-mentioned means, and means

responsive to the temperature inside said space for modifying the operation of said member.

48. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a variable resistance for controlling the speed of operation of said refrigeration unit, a lever for operating said resistance and adapted to increase said resistance when moved in one direction about a pivotal point and decrease said resistance when moved in another direction about said point, a temperature-responsive part adapted to move said lever in either of said directions in response to the temperature changes, electro-responsive means operatively associated with said lever and adapted to move said lever in said first-mentioned direction when energized, and means for energizing said electro-responsive means when the temperature of said space rises above that preferred.

49. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a variable resistance for controlling the speed of operation of said refrigeration unit, a lever for operating said variable resistance and adapted to increase said resistance when moved in one direction about a pivotal point and decrease said resistance when moved in the other direction, a temperature-responsive part adapted to move said lever in either of said directions in response to the temperature changes, electro-responsive means operatively associated with said lever and adapted to move said lever in said first-mentioned direction when energized, means for energizing said electro-responsive means when the temperature of said space rises above that preferred, and means for fixing the pivotal point of said lever in any one of a plurality of positions.

50. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a generator for supplying current to said motor, motive means for said generator, a variable resistance in the field of said generator, electro-responsive means for controlling said variable resistance, means acting against said electro-responsive means to maintain said resistance at a minimum when said electro-responsive means is deenergized, a second variable resistance, said last-mentioned resistance and said electro-responsive means being in a circuit, means for reducing to a minimum the amount of said last-mentioned resistance when the temperature outside said space is below that preferred and for increasing said last-mentioned resistance proportionately as the outside temperature rises, and means for modifying the action of said last-mentioned means in accordance with the temperature requirements of said space.

51. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a generator for supplying current to said motor, a pressure-responsive resistance for varying the output of said generator, said resistance adapted to decrease in accordance with the amount of pressure applied thereto, means for applying pressure to said resistance, electro-responsive means adapted to act against said last-mentioned means, a variable resistance, said variable resistance and said electro-responsive means being in the circuit of said generator, means for decreasing said last-mentioned resistance when the temperature outside said space is in the vicinity of that preferred within the space and for increasing said last-mentioned resistance as said outside temperature rises, electro-responsive means for increasing said last-mentioned resistance when energized, and means for closing a circuit to said last-mentioned electro-responsive means when the temperature of said space is above that preferred.

52. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, a motor for driving an element of said refrigeration unit, a generator for supplying current to said motor, a pressure-responsive resistance for varying the output of said generator, said resistance adapted to decrease in accordance with the amount of pressure applied thereto, means for applying pressure to said resistance, electro-responsive means adapted to act against said last-mentioned means, a second pressure-responsive resistance, said last-mentioned resistance and said electro-responsive means being in the circuit of said generator and said last-mentioned resistance adapted to decrease in accordance with the amount of pressure applied thereto, means for applying pressure to said last-mentioned resistance when the temperature outside said space is in the vicinity of that preferred within the space and for releasing said pressure as said outside temperature rises, electro-responsive means for decreasing the pressure upon said last-mentioned resistance when energized, means for closing a circuit to said last-mentioned electro-responsive means when the temperature of said space is above that preferred, and means for changing the operative standards of said last two mentioned means.

53. In a refrigerating system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for controlling an element of said refrigeration unit, a speed controlling resistance for said motive means, a variable resistance for regulating said speed controlling resistance, and means for varying said variable resistance in response to temperature changes.

54. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for controlling an element of said refrigeration unit, a speed controlling resistance for said motive means, a variable resistance for regulating said speed controlling resistance, means for varying said resistance in response to temperature changes outside said space, and means for modifying the action of said last-mentioned means in response to the temperature inside said space.

55. In a refrigeration system, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, motive means for controlling an element of said refrigeration unit, a speed controlling resistance for said motive means, a variable resistance for regulating said speed controlling resistance, means for regulating the effectiveness of said variable resistance in response to the temperature outside said space, and means for controlling the starting and stopping of said motive means in response to the temperature inside said space.

GEORGE E. HULSE.