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Kroll et al.

[11] **3,893,306**

[45] **July 8, 1975**

[54] **REFRIGERATOR CONTROL ARRANGEMENT**

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[30] **Foreign Application Priority Data**

Jan. 25, 1972 Germany 2203295

[52] **U.S. Cl.** ..... **62/148;** 236/48 R

[51] **Int. Cl.** **F25b 15/10**

[58] **Field of Search** ..... 62/148, 236, 151, 156; 236/15 A, 99 R, 48 R

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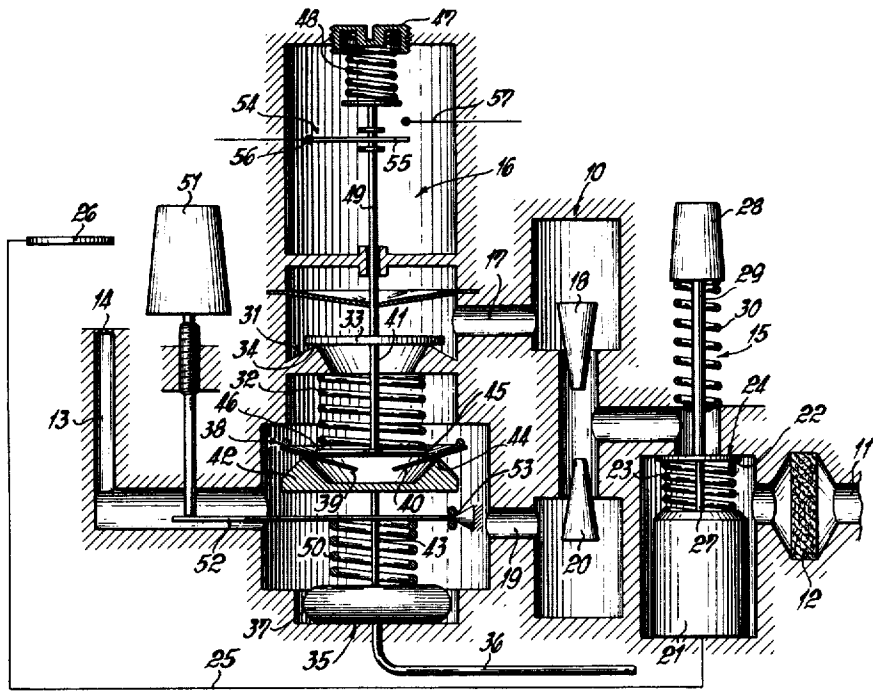
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Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

The burner of a gas refrigerator reduces the temperature by burning gas received from a gas control valve which is opened by the membrane capsule of a thermostat, or closed by a spring. The membrane capsule is connected by a snap spring disc with the gas control valve so that the valve is not slowly opened and closed by the membrane capsule and spring, but rapidly shifted by the snap spring disc between the open and closed positions.

23 Claims, 14 Drawing Figures



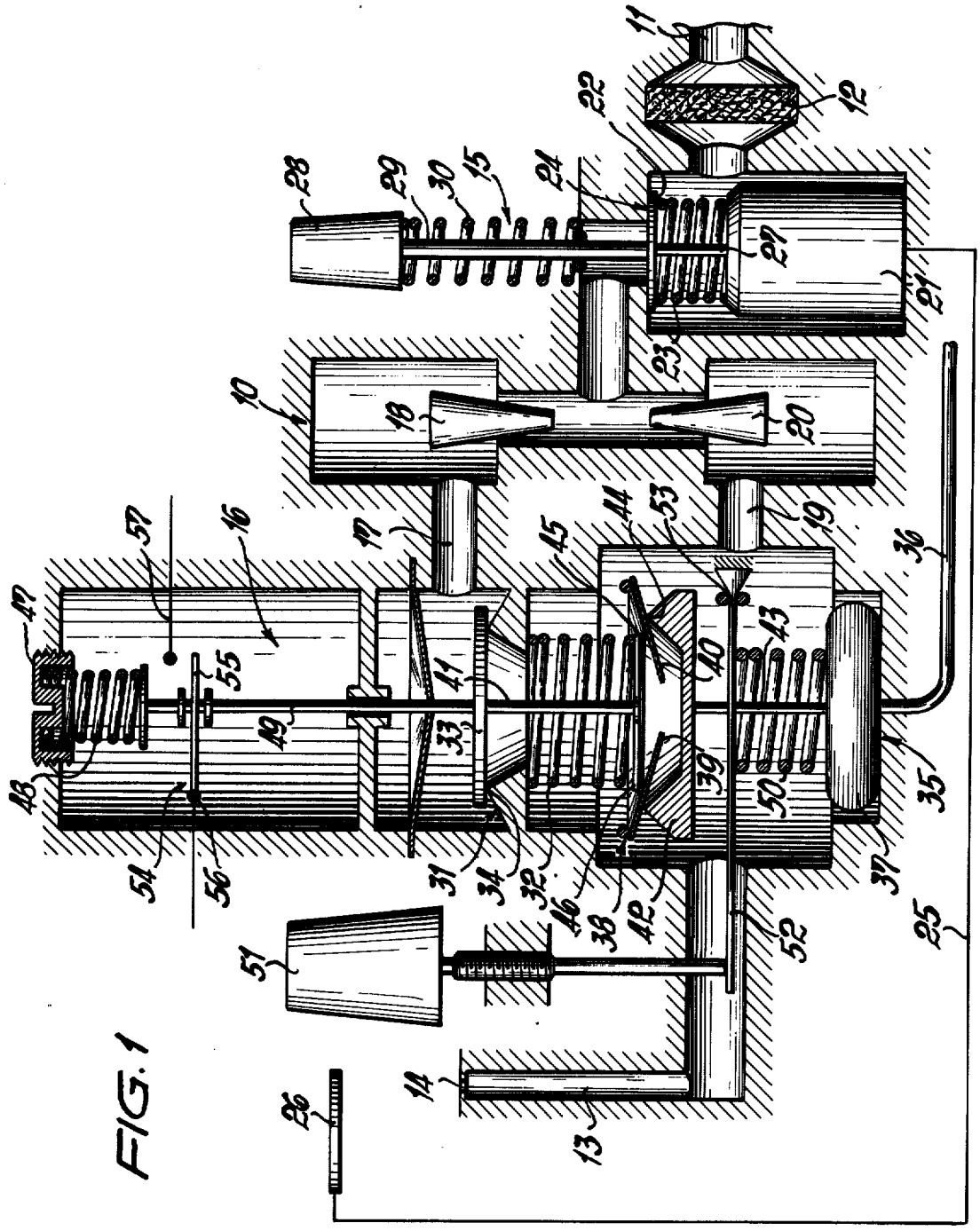


FIG. 1

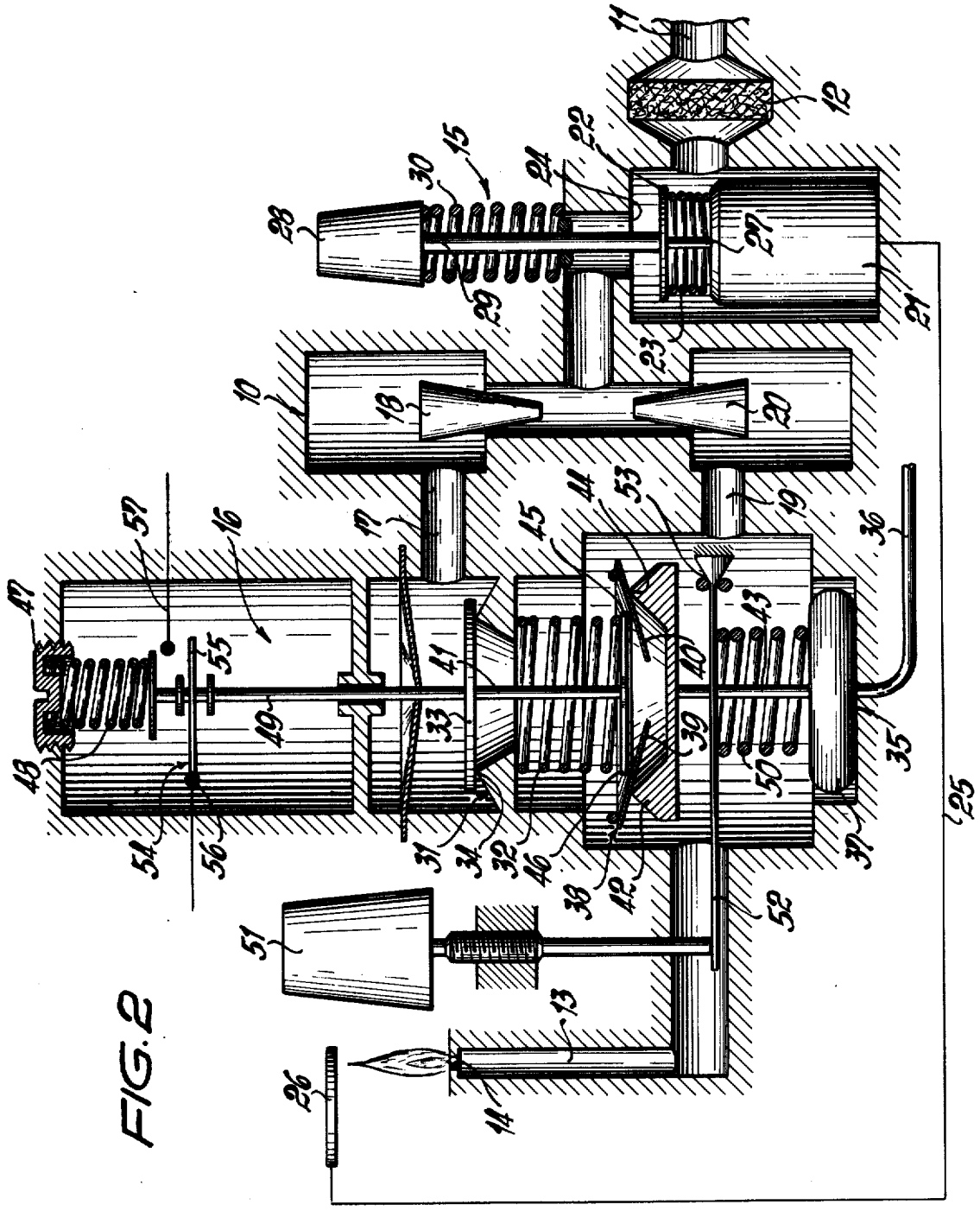

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FIG. 2

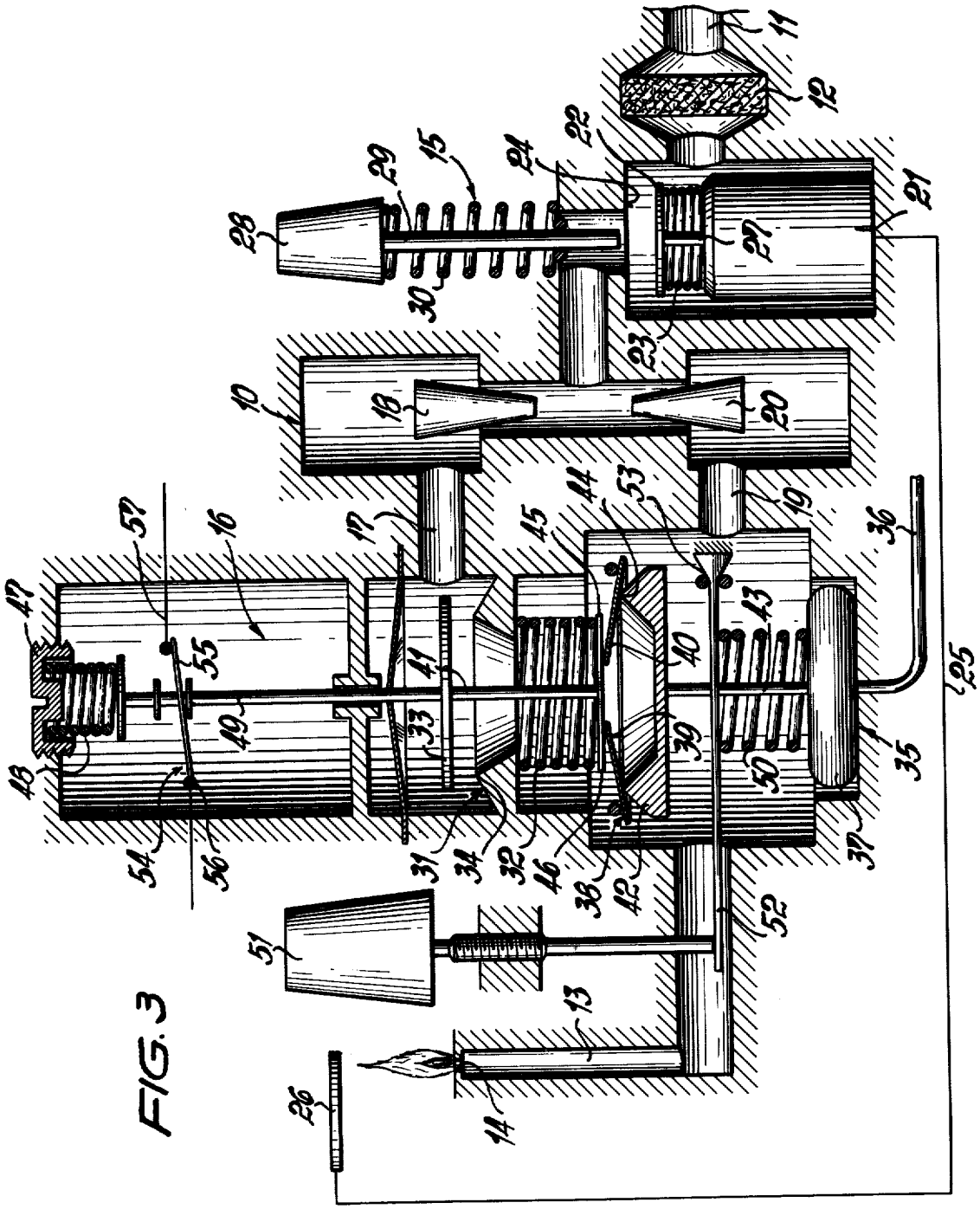


FIG. 3

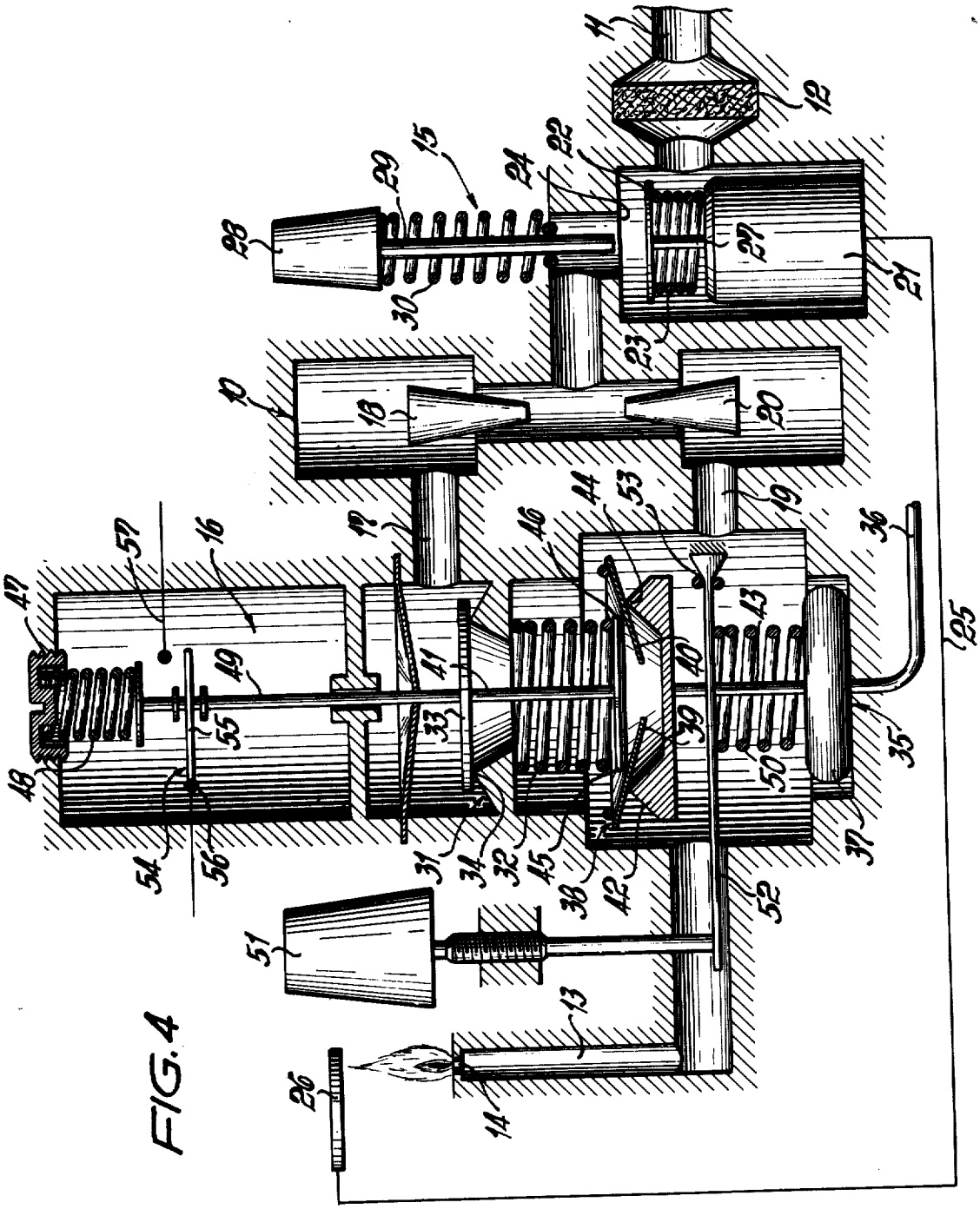


FIG. 4

FIG. 12

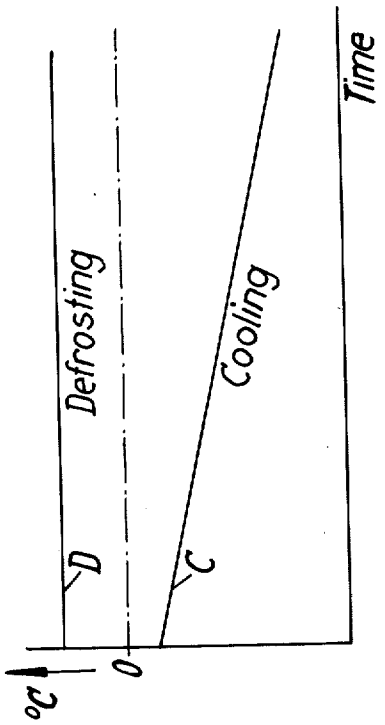


FIG. 13

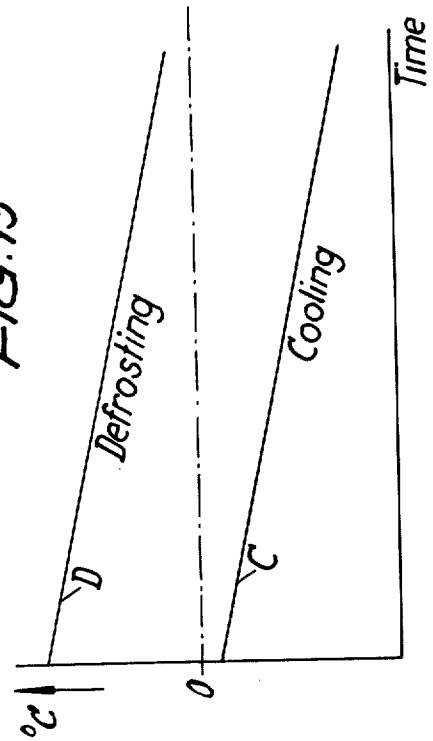


FIG. 5

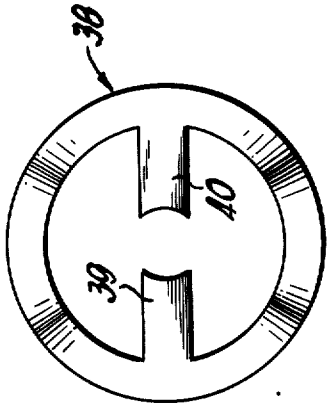


FIG. 6



FIG. 7



FIG. 9

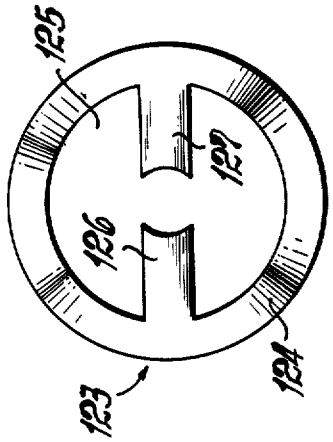


FIG. 10



FIG. 11

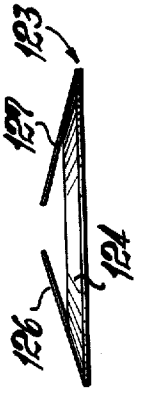
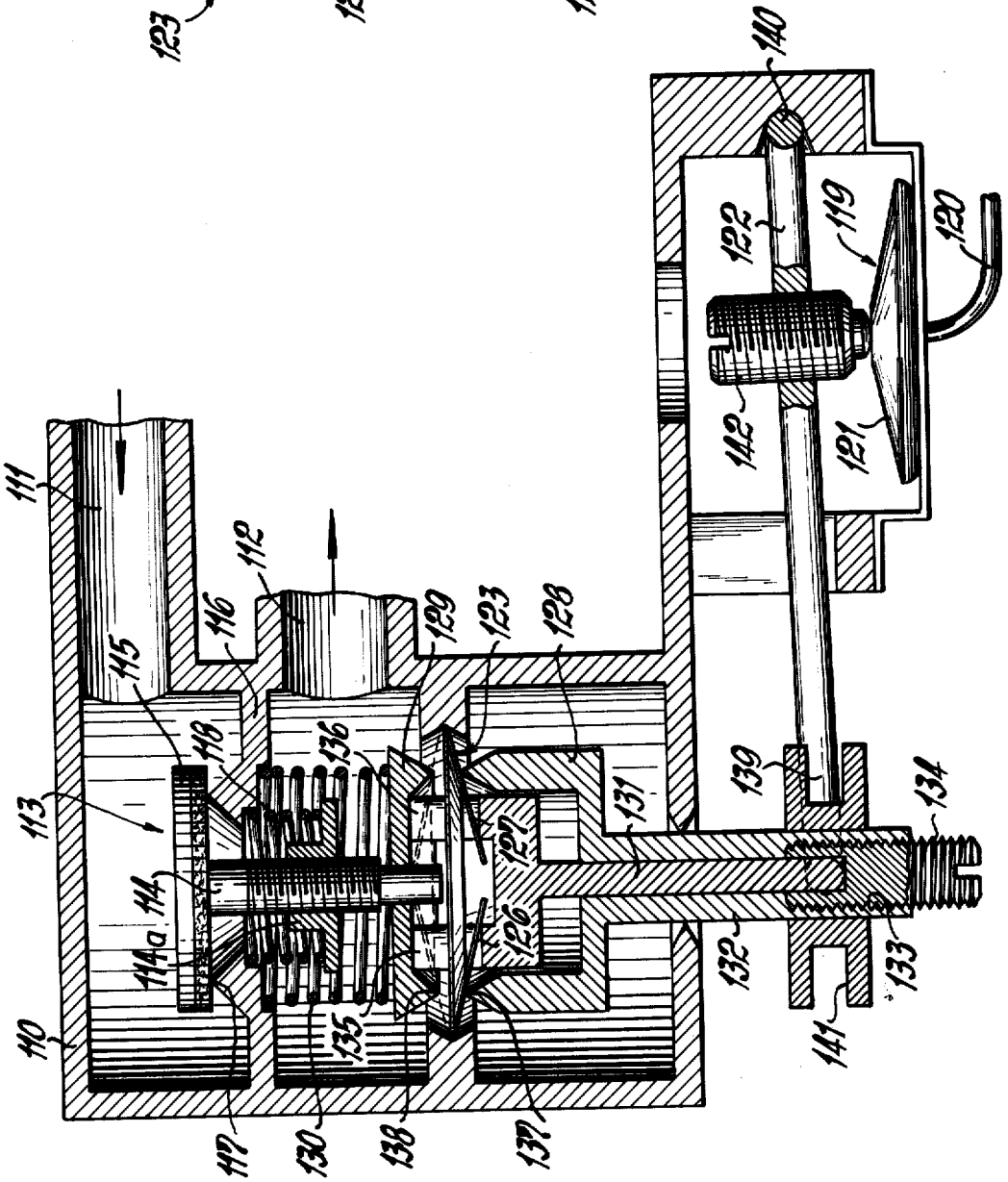


FIG. 8



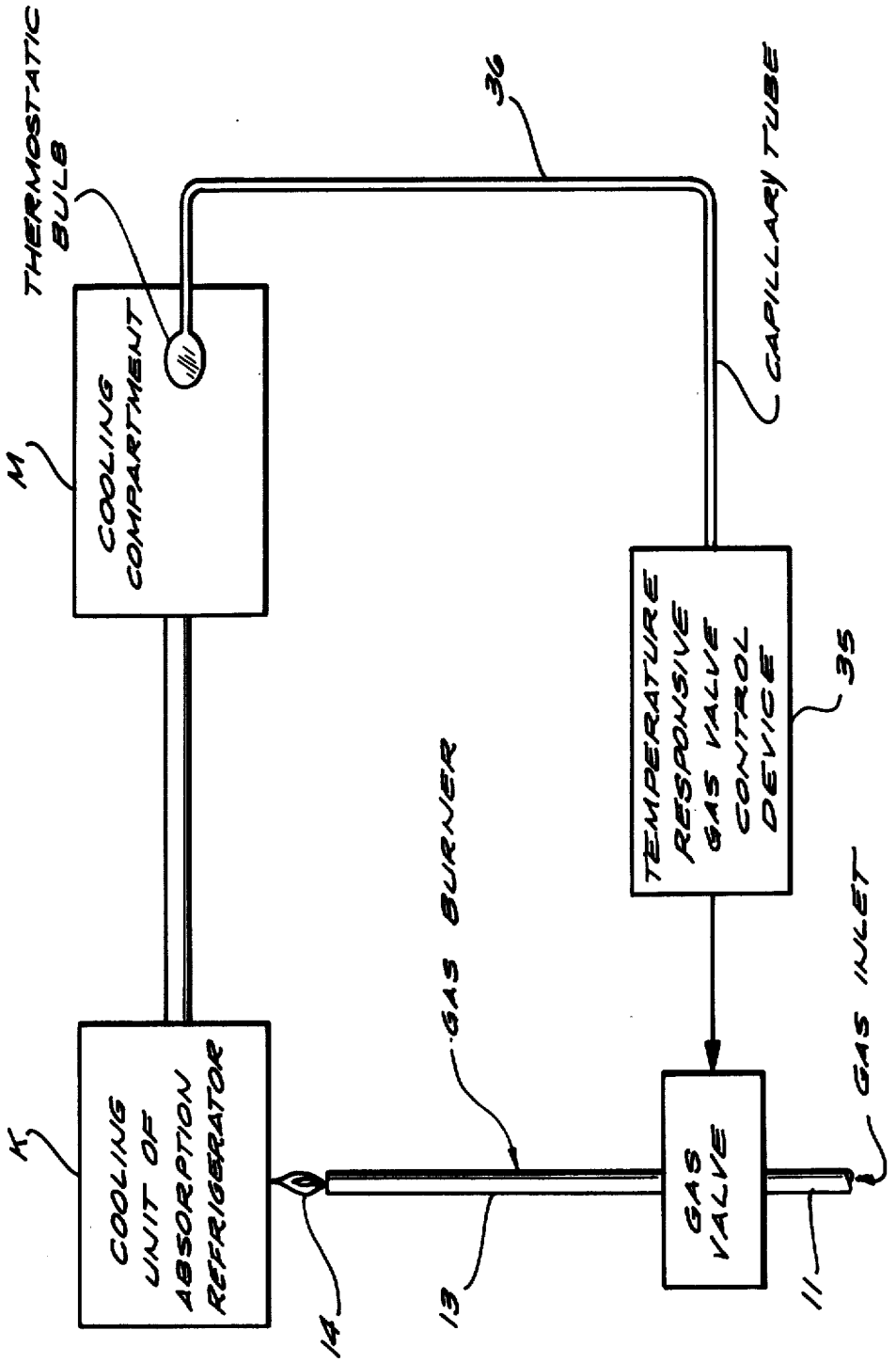

THERMOSTATIC BULB
36
CAPILLARY TUBE
M
COOLING COMPARTMENT
TEMPERATURE RESPONSIVE GAS VALVE CONTROL DEVICE
35
GAS BURNER
GAS INLET
K
COOLING UNIT OF ABSORPTION REFRIGERATOR
GAS VALVE
14
13
11

FIG. 14

REFRIGERATOR CONTROL ARRANGEMENT

BACKGROUND OF THE INVENTION

The present invention relates to a control arrangement for an absorption refrigerator provided with a gas control valve whose valve member is controlled by a thermostat which controls the volume of supplied gas in accordance with a desired cooling temperature which can be adjusted to a selected temperature.

Refrigerator control arrangements of this type are known, but it has been found that during operation of the refrigerator, the cooled space of an absorption refrigerator is frosted, particularly in the region of the evaporator, so that the operation of the refrigerator has to be interrupted from time to time in order to defrost the refrigerator by thawing or otherwise removing the accumulated frost. Such interruption for refrigerated food, which may be spoiled.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a refrigerator control arrangement which prevents the frosting of the cold space of a refrigerator.

Another object of the invention is to provide an arrangement serving this purpose, in which the selected cooling temperature, as well as the defrosting temperature can be adjusted or varied.

With these objects in view, the present invention provides a snap spring resiliently shiftable between two end positions, and connected with the closure member of the gas control valve. The snap spring is shifted from one end position upon reaching of predetermined limit temperatures of a temperature range by which cooling operation or a defrosting thawing operation are determined.

In a preferred embodiment of the invention, the snap spring is a frusto-conical snap spring disc which has an annular peripheral rim and two radially inwardly projecting spoke portions so that the spoke portions are spaced in axial direction in the two possible conditions of the snap spring disc in which the same is concave in opposite directions. The inner ends of the radial spoke portions are advantageously connected with a rod connected to the closure valve member of the gas control valve.

In a preferred embodiment of the invention, the snap spring disc is subjected to pressure on one side by the membrane capsule of the thermostat, and on the opposite sides to the pressure of a spring which biasses the valve closure member of the gas control valve to close.

It is advantageous to provide an annular pressure body having an annular edge cooperating with the circular spring snap disc and being controlled by the membrane capsule of the thermostat which is preferably coaxial with the pressure body and the closure member of the gas control valve.

In one embodiment of the invention, a rod secured to the closure member of the gas control valve, has diametrical lateral projecting arms which cooperate with the inner spoke portions of the snap spring disc.

In order to accurately determine and adjust the limit temperature of the thawing and defrosting operation, the closure spring of the gas control valve includes a spring which can be adjusted and set by operation of an adjustment screw.

For adjusting the thermostat to a desired position which is the first limit of the temperature range, manually operated means are provided for pressing a lever against the membrane capsule of the thermostat.

In a modification of the invention, an absorption refrigerator is used which can be heated by gas or electricity, and a microswitch controlling the electric heating means, is shifted under the control of the snap spring disc simultaneously with the shifting of the closure member of the gas control valve, which may not be used when the refrigerator is to be operated with electric heating elements. In such an arrangement it is advantageous to couple the gas control valve and microswitch in such a manner that the two control elements are simultaneously operated by the thermostat in a rapid shifting movement determined by the snap spring disc.

It is advantageous to provide a main valve for supplying gas to the gas control valve, and to operate the main valve manually, providing, however, electromagnetic means which respond to an electric voltage produced by the burner to hold the main gas valve in the open position after manual actuation.

The arrangement of the invention obtains the result that during each operation of the apparatus after termination of a cooling operation, the cooling temperature rises temporarily to a defrosting thawing temperature, so that no frost develops on the cooling surfaces.

The snap spring is used in accordance with the present invention not only for transforming the slow movement of the membrane capsule of the thermostat into a rapid opening movement of the closure member of the gas control valve, but also permits to vary the cooling temperature easily within a wide range. It is possible to adapt the temperature difference between the two shifting points which limit the cooling operation and the defrosting operation, to the prevailing conditions. In the present invention, the snap spring serves the purpose to maintain the switching differential determined by the adjusted temperature range, to a value which, when used for an absorption refrigerator, results in an operation of the refrigerator which is particularly advantageous, and assures proper cooling of the stored food.

It has been found that the temperature range which determines the cyclical operations, that is cooling and defrosting, can be particularly easily and precisely adjusted. In a preferred embodiment of the invention, the snap spring is located between an annular pressure body operated by the thermostat, and another annular pressure body, biassed by a return spring, and being mounted on the first mentioned pressure body in such a manner as to permit adjustment of the distance between the two annular pressure bodies.

The pressure bodies are preferably provided with annular edges cooperating with the peripheral rim of the snap spring disc.

It is also advantageous to connect a lever by an adjustable screw with the membrane capsule of the thermostat. The third embodiment of the invention obtains the result that during each operation of the control arrangement the temperature rises to a maximum defrosting temperature after termination of each cooling operation, so that no ice can form on the cooling surfaces. The arrangement makes it possible to vary the cooling temperature and the defrosting temperature within wide ranges, while the temperature difference between the two limit values of the cooling operation and defrosting operation, can be adapted to the prevail-

ing conditions. The two pressure bodies on opposite sides of the snap spring disc, can be used for very accurately adjusting the limit values of the temperature range between which the cyclical cooling and defrosting operations take place, and the temperature difference can be maintained at a value which is favorable for the stored and cooled goods.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary schematic and diagrammatic, partially sectional view illustrating a first embodiment of the invention in a position of rest;

FIG. 2 is a view corresponding to FIG. 1, but illustrating the ignited condition of the gas refrigerator;

FIG. 3 is a view corresponding to FIGS. 1 and 2, but illustrating the cooling condition of the refrigerator;

FIG. 4 is a view corresponding to FIGS. 1 to 3, but illustrating a defrosting condition of the refrigerator;

FIG. 5 is a plan view illustrating a snap spring disc used in the embodiment of FIGS. 1 to 4;

FIGS. 6 and 7 are side views illustrating the two positions of the snap spring disc shown in FIG. 5;

FIG. 8 is a fragmentary schematic sectional view illustrating a second embodiment of the invention in the defrosting position, or in the position of rest;

FIG. 9 is a plan view illustrating a snap spring disc used in the embodiment of FIG. 8;

FIGS. 10 and 11 are side views illustrating two end positions of the snap spring disc shown in FIG. 9;

FIG. 12 is a diagram illustrating graphically an arrangement in which the defrosting temperature is maintained constant, while the cooling temperature is reduced; and

FIG. 13 is a diagram graphically illustrating an arrangement in which the defrosting temperature is reduced at the same gradient as the cooling temperature.

FIGS. 1 to 4 illustrate the first embodiment of the invention including an igniting device which is omitted in FIG. 8 and it will be understood that the second embodiment of FIG. 8 can be provided with the parts shown in FIG. 1, but omitted in FIG. 8.

FIG. 14 is a schematic showing of the operative interconnection of the gas burner of FIGS. 1–4, the cooling unit of an absorption refrigerator, the cooling compartment of the refrigerator, and the membrane capsule thermostat arrangement of FIGS. 1–4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 to 7, an absorption refrigerator is schematically illustrated, which can be selectively heated by gas or electric current. A housing 10, consisting of several parts, has an inlet 11 provided with the filter 12 through which gas is supplied, and the gas flows through a conduit 13 through the burner 14, when the main valve 22, 24 is opened. In housing 10, a thermoelectric igniting device 15, and a regulating device 16 are provided, which are connected by a main conduit 17, in which a main gas throttle 18 is located, and by an igniting gas conduit 19, in which an igniting throttle 20 is located, with each other. The igniting device 15 includes an electromagnet 21 which cooperates with the closure member 22 of the main valve 22, 24, the closure member 22 being urged against the seat 24 by a spring 23 so that the main valve is normally closed, and does not permit gas to enter conduits 17 and 19. Electromagnetic means 21 is connected by an electric line with a heatable thermo element 26 which produces a voltage when heated by burning gas from burner 14, the voltage being supplied to the electromagnetic means 21 which cooperates with an armature plate, not shown, connected with closure member 22 by a shaft 27.

The closure member 22 is operated by depression of the manually operated button 28 which acts on a rod 29 against the action of return spring 30 and of spring 23 to move the closure member 22 into engagement with the electromagnetic means 21 which in energized condition holds the closure member 22 by the armature, not shown, so that the main valve 22, 24 is kept open after the manual starting button 28 has been shortly depressed.

The regulating means 16 includes a gas control valve 31 which has a closure means 33 biassed by a spring 32 to engage a valve seat 34 provided in the housing 10. The closure member 33 is indirectly controlled by the membrane capsule 37 of a thermostat 35 which has a capillary tube 36 connected with the heat sensor.

In accordance with the invention, the closure means of the gas control valve 31 is associated with a snap spring disc 38 which has two end positions, and snaps from any one end position to the respective other end position, when slightly displaced out of the first position. At a predetermined limit value of temperature range, determining a cooling operation or a defrosting operation, the snap spring disc 38 is shifted, so that the closure means 33 of the gas control valve 31 is shifted between open and closed positions. The snap spring disc 38 is preferably constructed as a circular disc having a circular peripheral rim with two diametrically arranged inwardly projecting spoke portions or arms 39 and 40 which can be snapped between the positions shown in FIGS. 6 and 7 to be concave in opposite directions, while the inner ends of the spoke portions 39, 40 are located in two axially spaced positions, as shown in FIGS. 6 and 7. The rod 41, which is secured to the closure means 33 of the gas control valve 31, has a lower end from which diametrically arranged lateral arms 45, 46 outwardly project which engage, respectively the spoke portions 39 and 40 under the action of the spring 32. An annular pressure body 42 with an annular edge 44 abuts the snap spring disc 38 in the peripheral region, and is connected by a rod 43 with the membrane capsule 37 of the thermostat means 35. Expansion of the capsule 37 will cause movement of the pressure body to shift the snap spring disc 38 to the position shown in FIG. 3 in which the gas control valve 31 is open, while contraction of the membrane capsule 37 will retract the pressure body 44 so that the return spring 32, acting on the lateral arms 45, 46 of the rod 41, will snap the snap spring disc 38 to the position shown in FIGS. 1, 2 and 4. The membrane capsule 37 is arranged coaxial with the pressure body 44, and with the gas control valve 31. Another rod 49 is secured to the closure means 33 of the gas control valve 31, and has an end plate on which a spring 48 acts to urge the

closure means 33 to close gas control valve 31. The pressure of spring 48 can be adjusted by an adjusting screw 47. Springs 48 and 32 act in the same sense so that the total spring pressure on the closure means 33, can be adjusted by screw 47.

The thermostat 35 can be adjusted to a desired condition, and for this purpose, a spring 50, abutting the membrane capsule 37 is compressed by turning an adjusting lever 52 about a pivot in housing 10. A manually operated knob 51 can be turned with a screw spindle in a threaded bore in the housing 10, so that the end of the screw spindle 51 acts on the free end of lever 52 to influence the membrane capsule 37 so that a shifting of the gas control valve 31 is obtained by the actuating means 43, 42, 44 and the return springs 32, 48 in accordance with desired temperature ranges.

The arrangement illustrated in FIGS. 1 to 4 is intended for absorption refrigerators which can be heated by gas or electric current, in accordance with available facilities. For this purpose, a microswitch 54 is arranged coaxial with thermostat 35 and gas control valve 31. The microswitch 54 includes a movable actuator 55, and two fixed connectors 56 and 57 which are connected with electric heating means, not shown, of the refrigerator, taking the place of burner 14.

Gas control valve 31 and microswitch 54 are connected by rod 49 which is secured to closure means 33, and has two flanges for operating the actuator 55 so that microswitch 54 and gas valve 31 are simultaneously operated by the membrane capsule 37 of thermostat 35, the arrangement being such that upon opening of the gas control valve 31, the microswitch 54 is simultaneously closed.

The apparatus illustrated in FIGS. 1 to 4 operates as follows: FIG. 1 shows a position of rest in which the gas supply is closed by main valve 22, 24 and control valve 31, 33, 34. The microswitch 54, 56, 57 is held open by rod 49 connecting switch contact 55 with the closure member 33. The refrigerator can be operated with gas or electricity, and a combined control switch and gas valve can be provided which are coupled in such a manner that upon opening of the the gas supply, the electric current is interrupted. It is assumed that the gas supply through the inlet 11 is free, while no current is supplied to the apparatus.

FIG. 2 shows the igniting position of the apparatus in which the manually operated button 28 has been depressed against the action of the return spring 30 and the closure spring 23 so that the valve member 22 is lifted off the valve seat 24 until abutting an armature plate, not shown, of the electromagnetic means 21. The ignition device 15 in this condition permits the flow of igniting gas through the throttle 20, the channel 19, and the gas conduit 13 to the pilot of burner 14 at which the pilot flame is ignited. The pilot flame heats the thermal element 26 whose current energizes the electromagnetic means 21 so that the armature plate, not shown, secured to rod 27, adheres to the energized electromagnetic means so that the gas valve 22, 24 is held open. Switch 54 remains in the open position, and the snap spring disc 38 remains in the downward snapped position in which valve 31 is closed. No force is exerted by the membrane capsule 37 of the thermostat 35 on the pressure body 42. When the valve member 22 is held by the electromagnetic means 21 in the open position after depression of the manual button 28, as shown in FIG. 2, the button 28 can be released, and is returned to its initial position by the return spring 30.

The membrane capsule 37 of the themostat 35 controls the closure means 33 of the gas control valve 31 together with the movable switch contact 55 of the microswitch 54 of the regulating device 16 so that the supply of gas, or the supply electric current, is controlled in accordance with a desired cooling temperature in the refrigerator. The setting of the desired temperature is effected by means of the turnable knob 51 which through screw spindle 51, lever 52, and spring 50, influences the membrane capsule 37 of thermostat 35. When no cooling takes place, the pressure in the thermostat 35 rises until the membrane capsule 37 overcomes the forces of the intermediate spring 50, and moves pressure body 42 upward so that its annular edge 44 deforms the snap disc 38 out of its previous position so that the spoke portions 39, 40 snap upward and engage the lateral arms 45, 46 of rod 41 of closure means 33 so that the closure means 33 is raised off the valve seat 34 against the action of the closure spring 32 and the additional spring 48, and the gas control valve 31 opens as shown in FIG. 3, while at the same time, the rod 49 moves the microswitch 54 to a closed position. However, since the apparatus was placed in a condition for gas operation by a switch, not shown, no current can flow through the closed microswitch 54.

The open gas control valve 31 permits the flow of gas through conduit 17 to the burner 14 at the end of the gas conduit 13, where the gas is ignited by the pilot flame and heats the generator of the absorption refrigerator, not shown. The cooling operation is thus started in the usual manner which, due to the supply of gas through the open gas control valve 31 is continued until the temperature of the cooled zone of the refrigerator, not shown, reaches a lower minimum temperature, for examaple −20°C. During the cooling operation, the membrane capsule 37 contracts and the force exerted thereby on the pressure body 42 is reduced due to the reduction of the volume, until this force reaches a limit value at which the snap spring 38 is displaced by the springs 32 and 48 out of the position illustrated in FIG. 3 to an intermediate position in which the snap spring 38 rapidly snaps to the other position shown in FIG. 4 in which the valve closure means 33 engages the valve seat 34 so that gas control valve 31 is closed. In the position of FIG. 4, the defrosting takes place directly and automatically after the desired and selected highest cooling temperature is reached. The snapping of the snap spring disc 38 to the position of FIG. 4 can be adjusted by adjusting the additional spring 48 by the schematically shown screw 47. When the desired temperature is reached in the cooled zone of the refrigerator, the gas supply to burner 14 is interrupted by the closed gas control valve 31, so that the temperature drops, and defrosting takes place so that the ice deposits at the cooled surfaces are thawed. The defrosting operation is continued until the maximum defrosting temperature is reached, for example +5°C, whereupon the membrane capsule 37 of the thermostat 35 expands to such an extent that the pressure body 42 is pressed by rod 43 against the snap spring 38 and shifts the same to the position of FIG. 3 in which the gas control valve 31 is again opened to start a new cooling cycle.

The arrangement of the invention obtains a continued sequence of cooling and defrosting cycles so that the ice formation at the evaporator of the refrigerator

is avoided. The temperature range between the highest defrosting temperature and the lowest cooling temperature depends on several factors, and is a function of the diameter of the annular edge **44** of the pressure body **42**, while the thermostat **35** can be set to a desired cooling temperature by means of the turnable knob **51**. The additional spring **48** which can be adjusted by screw **47**, permits a further adjustment of the moment of switching of the gas control valve **31**.

If no gas is available and electricity is to be used for operating the refrigerator, a gas valve and a switch, not shown, are closed so that a voltage is applied to the microswitch **54**. During the above described cyclical operation of the refrigerator, the microswitch **54** was closed during cooling in the first position of the snap spring **38** shown in FIG. **3**, and open in the second position of the snap spring **38** shown in FIG. **4**. Since the apparatus was set to a gas operation, the closing of the microswitch has no effect. However, if the refrigerator is set for electric operation by setting the combined gas valve and main switch, not shown, the closing of microswitch **54** in the position of FIG. **3** caused by expansion of the membrane capsule **37** due to higher temperature, causes the energization of the electric heating element, not shown, of the refrigerator, so that the defrosting operation takes place in the position of FIG. **4** in which the microswitch **54** has been opened by the snap spring **38** under the control of the thermostat **35**, so that no current is supplied to the electric heating element of the refrigerator, so that the temperature in the refrigerator rises and the apparatus is defrosted. During such an electric operation of the refrigerator, the gas valve **31** opens and closes without influence on the refrigerator since there is no gas supply through inlet **11** and no flame at burner **14**.

FIG. **14** depicts schematically the manner in which the burner **14** furnishes heat to the cooling unit of an absorption refrigerator. The burner and cooling unit K together constitute temperature changing means having a first mode (valve **31** in FIGS. **1–4** open) and a second mode (valve **31** closed). The cooling unit K cools a cooling compartment M on the walls of which frost tends to form. The capillary tube **36** in FIGS. **1–4** leads to the cooling compartment M to establish communication with the temperature-responsive membrane capsule **37**.

A second embodiment of the invention is shown in FIGS. **8** to **13**, and particularly FIG. **8** corresponds to FIG. **4** of the first embodiment. The microswitch **54**, the igniting device **15**, and the burner **14** of FIG. **4** are not shown, but it will be understood that the embodiment of FIG. **8** is operated basically in the same manner as described with reference to FIGS. **1** to **4**.

In the housing **110**, a gas inlet **111**, and an outlet **112** connected with the burner, not shown, are provided. A gas control valve **113** has a closure means **115** with a rod **114**, and cooperates with a stationary valve seat in the form of an annular edge **117** in a wall **116**. A return spring **118** abuts the wall **116** and a flange **114***a*. Flange **114***a* is turnably mounted on a thread on rod **114** so that the tension of the return spring **118** can be adjusted. The closure means **115** of the gas control valve **113** is controlled by a thermostat **119** which comprises a heat sensor, not shown, a capillary tube **120**, and a membrane capsule **121**. A lever **122** is mounted for pivotal movement on a pivot **140** in the housing, and has a forked end **139** located in an annular groove **141** of a flange on a hollow shaft **132** in which a rod **131** is mounted whose position can be adjusted by an adjusting screw **134** threaded into a threaded bore **133** of the hollow shaft **132**. Lever **122** is connected by an adjustable screw **142** with the membrane capsule **121** so that the pressure force exerted by the membrane capsule **121** through lever **122** on the hollow shaft **132** can be adjusted.

A pressure body **128** is provided at the upper end of the hollow shaft **132** and has an annular edge **137** cooperating with the peripheral rim **124** of a snap spring disc **123**, separately shown in FIGS. **9, 10** and **11**. The snap spring disc **123** has two radial inner spoke portions **126** and **127** which cooperate with the lower end of rod **114**. The snap spring disc **103** snaps between its two positions upon reaching of a limit temperature, namely the predetermined maximum temperature for a defrosting cycle, and minimum temperature for a cooling cycle.

While thermostat **119** acts through membrane capsule **121**, lever **122**, adjusting screw **142**, hollow shaft **132**, and pressure body **128** with edge **137** on the peripheral rim **124** of the snap spring disc **123** on rod **114** of the closure means **115** of the gas control valve **113**, the spring **130**, abutting wall **116**, engages another pressure body **129** which has another annular edge **138** located on the other side of the snap spring disc **123**, and cooperating with the peripheral rim **124** to snap the spring disc **123** from its upper position shown in broken line in FIG. **8** to its lower position shown in solid lines, when the reduced volume of the membrane capsule **121** of the thermostat **119** permits spring **130** to overcome the resistance of the snap spring and of the pressure body **128**.

Rod **131** which is mounted in the hollow shaft **132** of the pressure body **128** for movement by the adjusting screw **134**, has a forked upper end with forked portions **135** and **136** passing through the spaces between the peripheral rim **124** and the inner spoke portions **126** and **127** of the snap spring disc **123**, and abutting the pressure body **129**. By operation of the adjusting screw **134**, the axial distance between the annular edge **137** of pressure body **128** and annular edge **138** of pressure body **129** can be adjusted.

The rod **114** of the closure means **115** of the gas control valve **113** projects through the pressure body **129** and is engaged by the spoke portions **126, 127** of the snap spring disc **123** when the snap spring **123** snaps to its upper position whereby closure means **115** of the gas control valve **113** is raised of the seat **117** against the action of return spring **118**.

FIG. **8** shows the modified control arrangement of the invention in the defrosting position since the gas control valve **113** is closed so that no gas is supplied to the burner, see burner **14** and gas conduit **13** in FIGS. **1** to **4** which are supplied with gas from the outlet **112** in the housing **110** of FIG. **8**.

Since the cooling element does not operate, the temperature in the absorption refrigerator rises to a predetermined maximum temperature, the thermostat **119** responds, and the membrane capsule **121** expands and turns lever **122** in clockwise direction against the action of the return spring **130** which acts on pressure body **129**, rod **131**, **135**, **136**, adjusting screw **134**, hollow shaft **132**, lever **122** and adjustable screw **142** on membrane capsule **121**. The pressure of the membrane capsule **121** is thus transmitted to the pressure body

128 and to its edge 137 so that the snap spring disc 123 snaps from the position illustrated in FIG. 8 and FIG. 10, to the position illustrated in FIG. 11.

The spoke portions 126, 127 of the snap spring disc 123 engage the rod 114 of the closure means 115 and are somewhat spread to connect the inner ends of the spoke portions 126, 127 for movement with the rod 114, so that the closure means 115 is rapidly lifted off the valve seat 117 against the action of the return spring 118 so that gas can flow from gas inlet 111 to gas outlet 112 and to the burner of the absorption refrigerator.

In this manner, the cooling cycle is started which is continued due to the supply of gas through the open gas control valve 113 until the temperature in the refrigerator reaches the minimum of the temperature range, as graphically shown in FIGS. 12 and 13. During the cooling cycle, and until the lowest limit of the temperature range is reached, the force exerted by the membrane capsule 121 on the pressure body 128 is gradually reduced due to the contraction of the membrane capsule. Pressure body 128 is permitted to move due to the action of the return spring 130, which acts through pressure body 129 and its rod 131 on pressure body 128, downward until the annular edge 138 of the counterpressure body 129 abuts the snap spring disc 123 and causes the same to snap to the initial position shown in FIGS. 8 and 9, after moving the adjustable distance between the annular edges of the pressure bodies 128, 129.

In the shifted position of the snap spring disc 123, the rod 114 separates from the inner ends of the spoke portions 126, 127 so that the return spring 118 moves the closure means 115 to the valve closing position abutting seat 117 so that the supply of gas through outlet 112 to the burner is interrupted by the closed gas control valve 113, which takes place when the lowest desired cooling temperature is reached. The defrosting cycle starts now, since the temperature in the refrigerator gradually rises to maximum temperature of the range when the burner does not operate, so that the temperature exceeds 0°C, and frost and ice deposits, formed during the preceding cooling cycle, are thawed.

The control arrangement of the present invention assures a continuous automatic sequence of alternating cooling cycles and defrosting cycles so that heavy frost and ice formation in the refrigerator is avoided. The temperature range which is bounded by the two limits, namely the maximum defrosting temperature and the minimum cooling temperature, can be easily and exactly set in the arrangement of the invention, since the width of the temperature range is exactly determined as a function of the precisely adjustable distance between the pressure bodies 128 and 129.

Several possibilities for setting the temperature range exist, since either the adjusting screws 134 and 142 together, or only one or the other can be adjusted.

FIGS. 12 and 13 graphically illustrate the setting of the apparatus to different ranges of cooling and defrosting temperatures. The ordinate indicates the temperature, 0°C being shown as a chain line. The abscissa indicates the time. The highest defrosting temperature D is the upper limit, and the lowest cooling temperature C is the lower limit of the range. The defrosting cycle lasts until the desired maximum defrosting temperature is reached, at which the cooling cycle is again started by opening of the gas control valve 113, while the lower desired limit is the lowest cooling temperature obtained by cooling operation, upon reaching of which the new defrosting cycle is started by closing of the gas control valve 113.

In the adjusted arrangement shown in FIG. 12, the defrosting temperature D is substantially constant, provided that the adjusting screw 142 is not operated, while the band width of the temperature range is adjusted by adjusting screw 134 which influences the cooling temperature.

In the example of FIG. 13, the temperature range between the defrosting temperature D and the cooling temperature C is held constant, since the respective graphs D and C are parallel. Adjusting screw 134 is not operated, and the distance between the pressure bodies 128 and 129 is constant, while by operation of the adjusting screw 142, the constant temperature range can be moved on the ordinate upwards or downwards until a simultaneous change of the defrosting temperature and cooling temperature results. The two examples of FIGS. 12 and 13 illustrate the wide variations of temperature adjustments which can be obtained by the arrangement of the invention, so that the refrigerator can be set in accordance wtih all possible prevailing conditions by operating either adjustment screw 134, or adjustment screw 142, or both.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of control arrangements for refrigerators differing from the types described above.

While the invention has been illustrated and described as embodied in a control arrangement for an absorption refrigerator provided with a snap spring for rapidly shifting the gas control valve and provided with adjusting means for obtaining an automatic alternation of cooling and defrosting cycles, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. In a refrigerator comprised of a cooling compartment on the walls of which frost tends to form, an arrangement for counteracting such tendency, comprising, in combination, temperature changing means operative in a first mode for causing a decrease of the temperature of said cooling compartment and operative in a second mode for causing an increase of the temperature of said cooling compartment; and control means operative for maintaining said compartment cool by causing said temperature changing means to assume said first mode when the temperature of said cooling compartment rises to a higher first value, and operative for counteracting the accumulation of frost on said walls by causing said temperature changing means to

assume said second mode when the temperature of said cooling compartment will alternate between said first and second values, said control means including a control member movable between first and second positions for respectively causing said temperature changing means to assume said first and second modes, biasing means connected to said control member comprising a bistable snap-over spring member coupled to said control member and so disposed that said snap-over spring member must be snapped over to a first position and to a second position for respectively permitting said control member to be moved to said first and second positions of said control member, and temperature-responsive means operative for exerting upon at least one of said members a temperature-dependent force moving said members to said first positions when the temperature of said cooling compartment rises to said first value and moving said members to said second positions thereof when the temperature of said cooling compartment falls to said second value.

2. In a refrigerator as defined in claim **1**, wherein said temperature changing means comprises a gas burner, wherein said control means comprises a gas supply valve for controlling the supply of gas to said burner, said gas supply valve comprising a valve member constituting said control member.

3. In a refrigerator as defined in claim **1**, wherein said snap-over spring member is generally circular and annular and comprised of two radially inwardly extending spoke portions, and wherein said control member is comprised of an elongated linkage rod extending towards and connected to said spoke portions.

4. In a refrigerator as defined in claim **3**, wherein said elongated linkage rod is provided at the ends thereof with two radially outwardly projecting portions respectively bearing upon said radially inwardly extending spoke portions of said generally circular and annular snap-over member.

5. In a refrigerator as defined in claim **1**, wherein said biasing means comprises a biasing spring operative for always exerting upon said control member a biasing force tending to move said control member to one of said positions thereof, and wherein said temperature-responsive means comprises means for exerting upon said control member a temperature-dependent force opposing the biasing force of said biasing spring, and wherein said biastable snap-over spring member is so disposed as to oppose said temperature-dependent force when said control member undergoes a transition to one of said positions thereof and to supplement said temperature-dependent force when said control member undergoes a transition to the other of said positions thereof.

6. In a refrigerator as defined in claim **5**, wherein said control means further includes means for adjusting the biasing force exerted by said biasing spring.

7. In a refrigerator as defined in claim **6**, wherein said biasing spring is a helical compression spring, and wherein said means for adjusting the biasing force exerted by said biasing spring comprises means for varying the pre-compression of said helical compression spring.

8. In a refrigerator as defined in claim **5**, wherein said control means comprises means for changing the temperature at which said control means automatically causes said temperature changing means to undergo a transition from one to the other of said modes by adjusting the biasing force exerted by said biasing spring.

9. In a refrigerator as defined in claim **1**, wherein said temperature-responsive means comprises a membrane capsule having an interior communicating with said cooling compartment and undergoing changes of volume dependent upon the temperature of said cooling compartment, and an elongated linkage rod extending from said membrane capsule towards said bistable snap-over spring member, and a pressure body connected to said elongated linkage rod, said linkage rod and said pressure body being operative for transforming temperature-dependent volume changes of said membrane capsule into a temperature-dependent force applied to said snap-over spring member.

10. In a refrigerator as defined in claim **9**, wherein said temperature changing means comprises a gas burner, wherein said control means compries a gas supply valve including a circular valve member constituting said control member, wherein said biasing means comprises a helical biasing spring operative for always exerting upon said valve member a force tending to move said valve member to one of said positions thereof, and wherein said snap-over spring member is generally circular and so disposed as to oppose said temperature-dependent force when said valve member undergoes a transition to one of said positions thereof and supplement said temperature-dependent force when said valve member undergoes a transition to the other of said positions thereof, and wherein said pressure body is generally circular and has a circular knife edge engaging said circular snap-over spring member, and wherein said membrane capsule is generally circular, and wherein said helical biasing spring, said circular snap-over spring member, said circular membrane capsule, said circular pressure body and said circular valve member are coaxially aligned, with said linkage rod being substantially colinear with the common axis.

11. In a refrigerator as defined in claim **9**, wherein said control means further includes adjustable resisting means for exerting upon said membrane capsule a resisting force counteracting the tendency of said membrane capsule to exert a force upon said pressure body, and wherein said control means further includes adjusting means operative for effecting a change of the temperature at which said control means causes said temperature changing means to undergo a transition from one to the other of said modes by adjusting said resisting force of said resisting means.

12. In refrigerator as defined in claim **1**, wherein said control member is the moving switch member of an electrical switch.

13. In a refrigerator as defined in claim **1**, wherein said temperature changing means comprises a gas burner and wherein said control means comprises a gas supply valve including a valve member constituting said control member, and wherein said control member is further provided with the moving switch member of an electrical switch having first and second positions assumed simultaneously with said first and second positions of said valve member.

14. In a refrigerator as defined in claim **1**, wherein said temperature changing means comprises a gas burner, and wherein said control means comprises means operative for detecting the temperature in the vicinity of said burner and means operative for terminating the supply of gas to said gas burner when the

temperature in the vicinity of said burner falls below a predetermined value, whereby to prevent continued supply of gas to a non-functioning burner.

15. In a refrigerator as defined in claim **1,** wherein said temperature-responsive means includes a first pressure body located on one side of said snap-over spring member and operative for applying to the latter a temperature-dependent force, and wherein said control means further includes a second pressure body located at the other side of said snap-over spring member and a return spring for exerting upon said second pressure body a force causing said second pressure body to exert upon said snap-over spring member a force opposing said temperature-dependent force, and supporting means supported by said first pressure body and supporting said second pressure body, and means for adjusting the spacing between said first and second pressure bodies.

16. In a refrigerator as defined in claim **15,** wherein said snap-over spring member is generally annular having a central opening, and wherein said supporting means comprises a supporting member supported on said first pressure body and extending through said central opening of said snap-over spring member and having an end portion supporting said second pressure body.

17. In a refrigerator as defined in claim **16,** wherein said supporting member is comprised of an elongated portion partially accommodated within an elongated internal bore provided in said first pressure body and supported at the end of said supporting member remote from said second pressure body by a screw-threaded supporting unit adjustable for varying the relative positions of said supporting member and of said first pressure body.

18. In a refrigerator as defined in claim **17,** wherein said control member is provided with an elongated linkage rod projecting in direction towards said central opening of said snap-over spring member, and wherein said snap-over spring member has at least two radially inwardly projecting portions which when said snap-over spring member assumes one of said positions thereof engage said rod and transmit force to said control member via said linkage rod.

19. In a refrigerator as defined in claim **16,** wherein said supporting member is comprised of a forked end portion passing through said central opening of said snap-over spring member and engaging and supporting said second pressure body.

20. In a refrigerator as defined in claim **15,** wherein said snap-over spring member is generally circular, and wherein both said first and second pressure bodies are configurated to have projecting annular knife edges contacting opposite axial sides of said circular snap-over spring member at the radially outer portion of said circular snap-over spring member.

21. In a refrigerator as defined in claim **1,** wherein said temperature-responsive means comprises a pivoted lever having one end connected in force-transmitting manner to one of said members, and a membrane capsule positioned at the other end of said lever and having an interior communicating with said cooling compartment and undergoing volume changes dependent upon the temperature of said cooling compartment and operative for exerting upon said other end of said lever a force dependent upon the volume of said membrane capsule, and thereby dependent upon the temperature of said cooling compartment.

22. In a refrigerator as defined in claim **21,** wherein said temperature-responsive means comprises a pressure body engaging said snap-over spring member in force-transmitting manner, a shaft connected to said pressure body, means guiding said shaft so as to define a path of movement of said pressure body, and wherein said one end of said lever is forked and articulately connected to the end of said shaft remote from said pressure body, and wherein the other end of said lever is pivotally supported.

23. In a refrigerator as defined in claim **21,** wherein said lever is provided at said other end of said lever with a screw-threaded contact portion engaged by said membrane capsule and adjustable to permit adjustment of the effect upon said lever of volume changes of said membrane capsule.

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