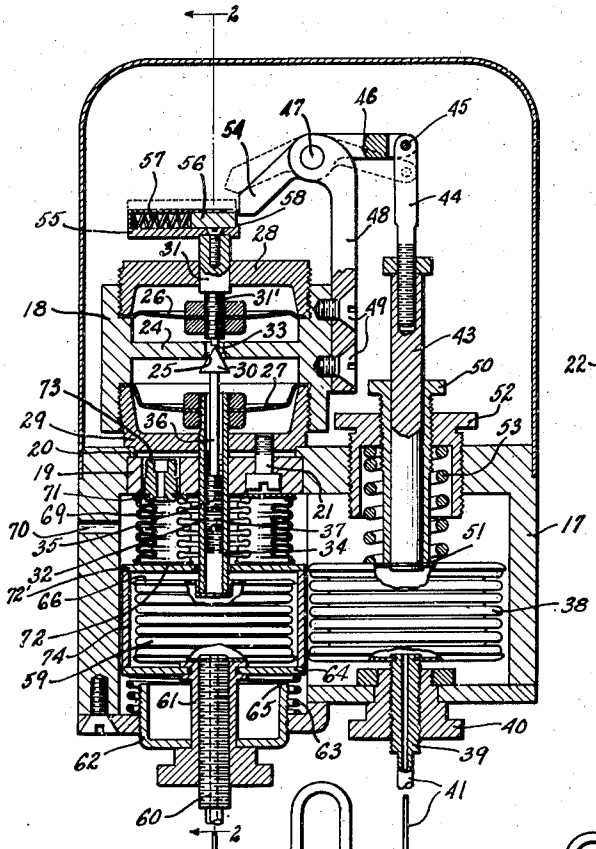
Feb. 16, 1937. F. E. BEEBE 2,071,019

REFRIGERATOR CONTROL

Filed Aug. 14, 1934



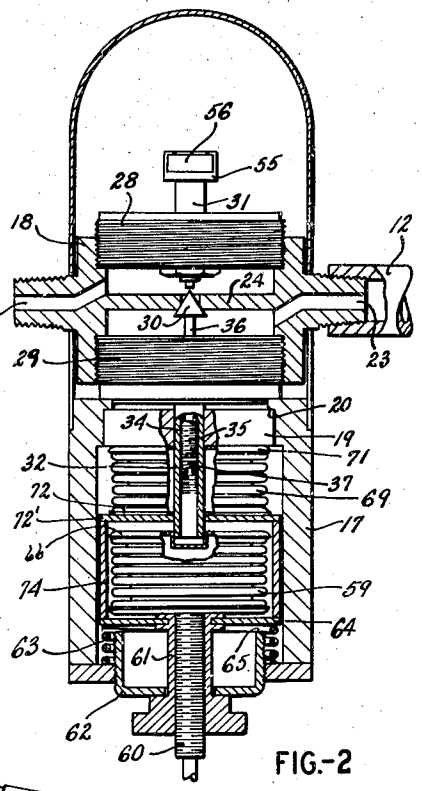


FIG.-2

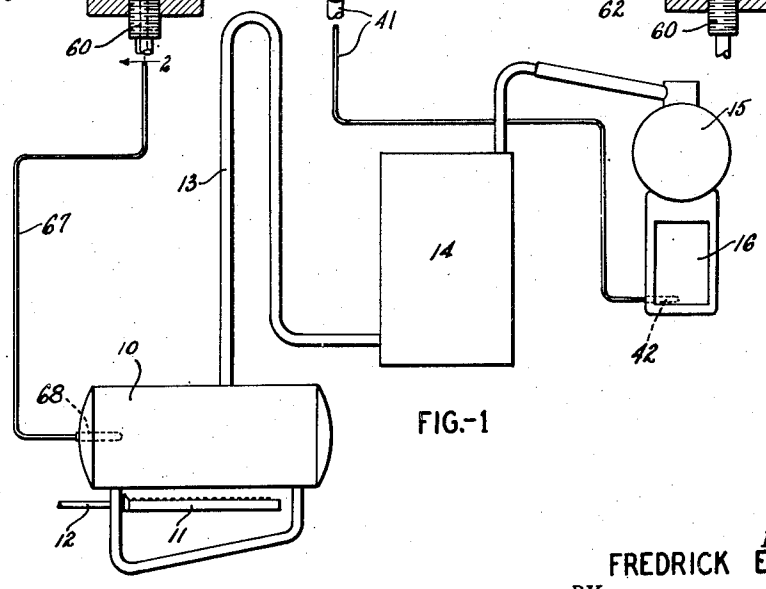


FIG.-1

INVENTOR
FREDRICK E. BEEBE
BY
Brockett, Hyde, Higley & Meyer
ATTORNEYS

Patented Feb. 16, 1937

2,071,019

UNITED STATES PATENT OFFICE

2,071,019

REFRIGERATOR CONTROL

Fredrick E. Beebe, Willowick, Ohio

Application August 14, 1934, Serial No. 739,741

13 Claims. (Cl. 236—99)

This invention relates to control mechanism and particularly to a type of temperature responsive control suitable for use in refrigerating systems.

In refrigerating systems of the intermittent absorption type, the refrigerating fluid is evaporated in a boiler by the application of external heat and the vapor thus produced takes up heat in another part of the system, thus cooling the contents of the so-called frost chamber of the refrigerator. The external heat is usually applied to the boiler in some form of fluid fuel and the present invention relates to a manner of controlling the flow of a fluid fuel in such a system. The quantity of vapor produced as the result of application of heat to the boiler will maintain the frost chamber at a suitable low temperature for a considerable period of time and it is the purpose of my invention to supply control mechanism which will shut off the flow of fuel when sufficient refrigerant has been evaporated to maintain the frost chamber at a low temperature for a more or less accurately determinable period of time, together with means for reestablishing the flow of fuel when the temperature of the frost chamber rises above a predetermined point.

An object of the present invention is to provide an improved fuel valve responsive both to conditions in the refrigerant boiler and in the frost chamber of a refrigerating system.

Another object of the invention is to provide a fuel valve responsive to conditions in a refrigerating system as above outlined, together with means responsive to a condition outside said refrigerator for controlling the action of the controlling means responsive to a condition in the refrigerant boiler.

Other objects include certain details of valve construction which are useful not only in refrigerating systems but in other applications, as will more clearly appear hereinafter.

In the accompanying drawing, Fig. 1 is a view partly in section through one form of my improved control mechanism including a diagrammatic illustration of a refrigerating system with which my control mechanism is adapted to be used; while Fig. 2 is a sectional view taken generally along the line 2—2 of Fig. 1.

Some of the features of my invention are valuable for other industrial uses than that illustrated, but I have chosen to show my control mechanism as applied to a refrigerating system of the intermittent absorption type which generally includes a boiler 10 to which external heat is applied by means of a burner 11 supplied with fuel through a conduit 12. The refrigerant vapor from the boiler passes through conduit 13 and condensing and rectifying apparatus indicated generally at 14, and thence to an evaporating chamber 15 which is thus cooled and in turn supplies a refrigerating effect to the frost chamber 16. The operation of this general type of refrigerating system is well understood and further explanation is thought unnecessary.

My control mechanism comprises a base member 17 upon which is mounted a valve casing indicated generally at 18 by means of a plate 19 which rests against a shoulder 20 of the base member and suitable securing means comprising one or more machine screws 21 pass through the plate 19 and secure it to a portion of the valve casing so that the parts are held firmly in assembled position, as shown in Fig. 1. The valve casing is provided with an inlet 22, an outlet 23 and a valve seat member 24 intermediate said inlet and outlet in which is formed a valve seat opening 25. Opposite sides of the valve casing are sealed in a fluid-tight manner by means of resilient diaphragms 26 and 27 which are preferably of the snap type for the purpose hereinafter explained. These diaphragms may be secured in position in any suitable manner, that shown comprising cup-shaped members 28 and 29 which have a threaded connection with the main portion of the valve casing and serve to retain the diaphragms firmly in position. The diaphragm 27 supports a valve member 30 in position to coact with the valve seat member 24. The particular method of mounting this valve member will be more fully described hereafter. The inlet 22 is connected to a suitable source of fuel supply and the outlet 23 communicates by way of conduit 12 with the burner 11 so that opening and closing of the valve initiates and cuts off the flow of fuel to the refrigerant boiler.

Stem means is provided for actuation of the valve 30 and in the present embodiment this comprises two separate parts indicated generally at 31 and 32. These parts with the valve open as shown in Fig. 1, do not quite contact at the point 33 but the distance between them is preferably a few thousandths of an inch. This distance is adjustable by a threaded connection 31′ where the stem portion 31 passes through the diaphragm 26. The stem portion 31 is rigidly connected with diaphragm 26 and mounted for reciprocation in cup member 28 and means is provided for pushing downwardly upon this stem portion to open the valve. Stem portion 32 comprises a tubular member 34 which is rigidly con-

nected with diaphragm 27 and mounted for reciprocation in cup member 29 and plate 19. The inner wall of tube 34 has a threaded engagement with a screw 35 to which is connected a flexible valve stem 36 and by which valve 30 is raised. The threaded engagement between screw 35 and tube 34 permits a close adjustment of this valve and a second screw 37 may be provided if desired for the purpose of locking this adjustment. The arrangement of valve stem means 31 and 32 in separate parts and the provision of the flexible stem 36 are both effective to permit valve 30 to find its own seat in the opening 25 regardless of slight inequalities in the formation and assembly of the parts.

Means responsive to a condition in the frost chamber of the refrigerator is provided for opening the valve 30, the means shown comprising a bellows member 38 mounted within the base member 17 by means of a nipple 39 and an adjusting nut 40. The interior of the bellows 38 communicates by conduit 41 with a bulb 42 located in the frost chamber 16. The system 38—41—42 is filled with a suitable fluid which when heated causes bellows 38 to expand and when cooled permits bellows 38 to contract. Such devices are well known. The upper end of bellows 38 is connected with a rod 43 which in turn carries a member 44 which is pivotally connected at 45 with a lever 46 which in turn is pivotally mounted at 47 on a bracket 48 which is supported on the base in any convenient manner, the particular mounting shown comprising a connection by machine screws 49 with the valve casing. The rod 43 is free to reciprocate in the sleeve 50, the lower end of which at 51 limits the upward movement of bellows 38. Sleeve 50 is adjustably supported by a nut 52 which has a threaded engagement with the base 17 and compresses a helical spring 53 against bellows 38 so that adjustment of nut 52 serves to regulate the resistance against expansion of bellows 38 and so determines the temperature necessary in frost chamber 16 to actuate bellows 38 and the connected mechanism.

For a purpose later described, the free end 54 of lever 46 is provided with a one-way operative connection with valve stem portion 31. The particular form illustrated comprises a plate 55 in which a slide 56 is mounted for horizontal reciprocation. The slide is biased toward the position shown in Fig. 1 by means of a spring 57 and is retained on the plate 55 by a lug 58. This construction provides a pass-by mechanism so that the end 54 of lever 46 in moving in a counterclockwise direction from the broken line position of Fig. 1 to the full line position, will press downwardly upon slide 56 and stem portion 31 and will thereafter clear said slide portion, as shown in the full line position, and thereafter in the normal operation of the mechanism slide member 56 will be slightly raised and lever 46, in returning in a clockwise direction to the broken line position, will engage the right-hand end of slide 56 and move it toward the left, compressing spring 57 and thus providing an idle stroke of lever 46 when oscillating in a clockwise direction.

Means responsive to a condition in the refrigerant boiler is provided for closing the valve 30. The means shown comprises a bellows 59 which has a downwardly extending stem 60 by which it is adjustably mounted in a sleeve 61 so that the bellows 59 is mounted for reciprocal movement relative to the base member 17. To this end sleeve 61 passes through an opening in a cup-shaped member 62 which in turn has a threaded engagement with the bottom member of base 17. This cup-shaped member serves also to retain a strong helical spring 63 extending about its outer periphery. This spring in turn supports a plate 64 which is rigidly carried on sleeve 61 so that bellows 59 rides on spring 63 and its lower limit of movement occurs when plate 64 strikes the edge 65 of cup member 62. The top member 66 of bellows 59 is adapted to engage stem portion 32 when the bellows expands for the purpose of closing valve 30. Spring 63 is strong enough to act as the lower abutment against which bellows 59 expands to close valve 30. Bellows 59 communicates by conduit 67 with a bulb 68 in the refrigerant boiler. The system 59—67—68 is filled with a suitable fluid which when heated causes expansion of bellows 59 and when cooled permits the bellows to contract.

It is sometimes advisable to modify the controlling effect produced by the opposed bellows members 38 and 59 in response to some other condition outside the refrigerator. To this end I supply means responsive to such external condition and in the present instance this means comprises a bellows member 69 which is subjected to outside atmospheric temperature by reason of its position in the base member 17 but with the additional provision, if desired, of one or more openings 70 through the wall of the base member.

In the particular type of refrigerating system illustrated, fuel is cut off beneath boiler 10 at a temperature which will supply sufficient refrigerant to maintain satisfactory conditions in the frost chamber 16 for the desired interval of time. Where the atmosphere surrounding the refrigerator is at a low temperature, fuel may be cut off beneath boiler 10 at a much lower temperature than when the exterior conditions are hotter, as will readily be understood. That is to say, if the adjustment of bellows 59 and valve 30 is such as to cut off the supply of fuel beneath boiler 10 at a point satisfactory for cold weather conditions, such a setting will not be satisfactory in hot weather. The member 69 therefore comprises a closed chamber between inner and outer bellows members which are confined between top and bottom members 71 and 72 so as to provide a fluid-tight chamber therebetween. Through a suitable nipple 73 the member 69 is filled with fluid and the nipple 73 is then plugged. The fluid in member 69 should preferably be one which expands upon increasing temperature and contracts with a decrease in temperature. It will be apparent therefore that the hotter external conditions are, the more member 69 will expand and modify the action of bellows 59 tending to close valve 30 so that the greater the external temperature the higher will be the point arrived at in boiler 10 necessary to cause closure of valve 30. The structure for thus modifying the action of bellows 59 by the bellows 69 comprises a sleeve 74 which extends between member 72' and plate 64. It will thus be apparent that expansion of bellows 69 will cause a downward pressure on plate 64 thus compressing spring 63 more or less so that bellows 59 will have to expand to a greater extent in order to contact stem portion 32 to close valve 30.

The action of my improved control mechanism through a cycle of operations is as follows: Assuming that the parts are in the full line position of Fig. 1, the temperature in frost chamber 16 has risen to a point sufficient to expand bel-

lows 38 against the action of spring 53 which has raised rod 43 and member 44 and oscillated lever 46 in a counterclockwise direction so that the free end thereof 54 has depressed slide 56 and its associated stem portion 31 which, bearing against valve 30 at the point 33, has moved the valve to open position. When snap diaphragms 26 and 27 passed their central or neutral point they snapped to the full line position shown in Fig. 1. Fuel is thus admitted through inlet 22, valve opening 25, outlet 23 and conduit 12 to burner 11 where it is lit by a suitable pilot valve. Heat is applied to boiler 10 causing a flow of vapor through conduit 13, condenser 14, to evaporating chamber 15. This continues until the temperature rises sufficiently in boiler 10 to expand bellows 59, the amount of which will depend upon the modifying action of bellows 69 at any given temperature, to a point where stem member 32 rises past the neutral point of diaphragms 26 and 27, whereupon valve 30 snaps to its shut position and is maintained therein by the tension upwardly on diaphragm 27. The movement upward of stem portion 32 and valve 30 will of course raise stem portion 31 and slide 56 to the broken line position of Fig. 1. Upon the cessation of evaporating action in boiler 10 and the evaporation and cooling consequent upon the evaporation of vapor in member 15, frost chamber 16 will be cooled, bulb 42 and corresponding bellows 38 will be cooled and bellows 38 will contract, thus oscillating lever 46 in a clockwise direction to the broken line position of Fig. 1 ready to perform another operation. In moving from its full line position to its broken line position in Fig. 1, lever 46 will move slide 56 to the left in an idle stroke and spring 57 will then return the slide to its right hand position ready to be engaged by the free end 54 of lever 46 when the frost chamber again becomes sufficiently warm.

The provision of stop 65 for limiting the movement of plate 64 which in turn limits the expansion necessary in bellows 59 to close valve 30 acts as a safety device to prevent dangerous conditions in the refrigerant boiler 10. That is to say, even under the hottest external conditions bellows 69 through its action on sleeve 74 can compress spring 63 only to the point where plate 64 contacts the edge 65 of cup member 62. This point is so adjusted that the temperature necessary in boiler 10 to expand the system 59—67—68 to valve closing position corresponds to a safe pressure condition in boiler 10.

What I claim is:

1. Control mechanism for a refrigerating system of the intermittent absorption type having a refrigerant boiler, a fuel burner therefor and a frost chamber, comprising a valve controlling the flow of fuel to said burner, a bellows responsive to a condition in said frost chamber for opening said valve, a bellows movable in response to a condition in said boiler for closing said valve, and means responsive to an increasing temperature condition outside said system for increasing the movement required of said second named bellows to close said valve.

2. Control mechanism as in claim 1 including means limiting the movement of said last named means at a predetermined point.

3. Control mechanism for a refrigerating system of the intermittent absorption type having a refrigerant boiler, a fuel burner therefor and a frost chamber, comprising a valve controlling the flow of fuel to said burner, control means responsive to a condition in said frost chamber for opening said valve, control means movable in response to a condition in said boiler for closing said valve, and means responsive to an increasing temperature condition outside said system for increasing the movement required of said second named control means to close said valve.

4. Control mechanism comprising a valve casing having its opposite sides sealed by resilient diaphragms, there being inlet and outlet openings through said casing and a valve seat member intermediate said openings, stems having operative connections with said diaphragms, said stems having adjacent ends adapted to mutually contact, a valve member on one of said stems adapted to coact with said seat member, temperature responsive means for moving one of said stems in valve opening direction, and another temperature responsive means for moving the other of said stems in valve closing direction.

5. Control mechanism as in claim 4 in which said resilient diaphragms are snap diaphragms having one position adapted to hold said valve member in contact with its coacting seat member.

6. Control mechanism as in claim 4 in which said valve member is resiliently mounted on one of said stems whereby to adjust itself to its coacting seat member.

7. Control mechanism as in claim 4 and including a third temperature responsive means arranged to have a controlling effect on one of said named temperature responsive means.

8. Control mechanism as in claim 4 in which the means for moving one of said stems in valve opening direction has a connection with said stem operative in valve opening direction only.

9. Control mechanism comprising a valve casing having its opposite sides sealed by resilient diaphragms, there being inlet and outlet openings through said casing and a valve seat member intermediate said openings, stems having operative connections with said diaphragms, said stems having adjacent ends adapted to mutually contact, a valve member on one of said stems adapted to coact with said seat member, a bellows for moving one of said stems in valve opening direction, and a second bellows for moving the other of said stems in valve closing direction.

10. Control mechanism comprising a valve, a bellows having operative connections for opening said valve, a second bellows having operative connections for closing said valve, and a third bellows arranged to modify the action of said second bellows.

11. Control mechanism comprising a valve, means for opening said valve, a bellows expansible for closing said valve, means forming a movable abutment against which said bellows expands, and bellows means for moving said abutment means.

12. Control mechanism comprising, a valve including a casing having an inlet and an outlet and a valve seat member intermediate said inlet and outlet, a valve member in said casing adapted to coact with said seat member, stem means for actuating said valve member, temperature responsive means for moving said stem means in valve closing direction, a second temperature responsive means for moving said stem means in valve opening direction, said last named temperature responsive means including a lever adapted to contact said stem means, and a pass-by mechanism between said lever and stem means

providing means for actuating said stem means when said lever moves in one direction only and whereby said lever performs an idle movement in the opposite direction.

13. Control mechanism for a refrigerator of the intermittent absorption type comprising a valve, means responsive to a temperature rise in the frost chamber of said refrigerator for opening said valve, means responsive to a temperature rise in the refrigerant boiler of said refrigerator for closing said valve, and means responsive to increased temperature outside said refrigerator for increasing the action of said last-named means necessary to close said valve.

FREDRICK E. BEEBE.