

July 21, 1953

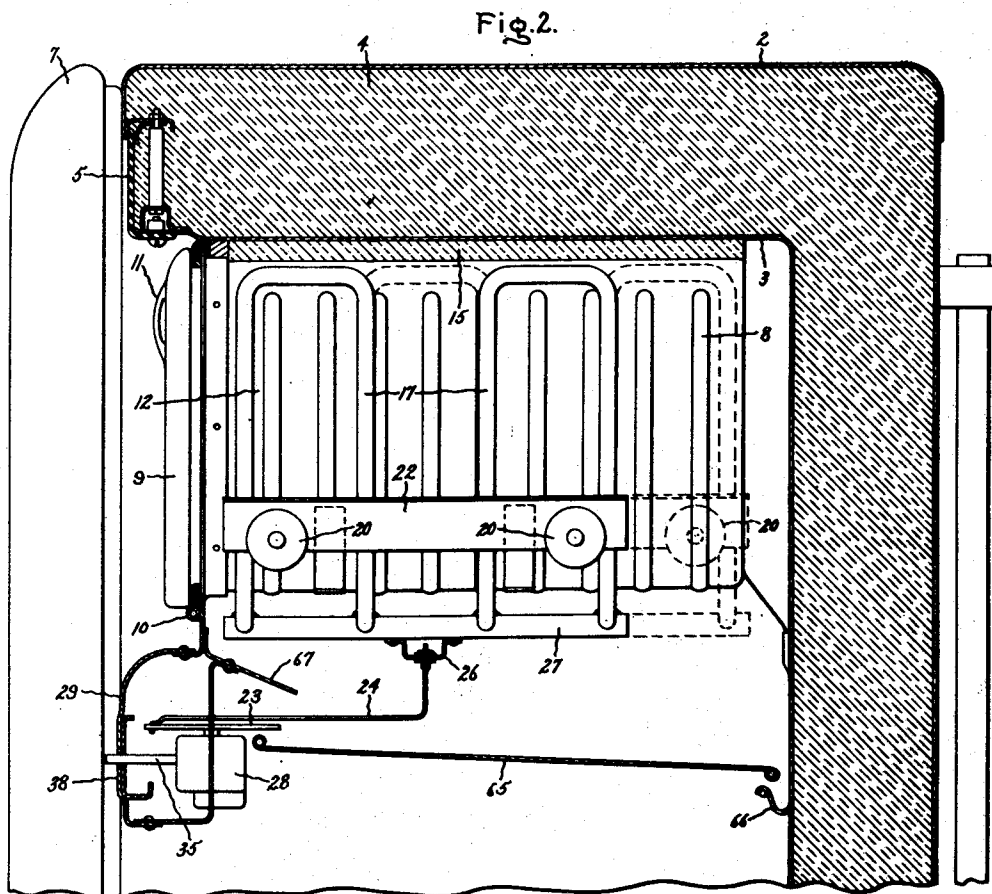
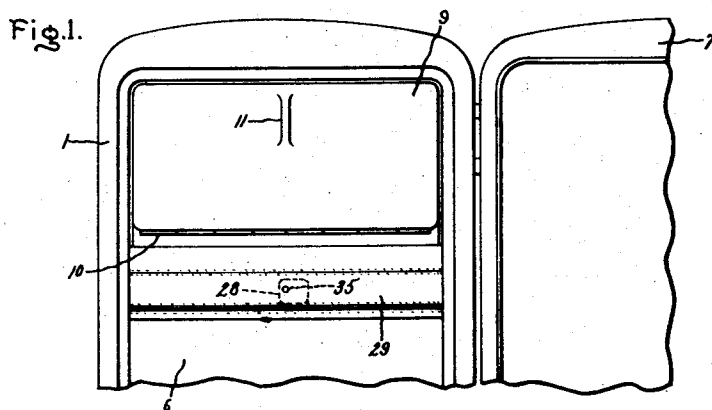
L. W. ATCHISON

2,645,905

ELECTRIC DEFROSTING ARRANGEMENT FOR REFRIGERATORS

Filed Nov. 15, 1950

2 Sheets-Sheet 1



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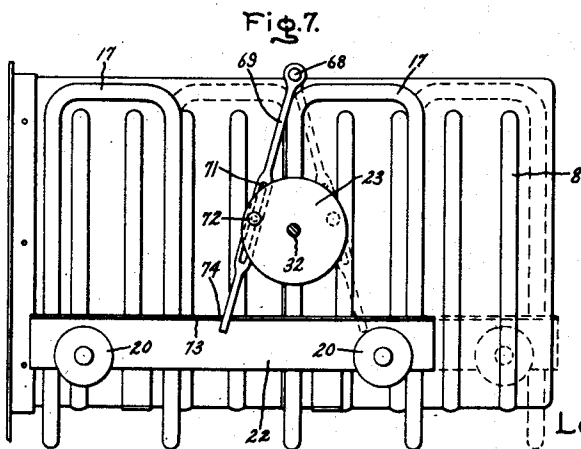
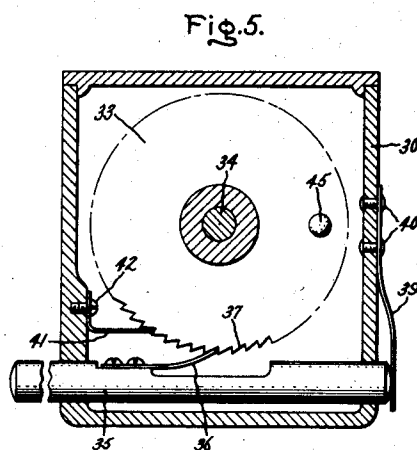
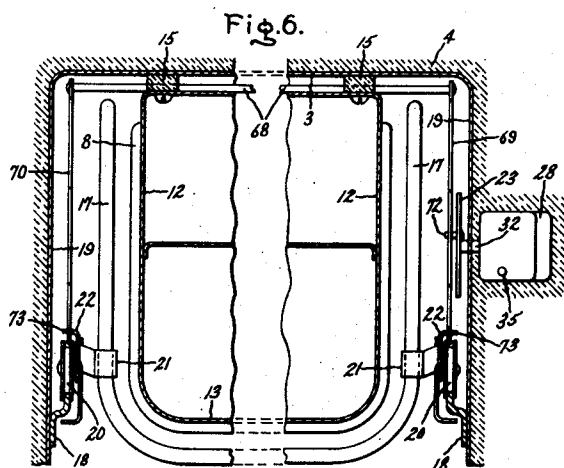
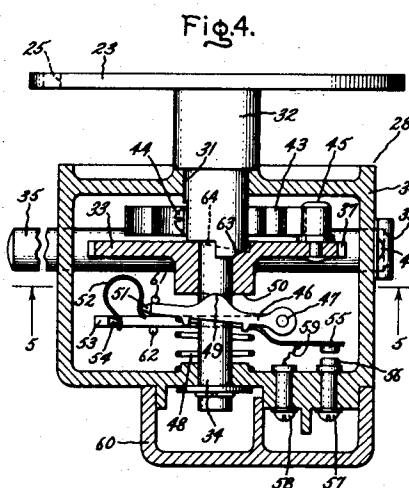
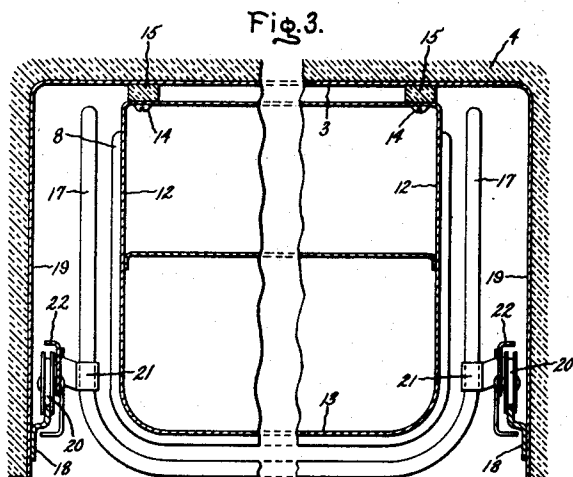
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ELECTRIC DEFROSTING ARRANGEMENT FOR REFRIGERATORS

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,645,905

ELECTRIC DEFROSTING ARRANGEMENT
FOR REFRIGERATORSLeonard W. Atchison, Erie, Pa., assignor to Gen-
eral Electric Company, a corporation of New
York

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8 Claims. (Cl. 62—1)

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My invention relates to refrigerators and more particularly to arrangements for defrosting refrigerator evaporators or cooling units.

It has previously been known to use electric heating for defrosting refrigerator evaporators. Also various means have been provided for automatically initiating the defrost period, for example, initiation in response to a predetermined number of door openings, number of unit cycles, etc. In my improved arrangement, however, provision is made for "scanning" or sweeping the evaporator with movable heating elements and also provision is made for storing energy for effecting such "scanning" period.

Accordingly, it is an object of my invention to provide an improved arrangement for automatically defrosting refrigerator cooling units or evaporators.

It is another object of my invention to provide an improved arrangement including movable electric heating elements for periodically defrosting a refrigerator evaporator.

It is a further object of my invention to provide an improved arrangement for rapidly defrosting a refrigerator evaporator.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In carrying out the objects of my invention, an electric heating element is disposed in a position spaced slightly from and parallel to the walls of a refrigerator evaporator. The heating element is movably mounted and mechanism is provided for reciprocating the heating element parallel to the refrigerator evaporator so as to "scan" the walls of the evaporator and thereby melt the frost from all portions of the walls. A rotatable element is provided for engaging the heating element structure to impart reciprocating movement thereto. The mechanism for obtaining such movement includes a spring which is adapted to be wound to store energy for moving the heating element and it further includes a switch mechanism actuated for energizing the heating element.

For a better understanding of my invention, reference may be had to the accompanying drawings in which Fig. 1 is a view of a portion of a refrigerator incorporating an embodiment of my invention; Fig. 2 is an enlarged sectional side elevation view of the refrigerator shown in Fig. 1; Fig. 3 is an enlarged front elevation view of the

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defrosting structure; Fig. 4 is a sectional view illustrating details of the mechanism employed for moving and energizing the heating element; Fig. 5 is a view taken along the line 5—5 of Fig. 4; Fig. 6 is a front elevation view showing a modified form of my invention; and Fig. 7 is a side elevation view of the modified form shown in Fig. 6.

Referring to Figs. 1 and 2, there is shown a refrigerator cabinet 1 including an outer wall 2 and a spaced inner wall or liner 3. The space between the inner and outer walls is filled with a suitable heat-insulating material 4, and the space between these walls adjacent the access opening of the refrigerator is closed by a breaker strip 5 of suitable heat-insulating material, such as any of a number of conventional plastic materials. The liner 3 defines a food storage compartment 6, and the access opening of this compartment is closed by a door 7.

In order to cool the food storage compartment 6 an evaporator as cooling unit 8 is mounted at the top portion of the compartment 6. The evaporator 8 illustrated is of the type which extends substantially the full width of the compartment 6. A door 9 is hinged at 10 for closing the access opening of the evaporator 8, a handle 11 being provided for the door 9. The evaporator 8 is formed of metal in a generally U-shape having two side walls 12 and a bottom wall 13 formed from a continuous strip of metal. The evaporator is supported from the top of the liner 3 by screws 14, insulating blocks 15 being provided between the liner and the evaporator. The evaporator walls are formed in a conventional manner from two sheets of metal, one of which is corrugated to provide refrigerant-conducting passages.

Because of the relatively low temperature at which the evaporator normally operates, a substantial amount of moisture condenses from the air onto the evaporator and forms frost. To insure operation of the refrigerating system at a relatively high efficiency, it is necessary to remove this frost from time to time. To effect such removal I have provided a structure which includes a heating element 17. The heating element is made in serpentine form and is bent into a generally U-shape conforming to the walls of the evaporator 8. The heating element may be of the sheathed conductor type, comprising, for example, a central electrical conducting wire, an outer metallic sheath, and an intermediate insulating powder. The U-shaped heating element structure is spaced slightly from the walls

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of the evaporator 8 and this structure extends parallel to the walls of the evaporator.

The heat radiating surface of the heating element is relatively smaller than the surface of the evaporator 8 and in order to insure the melting of frost from the entire outer surface of the evaporator 8, the heating element 17 is arranged for reciprocating movement relative to the evaporator so that this heating element in effect "scans" the entire outer surface of the evaporator. To provide for such reciprocating movement two tracks 18 are secured to the side walls 19 of the liner 3, these tracks extending horizontally from front to rear along the side walls. The heating element structure includes a plurality of rollers 20 which ride along the tracks 18. These rollers are supported from the heating element itself by brackets 21 which are secured to the heating element 17 and by flanged plates 22 which are secured to the brackets 21 and provide a mounting for the rollers 20. It can be seen that the mounting structure described allows movement of heating element 17 from front to rear of the refrigerator cabinet, the heating element moving parallel to the walls of the evaporator 8 and being slightly spaced therefrom, for example, by a distance of $\frac{1}{8}$ ".

In order to effect reciprocation of the heating element 17 a rotatable disk 23 is provided. This disk 23 is connected by a link 24 with the heating element structure. One end of the link 24 projects through an opening 25 in the disk 23 and the other end of the link 24 is connected to a bracket 26 which is secured to a bar 27. The bar 27 is secured to the heating element 17 substantially at the central area of the bottom portion thereof.

Mechanism 28 for rotating the disk 23 is supported on a transversely extending hollow structure 29. This structure 29 extends the full width of the storage compartment, is supported from the evaporator 8, and is further secured to the side walls of the liner 3. The mechanism employed is shown in detail in Figs. 4 and 5. This mechanism 28 includes a housing 30 having an opening 31 therein for receiving a shaft 32 to which the disk 23 is secured. The mechanism further includes a ratchet wheel 33 rotatably mounted on a shaft 34 which is also supported by the housing 30. The ratchet wheel 33 is actuated by a reciprocating plunger 35 having a pawl 36 secured thereto for engaging the teeth 37 of the ratchet wheel 33. The plunger 35 may be actuated in any desired manner. For purposes of illustration it has been shown projecting through the front face 38 of the structure 29 so that it is engaged by the door 7 each time the door is moved to the closed position. When the door is opened, the plunger is moved outwardly by a resilient leaf element 39 which is secured to the housing 30 by rivets 40 or other suitable securing devices. A stop 41 is secured to the housing by a screw 42 and engages the teeth 37 to prevent reverse movement of the ratchet wheel 33 as the pawl 36 is retracted during the outward movement of plunger 35. By this arrangement the ratchet wheel 33 is advanced one tooth each time the refrigerator door is opened and closed.

A spring 43 is employed for storing energy resulting from the movement of the ratchet wheel 33. The spring 43 is in the form of a spirally wound flat leaf member, one end of which is connected to the shaft 32 by a screw 44 or other suitable fastening device and the other end of which is secured to a knob or pin 45 which in turn is

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riveted to the ratchet wheel 33. Thus, assuming that the disk 23 and the shaft 32 are held from rotation as will be described below, movement of the ratchet wheel 33 is effective to wind the spring 43, storing energy which is ultimately available for rotating the disk 23. The mechanism 28 is further constructed to provide for actuation of a switch to energize the electric heating element 17. This latter portion of the mechanism includes an arm 46 pivotally mounted on a pin 47 which is secured to the housing 30. The arm 46 is biased by a spring 48 in an upward direction so that a portion 49 of the arm bears against the lower end 50 of the hub of the ratchet wheel 33. The free end of the arm 46 is provided with a knife edge 51 which engages one side of an overcenter hairpin spring 52. A movable switch arm 53 includes a knife edge 54 which engages the opposite side of the hairpin spring 52. The switch arm 53 includes a movable contact 55 at the opposite end thereof, the contact 55 being adapted to engage a stationary contact 56 for completing the circuit energizing the heating element 17. Two terminals 57, 58 are provided on the housing 30, the terminal 57 including the stationary contact 56 and the terminal 58 being connected by a wire 59 to the movable switch arm 53. A removable cap 60 is provided for covering the outer ends of the terminals 57, 58 to which the power supply leads are connected. Because of the overcenter hairpin spring 52 the switch arm 53 is adapted to snap from the open to the closed position of the contacts 55, 56, and the upper and lower stops 61, 62 respectively are mounted on the housing for limiting the movement of the switch arm 53 in each direction.

It can be seen that the switch mechanism is biased to the open position by the spring 48. In order to effect movement of the switch to its closed position the shaft 32 is formed on its lower end with a cam surface 63 and the upper end of the hub of the ratchet wheel 33 is formed with a cooperating cam surface 64. Assuming again that the disk 23 and its shaft 32 are held against rotation, the movement of the ratchet wheel 33 by the reciprocation of the plunger 35 gradually effects a downward movement of the ratchet wheel 33 because of the cooperation of the cam surfaces 63 and 64. The ratchet wheel 33 is arranged for sliding movement relative to the shaft 34 on which it is mounted. As the ratchet wheel 33 moves downwardly, the surface 50 of the hub of this wheel moves the engaging portion 49 of the arm 46 downwardly and ultimately shifts the arm 46 in a counterclockwise direction by an amount which is sufficient to snap the hairpin spring 52 over center. When this occurs, the hairpin spring effects a simultaneous upward movement of the left-hand end of the switch arm 53 causing the right-hand end of this switch arm to move downwardly and bring the contact 55 into engagement with the contact 56, completing the circuit of the heating element 17.

The operation of the defrosting arrangement is as follows. During normal operation of the refrigerating apparatus, frost gradually builds up on the exterior of the walls of the evaporator 8 and reaches a thickness where it blocks movement of the heating element 17 relative to the evaporator. When movement of the heating element 17 is so blocked, the disk 23 is unable to rotate. Accordingly, subsequent actuations of the plunger 35 as a result of door openings are effective to rotate the ratchet wheel 33 and to wind the spring 43. At the same time, since the shaft

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32 is held stationary, the relative movement of the ratchet wheel 33 effects, through the cooperating cam surfaces 63 and 64, a downward movement of the ratchet wheel 33. Ultimately this downward movement causes the switch to snap to its closed position energizing the heating element 17. The energization of the heating element 17 effects a melting of the frost in the region adjacent the position of the heating element at the time. As the frost melts, the spring 43 begins to unwind causing a rotation of the shaft 32 and the disk 23, and, through the link 24, a movement of the heating element 17 in a direction parallel to the walls of the evaporator 8. As the heating element progresses and melts the frost which it encounters, the spring 43 continues to unwind and thereby continues to move the heating element 17 against a resistance of the frost. The heating element moves back and forth parallel to the evaporator, the limits of its travel being indicated by the solid line and dotted line positions shown in Fig. 2. The heating element 17 moves in the manner described until the spring 43 has completely unwound. In the unwinding process, it will be noted that the reverse action takes place with respect to the cam surfaces 63 and 64 and the ratchet wheel 33 moves upwardly, being biased in this direction by the spring 48 which bears against the arm 46, the arm 46 in turn bearing against the surface 50 of the hub of the ratchet wheel 33. Ultimately the arm 46 moves to the overcenter position illustrated in Fig. 4, causing the switch arm 53 to snap the switch to its open position, de-energizing the heating element 17. This completes the defrosting operation.

In order to dispose of the water resulting from the defrosting of the evaporator, a sloping baffle plate 65 is provided beneath the evaporator. Water falling on the baffle plate 65 is directed toward the rear of the compartment 6 where it flows into a drain trough 66 mounted on the rear wall of the liner 3. Water from the drain trough may be disposed of in any desired manner, for example, by a tube connected to the trough and extending into the machinery compartment or by merely allowing the water to flow from the trough down the wall of the liner and ultimately through a drain opening in the bottom of the liner. The structure 29 is provided with a downwardly sloping plate 67 at the rear portion thereof for collecting defrost water falling from the forward portion of the evaporator and directing it onto the baffle plate 65.

In Figs. 6 and 7 there is shown a modified form of my invention which differs from that just described primarily in the specific arrangement for effecting movement of the heating element and in the particular location of the mechanism for effecting this movement. The same numerals have been used to designate corresponding parts in Figs. 6 and 7 and in Figs. 1 through 5 inclusive. Referring now to Figs. 6 and 7, the evaporator 8 is mounted in the manner previously described at the top portion of the food storage compartment. The heating element 17 is mounted adjacent and parallel to the walls 12 and 13 of the evaporator 8, and this heating element is supported for reciprocating movement by rollers 20 on tracks 18. The mechanism 28 for supplying the force for moving the heating element 17 and also for energizing the heating element is disposed within the insulation space between the inner and outer walls of the refrigerator. This mechanism 28 is secured in any suitable manner

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to the liner 3, and includes the plunger 35 which projects through the front face of the cabinet and is actuated by the door, and the shaft 32 which projects through an opening in the side wall of the liner 3. The disk 23 is mounted on the shaft 32 within the storage compartment. In order to translate rotary motion of the disk 23 into reciprocating motion of the heating element 17, a rod 68 is pivotally mounted at the top of the evaporator 8. Two downwardly extending arms 69 and 70 are secured to the rod 68, one at each end of the rod. The arm 69 has a slot 71 formed therein, and a pin 72 mounted on the disk 23 is arranged to project into the slot 71. When the disk 23 is rotated in the manner described above, the corresponding rotation of the pin 72 effects movement of the arm 69 between the solid and the dotted line positions shown in Fig. 7. Since both the arms 69 and 70 are fixed to the pivoted or rotatable shaft 68, movement of the arm 69 effects a simultaneous movement of the arm 70. The lower ends of the arms 69 and 70 are received within slots formed in the flange portion 73 of the plates 22, one such slot being indicated at 74. Thus movement of the arms 69 and 70 between the solid and dotted line positions shown also effects movement of the heating element 17 between the solid and the dotted line positions. This causes a melting and removal of frost from the evaporator in the same manner as that described in previously discussing the form of invention illustrated in Figs. 1 through 5.

While I have shown and described specific embodiments of my invention, I do not desire my invention to be limited to the particular construction shown and described and I intend, by the appended claims, to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, mechanism effective when operated for reciprocating said heating element parallel to said wall for melting frost therefrom, and means for periodically operating said mechanism and energizing said heating element.

2. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, and mechanism for reciprocating said heating element parallel to said wall for melting frost therefrom, said mechanism including a rotatable disk and a link engaging said disk near the outer periphery thereof and connected to said heating element whereby rotation of said disk is effective to reciprocate said heating element.

3. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, and mechanism for reciprocating said heating element parallel to said wall for melting frost therefrom, said mechanism in-

cluding a rotatable disk and shaft therefor, a link engaging said disk near the outer periphery thereof and connected to said heating element for translating rotary movement of said disk into reciprocating movement of said heating element, a spring connected to said shaft, and means for winding said spring for storing energy to rotate said disk.

4. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, and mechanism for reciprocating said heating element parallel to said wall for melting frost therefrom, said mechanism including a rotatable disk and a shaft therefor, a link engaging said disk near its outer periphery and connected to said heating element for translating rotary movement of said disk into reciprocating movement of said heating element, a ratchet wheel, a spiral spring connected to said ratchet wheel and to said shaft, and means for actuating said wheel to wind said spring whereby energy is stored in said spring for moving said heating element.

5. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, and mechanism for reciprocating said heating element parallel to said wall for melting frost therefrom, said mechanism including a rotatable disk and a shaft therefor, a link engaging said disk near the outer periphery thereof and connected to said heating element for translating rotary movement of said disk into reciprocating movement of said heating element, said shaft having a cam surface thereon, and a switch actuated by said cam surface for energizing said heating element.

6. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, and mechanism for reciprocating said heating element parallel to said wall for melting frost therefrom, said mechanism including a rotatable disk and a shaft therefor, a link engaging said disk near its outer periphery and connected to said heating element for translating rotary movement of said disk into reciprocating movement of said heating element, a ratchet wheel, a spiral spring connected to said ratchet wheel and to said shaft, means for actuating said wheel to wind said spring whereby energy is stored in said spring for moving said heating element, said shaft having a cam surface thereon, and a switch actuated by said cam surface for energizing said heating element.

7. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the wall of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said wall, said element being movably mounted for movement parallel to said wall, and mechanism for reciprocating said heating element parallel to said wall for melting frost therefrom, said mechanism including a rotatable disk and a shaft therefor, a link engaging said disk near its outer periphery and connected to said heating element for translating rotary movement of said disk into reciprocating movement of said heating element, a ratchet wheel, a spiral spring connected to said ratchet wheel and to said shaft, and means for actuating said wheel to wind said spring whereby energy is stored in said spring for moving said heating element, said shaft having a cam surface thereon, said ratchet wheel including a hub having a cooperating cam surface thereon, a switch for energizing said heating element, and an arm actuated by axial movement of said ratchet wheel for actuating said switch, said cooperating cam surfaces being effective for causing axial movement of said ratchet wheel and actuation of said switch when frost on said cooling unit blocks said heating element and prevents rotation of said disk.

8. In a refrigerator including a cooling unit upon which frost collects, a heating element spaced from the walls of said cooling unit, the heat radiating surface of said heating element being relatively smaller than said walls, means for movably mounting said heating element for movement parallel to said walls, a rotatable rod extending transversely of said cooling unit, two arms secured to said rod, each of said arms extending adjacent a corresponding side wall of said cooling unit, said arms being connected to said heating element, means including a rotatable disk for effecting reciprocation of said heating element, a pin mounted on said disk near the outer periphery thereof, one of said arms including a slot for receiving said pin whereby rotation of said disk is translated through said pin and slot connection into oscillation of said arm and reciprocation of said heating element for melting frost from said cooling unit.

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