Sept. 21, 1937. A. O. GROOMS 2,093,835

REFRIGERATING APPARATUS

Filed June 30, 1934 2 Sheets-Sheet 1

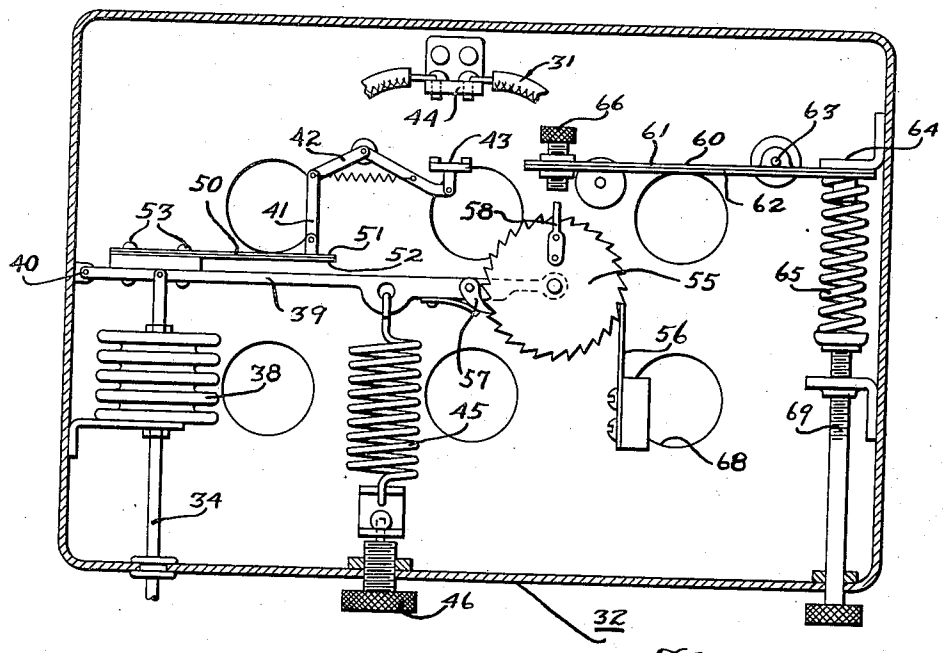


Fig. 2

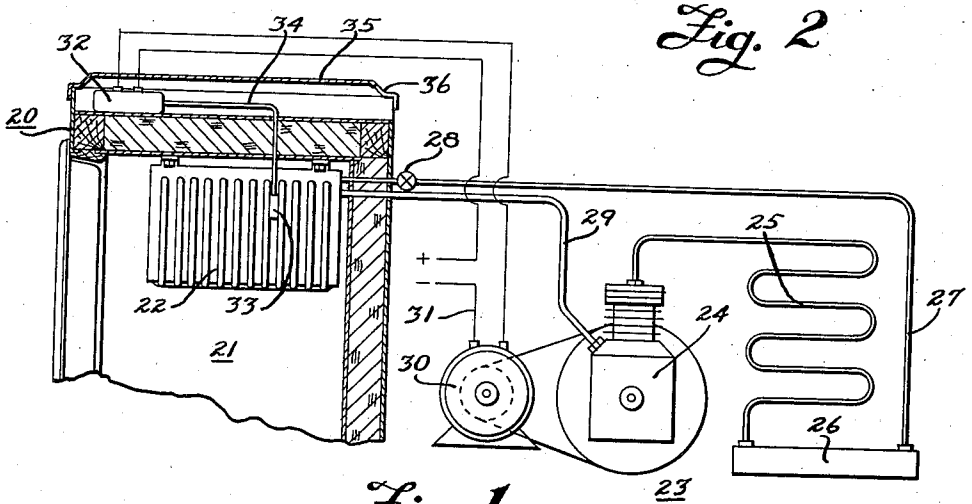


Fig. 1

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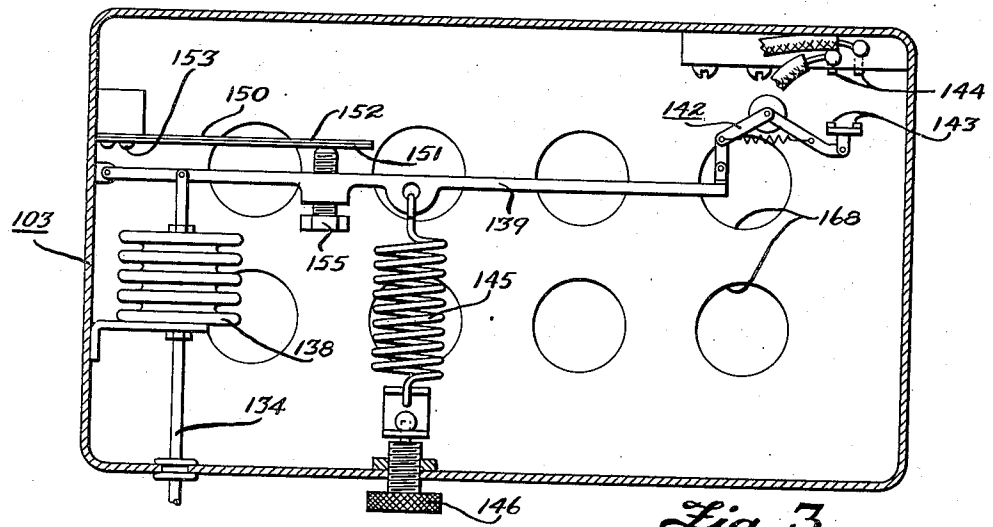


Fig. 3

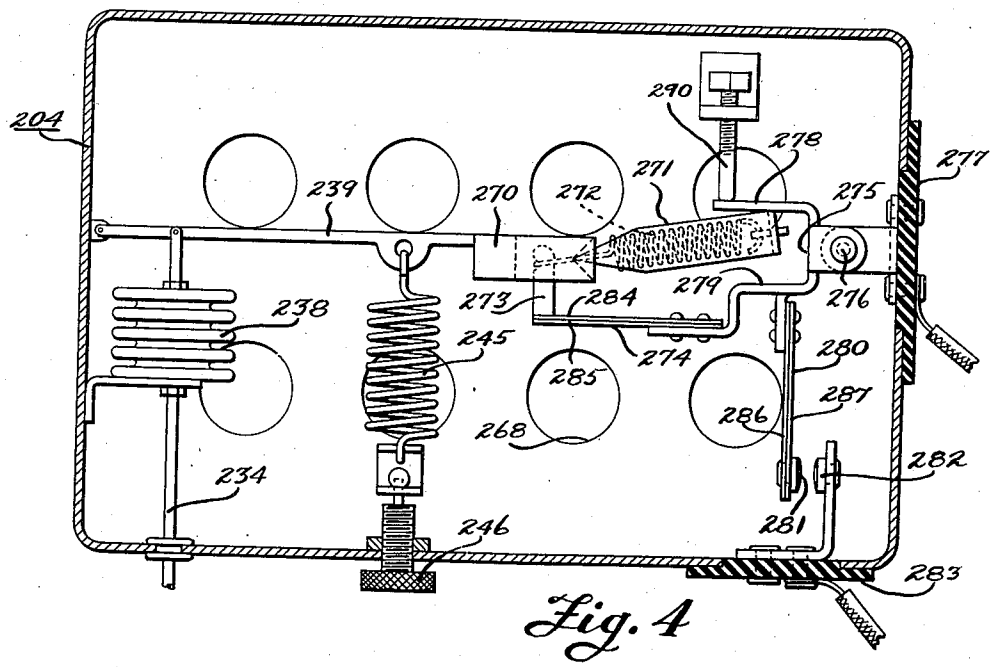


Fig. 4

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REFRIGERATING APPARATUS

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Application June 30, 1934, Serial No. 733,285

11 Claims. (Cl. 62—4)

This invention relates to refrigerating apparatus and more particularly to control means therefor.

In domestic refrigerating apparatus, as at present manufactured, the desirable control conditions both for normal operation and for defrosting, change according to the external or room temperature. For example, when the room temperature is relatively low, it is desirable to have a higher evaporator temperature for normal operation, but for defrosting under such conditions, it is desirable to have a lower evaporator defrosting temperature. Heretofore, no simple practical automatic means has been provided for attaining the desirable condition.

It is, therefore, an object of my invention to provide a simple, practical, inexpensive means occupying little or no additional space for compensating the refrigerating apparatus and particularly the control means thereof for changes in the environment or room temperature.

It is a more specific object of my invention to provide a simple bimetal means to compensate the control means for changes in external temperature for providing higher evaporating temperatures when the room temperature is relatively low and lower evaporating temperatures when the room temperature is relatively high.

It is also a more specific object of my invention to provide bimetal means for compensating the control means for changes in external temperature to provide lower evaporator defrosting temperatures when the room temperature is relatively low and higher evaporator defrosting temperatures when the room temperature is relatively high.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a sectional view of a domestic refrigerator partly diagrammatic embodying my invention;

Fig. 2 is a sectional view of the control means shown in Fig. 1;

Fig. 3 is a sectional view of a modified form of control means; and

Fig. 4 is a sectional view of another modified form of control means embodying my invention.

Referring to the drawings, and more particularly to Fig. 1, there is shown an insulated refrigerator cabinet 20 having a food compartment 21 containing a refrigerant evaporating means 22 for cooling the food compartment 21 and also for freezing comestibles in the ice trays with which it is provided. The evaporator 22 is supplied with liquid refrigerant by a refrigerant liquefying apparatus 23 including a compressor 24 for compressing the refrigerant and for forwarding the compressed refrigerant to a condenser 25 where the compressed refrigerant is liquefied and collected in a receiver 26. From the receiver 26, the liquid refrigerant is forwarded through a liquid conduit 27 to an expansion or other suitable type of control valve 28. This valve 28 controls the supply of liquid refrigerant into the evaporator 22. The evaporator 22 evaporates the liquid refrigerant which is returned to the compressor through the return conduit 29.

The compressor 24 is driven by an electric motor 30 which is supplied with electric energy through an electric circuit 31. Within the electric circuit 31 and in series with the electric motor 30 is a control means 32 which is operated by the thermostatic bulb 33 located in heat exchange relation with one of the walls of the cooling unit 22. The control means 32 is connected to the thermostatic bulb 33 by the tubing 34. The control means is located outside of the food compartment 34 beneath the ornamental top cover 35 of the cabinet which is provided with an opening 36 at the rear thereof for permitting the external air to contact with the control means.

Referring now more particularly to Fig. 2 for a more detailed description of the control means, there is shown a bellows 38 which is connected to the thermostatic bulb 33 by the tubing 34. The bellows in turn is connected to operate a lever 39 pivoted to a wall of the control means upon the pivot pin 40. The lever 39 is connected by a link 41 to a snap acting mechanism 42 which is provided with a set of switch contacts 43 which cooperate with a set of stationary switch contacts 44 for opening and closing the electric motor circuit 31 in order to control the operation of the refrigerating apparatus. The operation of the control means is controlled by a tension coil spring 45 which is provided with a manual adjusting means 46 for regulating the temperature at which the contacts 43 and 44 are opened and closed.

With such an arrangement, it will be understood that the temperature of the evaporating means will be maintained between given temperature limits for any particular setting of the adjusting means 46. Thus, if the external or environment temperature becomes warm, more heat will flow through the insulated walls of the cabinet into the food compartment 21. If the

evaporator or cooling unit is maintained at the same temperature limits, the temperature of the food compartment will necessarily rise slightly because the evaporating means is no longer able to absorb the heat from the air in the food compartment with sufficient rapidity without increasing the temperature differential between the air in the food compartment 21 and the evaporating surfaces. In order to maintain the same food compartment temperature when the external room temperature increases, it is necessary to lower the evaporator temperature. It is also true that when the room temperature is lowered, the temperature of the food compartment becomes lower than necessary for proper food preservation because less heat enters the food compartment and this smaller amount of heat can be absorbed by the evaporator or cooling unit at a lower temperature differential between the temperature of the food compartment air and the evaporator surfaces because the rate of heat supply is less. Thus, in order to maintain the same food compartment temperature under these conditions, it is necessary that the evaporator temperature limits be increased.

In order to lower the evaporator temperature automatically when the external or room temperature is warm and to increase the evaporator temperature when the room temperature is low, I provide a bimetal means 50 having an upper strip 51 of iron or some other suitable material, and a lower strip of brass 52 which is riveted at one end by the rivets 53 to the lever 39 and which is connected at its opposite end to the link 41 which connects to the snap acting mechanism 42. The control means is surrounded by air of room temperature and has the apertures 68 in the housing or walls of the control means so that when the room or external air temperature is higher, this temperature will effect the bimetal strip 50 and cause it to curl upwardly. This will cause the switch contacts 43 and 44 to be opened and closed at lower evaporator temperatures in order to maintain the evaporating means at a lower temperature. When the room temperature becomes colder, the bimetal strip 50 will curl downwardly and thus require higher temperatures in the bulb 33 and a greater expansion of the bellows 38 in order to move the contacts 43 and 44 to closed position. This will cause the evaporator to be maintained between higher temperature limits when the room temperature is lower.

In my control means, I have also provided a periodic automatic defrosting means for periodically increasing the temperature of the evaporating means to cause any frost to melt from its surfaces. This is provided by a ratchet wheel 55 which is mounted upon the end of the switch lever 39 and which is rotated a step at a time by the stationary resilient pawl 56. The switch lever is also provided with a spring pressed pawl 57 for controlling the direction of rotation of the ratchet wheel 55. The ratchet wheel 55 is provided with a projection 58 which, once every revolution, engages a resistance device which resists the movement of the switch mechanism toward the closed circuit position so as to cause a higher evaporating temperature before the switch contacts may be moved to closed positions.

It has been found that defrosting may be accomplished at a lower temperature when the room temperature is lower because the evaporator warms up more slowly and more uniformly under such conditions. In order to take advantage of this, I incorporate a bimetal compensating means in my resistance device responsive to external or room temperatures which reduces the amount of additional resistance provided by the defrosting means when the room temperature is lowered. This bimetal means takes the form of a bimetal strip 60 having an upper strip 61 of brass and a lower strip 62 of iron which is pivoted upon the pivot pin 63 and yieldingly held against a fixed stop 64 by the compression type coil spring 65 which is provided with an adjusting screw 69 for varying its tension. The opposite end of the bimetal strip 60 is provided with an adjusting screw 66 which engages the projection 58 for providing the additional resistance for defrosting and which may be adjusted so as to vary the additional resistance provided and thereby to vary the defrosting temperatures.

Once every revolution of the ratchet wheel 55, the projection comes up and engages the lower end of the adjusting screw 66. Further upward movement of the switch lever 39 is resisted by the bimetal strip 60 and the tension spring 65. When the external or room temperature is lowered, the bimetal strip 60 will curl upwardly, thus moving the adjusting screw 66 upwardly slightly and reducing the resistance provided by the defrosting mechanism. This will require a lesser force and a lower temperature in order to move the switch contacts 43 and 44 to closed circuit position. In this way, a lower defrosting temperature is provided when the external temperature is lowered.

In Fig. 3, I have shown a modified form of control means in which the bimetal compensating means is made adjustable. In this form, generally designated by the reference character 103, is the bellows 138, which is connected by the tubing 134 to a thermostatic bulb which is mounted upon and in heat exchange relation with the evaporator within the food compartment. The bellows 138 operates the lever 139 under the control of a tension coil spring 145 which is provided with an adjusting screw 146. The free end of the lever 139 is connected to a snap acting toggle type of switch contact mechanism 142 for opening and closing the switch contacts 143 and 144. The housing or walls of the control means are provided with apertures 168 for permitting the circulation of external or room air through the control means.

In order to compensate the switch means and the temperature limits of the evaporator for changes in the external or room temperature, I provide a bimetal strip 150 which is fastened at one end by the rivets 153 to a block fixed to the housing or walls of the control means. This bimetal strip has an upper strip 152 of iron and a lower strip 151 of brass. An adjusting screw 155 extends through the lever 139 and contacts and imposes a bending movement on the bimetal strip 150. By moving this adjusting screw 155 upwardly or downwardly, the tension exerted by the bimetal strip 150 upon the lever 139 may be adjusted. When the external or room temperature becomes lower, the bimetal strip 150 will tend to curl downwardly and increase the resistance to the expansion of the bellows 138 and thus control the operation of the compressor of the refrigerating system so as to maintain a higher temperature in the evaporator. When the external temperature becomes warmer, the bimetal strip 150 will tend to curl upwardly thus reducing the tension imposed upon the lever 139 and making it more easy for the bellows 138 to expand and move the switch contacts to closed circuit position to cause operation of the motor com-

pressor unit. Thus, in this form, the switch means is compensated by an adjustable bimetal resistance means.

In Fig. 4, I have shown another modification embodying a double toggle switch mechanism, the arms of which are formed of bimetal strips. In this form, generally designated by the reference character 204, there is provided a metal bellows 238 connected by the tubing 234 to a thermostatic bulb which is mounted upon and in heat exchange relation with the cooling unit or evaporator of the refrigerating system. The bellows 238 operate a primary lever 239 under the control of a tension coil spring 245, the tension of which may be adjusted by an adjusting screw 246. The primary lever 239 is provided with an insulating block 270 which is provided with notches to receive the knife edges at one end of a secondary lever 271 which has its opposite or free end connected by a tension coil spring 272 to a post 273 formed on a bimetal arm or strip 274 of the bell crank contact lever 275. This bell crank contact lever 275 is pivoted upon the pin 276 to an insulating portion 277 forming a part of the wall of the housing of the control means 204. This bell crank lever also has stop portions 278 and 279 which limit the movement of the free end of the secondary lever 271.

The bell crank lever 275 is provided with a second bimetal arm or strip 280 which carries a switch contact 281 at its lower end which cooperates with and is adapted to engage a stationary contact 282 which is mounted upon a second insulating portion 283 forming part of the wall of the housing of the control means 204. The housing of the control means 204 is provided with apertures 268 which provide for a circulation of external air from the room into heat exchange relation with the bimetal strips or arms 274 and 280. The bimetal strip or arm 274 has an upper strip 284 of brass and a lower strip 285 of iron or other suitable material, while the bimetal arm or strip 280 has a strip 286 of iron and a strip 287 of brass. It should be noted that in this arrangement, the two closer strips in the arms are of iron while the strips furthest away are of brass. This causes the arms to move closer together when the external temperature is warm, thereby reducing or lowering the cut-out temperature which controls the stopping of the refrigerating apparatus, but without effecting the cut-in temperature which controls the starting of the refrigerating apparatus and which is adjusted by the stop screw 290 which serves as the differential adjustment.

When the external or room temperature is colder, the bimetal arms tend to curl away from each other and thus to raise the cut-out temperature or temperature at which the refrigerating apparatus is stopped. The changing of the cut-in and cut-out temperatures by the bimetal arms and the differential adjusting screw 290 is accomplished by varying the angularity of the bell crank lever 275 at the time at which the contacts are moved to open or closed position. This changing of the angularity, changes the angularity of the secondary lever 271 with respect to the primary lever 239 at these tripping points and thereby varies the temperatures at which the opening and closing occurs. Thus, in this form, the bimetal compensating means acts merely to vary the cut-out point or the stopping temperature of the refrigerating apparatus.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including an insulated cabinet having a compartment to be cooled, a cooling means in heat exchange relation to said compartment to be cooled for cooling said compartment, compressing and condensing means for supplying medium to said cooling means, pressure operated means dependent upon the temperature of the cooling means for controlling said compressing means, and bimetal means thermally responsive to temperatures outside of said compartment for applying a resilient force for the operation of said controlling means.

2. Refrigerating apparatus including an insulated cabinet having a compartment to be cooled, a cooling means in heat exchange relation with said compartment to be cooled for cooling said compartment, compressing and condensing means for supplying cooling medium to said cooling means, means dependent upon the temperature of the cooling means for controlling said compressing means to normally maintain said cooling means at freezing temperatures, auxiliary means affecting the control of the compressing means for temporarily providing temperatures of the cooling means above freezing, and bimetal means responsive to temperatures outside of said compartment for regulating the temperatures provided by the auxiliary means.

3. Refrigerating apparatus including an insulated cabinet having a compartment to be cooled, a cooling means in heat exchange relation with said compartment to be cooled for cooling said compartment, compressing and condensing means for supplying cooling medium to said cooling means, means dependent upon the temperature of the cooling means for controlling said compressing means to normally maintain said cooling means at freezing temperatures, auxiliary means affecting the control of the compressing means for temporarily providing temperatures of the cooling means above freezing and thereafter resuming normal temperature control of the cooling means, and means responsive to temperatures outside of said compartment for regulating the temperatures provided by the auxiliary means without affecting the normal control of the temperature of the cooling unit.

4. Refrigerating apparatus including an insulated cabinet having a compartment to be cooled, a cooling means in heat exchange relation with said compartment to be cooled for cooling said compartment, compressing and condensing means for supplying cooling medium to said cooling means, means dependent upon the temperature of the cooling means for controlling said compressing means to normally maintain said cooling means at freezing temperatures, periodic means for periodically affecting the control of the compressing means for providing temperatures of the cooling means above freezing and thereafter resuming the normal temperature control of the cooling means, and means responsive to the temperatures outside of said compartment for regulating the temperatures provided by the periodic means.

5. Refrigerating apparatus including an insulated cabinet having a compartment to be cooled, a cooling means in heat exchange relation to said compartment to be cooled for cooling said compartment, compressing and condens-

ing means for supplying cooling medium to said cooling means, said compressing means including an electric motor and an electric circuit for supplying electric energy thereto, a set of switch contacts in series with said electric circuit for controlling the supply of electric energy, pressure means dependent upon the temperature of the cooling means, and bimetal means connecting the pressure means and the switch contacts for opening and closing the switch contacts.

6. Refrigerating apparatus including a cooling unit for cooling a medium and a circulating unit for circulating refrigerating medium through said cooling unit, a control means including a control casing containing pressure operated means dependent upon the temperature of the cooling unit for controlling the circulating unit, said casing also containing bimetal means thermally independent of said dependent means responsive to temperatures within the casing for applying a yielding force to the control provided by said dependent means.

7. Refrigerating apparatus including a cooling unit for cooling a medium and a circulating unit for circulating refrigerating medium through said cooling unit, a control means including a control casing containing pressure operated means dependent upon the temperature of the cooling unit for controlling the circulating unit, said casing being mounted within a medium surrounding and in contact with the medium surrounding one of said units of the refrigerating apparatus, said casing being provided with ventilating apertures, said casing also containing bimetal means for applying a yielding force to the control provided by said dependent means.

8. Refrigerating apparatus including a cooling unit for cooling a medium and a circulating unit for circulating refrigerating medium through said cooling unit, a control means including a control casing containing pressure operated means dependent upon the temperature of the cooling unit for controlling the circulating unit, said casing also containing bimetal means in the form of a cantilever operably connected to said dependent means for applying a yielding force to the control provided by said dependent means.

9. Refrigerating apparatus including a cooling unit for cooling a medium and a circulating unit for circulating refrigerating medium through said cooling unit, a control means including a control casing containing means dependent upon the temperature of the cooling unit for controlling the circulating unit for normally maintaining the temperature of the cooling unit within predetermined limits, auxiliary means for temporarily disrupting said temperature limits, and means responsive to temperatures within said casing for modifying the effect of said auxiliary means without affecting the normal control of the temperature of the cooling unit.

10. Refrigerating apparatus including a cooling unit for cooling a medium and a circulating unit for circulating refrigerating medium through said cooling unit, a control means including a control casing containing means dependent upon the temperature of the cooling unit for controlling the circulating unit for normally maintaining the temperature of the cooling unit within predetermined limits, auxiliary means for periodically disrupting said temperature limits, and means responsive to environment temperatures of one of said units of the refrigerating apparatus for modifying the effect of said auxiliary means.

11. Refrigerating apparatus including a cooling unit for cooling a medium and a circulating unit for circulating refrigerating medium through said cooling unit, a control means including a control casing containing means dependent upon the temperature of the cooling unit for controlling the circulating unit for normally maintaining the temperature of the cooling unit within predetermined limits, auxiliary means for temporarily disrupting said temperature limits, and bimetal means responsive to temperatures within said casing for modifying the effect of said auxiliary means.

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