

Refrigerated Food Safety Monitor

Shourya Pokhriyal¹ and Kanishk Rawat²

^{1,2}Agricultural Engineering Department, College of Technology, GBPUAT, Pantnagar
E-mail: ¹shouryapokhriyal@gmail.com, ²rawatkanishk01@gmail.com

Abstract: A food refrigeration monitor includes a thermometer for measuring the temperature. A switch is operatively coupled to the thermometer and switches from a first state to at least a second state when a thermometer measures a temperature above a predetermined temperature. The switch switches from the at least second state to the first state when the temperature is below the predetermined temperature. A timer is coupled to the switch for measuring an amount of time the switch is in the second state. If the measured time is greater than a predetermined time value, an alarm is sounded.

Keywords: Ambient, brownout, indicator, monitor, thermometer

1. INTRODUCTION

This invention is directed to a device for monitoring temperature within a refrigerator, and more particularly for monitoring the conditions within a refrigerator and notifying a user if the food has fallen into the danger zone for refrigerated foods.

In this day and age, refrigerators for both private and commercial use have become ubiquitous. They come in all sizes, all shapes and can be found everywhere from restaurants, to places of work, to personal homes, including outside of the kitchen, such as basements, wet bars, recreation rooms, garages and the like. Almost all foods are stored in a refrigerator at one time or another.

However, refrigerators are subject to breakage, brownouts, blackouts and the like. Brownouts occur in many areas on almost a weekly basis. For this reason, by way of example, it is known to back up computers at the workplace with uninterrupted power sources. Such secondary systems are usually not available for refrigerators, therefore, if in fact power is lost or diminished while a refrigerator user is away from the refrigerator, and power is restored, there is no way to determine that a diminution in the operation of the refrigerator has even occurred, or to what extent the loss of refrigeration may have damaged any foods therein. Even where there is no brownout, it is not apparent, particularly to homeowners not extremely knowledgeable in food preparation, or maintenance to determine, whether the temperature in the refrigerator is in fact sufficient to maintain the food outside of the danger zone. The longer the food is in the danger zone, the more likely that products such as milk, fish or poultry will grow dangerous

bacteria. Typically, someone at home only realizes that food is unsafe for consumption after it is consumed.

If food has been exposed to the danger zone for a prolonged period of time, it is subject to spoilage. One way of being able to tell if a food is spoiled is by odor. However, food may spoil or become unhealthy before an odor is created. In many cases, the odor is not significant enough to raise suspicion regarding the food. Many times, spoiled food may have a spoiled taste. However, in the early stages of spoilage, taste may not be sufficient, or may be masked by other ingredients, as evidenced by the number of cases of food poisoning reported each year. Taste and smell are not sufficient to warn food consumers that food may be unhealthy. The longer the food is in the danger zone, the more likely unhealthy bacteria will grow. However, bacteria growth may be sufficient to be unhealthy to food eaters, but may not be sufficient to provide an odor or a taste to warn the eater of spoilage.

Therefore, a device for determining the existence of the danger zone and the cumulative exposure to the danger zone and notifying the refrigerator user is desired.

2. MATERIALS AND METHODS

A refrigeration temperature time monitoring device comprising a thermometer for measuring an ambient temperature within a refrigerator providing an output when said thermometer detects at least a predetermined temperature; and a timer operatively coupled to said thermometer for counting elapsed time in response to the output of said signal from said thermometer and a switch operatively coupled between said thermometer and said timer, a power source providing a power input to said switch, said switch switching from a first state to at least a second state when said thermometer measures a temperature above said predetermined temperature and exhibiting said first state when said temperature is below said predetermined temperature, said switch outputting a power signal to said timer when said switch is in said second state, said timer counting an elapsed time in response to said power signal, said thermometer including a face having an analog indicator rotatably mounted on the face moving about said face to indicate measured temperature, said analog indicator electrically coupled to the

power source for receiving the power signal and, the switch being disposed on the face at a position corresponding to a position at which said analog indicator indicates measurement of said predetermined temperatures. a timer being coupled to said switch and said power source so that said analog indicator moving to a position corresponding to said predetermined temperature closes a circuit to power said timer by providing the power input to said timer.

Reference is made to FIG. 1 in which a schematic diagram of a monitoring device, generally indicated as **10**, constructed in accordance with the invention is provided. Device **10** includes a thermometer **12** and a timer **14**. A power source for powering timer **14** is coupled to timer **14** through a switch **18**. Time **14** is operatively coupled to an alarm **20**. The components of device **10** may be disposed in a housing **22**.

Device **10** is placed within a refrigerator. Thermometer **12** measures the ambient temperature within the refrigerator (not shown). If thermometer **12** senses a temperature greater than some predetermined value, 40° Fahrenheit, by way of example, representing the danger zone, thermometer **22** outputs a signal to switch **18**.

Switch **18** receives a power input from power source **16**. Switch **18** is capable of exhibiting at least two states, which are switched under the control of thermometer **12**. In a first state, switch **18** prevents power from power source **16** from flowing to timer **14** and in an at least a second state, switch **18** completes a circuit between power source **16** and timer **14** operating timer **14**. The output of thermometer **18** when above the danger zone temperature causes switch **18** to be in the at least second state.

It should be noted that the schematic of FIG. 1 is by way of example only. Thermometer **12** may also be powered by power source **16** so that power source **16** is coupled to both thermometer **12** and switch **18** if thermometer **12** is in fact an electronic, as opposed to a mechanical, thermometer.

Furthermore, if power source **16** provides an input through thermometer **12**, then thermometer **12** may also provide the power to timer **14** switched by switch **18**. In other words, power source **16** provides an input to thermometer **12** and not switch **18**, however, switch **18** still provides power to timer **14** under the control of thermometer **12**.

Timer **14** tracks elapsed time when powered. By way of non-limiting example, if switch **18** is in the second state for 20 seconds, timer **14** will register 20 seconds and display 20 seconds. If thermometer **12** senses a temperature above 40° F., by way of example, during a second period for two minutes, switch **18** causes timer **14** to be powered for an additional two minutes. Once the temperature of thermometer **12** falls below 40° F., switch **18** returns to the first state, opening the circuit preventing powering of timer **14**. At the end of this second period, timer **14** will display two minutes and 20 seconds. In other words, timer **14** displays elapsed time of exposure to the temperature which causes food spoilage.

Timer **14** may be either a digital elapsed time or analog elapsed timer such as a clock or stopwatch. Furthermore, if a clock, timer **14** may also be capable of tracking the time at which power was first supplied to timer **14** and even track succeeding beginning and ending time periods utilizing a memory chip or analogous mechanical device. This is particularly true if timer **14** is an electronic digital clock.

In a preferred embodiment, power source **16** is a battery, preferably a small sized battery such as an AAA battery. However, the voltage of the battery must be capable of powering timer **14** for at least 4 hours. Timer **14** is capable of storing and displaying the elapsed time even when not operatively coupled to power source **16**, such as when the switch is in the first state.

Timer **14** also determines whether the elapsed time is greater than a predetermined value. In our example, the elapsed time resulting in the danger zone is about 4 hours. If the elapsed time exceeds the predetermined time, timer **14** provides an output to an alarm **20**. Alarm **20** may be a sound device for creating a siren when food temperature has experienced the danger zone sufficiently to cause spoilage, or may be a visual display such as a red flashing LED. In this way, the user may easily determine that food within the refrigerator has been exposed to the danger zone and may be unhealthy.

It should be noted, as discussed above, that device **10** may be constructed as an electronic and digital device or as a mechanical analog device. As is known in the art, if electronic

FIG. 1

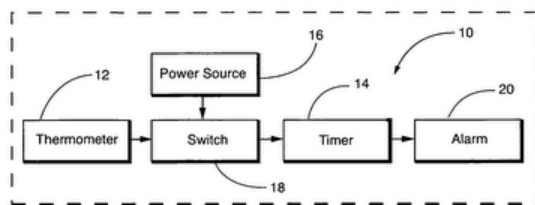
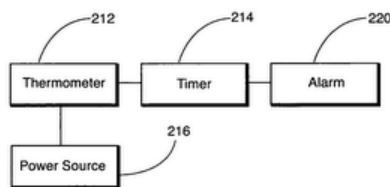


FIG. 3



and digital, then thermometer **12** and timer **14** would include logic circuitry such as AND and OR gates for determining the presence or absence of a desired state such as whether the predetermined temperature has been sensed by the thermometer and whether the timer has counted the elapsed time.

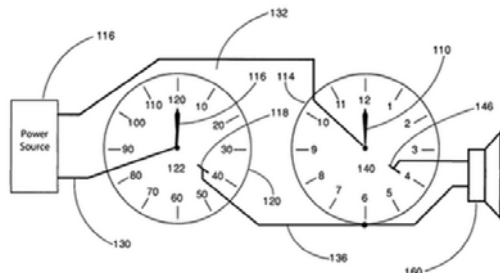


Fig. 1

In some situations, a mechanical analog device is better suited for the environment of the interior of a refrigerator. Reference is now made to FIG. 2 in which a mechanical version of the device, generally indicated as **100**, is provided. Device **100** includes a thermometer **120**. Thermometer **120** includes a face **122**, an indicator **124** rotatably mounted on the face. A switch is mounted on face **122** adjacent to the position on the face corresponding to the indicator indicating the predetermined temperature; in this example 40° F. Indicator **124** is electrically connected to power source **116** by a wire **130**.

A timer **114** is coupled to power source **116** by a wire **132** on an opposite side of the circuit from wire **130**. Timer **114** includes a face **140** and an indicator **142**. Wire **132** couples power source **116** to indicator **142**. A wire **136** couples timer **114** to switch **118** on face **122** so that when switch **118** is closed by indicator **124** contacting a switch **118** a circuit is complete to power timer **114**. In this embodiment, timer **114** is an analog timekeeper having hour markings along face **140** to indicate elapsed time to the nearest hour. It should be understood that timer **114** may also be a mechanical digital device exhibiting elapsed time as a digit such as 0:01 for one minute of elapsed time and 2:00 for two hours of elapsed time.

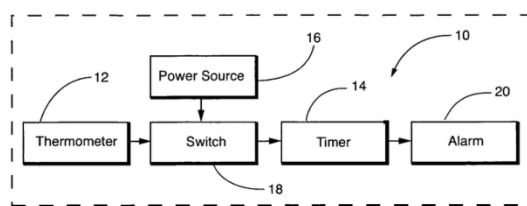
An alarm shown here as speaker **160** is coupled across power source **116** with timer **114** acting as a switch. A switch **146** is disposed on face **140** of timer **114** at a position corresponding to the danger zone elapsed time. One electrical input to alarm **160** is at switch **146** while the other input is from power source **116**. Accordingly, timer indicator **142** comes in contact with switch **146** at a predetermined time, a power circuit is open to power alarm **160** which may be a light bulb, but in this embodiment is a speaker to provide an audible alarm which may be heard through the door of the refrigerator.

Reference is now made to FIG. 3 in which another embodiment of the invention is provided. A monitor, generally

indicated as **200**, is an electronic embodiment of the invention. Monitor **200** includes a thermometer **212**, which receives an input from a power source **216**. Thermometer **212** acts as a switch relative to a power signal. When thermometer **212** senses an ambient temperature greater than the predetermined temperature (40° F. by way of example), thermometer **212** outputs a power signal to a timer **214**. Thermometer **212** may make use of AND and OR gate logic by way of non-limiting example to provide such a gating switch for the power source signal.

In response to a power source signal output by thermometer **212**, timer **214** counts elapsed time. Timer **214** utilizing similar logic circuitry compares the elapsed time to a predetermined elapsed time corresponding to food spoilage at the predetermined temperature. If the elapsed time equals the predetermined time, a power signal is output to alarm **220** which indicates either audibly, visually or both that the conditions within the refrigerator could lead to spoiled and unhealthy food.

By providing an elapsed timer triggered by a thermometer, a device, which provides refrigerator users with the knowledge of whether, the food has reached a danger zone is provided. Furthermore, by utilizing the timer gated by the thermometer, a user can determine the elapsed amount of time of exposure to the danger zone with a simplified device. Furthermore, the device provides a simple mechanism for allowing the user to be able to recognize if the refrigerator is operating properly, i.e., maintaining proper internal temperature. Most importantly, the device provides a quick, simple, automated way of determining whether food contained within the refrigerator is unsafe for consumption as a result of the refrigeration conditions, decreasing the risk of food poisoning.



In response to a power source signal output by thermometer **212**, timer **214** counts elapsed time. Timer **214** utilizing similar logic circuitry compares the elapsed time to a predetermined elapsed time corresponding to food spoilage at the predetermined temperature. If the elapsed time equals the predetermined time, a power signal is output to alarm **220** which indicates either audibly, visually or both that the conditions within the refrigerator could lead to spoiled and unhealthy food

3. RESULTS AND CONCLUSIONS

By providing an elapsed timer triggered by a thermometer, a device, which provides refrigerator users with the knowledge of whether, the food has reached a danger zone is provided. Furthermore, by utilizing the timer gated by the thermometer, a user can determine the elapsed amount of time of exposure to the danger zone with a simplified device. Furthermore, the device provides a simple mechanism for allowing the user to be able to recognize if the refrigerator is operating properly, i.e., maintaining proper internal temperature. Most importantly, the device provides a quick, simple, automated way of determining whether food contained within the refrigerator is unsafe for consumption as a result of the refrigeration conditions, decreasing the risk of food poisoning.

It should be noted that the above examples were given for food with a danger zone determined as greater than 40° F. for more than four hours.. Furthermore, the monitoring device may be used for frozen foods to determine whether thawing and refreezing has occurred.

4. ACKNOWLEDGEMENT

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