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**Vallee et al.**

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[54] **REFRIGERATOR/FREEZER SAFETY DEVICE**


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[52] **U.S. Cl.** ..... **49/2,** 49/31

[51] **Int. Cl.** ..... **E05f 15/20**

[58] **Field of Search** ..... 49/1, 2, 31; 160/1-6; 292/DIG. 65, DIG. 66



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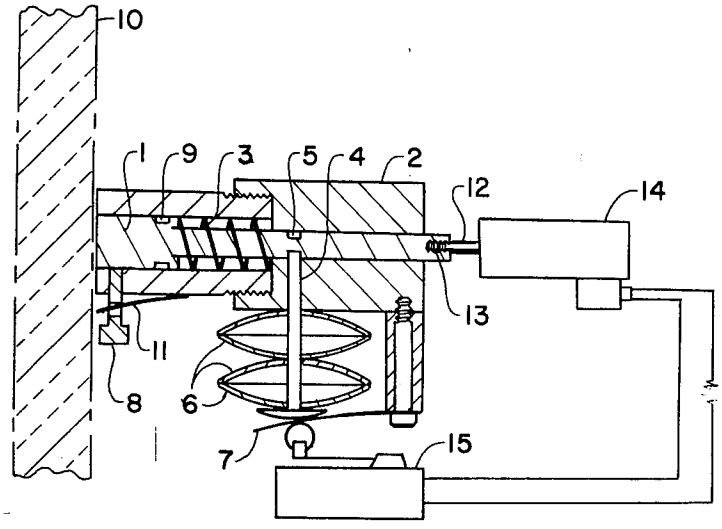
*Primary Examiner*—Dennis L. Taylor



[57] **ABSTRACT**

A device is described for opening the door of an enclosure, more particularly the magnetically held door of a refrigerator, freezer, or the like, which device is responsive to the temperature within the enclosure to open and hold the door thereof, to allow heat dissipation therefrom and air circulation therein, when the temperature within such enclosure exceeds a certain temperature.


**5 Claims, 4 Drawing Figures**



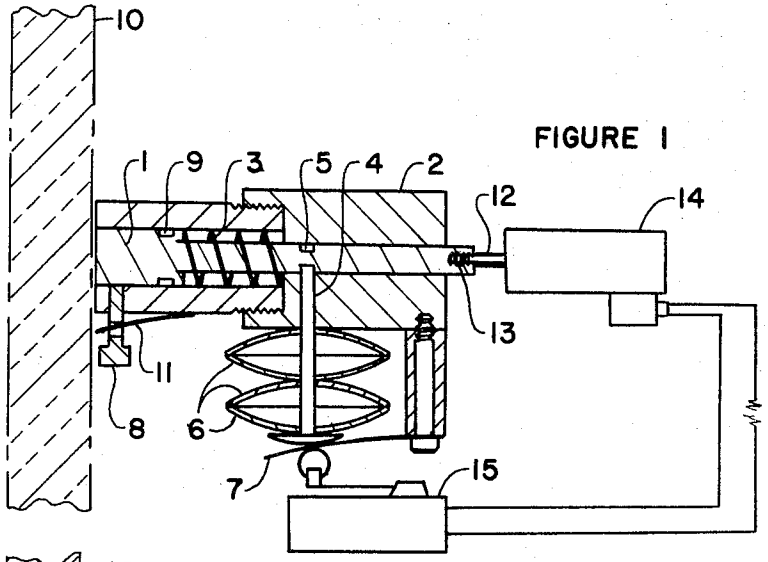



FIGURE 1

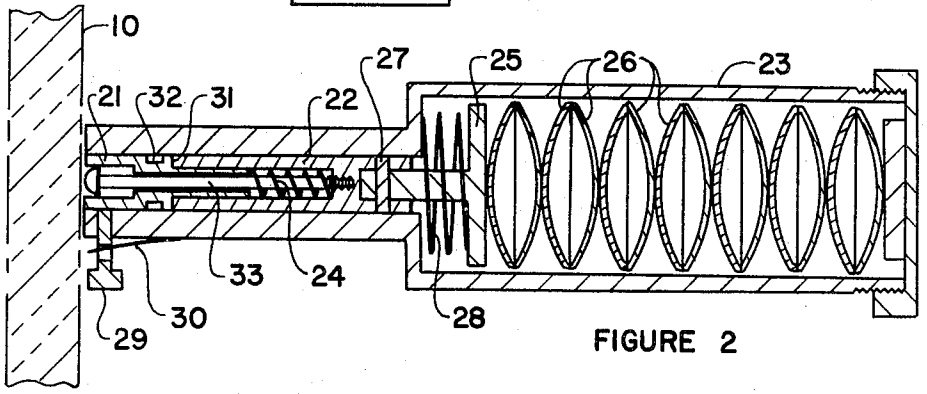



FIGURE 2

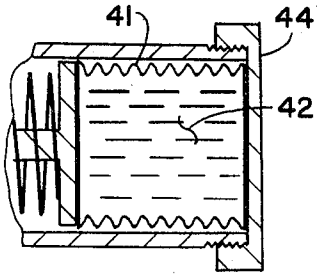



FIGURE 3

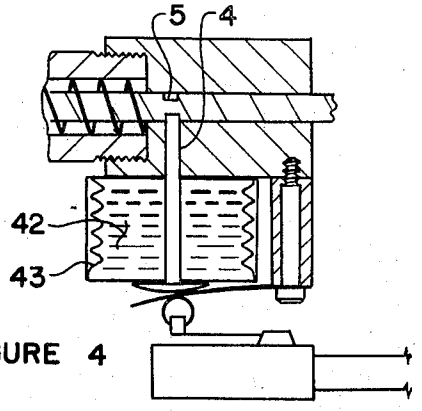



FIGURE 4

# REFRIGERATOR/FREEZER SAFETY DEVICE

## BACKGROUND OF THE INVENTION

This invention relates to door openers and more particularly to a door opener for use as a safety device on refrigerators, freezers and other airtight or semi-airtight enclosures.

Refrigerators, freezers, and the like, particularly those which have been abandoned, have been a source of danger for small children who might crawl inside such an enclosure and then become inadvertently trapped therein when the door of the enclosure closes. [See: "Hearing Before a Subcommittee on the Committee on Interstate and Foreign Commerce, House of Representatives, **88**th Congress, First Session, on Progress to Date in Achieving the Objectives of Public Law **930**, 84th Congress," Sept. 23, 1963 (U.S. Government Printing Office, 1964)].

Measures have been taken from time to time to eliminate the dangers to children which such enclosures present. For example, statutes have been passed in many jurisdictions to require the owner to remove the lock or hinges from the doors of refrigerators, ice boxes, or other airtight or semi-airtight containers, before discarding or otherwise abandoning them, to prevent persons from being trapped therein. In addition, most household refrigerators and freezers are no longer built with positive outside mechanical latching devices for securing the doors thereof, but are usually equipped with magnetic door gaskets or latches, with certain restrictions on the maximum force required to break the seal of such a magnetic closure. Further, devices such as door unlatching mechanisms activated from the interior of the door have been provided for such as large walkin refrigeration units, but such devices have not found use on smaller units, such as household units, because of complexity, prohibitive cost, or other objectionable features. These measures have not been entirely successful as evidenced by frequent deaths of children resulting from entrapment within refrigerators or freezers which have frequently been reported.

It has been determined (Clinical Research, 18, 2:492 (April 1970) that the cause of death among small children entrapped in abandoned refrigerators is not from lack of oxygen but, rather, is from heat. In refrigerators and freezers commonly in use in American households, sufficient oxygen is normally available in such a closed volume to sustain the life of a small child for a substantial period of time. For example, clinical tests using dogs showed that average survival time of such dogs to be approximately 4 hours in a closed commercial refrigerator not connected to a source of electrical power, but that when the refrigerator was on and cold the animals survived for more than 24 hours. Maintaining acceptable oxygen levels in the closed inoperable refrigerator did not significantly extend survival time of the animals; expiration was due to increased temperature within the closed inoperable refrigerator.

Thus a child entrapped in a closed refrigerator, freezer or the like would expire because of temperature rise within such an enclosure, generated by the body heat of the entrapped child, the effect of which is intensified by increased humidity within the enclosure supplied by body processes of the entrapped child. For example, in an average size commercial refrigerator (not operating), the body heat of a child of about 30 to about 60 pounds, coupled with the effect of increased humidity, would cause a temperature rise of an effective temperature of about 11°F. to about 15°F. in about 120 to about 240 minutes following entrapment; such a child would normally die due to the heat and humidity by the time the enclosure attained a temperature of 96° to 98°F. Because of oxygen content in the volume of the refrigerator and air leakage at the door seal, sufficient oxygen should be available to an entrapped child to sustain him for a considerably longer time except for the effect of temperature rise within the enclosure as hereinbefore discussed. Heat transfer calculations show that a gap of about ½ inch at the door is sufficient to maintain the temperature within such enclosures below acceptable levels, and, also, to provide sufficient air circulation to prevent suffocation of a child entrapped within such enclosure.



Various advantages other than prevention of temperature rise and allowance of air circulation are provided by the Refrigerator/Freezer Safety Device herein described: when the device is activated and the door of the enclosure is thereby opened, a child therein can readily hear and be heard, and sufficient light enters the enclosure to illuminate the interior thereof to allow escape of a child therefrom and to reduce the possibility of the child becoming frightened or panicked.

Therefore an urgent need is indicated for a simple, effective, and reliable device for opening and holding open the door of a refrigerator, freezer, icebox or the like, particularly those which have been abandoned, when the temperature inside such an enclosure exceeds a certain level. Such a device should be compact and easy to install, but must provide sufficient force when activated to open a magnetically held door of a refrigerator, freezer or the like.

The Refrigerator/Freezer Safety Device herein described satisifies the aforementioned need.

## SUMMARY OF THE INVENTION

This invention comprises a device for opening the door of an enclosure, particularly a refrigerator, freezer or the like having a magnetically held door, including a spring-loaded rigid member which is slideably mounted adjacent an inner surface of the door, a temperature sensing means responsive to the temperature within the enclosure, and a holding means, responsive to the temperature sensing means, for holding the rigid member in a retracted position against the tension of the spring, which holding means is released in response to the temperature sensing means when the temperature within the enclosure exceeds a certain level.

It is therefore an object of this invention to provide a novel safety device for refrigerators, freezers and the like.

Another object of this invention is to provide a device for opening a magnetically held door of a refrigerator, freezer or the like to allow sufficient heat dissipation therefrom and air circulation therein to prevent the death of a child which may be trapped therein.

Still another object of this invention is to provide a device to hold open the door of a refrigerator, freezer or the like to prevent the death of a child which may be trapped therein.

It is a further object of this invention to provide a device for opening and holding open a magnetically held door of a refrigerator or freezer, which device is activated by heat.

These and other objects of the invention will become apparent as the detailed description proceeds.

## DESCRIPTION OF THE DRAWINGS

The invention will be more clearly understood from the following detailed description of specific embodiments thereof read in conjunction with the accompanying drawings wherein:

FIG. 1 is a cross-sectional view of a preferred embodiment of the present invention, illustrating the use of bimetallic disks as a temperature sensing means, and a magnetic solenoid and associated switch and circuitry.

FIG. 2 is a cross-sectional view of another embodiment showing an alternative configuration for use of bimetallic disks as a temperature sensing means and means for releasing the rigid member.

FIG. 3 is a partial view in section of the embodiment of FIG. 2 which incorporates a volatile liquid as the temperature sensing means and means to urge the rigid member against the door of the enclosure.

FIG. 4 is a partial view in section of the embodiment of FIG. 1 which incorporates a volatile liquid as the temperature sensing means.

## DETAILED DESCRIPTION

The preferred embodiment of the present invention comprises a spring-loaded rigid member which may be held by any suitable holding means in a retracted position against the tension of such spring, which holding means is responsive to and released by a suitable temperature sensing means. Materials of construction and shapes of elements of the various embodiments of the invention herein described are not critical so long as the properties of such materials and shapes of such elements permit functioning of the elements of the invention as herein discussed.

As shown in FIG. 1, the rigid member may comprise a shaft 1 which may be slideably mounted within any suitable support or housing 2, which housing may be secured by any suitable mounting means (not shown) to the surface of or within a wall of an enclosure such that the sliding direction of the shaft 1 is along the axis thereof and substantially perpendicular to the plane of door 10 of the enclosure, and on end of shaft 1 is immediately adjacent the interior surface of door 10 as shown. Shaft 1 may be held in the retracted position against the tension of a suitable spring 3 by any suitable holding means such as shown in FIG. 1 as pin 4 and a slot 5 in shaft 1. A suitable temperature sensing means may be located in any convenient position within the enclosure, the purpose thereof being to sense the temperature within the enclosure and to release the holding means when the temperature within the enclosure reaches a certain level. Any suitable temperature sensing means may be used as are well known in the art, such as curved bimetallic members, fusible links, and thermocouple or thermostat controlled solenoids or switches, so long as the aforementioned purpose thereof is served. In the embodiment shown in FIG. 1, one or more curved bimetallic disks 6 are mounted axially on pin 4 and provide both the temperature sensing means and the means for releasing the holding means, i.e., withdrawing pin 4 from slot 5. In this embodiment any suitable number of curved bimetallic disks may be used depending on the amount of travel required to withdraw pin 4 from slot 5 upon thermal expansion of the bimetallic disks 6. In operation, shaft 1 may be pushed to its retracted position against the tension of spring 3; as the temperature within the enclosure reaches a sufficiently low level so that the curved bimetallic disks are not fully expanded, pin 4 will seat into slot 5 under the tension of a spring such as leaf spring 7 shown in FIG. 1. Whenever the temperature within the enclosure, such as refrigerator or freezer, exceeds a certain level, bimetallic disks 6 will expand sufficiently to withdraw pin 4 from slot 5 and thereby release shaft 1 to be urged against door 10 of the enclosure by the force of spring 3. The tension on spring 3 need be only sufficient to break the seal on the door 10 of the enclosure. Currently used household refrigerators have magnetic seals requiring less than about 15 pounds force at the handle of the door in order to break the magnetic seal, which would govern the required strength of spring 3 for design purposes. As hereinbefore discussed, the door of the enclosure need be opened approximately ½ inch to provide suitable heat transfer and air circulation within the enclosure, which amount of opening governs for design purposes the extension which is required of shaft 1 under the influence of the force of spring 3.

As also shown in FIG. 1, suitable lockout means may be provided to prevent inadvertant closing of door 10 by external forces which would overcome the resistance of spring 3. Such lockout means may be represented by stop pin 8 slideably mounted within housing 2 which may be urged under the influence of leaf spring 11 against shaft 1 and into a slot 9 provided in shaft 1 when shaft 1 is in its extended position.

Also as shown in FIG. 1, certain provisions for automatic retraction of shaft 1 may be provided. Such automatic retraction may be provided by various means, such as a motor drive or a magnetic solenoid. As shown in FIG. 1, a magnetic solenoid may be used, and toward this end, an extension 12 of shaft 1 may be provided as shown and either be an integral part of shaft 1 or be connected to shaft 1 by any suitable connecting means such as threaded connection 13. Extension 12 has as a material of construction thereof suitable magnetically susceptible material. Magnetic solenoid 14 surrounds a portion of extension 12 of shaft 1 and is controlled by a suitable switch, such as microswitch 15, which in turn is responsive to movements of the bimetallic disks 6. It should be noted that a motor drive (not shown) could be used to retract shaft 1, which motor drive may also be made to be responsive to microswitch 15. In the configuration shown, microswitch 15 would be of the normally open type. Power to solenoid 14 through microswitch 15 is provided by the household current (not shown) provided for normal operation of a refrigerator or freezer. During normal operation of a refrigerator or freezer, power provided to the solenoid by way of household current results in a retraction of shaft 1 by solenoid 14 through the magnetic interaction of the solenoid with extension 12 of shaft 1. As the temperature within the interior of the refrigerator or freezer drops, bimetallic disks 6 contract sufficiently to allow pin 4 to seat in slot 5 of shaft 1 under the influence of leaf spring 7. Microswitch 15 is controlled by the movement of pin 4 such that when pin 4 seats in slot 5, microswitch 15 is opened, thereby cutting off the power to solenoid 14, resulting in no electric power consumption by the solenoid during normal (cooled) operation of the refrigerator or freezer.

An alternative embodiment of the invention may be as shown in FIG. 2 wherein the travel imparted to the shaft may be provided directly through the thermal expansion of bimetallic disks. But, to avoid the requirement of a sufficient number of bimetallic discs to impart to the shaft the total of approximately ½ inch travel required to adequately open the door of the enclosure, the shaft may comprise two mating sections 21 and 22 slideably mounted within a suitable housing 23. Section 21 has a small diameter portion on one end thereof, which is received by and slideable within a bore of section 22 as shown. The bore within section 22 is sufficiently deep to receive a spring 24. It may be desirable to limit the extension of section 21 relative to section 22 to avoid inadvertant popping out or locking of section 21 during normal (cooled) operation of the refrigerator or freezer and opening and closing of the door thereof. This may be accomplished by providing a hole through section 21 along the axis thereof for receiving bolt 33. Section 22 has a tapped hole at the bottom of the bore therein for receiving the threaded section of bolt 33 as shown in FIG. 2. Section 21 is free to slide on bolt 33 relative to section 22. Section 21 may have a bore therein to receive the head of bolt 33, the depth of this bore being such that the extension of section 21 relative to section 22 is limited by the distance between the shoulder of bolt 33 and the bottom of the bore in section 21.

Bimetallic disks 26 are located within housing 23 in any suitable position such that thermal expansion of discs 26 provide movement to section 22 such as by way of a member 25 which may be rigidly connected to section 22 by any suitable connecting means such as pin 27. A weak tensioning spring 28 may be provided as shown to urge member 25 and section 22 toward a retracted position against bimetallic disks 26. A stop pin 29 urged by leaf spring 30 against the shaft may be provided to lock the shaft in an extended position under conditions similar to that described above in association with the embodiment represented in FIG. 1. In operation, when the temperature within the enclosure for which the embodiment in FIG. 2 is provided is sufficiently low so that bimetallic disks 26 are in their contracted condition, tensioning spring 28 holds section 22 in a retracted position within housing 23 by urging against member 25. Section 21 is free to reciprocate within section 22 under the influence of spring 24 and the opening and closing of the door 10. Spring 24 is such that it is of insufficient strength (for example, less than about 7 pounds) to break the magnetic seal such as would be provided to hold door 30 of the enclosure in a closed position. When the temperature within the enclosure rises, resulting in expansion of disks 26, the force of such expansion urges section 22 toward an extended position, and likewise section 21 is urged toward an extended position by reason of the mating shouldered section 31 of sections 21 and 22. This results in section 21 being urged against the surface of door 10, such force being of sufficient magnitude to break the seal which holds the door in a closed position. Spring 24 may be provided of sufficient strength to push door 10 open once the magnetic seal is broken by the expansive force of the bimetallic disks. A stop pin 29 may be slideably mounted within housing 23 in such a position that stop pin 29 will seat into slot 32 of section 21 when section 21 is in its full extended position, i.e., the sum of the extensions provided by spring 24 and the expansion of bimetallic disks 26.

As shown in FIGS. 3 and 4, still another temperature sensing means may be incorporated into the embodiments of FIG. 1 and FIG. 2. As shown in FIG. 3, an expandable container 41 may be provided within a suitable housing or support 44 similar to that for containing the bimetallic disks of the embodiment of FIG. 2. Alternatively, a piston and cylinder arrangement (not shown) could be used. Within expandable container 41 is provided a suitable liquid 42 whose properties are such that at the low temperature of operation of a refrigerator or freezer, the liquid 42 does not have significant vapor pressure associated therewith, but at room temperature, about 68°F. to about 80°F., the liquid 42 has a vapor pressure significant enough to create pressure within container 41, to exert force on member 25 so as to cause operation of the device in a manner similar to the operation of the embodiment of FIG. 2. Liquids which can be used with success include butane; 1,3-butadiene; 2,2-dimethyl propane; dichlorodifluoromethane; and 1,2-dichloro-1,1,2,2-tetrachloroethane. Each of these materials respectively exhibit a significantly higher vapor pressure at about 80°F compared to that which they exhibit at about 32°F, viz, for butane, about 2.7 atm compared to about 1.1 atm; for 1,3-butadiene, about 2.9 atm compared to about 1.2 atm; for 2,2-dimethyl propane, about 1.8 atm compared to about 0.7 atm; for dichlorodifluoromethane, about 1.9 atm compared to about 0.7 atm; and for 1,2-dichloro-1,1,2,2-tetrachloroethane, about 2.2 atm compared to about 0.9 atm. It is understood that other materials could be used so long as they exhibited suitable vapor pressure properties.

As shown in FIG. 4, a similar expandable container 43 containing a suitable liquid 42 as hereinbefore described may be used in association with the embodiment of FIG. 1 to provide sufficient force to withdraw pin 4 from slot 5 in response to temperature within the enclosure in a manner similar to the operation of disks 6 of the embodiment of FIG. 1.

It is understood that other configurations as are well known in the art for containing such liquids may be used to effect operation of the invention as herein described. For example, a pressure vessel and associated tubing (not shown) may be used to contain the liquid in any suitable location within the enclosure incorporating this invention through which vapor pressure may be transmitted to provide forces necessary to effect operation of the embodiments of FIGS. 3 and 4.

Other details of construction of the invention herein described may be applied as might occur to one skilled in the art, and have therefore not been shown in complete detail. Other embodiments may be developed without departing from the spirit and scope of this invention.

We claim:

1. A device for opening the door of an enclosure, particularly a refrigerator or freezer having a magnetically held hinged door, which comprises: a rigid member slideably mounted to a wall structure adjacent the door of the enclosure, the sliding direction thereof being substantially perpendicular to the plane of the door of the enclosure; a spring biasing said rigid member along the sliding direction thereof against the force holding closed the door of the enclosure; means for holding said rigid member in a retracted position against the

bias of said spring; and temperature sensing means comprising a curved bimetallic member, said curved bimetallic member engaging said holding means, said holding means being responsive to said temperature sensing means and releaseable in response to said temperature sensing means when the temperature within the enclosure exceeds a certain level.

**2.** A device as recited in claim **1** further comprising: an extension of said rigid member, said extension composed of magnetically susceptible material; an electrically powered solenoid surrounding said extension for magnetically attracting said extension when electric power is applied to said solenoid, thereby retracting said rigid member against the biasing force of said spring; and a switch, responsive to said temperature sensing means, for regulating electric power to said solenoid.

**3.** A device for opening the door of an enclosure, particularly a refrigerator or freezer having a magnetically held hinged door, which comprises a rigid member slideably mounted to a wall structure adjacent the door of the enclosure, the sliding direction thereof being substantially perpendicular to the plane of the door of the enclosure; a curved bimetallic member engaging said rigid member, for urging said rigid member along the sliding direction thereof against the force holding closed the door of the enclosure, to open the door when the temperature within the enclosure exceeds a certain level.

**4.** A device for opening the door of an enclosure, particularly a refrigerator or freezer having a magnetically held hinged door, which comprises: a rigid member slideably mounted to a wall structure adjacent the door of the enclosure, the sliding direction thereof being substantially perpendicular to the plane of the door of the enclosure; a spring biasing said rigid member along the sliding direction thereof against the force holding closed the door of the enclosure; means for holding said rigid member in a retracted position against the bias of said spring; and an expandable container and a volatile liquid contained within said expandable container, said expandable container engaging said holding means, said holding means being responsive to expansion of said expandable container and releaseable in response to said expansion when the temperature within the enclosure exceeds a certain level.

**5.** In a refrigeration unit comprising an enclosure having a magnetically held hinged door and a device for opening the door, the improvement comprising, a rigid member slideably mounted to a wall structure adjacent the door of the enclosure, the sliding direction thereof being substantially perpendicular to the plane of the door of the enclosure; a spring biasing said rigid member along the sliding direction thereof against the force holding closed the door of the enclosure; means for holding said rigid member in a retracted position against the bias of said spring; temperature sensing means comprising a curved bimetallic member, said curved bimetallic member engaging said holding means, said holding means being responsive to said temperature sensing means and releaseable in response to said temperature sensing means when the temperature within the enclosure exceeds a certain level; an extension of said rigid member, said extension composed of magnetically susceptible material; an electrically powered solenoid surrounding said extension for magnetically attracting said extension when electric power is applied to said solenoid, thereby retracting said rigid member against the biasing force of said spring; and a switch, responsive to said temperature sensing means, for regulating electric power to said solenoid.

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