April 6, 1954 E. C. RANEY ET AL 2,674,665

CLOCK INITIATED DEFROSTER CONTROL
FOR MECHANICAL REFRIGERATORS

Filed June 14, 1951 2 Sheets-Sheet 1

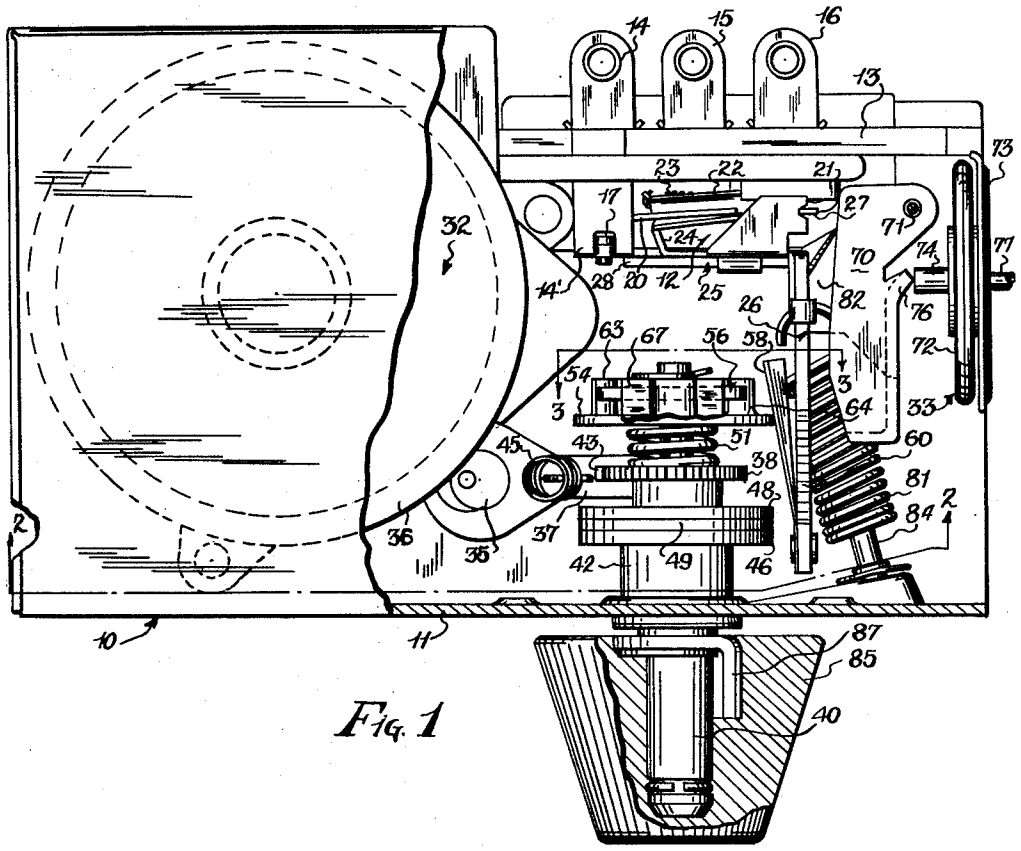


FIG. 1

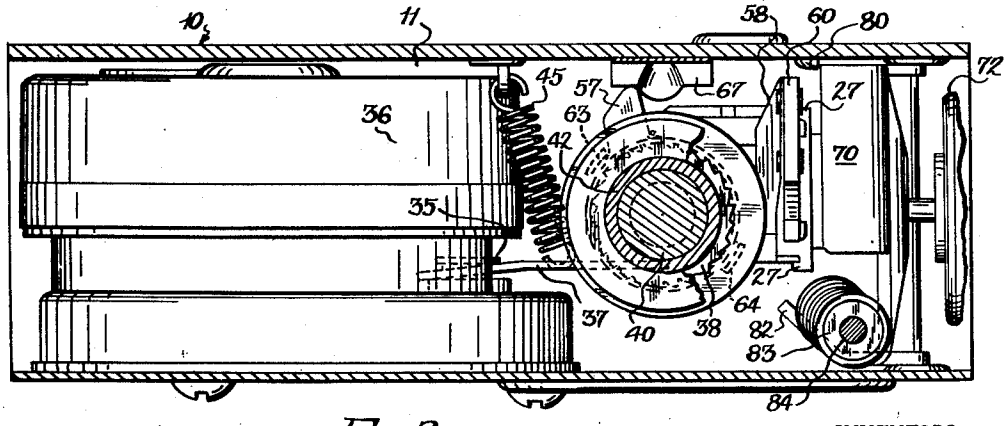


FIG. 2

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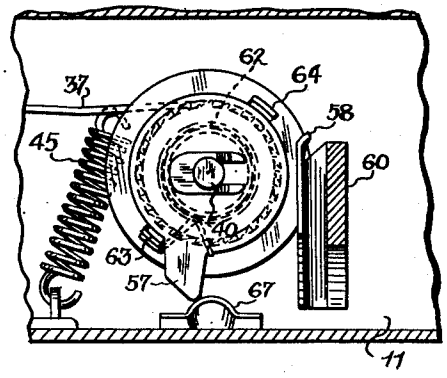


FIG. 3

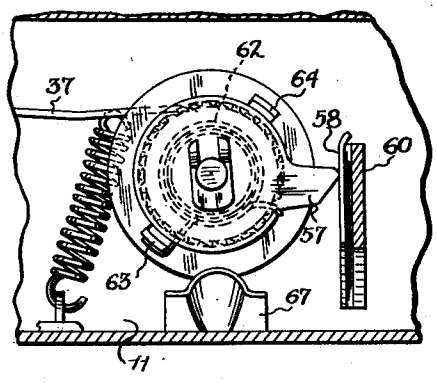


FIG. 4

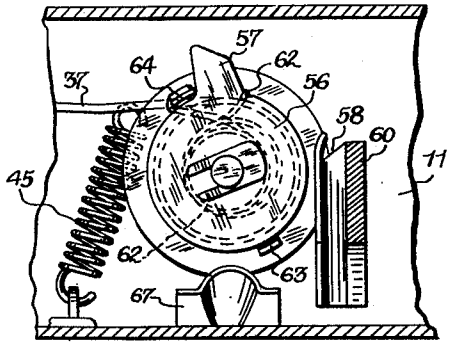


FIG. 5

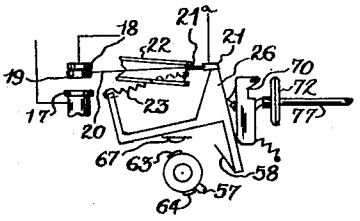


FIG. 7

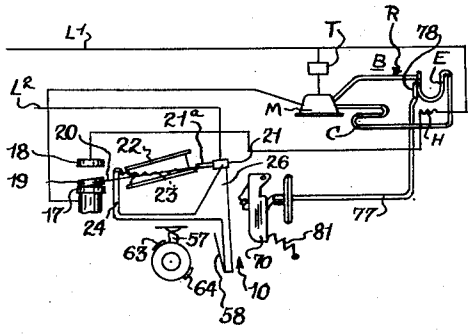


FIG. 6

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2,674,665

CLOCK INITIATED DEFROSTER CONTROL FOR MECHANICAL REFRIGERATORS

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Application June 14, 1951, Serial No. 231,464

4 Claims. (Cl. 200—38)

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The present invention relates to a control mechanism for refrigerators, and more particularly to a control mechanism to cause periodical defrosting of the evaporator of a mechanical refrigerator.

Another object of the present invention is to provide a control mechanism for a mechanical refrigerator, which mechanism is operative to initiate defrosting cycles in the evaporator of the refrigerator at predetermined times and to terminate such defrost cycles when the temperature of the evaporator reaches a predetermined temperature above the melting point of frost.

A more specific object of the invention is to provide a control mechanism of the character referred to having a motor-driven time mechanism which includes a normally relatively slowly driven actuator for moving a reciprocable control member from a normal control position to a defrosting control position at a predetermined time and which actuator is moved quickly beyond the range of contact with the control member following actuation of the control member thereby so that the control member may be returned to its normal position within a brief period without interference with the actuator.

Another object of the invention is to provide a control mechanism of the character described having a member movable in response to the temperature of the evaporator of the refrigerator to move the control member to its normal position to terminate the defrosting cycles, and which mechanism includes yielding means between the motor driven control member actuator and the control member so that the actuator cannot be stalled by the control member in the event the control member is held in its normal position by the temperature responsive member.

Other objects and advantages of the invention will be apparent from the following description of preferred forms of embodiments of the invention, reference being had to the accompanying drawings wherein;

Fig. 1 is a plan view of an automatic defrost control for an electrical refrigerator embodying the invention, certain parts being shown broken away;

Fig. 2 is a sectional view taken substantially along line 2—2 of Fig. 1;

Figs. 3, 4 and 5 are fragmentary sectional views taken substantially on line 3—3 of Fig. 1, showing certain parts of the control mechanism in different positions;

Fig. 6 is a schematic showing of an electrical refrigerator motor and evaporator heater circuits, and a switching device of the defroster control connected therein; and

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Fig. 7 is a view similar to Fig. 6, but showing the defroster control switch in a different position.

Referring to the drawings, a control mechanism 10 embodying the invention is shown which is operative to initiate and terminate defrosting cycles in the evaporator of an electrical motor-driven refrigerating apparatus R. The refrigerating apparatus comprises a compressor and motor unit M, a condenser C and an evaporator E, all connected to form the well known compressor-condenser expansion refrigerating system. The power for the motor is supplied through lines L1, L2 and the operation of the compressor motor is controlled by a thermostatically operated switch T which may be of any conventional construction and is preferably responsive to the temperature of the evaporator. An electrical heating element H is arranged to heat the evaporator E and melt the frost therefrom when the heater is energized. The control mechanism 10 is operative to open the circuit for the motor M and close the heater circuit to defrost the evaporator at a predetermined hour of each day, and to open the heater circuit and reclose the motor circuit to restore normal refrigeration when the temperature of the evaporator has reached a predetermined maximum. It is to be understood that the invention could be used in connection with mechanical refrigerating systems other than that disclosed and that other means for applying heat to the evaporator to defrost the same could be employed.

The control mechanism 10 includes a housing 11 having a snap switch 12 supported in one end thereof. Any suitable switching mechanism could be used and in the form shown the switch comprises a base 13 formed of a suitable dielectric material having terminal members 14, 15, 16 attached thereto and projecting therethrough to the exterior of the housing. The terminal member 14 is part of a bridge-like bracket 14' which carries a fixed contact 17 on the interior of the housing and spaced from the base 13. The terminal member 15 is part of a bar which is attached to base 13 and carries a contact 18 which is spaced from and opposite the contact 17. A double contact 19 is carried on one end of a pivoted contact strip 20 which end is snap moved between the contacts 17, 18 to alternately engage contact 19 with the latter contacts. The opposite end of the contact strip 20 is attached to a bracket 21 of which the terminal 16 is a

part and the contact strip is formed of conducting material so that a circuit may be established from the terminal 16 through the contact strip to either terminal 14 or 15.

The strip 20 is snap moved in opposite directions by a toggle member 22 which is disposed in a central opening in the strip and has one end pivoted to the strip and the opposite end of the toggle member has spaced stops which engage opposite surfaces of a stop lug 21a to limit the swinging movement of the toggle. A tension spring 23 is connected at one end to the swinging end of the toggle and the opposite end is attached to a tongue 24 which extends from a leg 25 of an L-shaped operating lever 26 which is pivoted to shoulders 27 on the bracket 21. The tongue 24 is adapted to extend through the opening in the contact strip, and when the lever 26 is oscillated the spring 23 is shifted so that its line of tension moves from one side to the other of a dead center line, extending through the pivot of the toggle member and the axis of the spring, and the toggle member is thereby snapped from one of its stops to the other and urges the contact strip in one direction or the other between contacts 17, 18 as the case may be. The leg 25 of lever 26 includes an extension 28, preferably formed of dielectric material which strikes the bracket 14' to limit clockwise movement of the lever 26.

The particular switch construction shown is the subject of the United States patent of Estel C. Raney, No. 2,651,690, and as mentioned previously this particular construction is not essential to the invention.

The pivot for the operating lever 26 is located relative to the toggle member 22 so that the tension of the spring 23 tends to rotate the lever clockwise when the axis of the spring moves to the upper side of the center of contact strip 20, as seen in Fig. 6, and urges the lever counterclockwise when the center tension is on the lower side of the contact strip, as seen in Fig. 7. By this arrangement the operating lever 26 is urged by the spring 23 to either of two extreme positions, which may be referred to as control positions, and by initially moving the lever a predetermined distance from either control position toward the other, the spring 23 becomes effective to urge the lever to the other position.

The switch mechanism is connected in the circuit of the refrigerating apparatus so that when the operating lever 26 is in the position shown in Fig. 6 the circuit for the motor M is established from L1 through the switch T, motor M, contacts 17, 19, contact strip 20, terminal 16 to L2, and when the operating lever is moved counterclockwise to the position shown in Fig. 7, the motor circuit is interrupted at the contacts 17, 19 and a circuit through the evaporator heater H is established from line L1 through heater H, contacts 18, 19, contact strip 20, terminal 16 to line L2.

The operating lever 26 is moved from the position shown in Fig. 6, which may be considered its normal position, to the defrost cycle initiating position shown in Fig. 7 by a clock or time device 32, and is moved from the defrost position to its normal position by a thermo-responsive mechanism 33 which is responsive to temperature in the evaporator to terminate the defrost cycle and restore normal refrigerating cycles.

The time mechanism 32 preferably comprises an electric synchronous motor 36 which drives an eccentric 35 through a suitable reduction gear train which drives the eccentric at one revolution per hour. A pawl 37 is attached to the eccentric and is oscillated thereby to drive a ratchet wheel 38 mounted on a shaft 40 which is journalled in a bushing 42 in a wall of the housing 11. The ratchet wheel 38 preferably has twenty-four teeth, and the pawl 37 advances the wheel one tooth per hour so that the wheel makes one revolution each twenty-four hours. The pawl 37 has a slot 43 therein into which the wheel 38 projects, and a spring 45 urges the pawl into engagement with the ratchet teeth of the wheel. By this construction, the walls of the slot 43 cooperate with the sides of the ratchet wheel to guide the pawl in its reciprocation. The ratchet wheel has sufficient resistance to rotation thereof to prevent movement of the pawl along the inclines of the ratchet from rotating the wheel counterclockwise, as viewed in Fig. 2.

In the preferred form the ratchet wheel 38 is frictionally connected to the rod 40 so that the rod may be rotated manually counter to the direction of rotation of the ratchet, and a friction clutch is provided which comprises a flange 46 formed integral with the rod 40 and a hub and flange 48 formed integral with the ratchet wheel 38, and the flanges 46 and 48 face one another and have a washer 49 of suitable friction material therebetween. The flange 46 is urged against the washer by a coil spring 51 which surrounds a portion of the rod 40 and is compressed between the ratchet wheel 38 and a disk 54 on the rod.

As actuator is carried on the shaft 40 so that it may rotate freely relative to the shaft, and the actuator comprises a disk-shaped member 56 having an arm 57 projecting radially therefrom. The arm 57 is arranged to engage and depress a leaf spring 58 attached to the leg 60 of the operating lever 26 to move the lever to initiate a defrosting cycle as the disk 56 rotates on the shaft. It is desirable that the movement of the disk 56 through that segment of its rotation in which the arm 57 engages the spring 58 of the lever 26 be greatly accelerated over the speed of rotation of the shaft 40 so that the switch actuating lever can be restored to its normal position within a relatively short period without interference with the arm 57. To provide for the accelerated movement of the actuator disk 56, the disk is rotated by the driving member or disk 54 which is attached to and rotates with the shaft 40 and is connected with the actuator by a torsion spring 62 and a lost motion connection. The lost motion connection is effected by two axially projecting stops 63, 64 located adjacent the periphery of the driving disk 54 and which are located at 180° with respect to one another. The stops 63, 64 are arranged to engage opposite sides respectively of the arm 57. The torsion spring 62 is coiled around the rod 40 and one end thereof is hooked to the stop 64 and the other end is hooked to arm 57 and tends to urge the actuator disk 56 in the direction of rotation of the rod 40 by the ratchet wheel 38 and urges the arm 57 to the stop 64, as shown in Fig. 5.

The actuator disk 56 is restrained from rotation by the torsion spring as the arm 57 thereof approaches the spring 58 by a restraining means comprising a detent spring 67 attached at one end to a wall of the housing 11 and having the other end yieldingly disposed in the path of the arm 57. When arm 57 engages the detent 67 as

shown in Fig. 3, its rotation is arrested until stop 63 engages and drives it to deflect the detent to release the arm. The stoppage of rotation of the actuator disk 56 by engagement of the arm 57 with the detent causes the tension of the torsion spring 62 to build up as the disk 54 is rotated and when the arm 57 is positively moved by the disk 54 to actuate the detent to release the arm, the torsion spring snap moves the arm to stop 64 and during the snap movement arm 57 engages the spring 58 and deflects the operating lever 26, as seen in Fig. 4. The stop 64 is located relative to stop 63 to assure sufficient movement of the arm 57 that it will pass from the range of engagement with the spring 58 so that the operating lever can be returned to its normal position within a much shorter period than would be required for the rod 40 to rotate through the angle in which arm 57 is effective to move the operating lever to the defrost position.

In the form shown, stop 64 is 180° from stop 63, but this angle could be more or less provided the angle through which arm 57 is snapped is sufficient to clear the spring 58 of the operating lever as described.

When the control lever 26 is moved by the arm 57 to initiate defrosting it engages a lever 70 which is pivoted on a pin 71 supported in the walls of the housing 11. The lever 70 is preferably formed of sheet metal and the end opposite the pivoted end has an upturned lip which is engaged by the leg 60 of the operating lever. Preferably the leg 60 is formed of insulating material to prevent short-circuiting through the lever 70.

The lever 70 is a part of the thermoresponsive mechanism 33 and it is movable clockwise by an expansible wafer 72 to return the lever 26 to its normal position when the temperature of the evaporator has reached a predetermined degree above the melting point of frost. The wafer 72 is attached to a plate 73 which is supported in an opening in the housing 11 and it has a button 74 which engages a turned edge portion 76 of the lever 70. The wafer has a tube 77 connected therewith and the tube has a bulb 78 at its outer end which is suitably secured in heat exchange relation with the evaporator E. The wafer, tube and bulb are filled with a vapor, such as methyl chloride or sulphur dioxide, and the vapor pressure varies according to the temperature of the bulb, as is well understood in the art. Accordingly, as the temperature of the evaporator and bulb increases the vapor pressure increases and the wafer urges the lever 70 clockwise to move the operating lever 26 toward its normal position. Clockwise movement of the lever 70 is limited by a stop 80 struck inwardly from a wall of the housing 11.

The movement of the lever 70 by the wafer 72 is opposed by a tension spring 81, one end of which is hooked to a lug 82 on the lever 70 and the other end of which is attached to a nut 83 threaded on a bolt 84 rotatably supported in a bearing in a wall of the housing 11.

Preferably, the head of the bolt 84 is slotted so that the bolt may be rotated by a screwdriver to move the nut 83 therealong and thereby change the tension of the spring. The tension of the spring governs the temperature at which the lever 70 is moved by the wafer 72 to cause the operating lever 26 to be returned to its normal position, and ordinarily the spring 81 is adjusted so that the operating lever is returned to its normal position when the temperature in the evaporator and bulb is at least several degrees above the melting point of frost.

It is to be noted that spring 58 normally yieldingly moves the operating lever 26 when it is deflected by the arm 57 as described, but in the event lever 70 is in a position to block movement of the operating lever to initiate defrosting, spring 58 yields to the arm 57 so that the latter passes on to the stop 64, although the operating lever has not moved to cause defrosting. This situation may occur when the temperature of the evaporator is relatively high due to loading of the refrigerator with warm articles or by prolonged or frequent opening of the refrigerator cabinet door. The spring 58 thus eliminates the possibility of the arm 57 becoming stalled, in the situation just mentioned, and causing distortion or damage to parts or stalling of the synchronous motor.

It is desirable to provide for the selection of the hour of day at which the defrost cycles will occur, and this selection may be made by setting the driving disk 57 at a predetermined angular position by rotating the rod 40. A knob 85 is drivingly connected to the outer end of the rod 40 by a key 87 attached to the rod, and the knob preferably has a pointer thereon (not shown) which registers with a dial (not shown) on the face of the housing. The dial preferably has twenty-four markers indicating the hours of the day, and assuming that the knob is mounted on the rod so that the defrosting cycles are initiated when the pointer is at the 2:00 a. m. marking, the knob can be rotated accordingly to cause defrosting to occur at any other desired hour. The clutch mechanism comprising flanges 46, 48 and washer 49 permits the rod 40 to be rotated by the knob in either direction, although the ratchet wheel is prevented by the pawl from rotation in one direction.

Alternatively, the friction clutch between the rod 40 and ratchet wheel 38 could be omitted and the rod could then be turned only in the direction of rotation of the ratchet wheel to change the defrost hour.

By our invention we have provided a relatively inexpensive and reliable control mechanism for automatically initiating and terminating defrosting cycles in mechanical refrigerators. The mechanism is particularly suitable for use in refrigerators having means for accelerating the application of heat to the evaporator to melt collected ice or frost therefrom since the clock operated member for initiating the defrosting cycle is quickly removed from its actuated position following the initial operation of the control mechanism. Furthermore, in the event the evaporator is too warm for effecting the defrosting operation, the time mechanism cannot be stalled by the inability of the control lever to move to its defrosting position.

While the preferred form of the invention has been shown, it is to be understood that other forms and adaptations of the invention may be made without departing from the spirit of the invention as defined in the claims which follow.

Having thus described our invention, we claim:

1. A control mechanism comprising a control member movable between two control positions, means for moving said member from one of said positions to the other, an actuator movable in a path in which it moves into and out of range of operative engagement with said control member to move said member from said other position toward the first mentioned position, power means

including a driving member having a lost motion driving connection with said actuator permitting movement of said actuator independently of said driving member through said path, spring means urging said actuator from one limit of said lost motion connection and operative to move said actuator relative to said driving member through said path to actuate said control member, and means to prevent movement of said actuator by said spring through said path, the last mentioned means operative to release said actuator in response to predetermined movement of said actuator by said driving member.

2. A control mechanism comprising a control member movable between two control positions, means for moving said member from one of said positions to the other, a rotatable actuator including an arm movable in a rotary path in which it moves into and out of range of engagement with said control member during movement through a predetermined segment of said path to engage and move said member from said other position toward the first mentioned position, power means including a rotating driving member having a lost motion driving connection with said actuator permitting rotation of said actuator relative to said driving member to cause movement of said arm through said segment of said path independently of said driving member, spring means urging said actuator from one limit of said lost motion connection and operative to move said actuator through said segment of said path to actuate said control member, and means to restrain movement of said actuator by said spring through said segment of said path, the last mentioned means operative to release said actuator in response to predetermined movement of said actuator by said driving member.

3. A control mechanism comprising a control member movable between two control positions, means for moving said member from one of said positions to the other, a rotatable actuator including an arm movable in a rotary path in which it moves into and out of range of engagement with said control member during movement through a predetermined segment of said path to engage and move said member from said other position toward the first mentioned position, power means including a rotating driving member having a lost motion driving connection with said actuator

permitting rotation of said actuator relative to said driven member to move said arm through said segment of said path independently of said driving member, spring means urging said actuator from one limit of said lost motion connection and operative to move said actuator through said segment of said path to actuate said control member, means to restrain movement of said actuator by said spring through said segment of said path, the last mentioned means operative to release said actuator in response to predetermined movement of said actuator by said driving member, and means forming a resilient operative connection between said actuator and control member to permit movement of said arm through said segment of said path in the event the first mentioned means is operative to urge said control member toward said other position.

4. A control mechanism comprising a control member movable between two control positions, means for moving said member from one of said positions to the other, a rotatable actuator movable in a rotary path in which it moves into and out of range of engagement with said control member to engage and move said member from said other position toward the first mentioned position, power means including a driving member having a lost motion driving connection with said actuator permitting rotary movement between said driving member and actuator during movement of said actuator through said path, spring means urging said actuator from one limit of said lost motion connection and operative to move said actuator through said path to actuate said control member, and a yieldable detent engageable by a part of said actuator to restrain movement of said actuator by said spring through said path, said detent being deflected by movement of said actuator by said driving member and operative to release said actuator at a predetermined angular position of the latter.

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