United States Patent

[11] **3,625,197**

[72] Inventors **Rudolf Pirker**
Nurnberg;
Walter Link, Nurnberg; Hans Grunbauer, Beiersdorf; Roland Kelchner, Furth, all of Germany

[21] Appl. No. **883,252**
[22] Filed **Dec. 8, 1969**
[45] Patented **Dec. 7, 1971**

[73] Assignee **Licentia Patent-Verwaltungs-G.m.b.H. Frankfurt am Main, Germany**

[32] Priorities **July 31, 1969**
[33] **Germany**
[31] **P 19 38 908.3;**
Aug. 28, 1969, Germany, No. P 19 43 668.1; Sept. 12, 1969, Germany, No. P 19 46 201.2

[54] **CONTROL DEVICE**
31 Claims, 19 Drawing Figs.

[52] **U.S. Cl.** ..... **126/273 R,** 126/197, 219/413
[51] **Int. Cl.** **F24c 15/02**
[50] **Field of Search** 126/273, 197; 219/412, 413

[56] **References Cited**
UNITED STATES PATENTS

3,214,567	10/1965	Chisholm	219/413
3,317,708	5/1967	Bowling	219/412
3,410,988	11/1968	Nagel	219/412

Primary Examiner—Charles J. Myhre
Attorney—Spencer & Kaye

ABSTRACT: A device for controlling the cleaning cycle of a self-cleaning oven. A timer mechanically actuates a mechanism for locking the oven door before the cleaning cycle begins. This door-locking device has a bolt which is retained either by a bimetallic element or by the timer itself. An additional latching device assures that the bolt of the door-locking device can not be advanced unless the oven door is fully closed. A mechanism is provided that makes it necessary to set the oven control switch before the timer can be wound up. Once the timer is wound, and the heating elements for the cleaning cycle have been actuated, the timer can not be unwound except by running through the cleaning cycle. A thermal protection device is arranged in heat-conductive communication with the oven. A ventilator device, such as a fan, is arranged so as to normally cool this thermal protective device, as well as the other switching elements. If the timer fails to shut off the heating element for the cleaning cycle at the proper time, the thermal protective element will shut them off shortly after the ventilating device has been shut down by the timer. The timer only permits the locking device to be unlocked and the oven door opened after an appropriate cooling-off period.

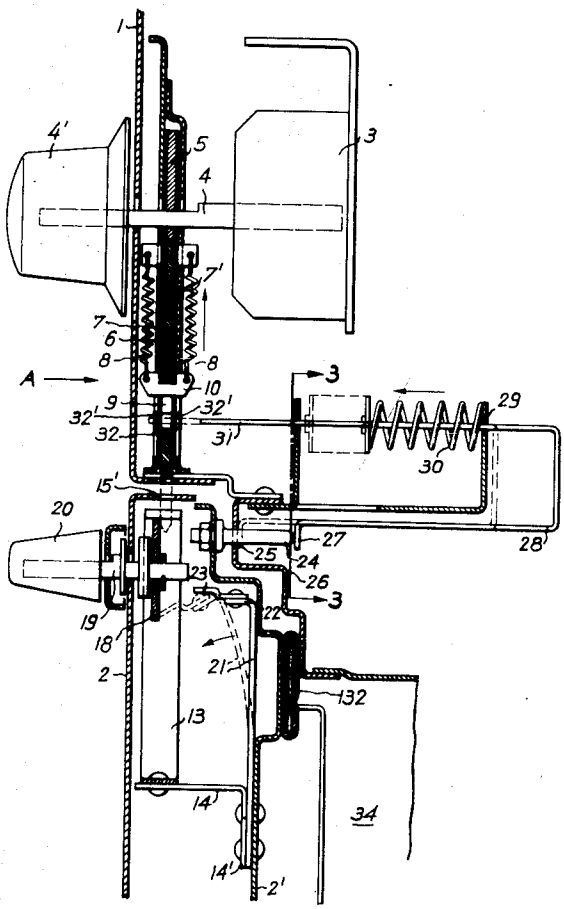
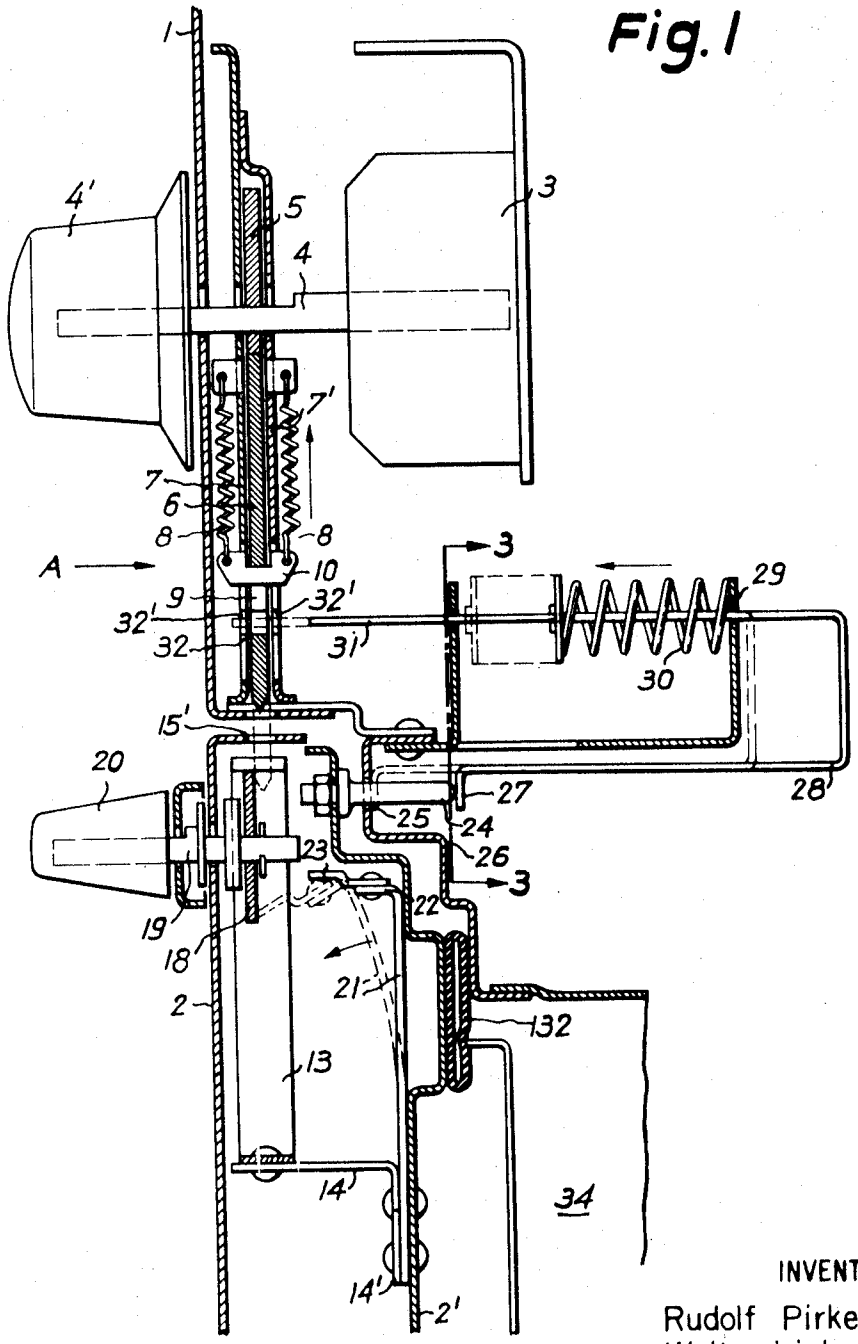


Fig. 1



INVENTORS.
Rudolf Pirker
Walter Link
Hans Grünbauer
Roland Kelchner

BY Spencer & Kaye
ATTORNEYS.

Fig. 2

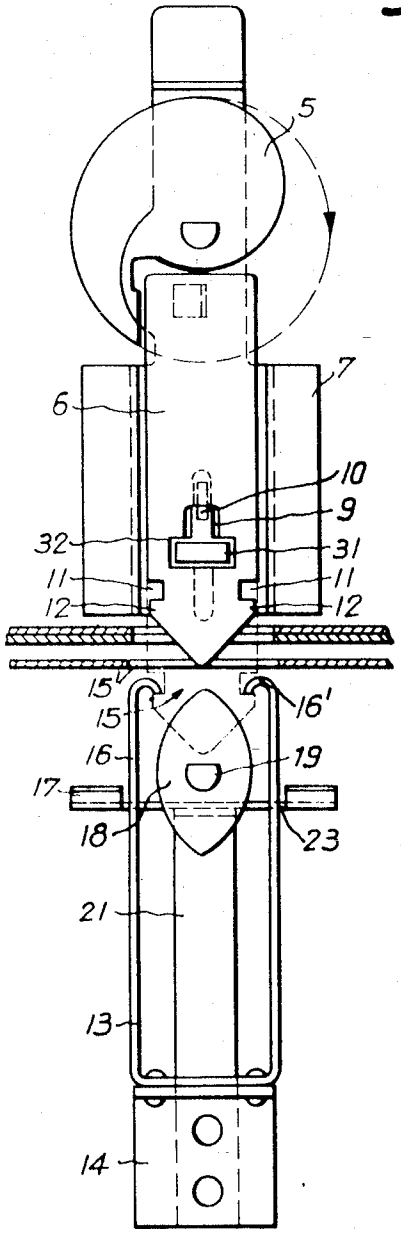


Fig. 3

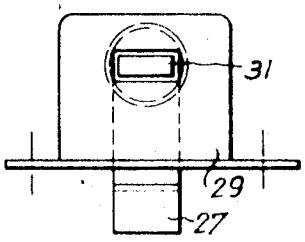
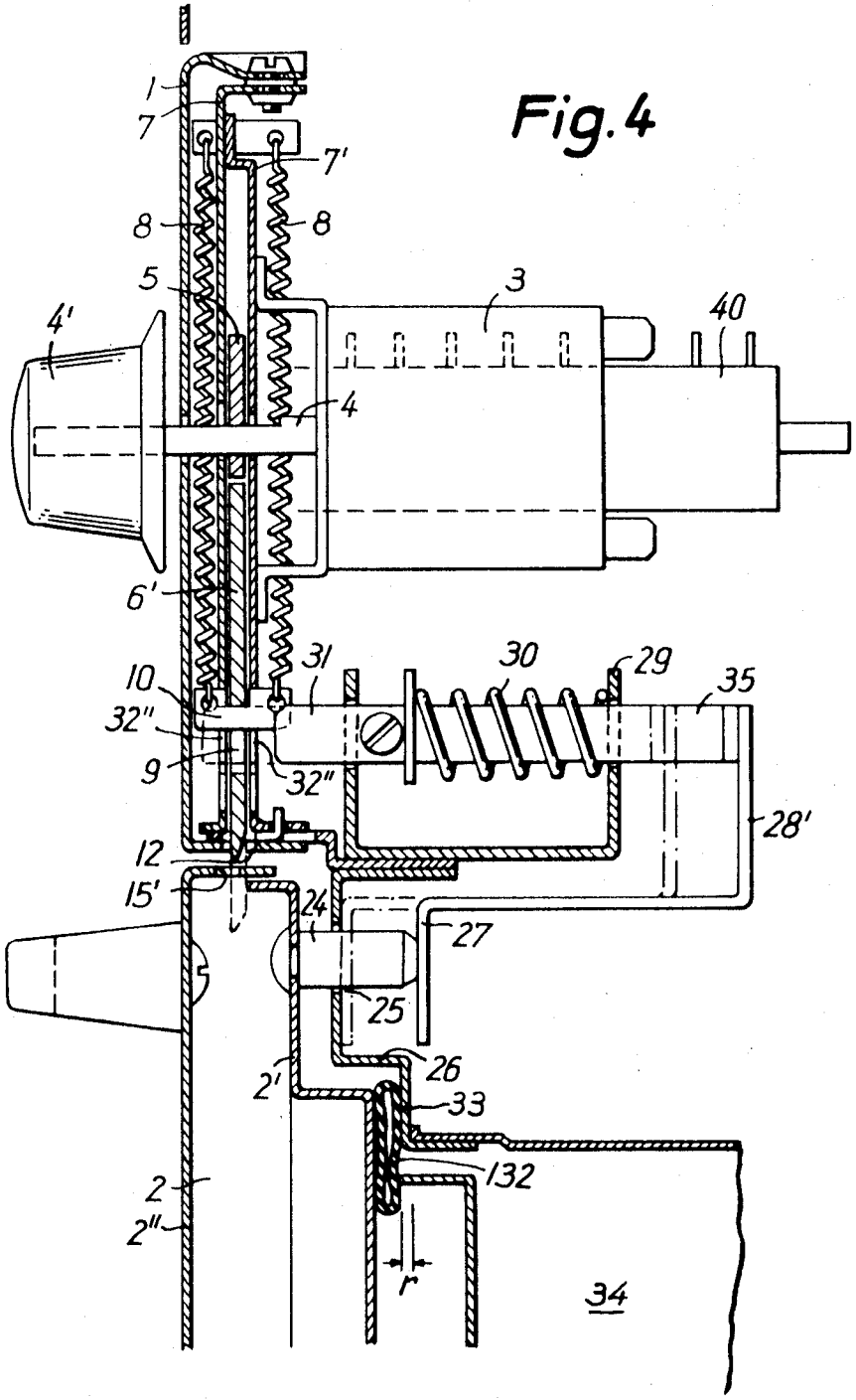


Fig. 4


1
7
7'
8
8
5
3
40
4'
4
6'
31
30
29
35
10
32''
9
32''
28'
12
15'
24
27
25
26
2'
33
132
2
2''
r
34

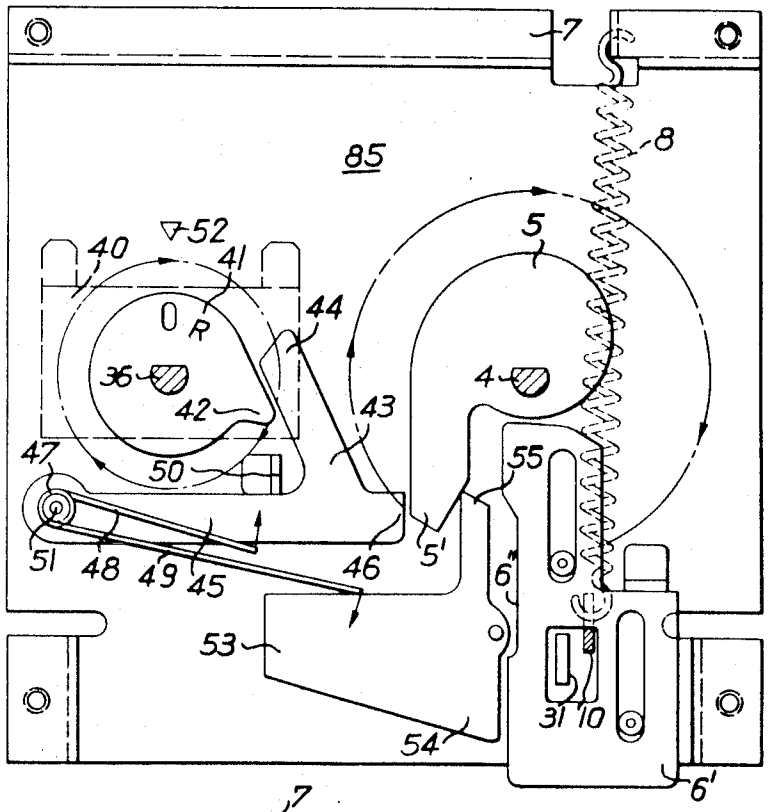

7
8
85
5
52
40
41
44
O R
36
42
43
4
47
50
55
51
48
49
45
46
5'
6"
53
31
10
54
6'

Fig.5

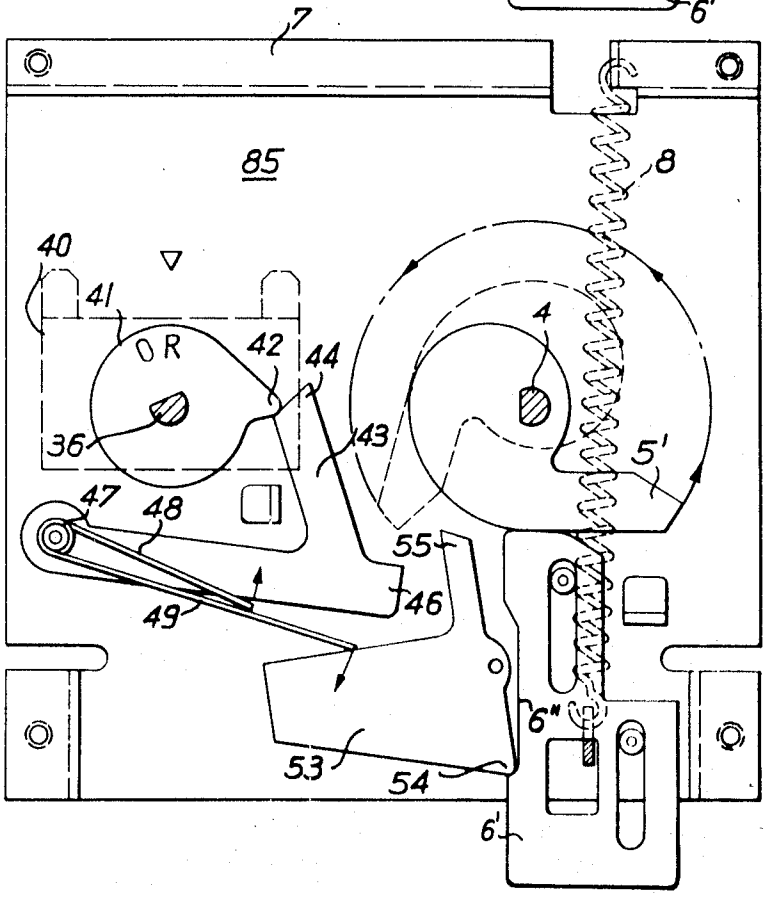

7
8
85
40
41
4
O R
42
44
36
43
5'
47
48
55
49
46
6"
53
54
6'

Fig.6

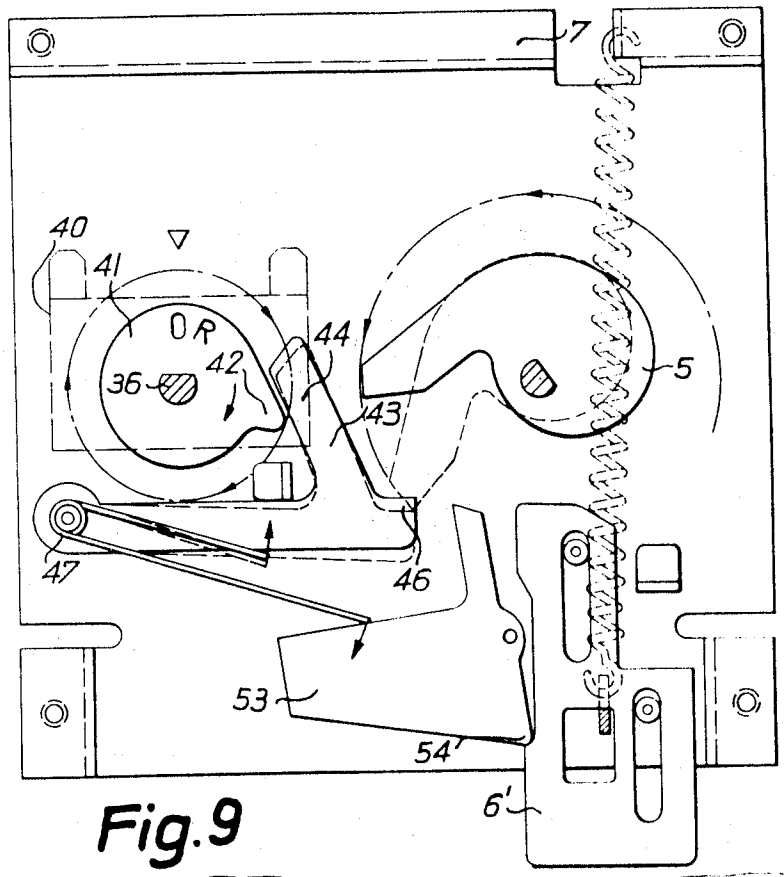


Fig.7

Fig.9

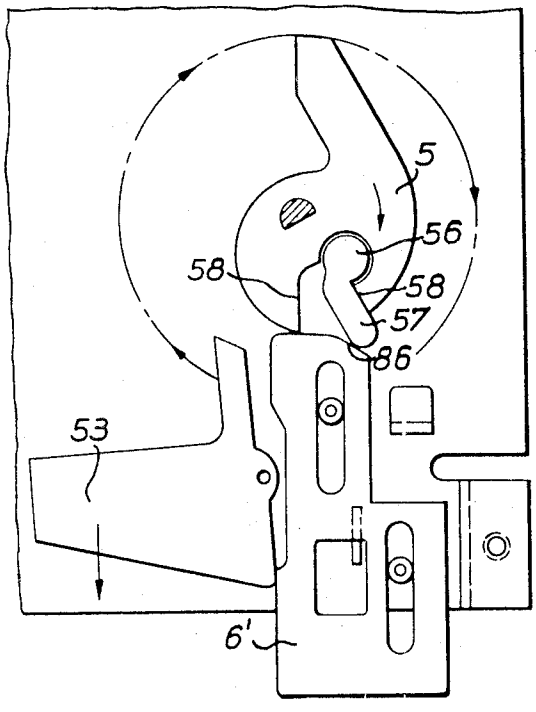
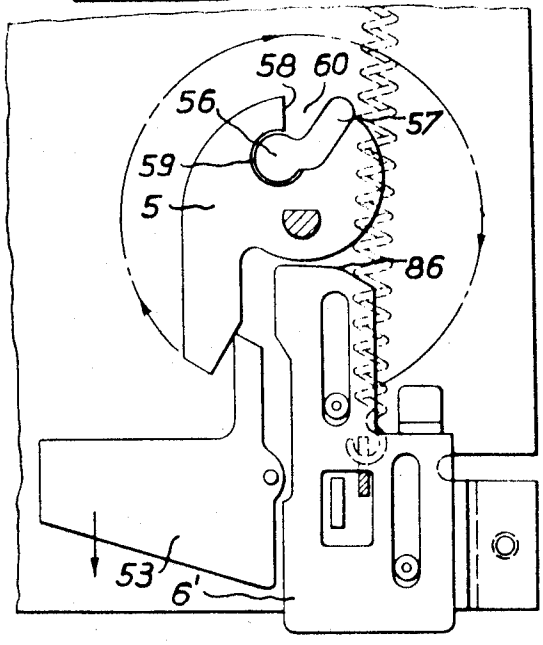


Fig.8



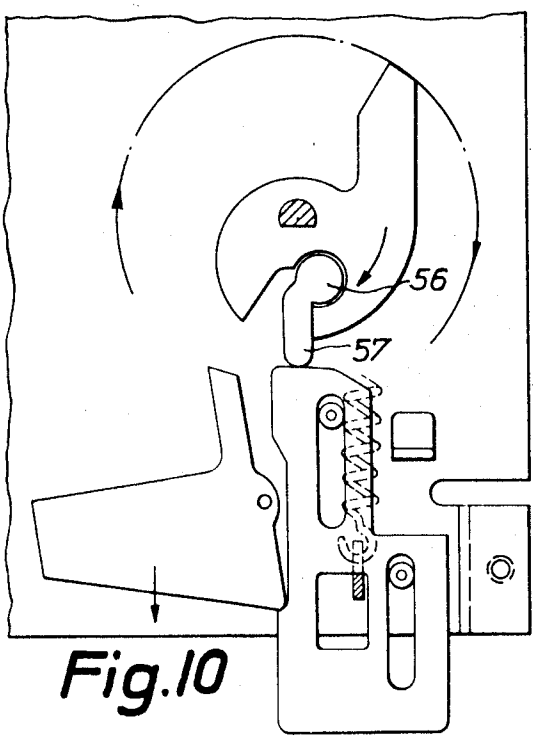


Fig.10

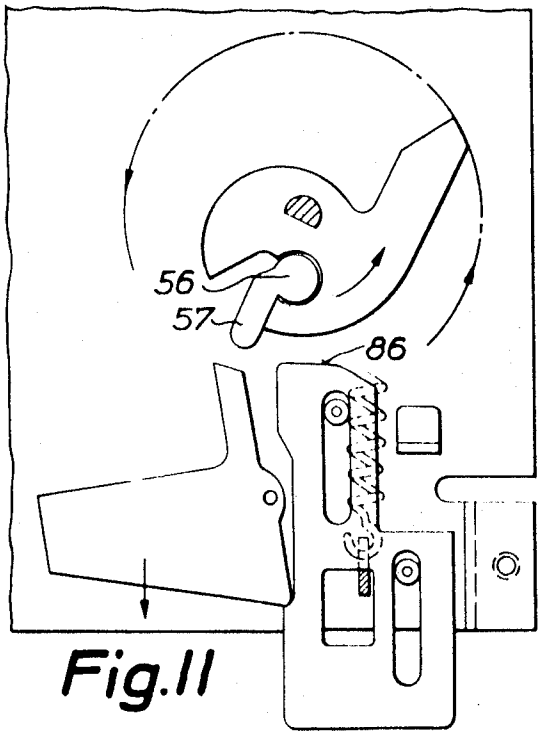


Fig.11

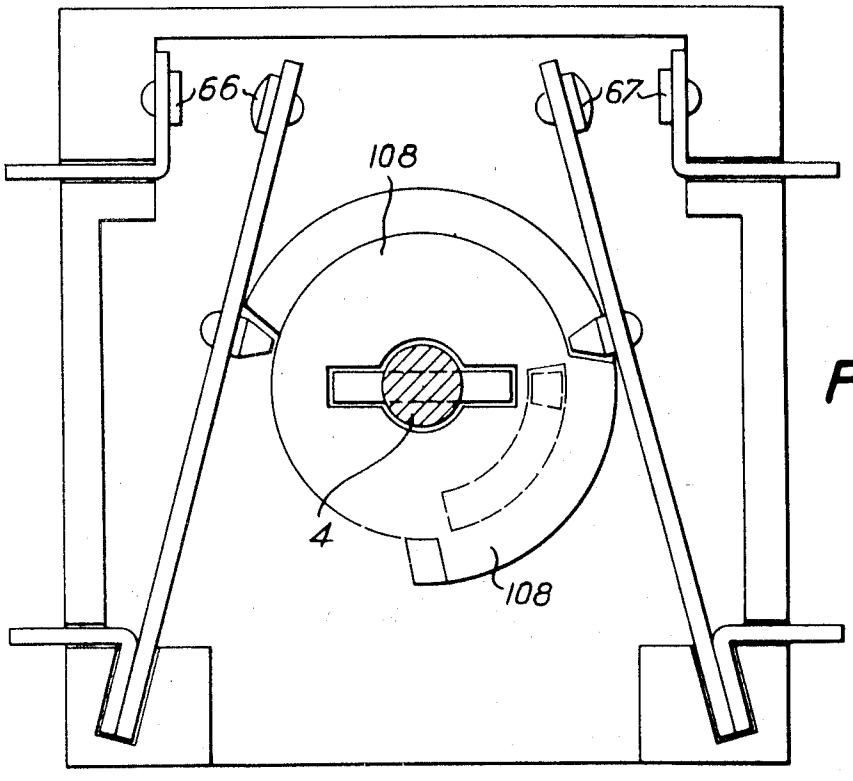


Fig.17

Fig.12

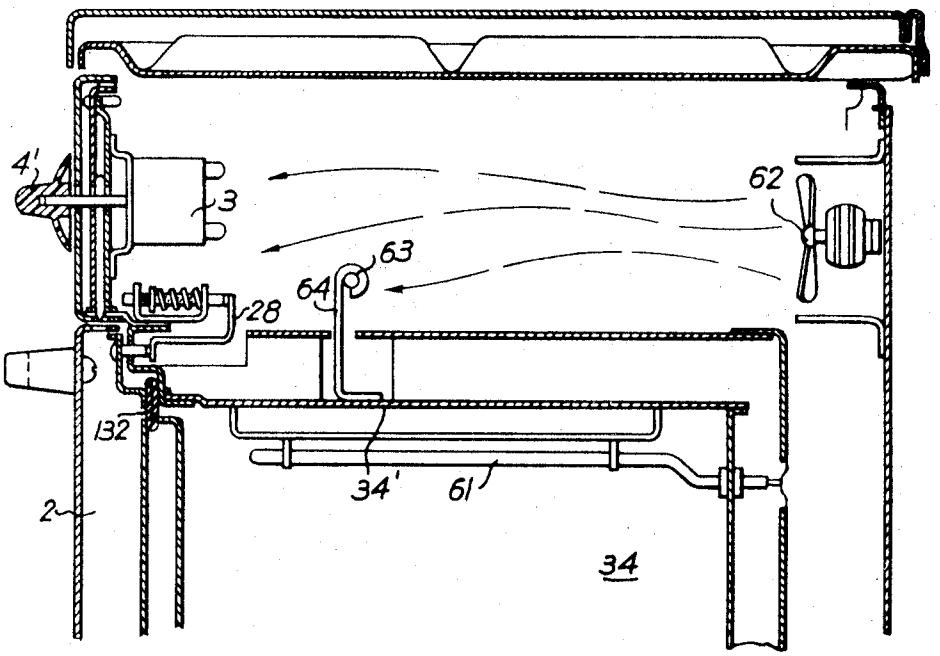

4'
3
62
63
64
28
132
2
34'
61
34

Fig.13

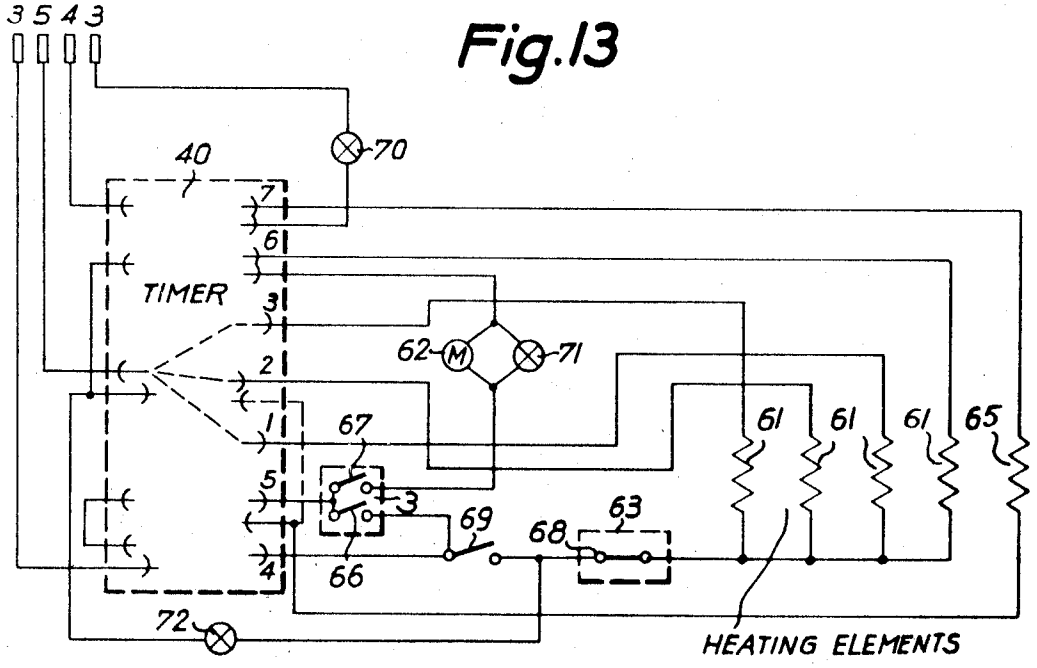

3 5 4 3
40
70
7
6
TIMER
3
2
1
5
4
62
M
71
67
3
66
69
68
63
61
61
61
65
72
HEATING ELEMENTS

Fig. 14

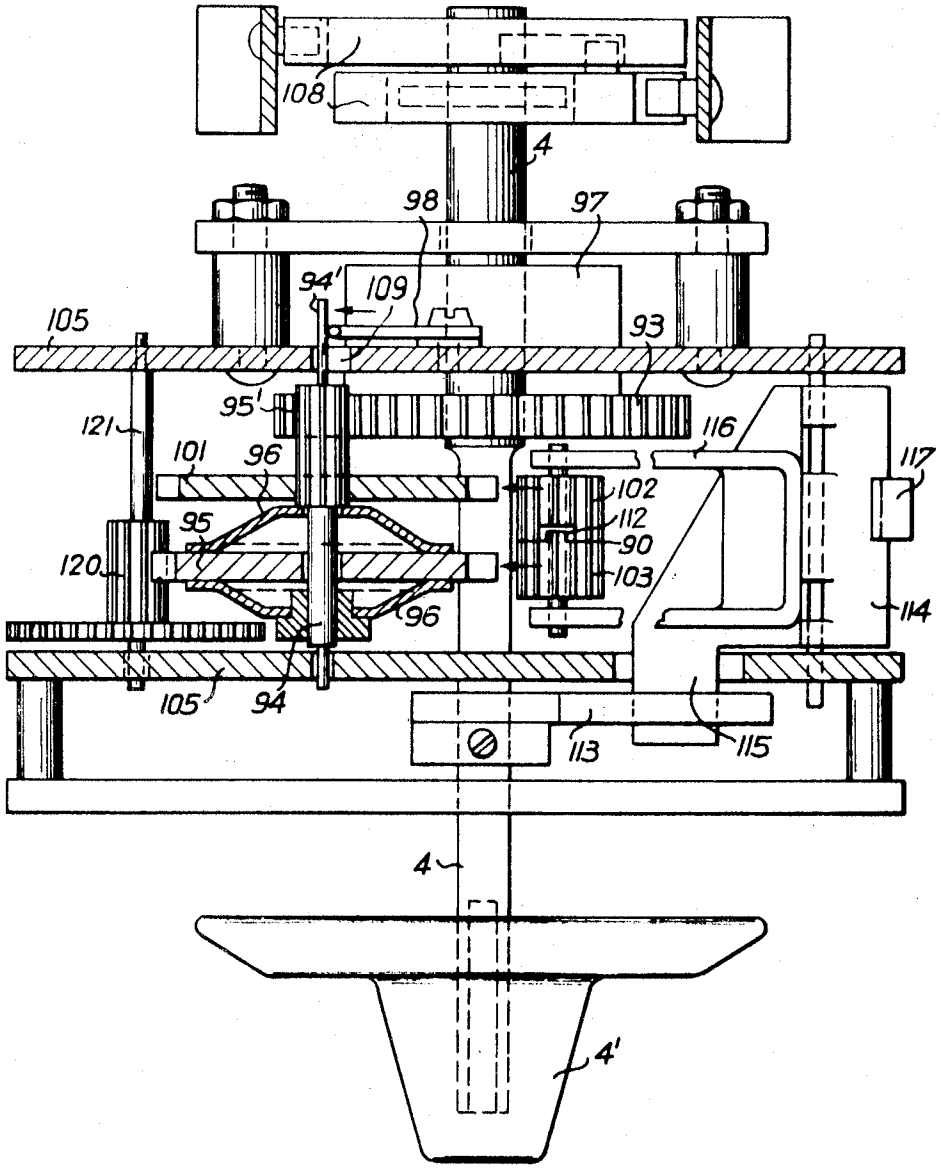

108
4
98
97
94'
109
105
93
95'
121
116
117
101
96
102
112
95
90
120
103
96
114
105
94
113
115
4
4'

Fig. 15

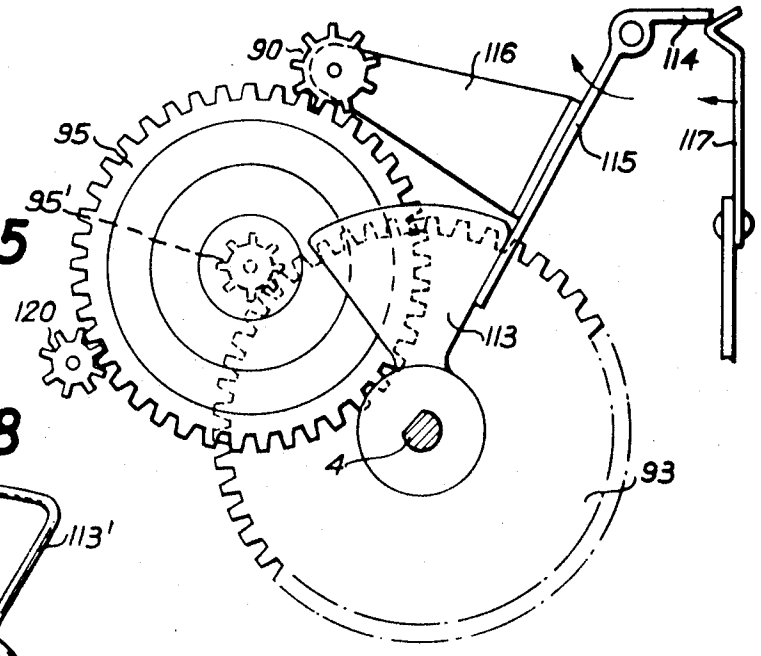


Fig. 18

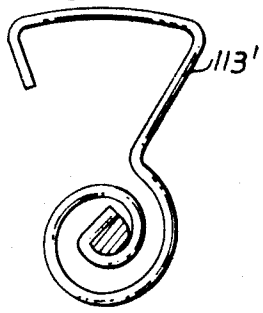


Fig. 16

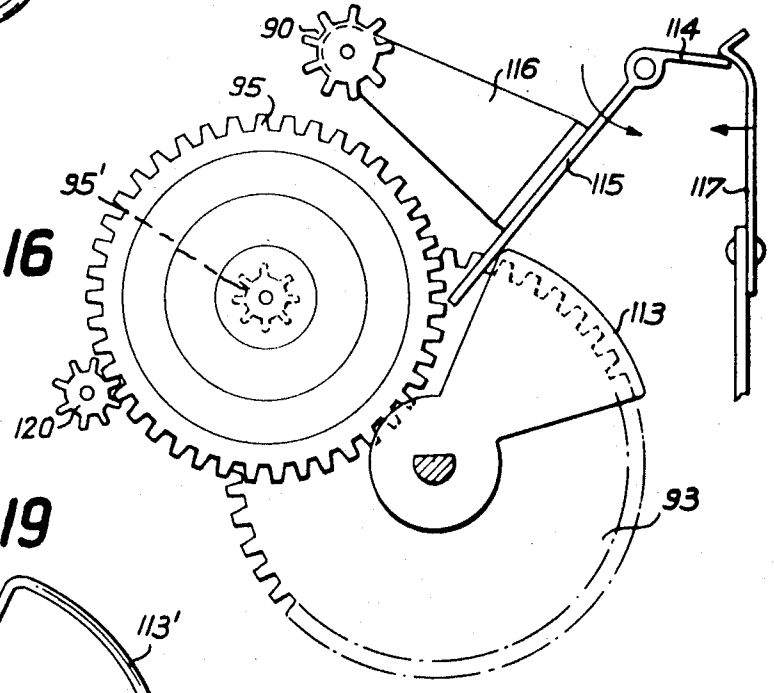
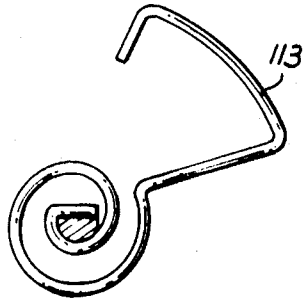


Fig. 19



CONTROL DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a kitchen range of the type which has a device for automatically cleaning the interior of the oven and a device which locks the oven door during the automatic cleaning process.

During baking or roasting there occur deposits on the interior surfaces of the oven. These deposits are especially due to the evaporation and splashing of greases. The removal of these deposits is extremely difficult and time consuming, even with the use of chemical cleaners. In a known baking and roasting oven, the interior surfaces of the oven are cleaned by heating the oven to a temperature substantially above the conventional baking and roasting temperatures. This method results in a decomposition of the food residues by pyrolysis, without ignition of the food residues. At the conclusion of the heat-cleaning process, and after the interior walls of the oven have cooled to room temperature, there only remains a slight residue in the form of ashes or dust on the interior walls. This residue, which does not adhere to the walls, can be wiped off with a dry cloth.

In order to be able to perform this combustion process smoothly, a large number of control and regulating devices are necessary. It is also necessary to take appropriate safety measures during the combustion process to provide protection against the high temperatures developing in the oven. These temperatures are usually between 400° C. and 530° C.

The most important feature of these safety measures is that the oven door can not be opened both during the combustion process and immediately after its completion. This assures that no personal or material injuries may occur from the high temperatures.

In a known electric range of the type mentioned above, the range is prepared for the combustion-cleaning process by the actuation of a preselect switch. A locking lever mounted on the oven door is then actuated and temporarily closes a microswitch through a suitable rod assembly. An electromagnet associated with the microswitch receives a voltage and advances a bolt. This opens the microswitch again, the coil of the electromagnet becomes free of current, and the bolt falls onto the microswitch.

At the same time, a gear is brought into engagement with a worm gear through the rod assembly of the locking lever, the gear being driven by a synchronous motor.

Voltage is applied to the synchronous motor when the preselect switch has been brought into position "clean," and the microswitch is closed. However, the lock can still be opened as long as the temperature in the oven remains below about 300° C. Once this temperature has been reached, a bimetallic switch is closed, which simultaneously short circuits the electromagnet and the microswitch, so that no more current flows through these two switches. The bolt held by the electromagnet falls down and blocks the locking lever so that it can no longer be moved. The oven door can now no longer be opened. The duration of the combustion process is determined by the gear driven by the synchronous motor. Upon completion of the combustion process, and after the temperature in the oven has fallen, the bimetallic switch opens, and the oven door can be opened again. The construction of this locking device is very complicated and expensive. The installation of this device is also very time consuming.

SUMMARY OF THE INVENTION

It is an object of the present invention to simplify the preparation of the range for the accomplishment of the automatic cleaning process and to provide the best possible operating safety for the user of the range. The construction of the present safety device is intended to be simple and easy for the user to operate.

This is accomplished according to the present invention in that the entire sequence of the automatic cleaning process and the device for locking the oven door is controlled by a timer.

Actuation of the timer causes the locking device for the oven door to lock at the beginning of the cleaning process and releases it upon completion of the cleaning process. The timer also controls the heating of the oven during the cleaning process. In addition to this, it is connected electrically in series with a protective device which, should the timer fail to switch off the heat in the oven after the automatic cleaning process is completed, takes over the monitoring of the temperature of the oven and cuts off the heating current to the oven.

The timer is connected electrically in series with a control switch controlling the heating of the oven and acts together with this control switch, so that the timer can only be wound after the control switch has been set to the automatic cleaning range and when the oven door is closed. In this way, it becomes impossible to unintentionally switch on the cleaning process, or to switch on the process when the oven door is open.

The locking device for the oven door, which is in operative connection with the timer, comprises a locking bolt under spring tension which, after being actuated by the timer, engages into the oven door. There is provided a latch device, or keeper, in the interior of the oven door for the locking bolt, which keeper comprises a U-shaped member, whose arms for holding the locking bolt are constructed to be flexible. During the cleaning process, the release of the locking bolt from the U-shaped keeper may be prevented by a bimetallic sheet metal strip disposed in the interior of the oven door. This bimetallic element prevents the release of the bolt by bending to a certain position at a certain temperature.

In this way, it is assured that the locking bolt engaged in the oven door can no longer be brought out of its latched position and, thus, the oven door can not be opened after a certain temperature, or temperature range has been reached.

In addition, the present invention provides a multiarm latch disposed behind the oven switch plate, which latch is under the pressure of a spring element acting in the direction of the bolt. When the oven door is open, the end of one arm of the latch engages into a transverse slot disposed in the bolt so that it prevents the bolt from being displaced. The end of the latch can be brought out of the slot when the oven door is closed by means of a pressure bolt mounted on the end of another arm of the latch. Thus, it is assured that the oven-locking device and, thus, the cleaning process, can be operated only when the oven door is closed.

In a further development of the present invention, there is proposed a device which cooperates with the timer and with which the bolt is retained in the oven door during the course of the cleaning process without the aid of a bimetal element.

This device is characterized by a latch latching the bolt when the bolt is retained in the oven door; which latch is under spring pressure and is pivotally mounted. This latch holds the bolt in its locking position until the timer has run down, whereupon the latch is suddenly released from the locking engagement with the bolt by means of an eccentric cam disposed on the setting shaft of the timer.

For certain switching processes, particularly those during the heating periods in an oven having a mechanism for self-cleaning the inner surfaces of the oven area, it is now necessary that, once the switch contacts for the heating circuit have been closed and the oven is being heated, it is no longer possible to reset the timer.

It is, therefore, a further object of the present invention to construct the timer in such a manner that it is possible to reset the timer to zero within a certain operating range, but that once the heating current contacts for the oven heating element are closed and the self-cleaning process has been switched on, the timer can no longer be interfered with. This assures a safe and dependable performance of the entire cleaning process. Accordingly, the timer is further so constructed that closing of the heating circuit contacts and the prevention of resetting of the timer occurs only when the time set on the timer is sufficient in each case for the control of the entire cleaning process. In other words, the timer can not be

reset once it has been wound to a sufficient extent for full cleaning cycle.

This is accomplished according to the present invention in that a device is disposed in the timer with a friction coupling rigidly connecting it with a winding mechanism when the timer has been wound over half the operating range of the timer winding knob, at which point the switch contacts are closed so that the knob can be operated only in the windup direction.

The advantages provided by this embodiment of the present invention consist particularly in that it is possible within a certain rotating range to effect a correction of an erroneous setting of the timer. Yet after the closing position for the heating current contacts has been reached, an uninterrupted operating sequence is assured for the entire cleaning process. In addition, the timer according to the present invention still offers the possibility to be wound, for demonstration purposes, to a point shortly before the contact closing position and then to be reset to zero again. The object set out above is furthermore accomplished in that the closing position for the heating current contacts is disposed at the halfway point of the rotating range. This allows a sufficiently large time period to be set for the performance of the cleaning process.

In yet another development of the present invention, it is advisable to effect the rigid connection of the friction coupling by means of a pivotal turning pinion which connects the friction coupling with a rigidly disposed gear. Advisably, the pinion is constructed to be divided into two cylindrical sections, and is provided with a jaw coupling which can compensate for the different tooth positions in the two gears to be connected together.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational cross-sectional view of a locking device for an oven door of a range according to the invention.

FIG. 2 is a front elevational view of the structure in the direction of the arrow A of FIG. 1, with the vertical portions of elements 1 and 2, part of element 7, and knob 4' removed.

FIG. 3 is a view along the line 3—3 of FIG. 1.

FIG. 4 is a view similar to that of FIG. 1 of a further embodiment according to the invention of a locking device for an oven door in which a bolt retained in the oven door is blocked by a device associated with a timer.

FIG. 5 is a front elevational view of the locking device and a blocking device of the bolt according to FIG. 4, with the switch aperture plate removed and the locking timer in its zero, or rest position.

FIG. 6 is a view similar to that of FIG. 5 showing the locking device and the blocking device of FIG. 5 in the switched-on position at the beginning of the cleaning process.

FIG. 7 is a view similar to that of FIG. 6 showing the same locking device and blocking device during the cleaning process, shortly before the timer which controls the locking device has run out.

FIG. 8 is a view similar to that of FIG. 5 of another embodiment of the door locking components when the associated timer is at its zero, or rest, position.

FIGS. 9 and 10 are views similar to that of FIG. 8 of the embodiment of FIG. 8 for two intermediate positions during the setting of the timer.

FIG. 11 is a view similar to that of FIG. 8 of the embodiment of FIG. 8 when the timer is fully set and at the beginning of its timing cycle.

FIG. 12 is a side elevational cross-sectional view through the upper portion of a range according to the invention with devices for performing the cleaning process.

FIG. 13 is a block circuit diagram of an electrical circuit for the cleaning process according to the invention.

FIG. 14 is a cross-sectional view of a timer for use in embodiments of the invention.

FIG. 15 is a front elevational view of a part of the timer of FIG. 14 showing the winding mechanism with a friction clutch.

FIG. 16 is a view similar to that of FIG. 15 showing a different position of the mechanism of FIG. 15.

FIG. 17 is a front elevational view of the electrical contact elements of the timer of FIG. 14.

FIGS. 18 and 19 are front elevational views of two respective positions of an alternative element for the mechanism of FIG. 15.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1, 2 and 3 of the drawings, there is shown a locking arrangement which includes a switch aperture plate 1, not shown in detail, and an oven door 2. Behind the switch aperture plate 1, there is disposed a timer 3 which is shown only generally and which can be set by means of a setting shaft 4 passing through the aperture in plate 1. With this timer, the time required to burn off the dirt in the oven 34 is set, or preselected, depending for example, on the amount of dirt present. An eccentric cam 5 is keyed on the setting shaft 4 and is arranged to act on a bolt 6 disposed behind the switch aperture plate 1 in a guide housing made up of plates 7, 7' parallel with the plate 1. The bolt 6 is acted on by tension spring elements 8 which have one end connected to the guide plates 7, 7' and their other end connected to a bar passing through a slot 9 in the bolt 6 and slots 32' in plates 7, 7'. Spring elements 8 may be of a type well known in the art. The end of the bolt 6 which serves to lock the oven door 2 is provided with a recess 11 on each side, so that at the end of the bolt there are formed two tongues 12.

A keeper 13 is disposed in the interior of the oven door 2 and is mounted on an angle bracket 14 fastened to the inside wall 2' of the oven door. The keeper 13 is provided with an opening 15 (see FIG. 2) which faces a somewhat wider opening 15' in the upper horizontal wall of oven door 2. The arms 16 of keeper 13, which are each provided with a bent portion 16' at their upper ends, are constructed to be flexible and are prevented from being deflected outwardly during the combustion, or cleaning, process by means of abutments 17.

To release bolt 6, the two arms 16 of the keeper 13 are bent outwardly by a spreader 18 disposed between the two arms. The spreader 18 is a cam element keyed to, and actuated through, a shaft 19 which is coupled with an actuation knob 20 extending from the oven door 2. A bimetallic sheet metal strip 21 is also disposed in the interior of the oven door and is cantilever-mounted between the arm 14' of the angle bracket 14 and the inside door wall portion 2'. The free end 22 of this sheet metal strip 21 is, for example, bent at a right angle. To this bent portion there is fastened a metal fork 23, which is provided with the abutments 17 for preventing the arms 16 from being deflected outwardly under the influence of thermal effects when the oven is at a high temperature.

In order to provide an additional guard against initiating the cleaning process when the oven door is not closed, a pressure bolt 24 is attached to the upper end of the door wall 2'. This bolt extends, when the oven door is closed against a suitable seal 132 through an opening 25 in the frame 26 of the oven 34 and presses against the angularly bent end 27 of a latch 28. The bearing for the latch is a guide element 29 mounted in the frame 26 of the oven. A suitable tension spring 30, such as a coil spring, guided along one arm of the latch 28 assures that the latch 28 is always urged in the direction toward bolt 6 so that end 31 of the one latch arm engages, whenever the oven door is open, into a transverse slot 32 provided in the bolt 6 and slots 32' in the guide housing 7, thereby to prevent downward movement of the bolt.

The operation of the locking device set out above will now be described.

When the timer 3 is wound through the setting shaft 4, the cam 5 is simultaneously rotated. The cam 5 acts on the bolt 6, and displaces it in a downward direction against the action of the spring elements 8. The bolt 6 penetrates between the upper ends of arms 16 with its downwardly pointed end. When the setting shaft 4 and the cam 5 are rotated further, the pointed end of the bolt spreads the ends 16' of the resilient

arms 16 apart until they engage into recesses 11 above tongues 12 when the bolt 6 is moved further on. The oven door is now locked.

After a certain temperature has been reached in the oven, the bimetallic sheet metal strip 21 bends out in the direction of the arrow in FIG. 1 and encloses the two arms 16 with the abutments 17 on its metal fork 23, so that the oven door can not be unlatched during the high temperature period of the cleaning cycle. Upon completion of the combustion process, i.e., when the time set on timer 3 has run out and the cam 5 and the bimetallic sheet metal strip 21 have returned to their starting positions, the oven door 2 can be unlatched and opened. In order to unlatch the door, the spreader element 18 is rotated which causes the arms 16 of latch 13 to be bent out until tongues 12 of the bolt 6 are released. The bolt 6 is then retracted into its rest position by the spring elements 8.

When the oven door is open, or only partially closed, spring 30 moves latch 28 in the direction of bolt 6 until the end 31 of latch 28 has been brought into the slots 32, 32' in bolt 6 and the guide housing plates 7, 7'. If one attempts to wind the timer in order to initiate the cleaning process, the end 31 of bolt 28 inserted into the slots 32, 32' prevents downward movement of the bolt 6. Thus, the bolt 6 can not be brought into its latched position in the oven door, the contacts of the timer 3 remain open and the heating elements 61 for the cleaning process (see FIGS. 12 and 13) can not be supplied with voltage. If, however, the oven door is closed, the pressure bolt 14 presses onto the bent-over end 27 of the latch 28 and moves the end 31 out of the slots 32, deflecting spring 30 in the process, so that the bolt 6 may engage in the oven door 2. The cleaning process can now be initiated as described.

The oven door locking device shown in FIGS. 4 to 11 has an advantage over the device described above in that the bolt 6' is retained in its keeper during the course of the cleaning process not by a bimetallic element, but by a device associated with the timer. This device will now be described.

The switch aperture plate is again marked 1 and the oven door of a range that is not shown in detail is again marked 2. The range is provided with a device for automatically cleaning the interior of the oven 34. The oven door 2 consists of an inner metal sheet 2' and an outer metal sheet 2'', and rests, when it is closed, against the edge 33 of the oven 34 via a suitable sealing element 132. Behind the plate 1 there is disposed a timer 3 which is shown only schematically and which can be set, or wound up, by means of the setting shaft 4 brought through the switch plate 1; a setting knob 4' is mounted on the outer end of the setting shaft. The timer serves to set, or preselect, the time required for burning off the deposits in the oven by the cleaning process, which time depends on the degree of soiling, and at the same time a device is actuated which causes the oven door to be locked during the cleaning process. This device will be described in detail below.

An eccentric cam 5 is keyed onto the setting shaft 4 of the timer 3, which cam acts on a bolt 6'. This bolt 6' is mounted so as to be displaceable behind the plate 1 in a direction parallel with the plate 1 between front and rear bearing plates 7 and 7', respectively. The bolt is under the influence of tension springs 8. The tension springs 8 are each mounted at one end by the plates 7, 7' and at the other end by the bar 10, which is brought through an opening 9' in bolt 6' and opening 32'' in plates 7, 7'. The end 12 of bolt 6', which serves to lock the oven door 2, is preferably of a wedge-shaped construction. When the oven door is locked, the oblique plane of the wedge presses this end against the edge of a passage opening 15' in the outer sheet 2'' of the upper surface of the oven door 2.

Thus, the door-sealing material 132 is compressed by the distance and is pressed firmly against the abutting surface 33 of the oven frame 26, so that the seal of the oven door is substantially improved during the course of the cleaning process.

In order to make certain that the cleaning process is not initiated when the oven door is not closed, a bolt 24 is attached to the inner sheet 2' of the door 2, which bolt 24 passes through an opening 25 in oven frame 26 onto the angularly bent end 27 of a latch 28' when the oven door 2 is closed. When the oven door 2 is open, the latch 28' keeps the bolt 6' in its rest position in a manner similar to that of latch 28, so that the timer 3 can not be wound up. The latch 28' is firmly connected with a metal tongue 35 which is mounted in a guide bracket 29 fastened to the oven frame 26. A coil spring 30, which is arranged around the metal tongue 35, biases the front end 31 of the metal tongue toward the bolt 6', so that the end of the tongue 31 can pass into the slot 9' provided in bolt 6' when the oven door is open. This prevents the timer 3 from being wound up.

FIG. 5 shows the oven door lock with the plate 1 and the front bearing plate 7 removed. In order to prevent unintentional winding of the timer, the setting shaft 36 of a conventional oven control switch 40 which controls the heating elements 61 (FIG. 13) of the oven and which is arranged adjacent the timer 3 behind the plate 1 is provided with a cam plate 41 bearing a cam 42 which controls a lever 43 blocking the actuation of the oven door lock in the normal setting range of the oven control switch 40. The oven door lock is blocked in such a manner that the end 46 of lever 43 comes to rest in front of the finger-shaped protrusion 5' of the eccentric cam 5, so that cam 5 can not be rotated in the direction of the arrow.

The lever 43, which consists of two arms 44 and 45 disposed at an angle to one another, is pivotally mounted by its arm 45 on a pivot bolt 51. The other arm 44 points in the direction of the cam plate 41 and extends parallel to the cam 42 of the cam plate 41 when the oven control switch 40 and, thus, the cam plate 41 are in zero position. The lever 43 is pushed upwardly against an abutment flap 50 during the zero position of the cam plate 41 by means of one arm 48 of a two-armed torsion spring 47, which is also mounted on pivot bolt 51. The other arm 49 of the spring 47 is supported by a pivotal latch 53 which holds the oven door 2 in its locked position after the bolt 6 has been displaced. For this purpose, bolt 6 is provided with a recess 6'' facing the latch 53, in which recess the latch 53 catches with its corner surface 54.

The timer 3 is advisably so constructed that the door-locking device does not become effective and the electrical contacts 66 and 67 (FIG. 13) of the timer do not close over a turning range of, for example, approximately 300 angular degrees of the timer setting knob 4', and, thus, the timer can be brought back into its starting position whenever desired. Only after an angle of, for instance, about 300° on the setting knob 4' has been exceeded are the switching contacts 66 and 67 closed, so that the oven-heating elements 61, the ventilation device 62 and an indicator device 71 are supplied with voltage (see FIG. 13). From this moment on the timer can no longer be returned into its starting position. The reason for this will be set out later.

In addition, the timer 3 is so constructed that it is possible to select a longer period for a heavily soiled oven and a shorter period for a less soiled oven. For this purpose, the setting knob 4' of the timer 3 is inscribed with, for instance, a capital "R" for a heavily soiled oven and a lowercase "*r*" for a slightly soiled oven.

In order to assure safe, reliable unlatching of the oven, approximately the last 30 degrees of the timer runs down in jumps. This produces the force which releases the latch 53 from its locked position with the bolt 6. Release of the latch is accomplished in that the finger-shaped protrusion 5' of the eccentric cam 5 suddenly hits against the arm-type abutment 55 of the latch 54.

To facilitate installation, the timer 3, the oven control switch 40, as well as all components of the oven door lock are combined on a mounting plate 85. This separately constructed component is disposed behind the switch plate 1 of the range.

The operation of the embodiment described above will now be set out.

In order to be able to wind the timer 3 by rotating the setting shaft 4 by means of knob 4' so that this winding process takes over the control of the entire cleaning process, it is necessary

to first rotate the setting shaft 36 of the oven control switch 40 until the "R" designating the cleaning process is opposite a marking point 52 on plate 1. According to FIG. 6, the cam 42 of the cam plate 41 has then pressed the member 44 of lever 43 downward against the effect of arm 48 of spring 47 to such an extent that the end portion 46 of lever 43 no longer prevents rotation of the cam 5 on the setting shaft 4 of the timer 3. By winding the timer 3 by means of the setting shaft 4, the cam 5, which is in operative connection with the setting shaft 4, will simultaneously be actuated. The cam 5 acts on the top end of the bolt 6 so that it is pushed downward, i.e., toward the oven door 2, against the force of the springs 8. At the instant shown in FIG. 6, the latch 53, which the arm 49 of spring 47 is biasing, has engaged recess 6'' of bolt 6' with its lower corner 54. The oven door 2 is now locked, and can only be opened after the timer 3 has completely run down and, thus, has brought the finger-shaped protrusion 5' of the cam 5 into contact with the arm-type abutment portion 55 of latch 53, so that latch 53 is brought out of engagement with the recess 6'' in bolt 6'. Bolt 6' is then pulled out of the oven door locking position by the force of tension springs 8.

Since the timer 3 is so constructed that once it has been set to a cleaning range, either "R" or "r," it can no longer be reset, it must always completely run down after the completed heating and cooling periods before it releases the bolt 6' and, thus, permits the oven door 2 to be opened. Even if during the course of the cleaning process the oven control switch 40 with its cam plate 41 is set to zero, or any other setting, the timer 3 can still return unhindered to its starting position, since, as shown in FIG. 7, during the return movement of the oven controller 40, the cam plate 41 mounted on the setting shaft 36 of the oven controller 40 does not cause the lever 43 to make contact with the latch 54 and bolt 6' so as to release portion 54 from bolt 6'. Thus, it does not unlock the door.

In order to avoid friction between the cam 5 and the slanted contact edge 86 of bolt 6' while the timer 3 is running down, FIG. 8 shows the cam 5 provided with a recess 59 in which a latch lever 56 is mounted. Latch lever 56 has a latch arm 57 which extends over the edge of the cam 5. The recess 59 becomes wider toward the edge of the cam 5 and is here so dimensioned that the protruding latch arm 57 is free to tip over a certain range 60 between two abutment points in the cam 5.

FIGS. 8, 9, 10 and 11 show separate views of the individual phases during the oven door locking process where the cam 5 is widened around the latch lever 56. As can be seen in these figures, winding up the timer 3 causes the cam 5, which is mounted on the setting shaft 4 of the timer, to be rotated in the direction of the arrow. After a certain angle has been passed, the bolt 6' is brought into the door locking position through the latch lever 57 mounted in the cam 5, after the abutment edge 86 of bolt 6 has been contacted. Since the bolt 6' is operated through latch arm 57, which is freely tiltable between two abutment points 58 within the recess 60 in the cam 5, during the rundown of the timer 3 the cam 5 does not come in frictional contact with the abutting edge 86 of bolt 6'. This keeps the running-down process of the timer free from any disadvantageous frictional influences.

The electrical sequence of the cleaning process will now be described with the aid of FIGS. 12 and 13.

The oven control switch 40 (FIG. 13) is used to set the individual heating possibilities, or specific temperatures, for the oven 34. A control switch 69 associated with the oven control switch 40 takes care that the oven 34 is held in the selected temperature range. The oven is heated by a plurality of conventional heating elements 61 which are connected in series with the control contact 69. There is also provided a further heating element for an afterburner 65, which is switched through a separate circuit.

A signal lamp 70 indicates when a voltage is applied to oven 34. The timer 3, which controls the entire course of the automatic cleaning process for the oven, is connected in series with the control contact 69. Two contacts 66 and 67 are associated with the timer. Contact 66 serves to close the circuit for heating the oven, whereas contact 67 closes the circuit for a ventilating device 62, which may be a propeller fan, and which provides cooling air to the switching elements. A signal lamp 71 is connected in parallel with ventilator 62, which lamp lights up when the cleaning process is switched on. A safety device 63, preferably a thermal fuse, is disposed in the air current produced by the ventilator, which device monitors the temperature in the oven and which is electrically connected in series with the heating elements 61 as well as the control contact 69 and the timer 3.

A signal lamp 72 is connected between control contact 69 and contact 68 of the safety device, which lamp lights up as soon as the heating elements for the oven are switched on. The safety device 63 is mounted on an angular iron member 64 which is fastened to the oven frame 34' of oven 34 in a good heat-conducting relationship (see FIG. 12).

The timer 3 for controlling the self-cleaning cycle for the oven 34 is so designed that a period of approximately 3 hours is available from the beginning of the cleaning process, when the oven door is locked by the locking device actuated by the timer, to the end of the cleaning process, when the oven door lock is released by the timer. During this period the entire cleaning process takes place, i.e., heating the oven to a temperature which is substantially above that generally used for baking and roasting, maintaining this temperature over a certain period of time and cooling the oven to a temperature which is harmless to the user.

Furthermore, the timer 3 is so designed that approximately one hour before completion of the timer period, the heat in the oven is turned off by the timer. The ventilator 62 remains switched on for approximately another 30 minutes in order to support the cooling process in the oven with its flow of air.

In order to initiate the self-cleaning process for the interior walls of the oven, the oven control switch 40 is set to position "R," thus winding the timer 3 and activating the above-described locking device. When a certain position of the timer knob 4' has been reached, it closes contact 66 which closes the heating circuit for the oven and also closes contact 67, which controls the circuit for the ventilator 62.

The temperature required for the cleaning process is reached in the oven after approximately 30 to 45 minutes. The actual cleaning process then takes another 75 minutes. After this time—a total of approximately 2 hours—the timer 3 opens contact 66, which controls the heating circuit, while the contact 67 for the ventilator circuit remains closed for approximately another 30 minutes. At this time the timer also opens it. After expiration of another 30 minutes, after the opening of contact 67, the timer 3 also makes the locking device in the oven door ineffective.

If the heating current is not switched off at the time determined by the timer, which is approximately 60 minutes before the timer is run down, due to burning or sticking of contact 66, the oven continues to be heated. The fan 62 is still switched on at this time. After approximately 30 minutes, the timer opens the contacts 67 in the ventilator circuit 62. Since now the overheating protection element 63 which is disposed in the air stream of the ventilator, and which is in heat-conductive connection with the oven walls, no longer receives any cooling air, the temperature at the protective device 63 increases sharply and trips the device by opening contact 68. The current supply to the heating elements 61 of the oven is interrupted. There are still approximately 25 minutes left for the oven to cool.

The described device has the advantage that the course of the cleaning process, as well as the control of the oven door lock, is accomplished completely mechanically. Only two elements must be manipulated to switch on the cleaning process once the oven door is closed. They are the knob (not shown) of the oven control switch and the winding knob 4' for the timer. The oven door locking mechanism of the present invention can also be used when the range is not electrically connected. Thus, it is also very well suited for ranges which are heated with gas.

In order to obtain sufficient time for switching, the position of the winding knob 4' at which the heating current contacts 66, 67 are closed is preferably placed at an angle of about 250°. This results in the advantage that there is still sufficient windup available for the timer after the heating current contacts have been closed to carry out a cleaning cycle.

FIGS. 14 to 19 show a timing mechanism for a preferred embodiment of the present invention.

The operating shaft 4 for the timer 3 has a turning, or winding, knob 4' fastened on one end. On the operating shaft 4, there is also disposed a gear 93 which is normally in engagement with a pinion 95' disposed on a shaft 94. Shaft 94 is mounted between the housing walls 105, 105' of the timer 3 so as to have a certain amount of axial play. One end 94' of shaft 94 is mounted in a slot 109 in housing wall 105' so that it has lateral play. A gear 95 is arranged on shaft 94 so as to rotate relative to it. Gear 95 is rotated with shaft 94 by means of friction disc springs 96, which act as a clutch so that gear 95 can serve to wind a conventional clock spring 97. The presence of the disc springs 96 makes it possible to turn the gear 95 in both the clockwise and counterclockwise directions. When gear 95 is rotated in the clockwise direction, the rear end 94' of the shaft 94, which is normally biased to the left by a spring 98, is pivoted toward the right of the slot 109 by the well-known action of pinion 95' with gear 93 until the gear 95 no longer engages in an associated pinion 120. This makes it possible to wind the clock. Pinion 120 is keyed on fixed, nonrotating shaft 121. When the gear 95 is rotated in the opposite direction, the gear 95 slides between springs 96 so that the winding knob 4' can be turned back. At a winding angle of approximately 250° for the turning knob 4', abutment discs 108, which are provided with cams 108', close contacts 66, 67. The abutment discs 108 actuating the contacts 66, 67 are placed on the end of operating shaft 4 which is opposite the winding knob 4'. Simultaneously with closing of contacts 66, 67, the present invention provides that a pivotally mounted, two-part pinion 90 is pivoted into position. Pinion 90 connects the gear 95 with a further gear 101, which is rigidly mounted on shaft 94. The pivot action of the two-part pinion 90 is initiated by an operating arm 113 fastened to the operating shaft 4. Arm 113 acts, when a turning angle of about 250° has been reached by the knob 4', on a two-armed pivoting lever 115 disposed in the housing walls 105, 105' of the timer, on which pinion 90 is mounted by means of a U-shaped holding bar 116 (see FIGS. 14–16). While the pinion 90 is in its pivoted-out position (FIG. 16) it is maintained at rest by a spring element 117 which engages the shorter end 114 of the two-armed lever 115. The operating arm 113 fastened to operating shaft 4 can also be replaced by a clock-spring-type bar 113' (FIGS. 18 and 19). This has the advantage that the clock can be wound further after the winding angle of about 250° has been exceeded, in order to be able, for example, to vary the cycle time.

In order to provide smooth engagement of pinion 90 into both gears 95 and 101 when they are in different positions during the pivoting of pinion 90, pinion 90 is constructed in two parts and is provided with a square jaw coupling 112. The jaws of coupling 112 are designed without a certain amount of play between them (see FIG. 14). This makes it possible for the two portions 102, 103 of pinion 90 to rotate against one another and safely catch in the teeth of gears 95 and 101.

The pivoted-in pinion 90 rigidly couples gear 95 with gear 101, and the effect of friction springs 96 is cancelled. After pinion 90 is pivoted in there is no longer a possibility to turn the turning knob 4' in a direction opposite to the winding direction of clock spring 97.

It is also possible to perform the coupling of the two gears 95 and 101 in another manner. The significant part is that simultaneously with the closing of contacts 66, 67 the effect of the friction coupling is cancelled and it becomes impossible to turn back the turning knob 4' of the timer 3.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

We claim:

1. A device for use with a self-cleaning oven having a door and a plurality of heating elements, comprising, in combination:
   a. timing means connected to the oven heating elements and controlling the energization of said elements thereby to control the sequence of the self-cleaning cycle;
   b. locking means connected to be actuated by said timing means for locking the oven door at the beginning of the cleaning cycle and releasing it at the end of the cleaning cycle; and
   c. temperature-responsive protection means connected electrically in series with said timing means and the heating elements for monitoring the temperature of the oven after completion of the self-cleaning cycle and interrupting the current to the heating elements should said timing means fail to do so.

2. A device as defined in claim 1 further including a control switch means for controlling the heat in the oven, said switch means electrically connected in series with said timing means, said timing means being windable, and said timing means and said switch means cooperating in such a manner that the timing means can only be wound after the oven door is closed and said switch means has been set to put the heating elements into the self-cleaning range.

3. A device as defined in claim 2, further comprising ventilator means for cooling said protection means, said protection means only taking over the monitoring of the temperature in the oven after said ventilator means has been switched off.

4. A device as defined in claim 3 wherein said timing means has two contacts, one of said contacts being connected in series with the heating elements, the control switch means and said protection means and the other of said two contacts being arranged in the circuit of said ventilator means, the sequence of said timing means being such that it first terminates the heating period of the cleaning process and disconnects the ventilator only after a portion of a cooling period of the oven has expired.

5. A device as defined in claim 4 wherein said timing means can be turned back to its initial position until being wound approximately 250 to 300 angular degrees, after which range the timing means closes and two switching contact to turn on the oven-heating elements.

6. A device as defined in claim 2, further comprising a cam plate associated with said control switch means, said cam plate being arranged as to only actuate said locking means when said switch means is set to the cleaning cycle.

7. A device as defined in claim 2 wherein said locking means includes a plurality of mechanically coacting elements, these elements, said timing means, and said control switch means being combined into a unitary structural unit arranged behind a stationary plate of the oven.

8. A device as defined in claim 1 wherein said locking means includes a bolt mounted on a stationary surface of the oven, said bolt biased in its retracted position by a spring, retaining means operative to retain said bolt in its forward position, and wherein said timing means is windable and has a winding shaft, and an eccentric cam element mounted on the winding shaft of said timing means and operatively connected to said retaining means so as to release said bolt when the cleaning cycle has ended.

9. A device as defined in claim 1 wherein said timing means includes a friction coupling element, a winding mechanism arranged to be connected with said friction coupling, means to connect said winding mechanism with said friction coupling when said timing means has actuated the oven heating elements.

10. A device as defined in claim 9 wherein said means to connect said friction coupling and said winding mechanism is a pivotally mounted pinion and a gear element, said pinion

being constructed in two cylindrical sections and having a square jaw coupling to connect the two sections together.

11. A device as defined in claim **10** wherein said timing means includes an operating shaft, an operating arm fastened to said operating shaft, said pivotally mounted pinion being pivoted by means of said operating arm.

12. A device as defined in claim **11** wherein said timing means further includes at least two housing walls, a pivoting arm mounted between said housing walls, said pivotally mounted pinion being mounted on said pivoting arm.

13. A device as defined in claim **1** wherein said timing means is so constructed that the time of the cleaning cycle may be varied, depending upon the degree of soiling of the oven.

14. A device as defined in claim **1** wherein said locking means includes a bolt mounted on a stationary plate of the oven, means biasing said bolt away from the door, a keeper mounted on the oven door; and means to retain said bolt in said keeper during the cleaning cycle.

15. A device as defined in claim **14** wherein said timing means includes a winding shaft, and said locking means includes an eccentric cam mounted on said winding shaft, said cam operable to advance said bolt into the oven door.

16. A device as defined in claim **15** further including a control switch means for controlling the heat in the oven, and wherein said locking means includes a lever which blocks said cam in the normal operating range of said control switch means, said lever actuated by said control switch means to release said cam when said switch means is set to the cleaning cycle, and said oven control switch means has a setting shaft on which a cam plate is mounted, said cam plate responsive to the rotation of said setting shaft to actuate said lever.

17. A device as defined in claim **16** wherein said lever has two arm members disposed at an acute angle with respect to each other and wherein said lever is pivotally mounted.

18. A device as defined in claim **17** wherein said locking means further includes a spring element pivotally mounted with said lever so as to bias said lever.

19. A device as defined in claim **17** wherein one of said two arms of said lever extends parallel to at least a portion of said cam plate when the oven control switch means is in its initial position.

20. A device as defined in claim **17** wherein said spring element has two arms, one arm pressing said lever against an abutment when the control switch means is in its initial position and the other arm being supported by at least a portion of said retaining means.

21. A device as defined in claim **20** wherein said bolt is held in its locked position by said retaining means after it has been advanced into said keeper.

22. A device as defined in claim **21** wherein said bolt has a recess at least on its side facing said retaining means, said retaining means engaging in said recess.

23. A device as defined in claim **22** wherein said timing means is designed so that the last 30 angular degrees of the timer run in jumps of more than 1°, so that said timing means suddenly releases said locking means when the cleaning cycle is completed.

24. A device as defined in claim **23** wherein said eccentric cam has a recess in its periphery, a freely movable latch lever mounted in the recess, said latch lever operative to advance said bolt (**6**) into the said keeper when said timing means is being wound.

25. A device as defined in claim **24** wherein said latch lever has a latch arm protruding over the edge of said eccentric cam, said eccentric cam having a recess in its periphery, said latch lever being arranged in said recess.

26. A device as defined in claim **25** wherein the recess becomes wider toward the edge of said eccentric cam.

27. A device as defined in claim **26** wherein said eccentric arm, said bolt, said cam plate, said lever, said retaining means and said latch lever are disposed in a common plate behind a stationary plate of the oven structure.

28. A device as defined in claim **14** further comprising means to retain said bolt in its retracted position, spring means to bias said retaining means in its retaining position, said retaining means including two parallel, spaced arm members, means in said bolt to receive one of said arm members, and means on the oven door to engage the other of said arm members and move said retaining means out of engagement with said bolt when the oven door is fully closed.

29. A device as defined in claim **14** wherein said means to retain is a cantilever-mounted bimetallic element having a metal fork element at its free end, said keeper being a U-shaped element constructed of a flexible material and having hooks on the end of each arm, a portion of said bolt engaging with at least one of said hooks, said fork having two abutment members which enclose the arms of said U-shaped element to retain said bolt in said keeper during the cleaning cycle.

30. A device as defined in claim **29**, further comprising a rotatably mounted spreader element mounted between the arms of said U-shaped keeper, means mounted on the oven door to rotate said spreader element so as to release said bolt from said keeper.

31. A device as defined in claim **29** wherein the portion of said bolt which engages with said keeper is provided on at least one side with a recess which engages with at least one of said hooks on the end of the arms of said keeper.

* * * * *