United States Patent [19]

Tapper

[11] **3,824,365**

[45] **July 16, 1974**

[54] **MICROWAVE OVEN CONTROL SYSTEM**

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[73] Assignee: **Litton Systems, Inc.,** Beverly Hills, Calif.

[22] Filed: **Dec. 7, 1972**

[21] Appl. No.: **313,188**

[52] **U.S. Cl.** ..... **219/10.55,** 200/38 B

[51] **Int. Cl.** **H05b 9/06**

[58] **Field of Search** ... 219/10.55; 200/38 B, 38 BA, 200/38 C, 38 CA, 38 FA

[56] **References Cited**

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Assistant Examiner—Hugh D. Jaeger
Attorney, Agent, or Firm—Robert M. Vargo

[57] **ABSTRACT**

A control circuit for a microwave oven is disclosed which functions to automatically control the running time of the microwave generator to enable it to run continuously, during its cooking cycle, or intermittently, during its defrosting cycle. The control circuit includes a timer control switch operatively coupled to a timer motor. The timer control switch functions to control the current flow from the source of electrical power to the microwave generator. The circuit also includes a defrost control switch which functions to cyclically open and close a series current path to the microwave generator. A bypass circuit is also provided across the defrost control switch to short-circuit the defrost switch and provide a bypass current path to the microwave generator. A "cook-defrost" switch is provided to connect the circuit to the bypass circuit for the cooking mode, or to disconnect the bypass circuit to enable the current path to be governed by the defrost control switch for the defrosting mode. In one embodiment, the defrost control switch is coupled to a second timer motor which, in turn, is adapted to be cut into and out of the circuit by the "cook-defrost" switch. In a second embodiment, the defrost control switch is coupled to the first timer motor and is continuously operated thereby.

21 Claims, 2 Drawing Figures

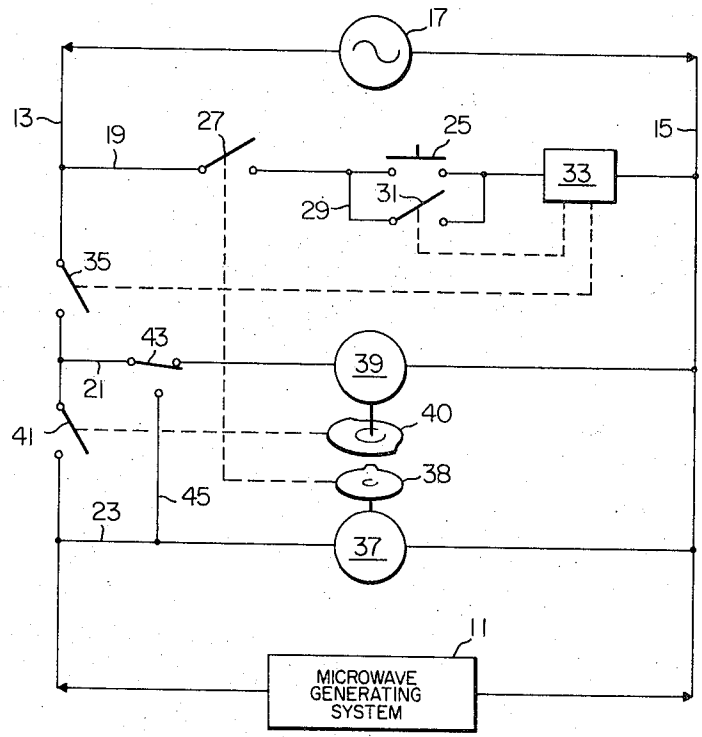
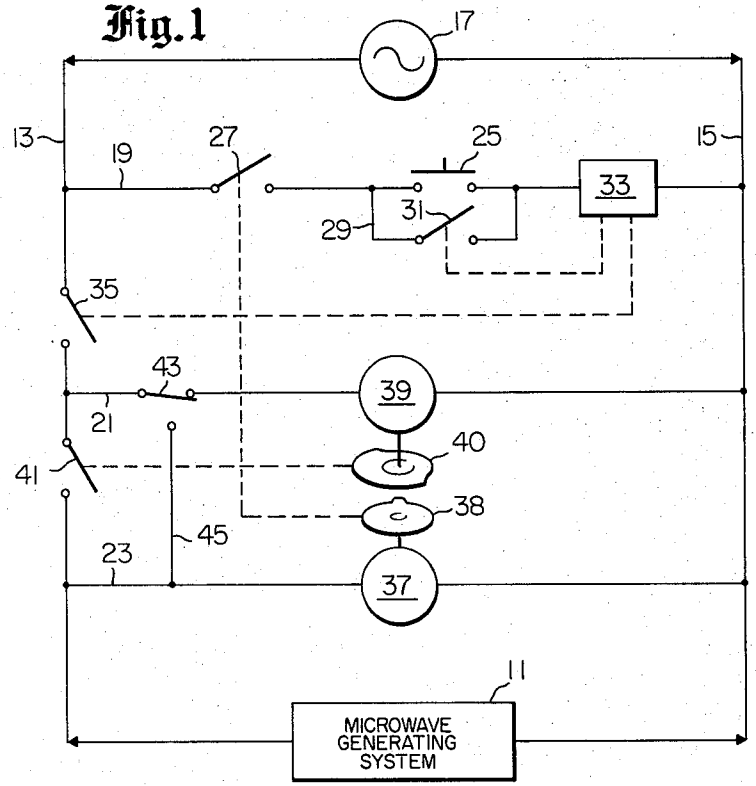


Fig. 1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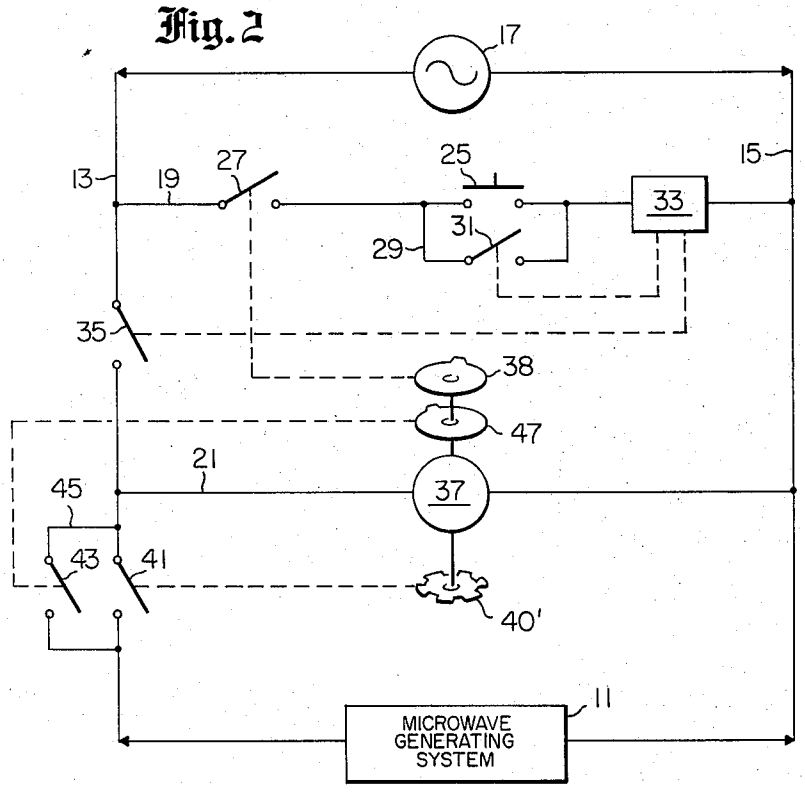
MICROWAVE GENERATING SYSTEM

Fig. 2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MICROWAVE GENERATING SYSTEM

MICROWAVE OVEN CONTROL SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to microwave cooking ovens and more particularly to systems for controlling the operating cycle of the microwave generators.

2. Description of the Prior Art

It has been found that in defrosting frozen products within a microwave cooking oven, the heating cannot be continuous but must be intermittent in order to enable the heat absorbed in each frozen product to be distributed throughout the body of the product. If standing times were not permitted to allow for this heat distribution, the exterior surfaces of the product would be entirely cooked, while the center would still be frozen.

Heretofore, defrosting operations conducted in microwave ovens had to be performed manually. In other words, the operator had to set the timer on the oven to a very short time (approximately one minute), then time the standing time with an independent timer, and repeat this process as many times as necessary to accomplish complete defrosting. This, of course, is very cumbersome, since it requires the constant attention of the operator. As a result, defrosting of frozen products, especially large frozen products, was highly impractical.

SUMMARY OF THE INVENTION

The present invention obviates the above-mentioned short-comings by providing a microwave oven having a control system which enables both the cooking and defrosting cycles to be accomplished automatically.

In its broadest aspect, the present invention comprises a microwave oven control circuit having a defrost control switch for opening and closing a current path between the power supply and the microwave generator, and a bypass circuit to short-circuit the defrost control switch and provide a bypass current path to the microwave generator. A "cook-defrost" switch is provided to selectively connect the circuit to the bypass circuit for the continuous cooking mode, or to disconnect the bypass circuit to enable the current path to be operated intermittently by the defrost control switch for the defrosting mode.

The features of the present invention which are believed to be novel are set forth with particularity in the appended Claims. The present invention, both as to its organization and manner of operation, together with the further advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of the control circuit for a microwave oven of the present invention; and

FIG. 2 is a schematic view of a second embodiment of the control circuit for a microwave oven of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, FIG. 1 illustrates a control circuit generally indicated by arrow **10** for controlling the on-time of a microwave generating system

11. Shown schematically, the microwave generating system **11** is conventional in construction and typically includes a magnetron for emitting microwaves into an oven cavity.

The control circuit **10** includes a two-part power line **13** and **15**, the two parts being connected at their one ends to a source of electric power **17.** Three lines **19, 21,** and **23** are connected in parallel across the lines **13** and **15.** The first line **19** includes a manual "cook" switch **25** which is normally biased in an open position, a timer control switch **27,** and a relay coil **33.** The cook switch **25** is preferably positioned to physically extend through the control panel of the oven. A bypass line **29** is connected across the cook switch **25** and includes a normally open relay switch **31.**

A second normally open relay switch **35** is located on the power line **13** between the parallel lines **19** and **21.** Both of the relay switches **31** and **35** are operatively coupled to the relay coil **33** to be closed thereby when energized.

The timer control switch **27** is mechanically coupled to a timer motor **37** which is located across the line **23.** This coupling is accomplished by means of a cam **38** mounted on the output shaft of the timer motor **37.** The angular position of the timer motor **37** and its cam **38** are adapted to be manually set by an interconnected dial which is preferably adapted to extend through the control panel of the oven. The cam **38** is adapted to be circular in shape with a single projection or cut-out located on the periphery thereof. The projection is adapted to trigger the timer control switch **27** at the end of the cam travel.

The line **21** includes a defrost timer motor **39** which is mechanically coupled to a defrost control switch **41** to open and close the current path through that portion of the power line **13** extending between the parallel lines **21** and **23.** As in the prior instance, this mechanical coupling is accomplished by a cam **40** mounted on the output shaft of the defrost timer motor **39.** The cam **40** is irregularly shaped to have a lower and upper cam surface, each representing half of the total cam travel. The cam **40** then functions to open and close the switch once for each cam revolution. For convenience, a conventional minute-timer motor rotating a one RPM is provided to enable the defrost control switch **41** to operate in 30-second equal cycles.

A cook-defrost switch **43** is provided to operate in a first position, which closes the line **21** to energize the defrost timer motor **39,** and a second position to interconnect the portion of the line **21** connected to the power line **13** with a lead **45** which, in turn, is connected to the line **23.** For convenience, this current path shall be called the bypass circuit which functions to short-circuit the defrost control switch **41** and enable current to be bypassed to the timer motor **37** and the microwave generating system **11.** It is preferable to have the cook-defrost switch **43** also extend through the control panel of the oven.

In operation when it is desired to operate the microwave oven in its cooking cycle, the timer dial on the control panel is first set to a setting corresponding to the duration of oven on-time desired. This action sets the cam **38** of the timer motor **37** to a predetermined position which in turn closes the timer control switch **27.** The cook switch **25** is then depressed to close the line **19** and activate the relay coil **33.** Upon actuation the relay coil **33** closes the relay switches **31** and **35.**

The first relay switch **31** functions to keep the line **19** closed after the cook switch **25** is released. The line **19** will remain closed until the timer control switch **27** is again opened by the timer motor **37.** The second relay switch **35** functions to close the power line **13** to enable current to pass therethrough.

In the cooking cycle, the cook-defrost switch **43** is in its second position to enable current to pass through the bypass circuit to energize the timer motor **37** and the microwave generating system **11.** Current continues to be fed to the microwave generating system **11** until the cam **38** on the timer motor **37** reaches its zero-time position to open the timer control switch **27.** This action functions to open the line **19** and de-energize the relay coil **33,** thereby releasing the first and second relay switches **31** and **35.** As a result, the line **19** is maintained in an open position and the power line **13** is opened. The opening of the line **13** stops the current flow to the timer motor **37** and the microwave generating system **11,** thereby shutting off the magnetron located therein. As can be seen, the microwave generating system **11** is dependent only upon the operation of the timer control switch **27** during the cook cycle, and the operation of the oven is continuous.

In the defrost mode, the timer dial is again set as before to close the timer control switch **27.** The manual cook switch **25** is then depressed to energize the relay coil **33** and close the relay switches **31** and **35.** The cook-defrost switch **43** is then manually depressed to move to its first position as shown on FIG. **1.** In this position, current is fed to the line **19** to energize the defrost timer motor **39.** The defrost timer **39** then functions to open and close the defrost control switch **41.** In the open position of the defrost control switch **41,** current cannot pass to the microwave generating system **11** or to the timer motor **37,** since the bypass path circuit **45** is also opened by the cook-defrost switch **43.**

In the closed position of the defrost control switch **41,** current passes through the line **13** to the timer motor **37** and the microwave generating system **11.** As stated previously, the cam **40** and the speed of the defrost timer motor **39** cooperate to cause the timer motor **37** and the microwave generating system to operate intermittently; i.e., 30 seconds on and 30 seconds off. After the timer motor **37** has been on the duration predetermined by the dial setting, the cam **38** reaches its zero-time position to open the timer control switch **27,** which in turn releases the relay switches **31** and **35** through the relay coil **33.**

The second embodiment of the present invention is shown in FIG. **2.** In this embodiment, the second timer motor **39** is eliminated and the defrost control switch **41** is mechanically coupled to the first timer motor **37.** Since the timer motor **37** is continuously running during the operation of the oven, the defrost control switch **41** is continuously opening and closing. This is different than the operation of the first embodiment in which the defrost timer motor **39** was inactivated during the cooking cycle and the defrost control switch **41** did not operate. In the second embodiment, the bypass circuit **45** is provided to again extend across the defrost control switch **41** to short-circuit the defrost cycler switch **41.** As a result, during the cooking cycle, the cook-defrost switch **43** is closed to provide a current path to the microwave generating system **11** independent of the defrost control switch **41.** During the defrost cycle, the cook-defrost switch **43** is opened to enable the current path to be controlled by the defrost control switch **41.** The operation of the manual cook switch **25,** the timer control switch **27,** and the relay switches **31** and **35** all function in the same manner as described in the first embodiment.

In the second embodiment, the cams **38** and **40** can be coupled to the timer motor **37** through gear train in order to slow down their rotational speed with respect to the speed of the timer motor **37.** In this embodiment, the speed of the defrost cam **40** is sufficiently slowed down to enable the cam **40** to be profiled with a plurality of cam projections spaced about the periphery thereof. As in the first embodiment, the defrost cam **40** is profiled to enable the defrost control switch **41** to be sequentially opened and closed at 30 second intervals.

As shown in FIG. **2,** the oven control system **10** further includes a third cam **47** connected to the output shaft of the timer motor **37.** The third cam **47** is operatively coupled to the defrost-cook switch **43** to automatically open and close the switch **43.** In its preferable mode of operation, the defrost-cook switch **43** is manually opened to initiate the defrost cycle. The angular position of the cam **47** is then set to a predetermined setting, deemed sufficient to allow the frozen product within the oven to be completely defrosted. As with the timer control cam **38,** the cam **47** has a single projection at its zero time position to close the defrost-cook switch **43** and enable the oven to automatically switch to the cooking mode.

As can be seen, the present invention provides a microwave oven that functions automatically in both the cooking and defrosting modes.

It should be noted that various modifications can be made to the apparatus while still remaining within the purview of the following claims.

What is claimed is:

1. A microwave oven defrosting and cooking cycle control system comprising:

a microwave oven;

a microwave generating system for said microwave oven;

a current path coupling said microwave generating system to a source of electrical energy;

timer control switch means for opening and closing said current path;

defrost control switch means for opening and closing said current path; and

bypass circuit means extending across said defrost switch means for short-circuiting said defrost switch means to enable said current path to be selectively controlled by said timer control switch means in one mode and by both control switch means in a second mode.

2. The invention of claim **1** further comprising means for cyclically opening and closing said defrost control switch.

3. The invention of claim **1** further comprising a defrost-cook switch means for cutting said bypass circuit into and out of said current path.

4. The invention of claim **3** further comprising means for automatically opening and closing said defrost-cook switch means.

5. The invention of claim **1** wherein said timer control switch is coupled to a first timer to be governed thereby.

6. The invention of claim 5 wherein said first timer comprises a motor-cam assembly operatively coupled to said timer control switch means.

7. The invention of claim 5 wherein said defrost control switch means is coupled to a second timer to be governed thereby.

8. The invention of claim 7 wherein said second timer comprises a second motor-cam assembly operatively coupled to said defrost control switch means.

9. The invention of claim 5 wherein said defrost control switch means is coupled to said first timer to be governed thereby.

10. The invention of claim 9 wherein said first timer comprises a motor coupled to a pair of cam members, each cam member being mechanically coupled to said respective switch control means.

11. The invention of claim 10 further comprising:

a defrost-cook switch means for cutting said bypass circuit into and out of said current path; and

a third cam member coupled to said first timer motor, said third cam being operatively coupled to said defrost-cook switch means for automatically opening and closing said defrost-cook switch means.

12. A control circuit for coupling a power supply to a microwave generator comprising:

a pair of power lines interconnecting the power supply to a microwave generator;

a first line connected in parallel to said pair of power lines, said first line having a timer control switch and a relay coil located thereon;

a holding contact switch serially connected to one of said power lines, said contact switch being operatively coupled to said relay coil;

a second line connected in parallel to said pair of parallel lines beyond said holding contact switch with respect to the power supply, said second line having a first timer motor coupled thereto, said first timer motor being operatively coupled to said timer control switch;

a defrost control switch serially connected to one of said power lines beyond said second line with respect to the power supply; and

a bypass circuit for selectively shortcircuiting said defrost control switch.

13. The invention of claim 12 further including a defrost-cook switch for opening and closing said bypass circuit.

14. The invention of claim 12 wherein said first timer motor is mechanically coupled to said defrost control switch.

15. The invention of claim 12 wherein said first line further includes a switch connected across said first line, said switch being biased in the open position, and a bypass circuit having a second holding contact switch coupled thereto, said second holding contact switch being operatively coupled to said relay coil.

16. A control circuit for coupling a power supply to a microwave generator comprising:

a pair of power lines interconnecting the power supply to a microwave generator;

a first line connected in parallel to said pair of power lines, said first line having a timer control switch and a relay coil located thereon;

a holding contact switch serially connected to one of said power lines, said contact switch being operatively coupled to said relay coil;

a second line connected in parallel to said pair of parallel lines beyond said holding contact switch with respect to the power supply, said second line having a defrost timer motor coupled thereto;

a defrost control switch serially connected to one of said power lines beyond said second line with respect to the power supply, said defrost timer motor being operatively coupled to said defrost control switch; and

a third line connected in parallel to said pair of power lines beyond said defrost control switch with respect to the power supply, said third line having a timer motor coupled thereto, said timer motor being operatively coupled to said timer control switch.

17. The invention of claim 16 further including a defrost-cook switch for opening and closing said bypass circuit.

18. The invention of claim 17 wherein said bypass circuit comprises a lead interconnecting said second line to said third line.

19. The invention of claim 18 wherein said cook-defrost switch is adapted to interconnect in one position, the second line with said lead.

20. The invention of claim 19 wherein said cook-defrost switch is adapted to interconnect, in a second position, the power line with the defrost timer motor.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,824,365
DATED : July 16, 1974
INVENTOR(S) : William R. Tapper

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

21. A microwave oven comprising:

a source of microwave energy;

a control circuit including a cyclically operated switch for energizing the source of microwave energy in a mode of intermittent energization of the source of microwave energy;

a bypass circuit path shunting the cyclically operated switch; and

a mode selector switch in the bypass circuit path for closing the bypass circuit path to initiate and maintain continuous operation of the source of microwave energy in a mode of continuous operation.

Signed and sealed this 10th day of June 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

UNITED STATES PATENT OFFICE

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