United States Patent

Javes et al.

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[45] **Apr. 4, 1972**

[54] MICROWAVE OVEN INCLUDING AIR FLOW SYSTEM

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

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[21] Appl. No.: **85,539**

[52] **U.S. Cl.** **219/10.55**

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

[58] **Field of Sear ch** 219/10.55

[56] **References Cited**

UNITED STATES PATENTS

3,430,023	2/1969	Tingley	219/10.55
3,410,116	11/1968	Levinson	219/10.55 X
3,440,385	4/1969	Smith	219/10.55

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[57] **ABSTRACT**

An improved air flow system for a microwave oven which includes blower means for providing a heated air flow, a portion of this heated air flow is directed into the cavity of a microwave oven by duct means. Filter means is located on the air exhaust end of the cavity, such filter means having a reservoir to collect condensation so that a large volume of condensation-laden air is not exhausted from the microwave oven at any one time.

3 Claims, 6 Drawing Figures

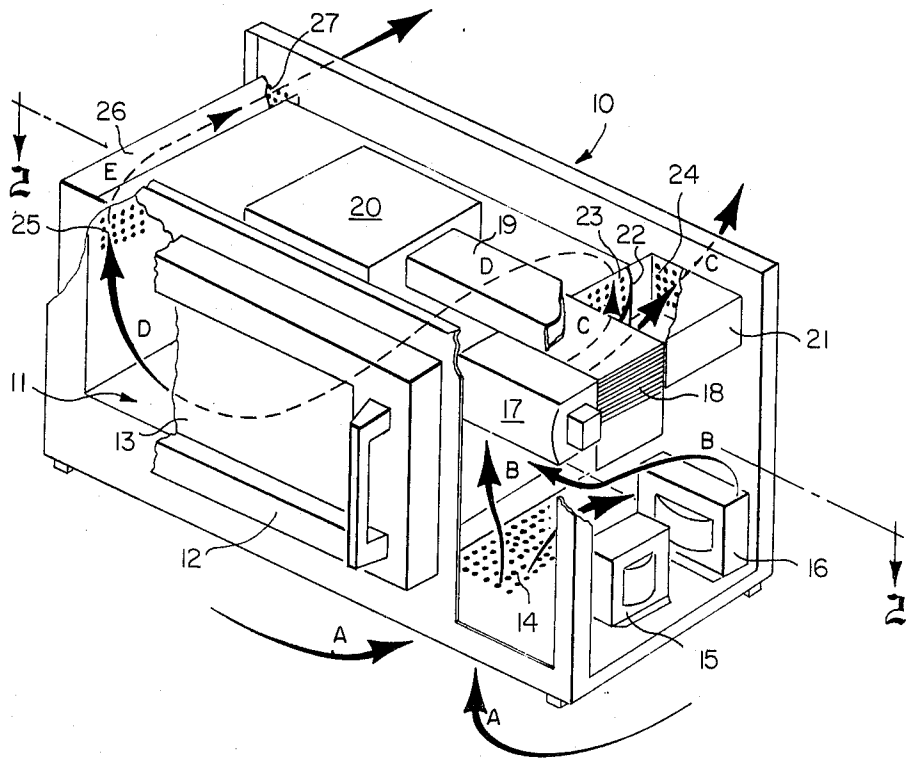

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Fig. 1

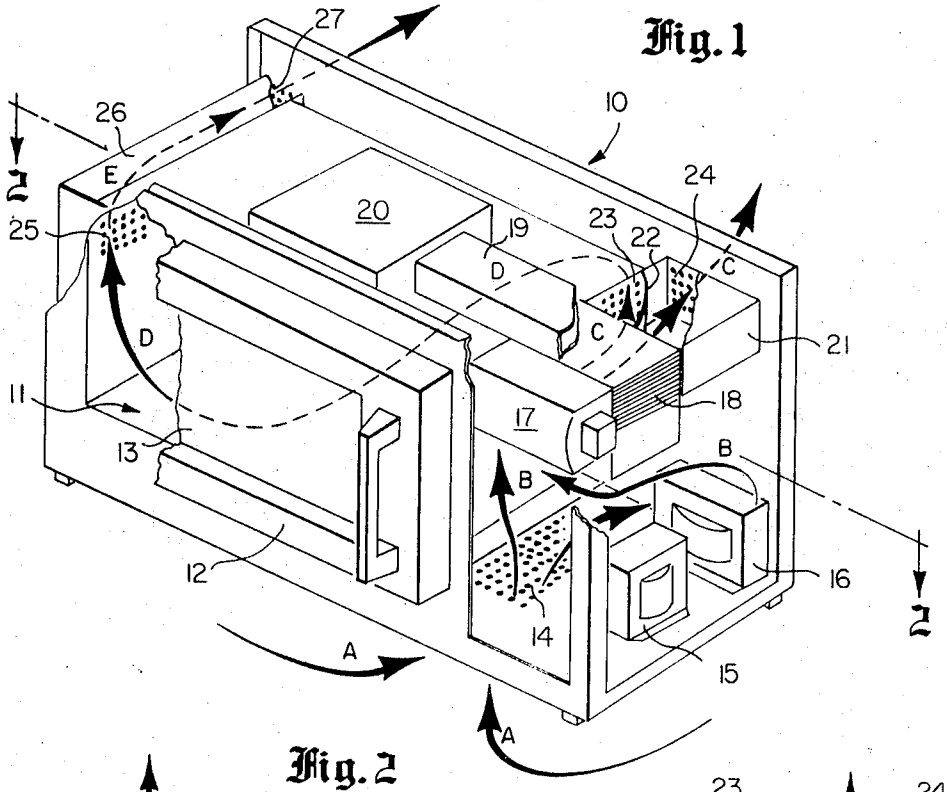

Fig. 2

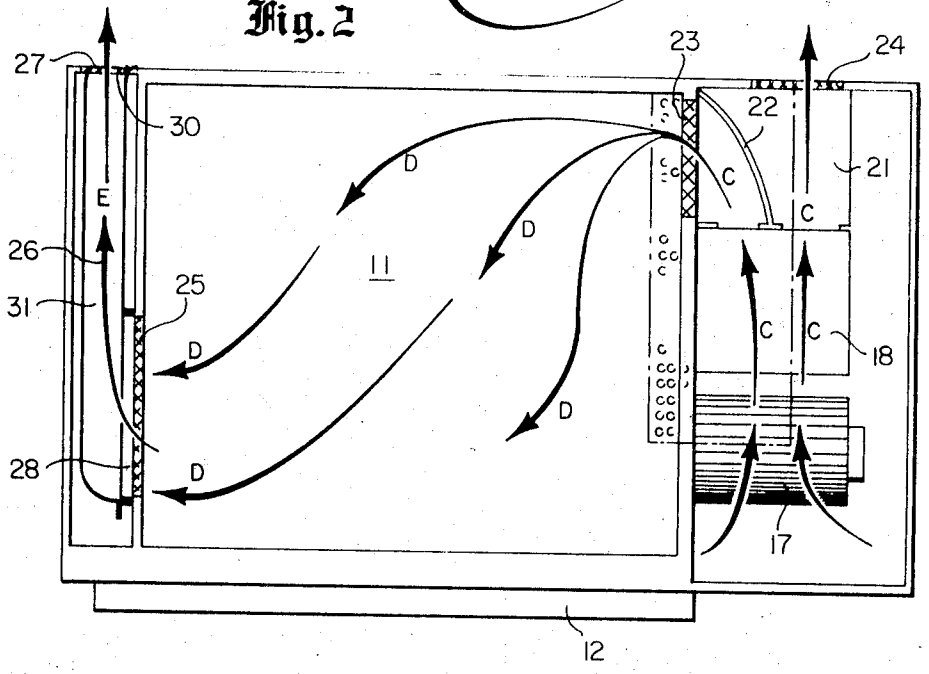

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Fig. 3

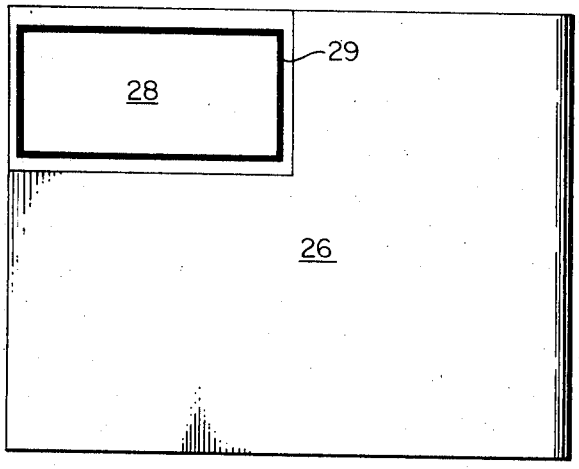


Fig. 4

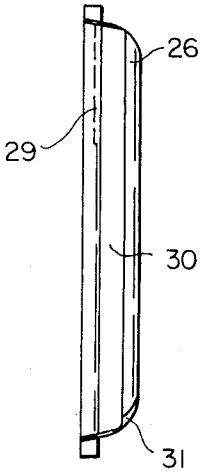


Fig. 5

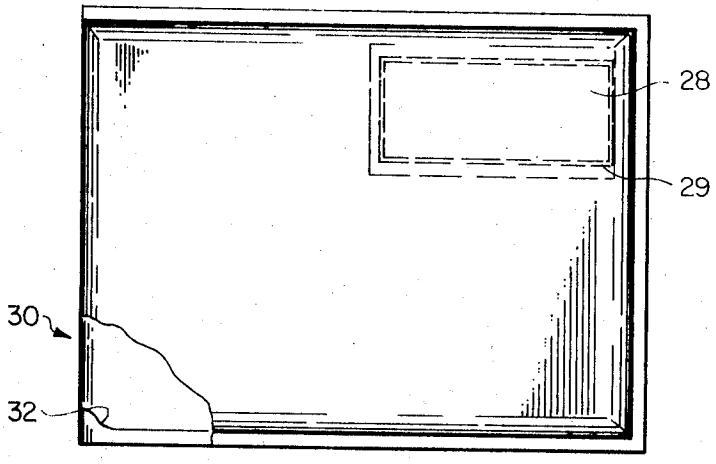
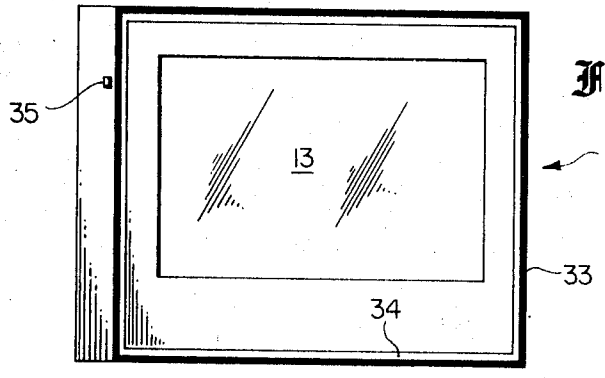


Fig. 6



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MICROWAVE OVEN INCLUDING AIR FLOW SYSTEM

FIELD OF THE INVENTION

This invention relates to air flow within a microwave oven and more particularly to a novel air flow system within a microwave oven which employs an intrusion-proof window as part of the door that forms a wall of the cavity of the microwave oven.

DESCRIPTION OF THE PRIOR ART

It is well known that microwave ovens operating usually at the frequency of 2.45 gigaHertz may be utilized for heating foodstuff. The foodstuff may be placed in a heating cavity of a microwave oven and exposed to microwave energy supplied by a suitable source, e.g., a megnetron. Molecular agitation within the foodstuff resulting from its exposure to microwave energy provides frictional heat to cook the foodstuff in a relatively short period of time as compared to conventional gas or electric heating. In the earlier microwave oven technology, solid door construction was utilized to form one of the walls of the heating cavity. For example, G. B. Long et al., in U.S. Pat. No. 2,748,239 issued May 29, 1956 taught a microwave oven having solid door construction on the side of the oven and a small glass window on the top of the oven. Heated air was directed under the window and then directed into the cavity. The heated air was then vented out of the cavity through an exhaust located in proximity to the glass window.

In later years, the microwave ovens incorporated an RF screen, which is a sheet of metal having a plurality of holes located therein, which, in conjunction with the inner surface of the door formed the wall of the cavity to prevent microwave energy from escaping through the door, but permitted one to view any foodstuff that was being heated within the cavity. However, it is presently felt that it would possibly be dangerous to employ a door having an RF screen that would allow an individual to insert a metal object into the holds of the RF screen. Therefore, RF screens are now employed that include sheets of glass, or plastic material on both sides of the RF screen. One of the problems incurred because of the use of this type of intrusion-proof window is that condensation builds up within the cavity, particularly on the inner surface of the intrusion-proof window because the cavity is relatively airtight.

Accordingly, it is an object of the present invention to provide an improved air flow system for a microwave oven employing an intrusion-proof type window.

It is a further object of the present invention to provide an improved air flow system for a microwave oven to ensure purging of condensation-laden air from the cavity of the microwave oven.

It is a still further object of the present invention to provide an improved air flow system for a microwave oven which ensures that relatively heavy volume condensation-laden air is not expelled from the microwave oven at any one time.

SUMMARY OF THE INVENTION

In accordance with the objects set forth above, the present invention provides an improved air flow system for a microwave oven which includes a blower means for providing a heated air flow, a portion of this heated air flow is directed into the cavity of a microwave oven by duct means. Filter means is located on the air exhaust end of the cavity, such filter means having a reservoir to collect condensation so that a large volume of condensation-laden air is not exhausted from the microwave oven at any one time.

BRIEF DESCRIPTION OF THE DRAWINGS

Additional objects, advantages, and characteristic features of the present invention will become readily apparent from the following detailed description of the preferred embodiments of the invention when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a microwave oven, with portions of the housing and the door cut away to expose various components located therein, in accordance with the present invention;

FIG. 2 is a plan view of a microwave oven taken along lines 2—2 of FIG. 1, in accordance with the present invention;

FIG. 3 is an elevational view of the inner side of a filter of the microwave oven, in accordance with the present invention;

FIG. 4 is an elevational view of the rear end of the filter of FIG. 3, in accordance with the present invention;

FIG. 5 is an elevational view of the outer side of the filter of FIG. 3, in accordance with the present invention; and

FIG. 6 is an elevational view of the inner side of the door of the microwave oven, in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and 2, there is respectively shown a perspective view of a microwave oven **10** with various portions of the housing and a door **12** cut away to expose components located herein, and a plan view of the microwave oven **10** taken along lines 2—2 of FIG. 1, in accordance with the present invention. The door **12** is cut away to illustrate a cavity **11** and other components which will be described in detail later in the specification. The door **12** includes an intrusion-proof window **13**, which is comprised of two panes of glass having a conventional RF screen located between the panes of glass. As is well known, the RF screen is a sheet of metal having a plurality of holes located therein which in conjunction with the inner surface of the door **12** forms a wall of the cavity **11** to prevent microwave energy from escaping from that portion of the microwave oven **10**, but permits one to view any foodstuff that is being heated within the cavity **11**.

Referring now to the components that are part of or are located within the housing of the microwave oven **10**, the various components incorporated within the air flow system of the present invention will be described. An air input opening **14**, comprised of a multitude of small openings over an area approximately 40 square inches, is located on the bottom housing of the microwave oven **10**. Located in proximity of or above the air input opening **14** is a pair of transformers, namely, a filament transformer **15** and a high voltage transformer **16**. Located directly above the air input opening **14** are a motor-driven blower **17**, a conventional magnetron **18** having horizontal cooling fins, as shown, and a duct **21**. Further illustrated is a waveguide **19** and a stirrer housing **20**. As is well known in the art, the microwave energy from the magnetron **18** travels within the waveguide **19** to the stirrer housing **20**, which includes a conventional stirrer, or metallic fan, to "stir" the microwave energy in order to establish a multiplicity of modes of microwave energy within the cavity **11**. Since the transmission of the microwave energy from the magnetron **18** to the cavity **11** per se is well known to those skilled in the art, such transmission need not be further described herein.

The duct **21** may be constructed of electrical fish paper which is a fire-retardant and electrical insulating material, and is divided into two compartments by means of a divider **22** of like material. Thus, air flowing over the cooling fins of the magnetron **18** will be divided into two parts, so that a portion of the air will be exhausted from the microwave oven **10** through the opening **22** and the rest of the air will flow into the cavity **11** through an opening **23**. The opening **23** consists of a multiple number of holes drilled in the illustrated right side metallic wall of the cavity **11** and the opening **24** consists of a multiple number of holes that are drilled in the rear housing of the microwave oven **10**. On the upper front part of the left side metallic wall of the cavity **11** there is shown a cavity air exhaust opening **25** which allows air within the cavity **11** to be exhausted therefrom. On the other end of the cavity air exhaust opening **25** there is shown a filter **26** which permits exhausted air from the cavity **11** to flow out of the microwave

oven **10** by means of an air exhaust opening **27** which is the approximate height of the filter **26**. The filter **26** may be of natural polystyrine material and may be constructed by a vacuum formed process. The filter **26** has respective openings **28** and **30** which allow the above-described air flow through the filter **26** to be accomplished.

During the operation of the microwave oven **10**, outside air, illustrated by the arrows designated A, is drawn into the microwave oven **10** by means of the blower motor **17**, which may be of the conventional squirrel cage type. The arrows designated B illustrate the air flow established around the filament transformer **15** and the high voltage transformer **16**, and other smaller electronic components and connection means, not shown. The transformers **15** and **16** and the other electronic components dissipate heat during the operation of the microwave oven **10**. Thus, the temperature of the air designated by the arrows B is at a higher temperature than the air designated by the arrows A. The blower **17** draws in such heated air and exhausts it over the cooling fins of the magnetron **18** to cool the magnetron **18**, thus accomplishing further heating of the air. The divider **22** of the duct **21** ensures that approximately three-fifths of the air is vented out of the microwave oven **10** through the air exhaust opening **24** and the other two-fifths is vented into the cavity **11** through the air input opening **23**. The above-described air flow is illustrated by the arrows designated C, while the air flow within the cavity **11** is illustrated by the arrows designated D. The latter air flow picks up any condensation that forms on the walls of the cavity **11**, particularly any condensation on the intrusion-proof window **13**. Condensation forms on the walls of the cavity **11** because such walls, including the window **13**, are cooler than the rising temperature of the foodstuff being heated. This condensation-laden air then travels out of the cavity **11** by means of the air exhaust opening **25** and the opening **28** of the filter **26**. The arrow designated E illustrates the air flow through the filter **26** that is then exhausted out of the microwave oven **10** by means of the air exhaust opening **27**.

Referring now to FIGS. **3**, **4** and **5**, there are shown respective elevational views of the inner side, the rear end, and the outer side of the filter **26**, in accordance with the present invention. The opening **28** has a rubber grommet **29** which is located flush against the outer wall of the left side of the housing in order that all of the condensation-laden air travels into the filter **26** rather than to other parts of the microwave oven **10** so that no moisture collects within portions of the microwave oven **10** containing electronic components, e.g., directly below the filter **26**. Further illustrated is a condensation reservoir **31** of the filter **26** that is formed by a raised lip portion **32** of approximately one-fourth inch in height to establish the reservoir **31** that runs the approximate length of the filter **26**. Thus, a majority of the condensation existing in the air flow defined by the arrow designated E is retained in the reservoir **31** and is not directly exhausted to the outside of the microwave oven **10**. The water collected in the reservoir **31** will evaporate into the air when the microwave oven **10** is not in operation. Since the microwave oven **10** illustrated is of a portable consumer type that may be moved anywhere within a household, it is important that the condensation-laden air is not directly exhausted from the microwave oven **10** because of the accompanying puddles of water that could form anywhere in the home.

Referring now to FIG. **6**, there is shown an elevational view of the inner side of the door **12** of the microwave oven **10**. A rubber gasket **33** is shown located approximately around the entire perimeter of the door **12**, except in the area of the latch **35**. While rubber gaskets similar to the type shown had been used in the early years of microwave oven manufacture to prevent the escape of microwave energy through the perimeter of the door of a microwave oven, since such rubber gaskets tended to burn due to arcing of microwave energy, manufacturers have generally employed microwave energy chokes, either metallic channels, or channels filled with a dielectric such as, polypropolyne to attenuate such microwave energy. The choke **34** illustrates such attenuation means and it attenuates the majority of the microwave energy that might otherwise escape through the perimeter of the door **12**. While the rubber gasket **33** will attenuate the second harmonic of the microwave, if the rubber gasket **33** is flush with the front housing of the microwave oven **10**, it further serves the purpose of retaining the condensation-laden air within the cavity **11** rather than forming water which drops down the front of the microwave oven **10**.

Thus, although the present invention has been shown and described with reference to particular embodiments, for example, filter means having a reservoir located in the bottom thereof, nevertheless, various changes and modifications obvious to a person skilled in the art to which the invention pertains, for example, filter means having absorptive means located therein, are deemed to lie within the spirit, scope and contemplation of the invention as set forth in the appended claims.

What is claimed is:

1. An air flow system for exhausting condensation from a portable microwave oven comprising:

a cooking cavity having six electrically conductive bounded walls, one of said walls being the exterior surface of a partially transparent door that provides access to said cooking cavity, said cooking cavity including air flow means for directing air over said interior surface of said door, said air flow means including a first plurality of relatively small sized diameter openings for allowing heated air to flow into said cooking cavity and a second plurality of relatively small sized diameter openings located in close proximity to said interior surface of said door for exhausting condensation-laden air from said cooking cavity;

electrical means, including a magnetron and a waveguide coupled between said magnetron and said cooking cavity, for supplying electromagnetic wave energy to said cooking cavity;

blower means located on the one side of said magnetron for directing air to said magnetron for cooking said magnetron and for providing a heated air flow;

duct means located on the opposite side of said magnetron for directing a first portion of said heated air flow out of said portable microwave oven and a second portion of said heated air flow into said cooking cavity via said first plurality of openings of said air flow means; and

filter means located outside of said cooking cavity and abutting said second plurality of openings of said air flow means for receiving said exhausted condensation-laden air from said cooking cavity, said filter means including a reservoir for extracting and retaining moisture within said exhausted condensation-laden air prior to exhausting the air within said filter means from said microwave oven.

2. An air flow system as recited in claim **1** wherein said filter means has an opening located in proximity of said second plurality of openings of said air flow means, said filter means further including a rubber grommet around the perimeter of said opening of said filter means for ensuring that all of said condensation-laden air is directed to said filter means.

3. An air flow system as recited in claim **2** wherein said reservoir of said filter means is the approximate length of said filter means and has a height of approximately one-fourth inch.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,654,417 Dated April 4, 1972

Inventor(s) Wallace R. Javes; Vernon E. Cassibo

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

Col. 1, line 16: "megnetron" should be --magnetron--

Col. 2, line 23: "herein" should be --therein--

Col. 4, line 44: "cooking" should be --cooling--

Signed and sealed this 28th day of November 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
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