United States Patent

Schiffmann et al.

[15] **3,665,141**

[45] **May 23, 1972**

[54] END TRAP FOR MICROWAVE OVEN

[72] Inventors: **Robert F. Schiffmann**, Brooklyn; **Ernest W. Stein; Harold B. Kaufman, Jr.**, both of New York, all of N.Y.

[73] Assignee: **DCA Food Industries, Inc.**, New York, N.Y.

[22] Filed: **July 1, 1970**

[21] Appl. No.: **51,531**

[52] **U.S. Cl.** **219/10.55,** 219/10.61

[51] **Int. Cl.** **H05b 5/00**

[58] **Field of Search** 219/10.55, 10.61

[56] **References Cited**

UNITED STATES PATENTS

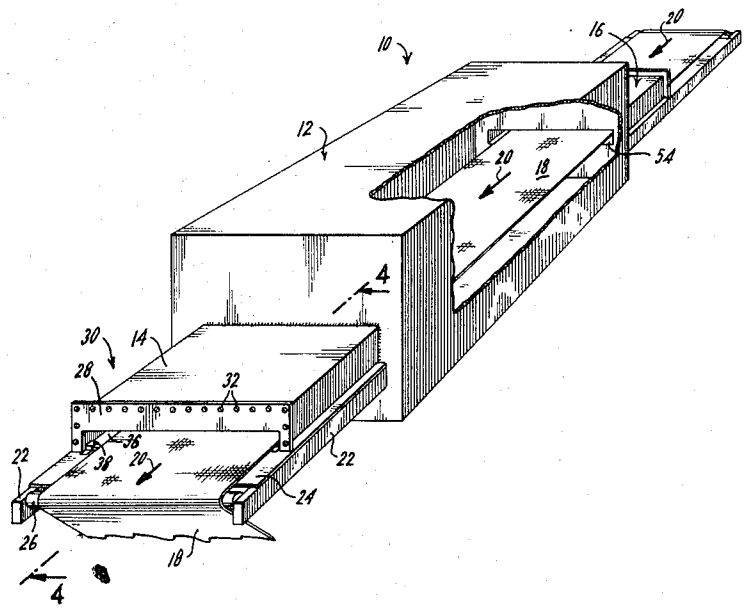
2,868,939	1/1959	Pound	219/10.55
3,461,261	8/1969	Lewis et al.	219/10.55
3,050,606	8/1962	Tibbs	219/10.55
3,239,643	3/1966	Kluck	219/10.55

Primary Examiner—J. V. Truhe
Assistant Examiner—Hugh D. Jaeger
Attorney—Amster & Rothstein

[57] **ABSTRACT**

An end trap for a microwave oven. An enclosure defining a relatively high tunnel is disposed around a port of the oven. A conveyor moves through the port of the oven, and through and over the bottom of the tunnel. Along each side of the tunnel is a bracket, a metallic baffle plate being placed across the two brackets adjacent to the oven port. At the forward end of the tunnel, a slab of energy absorbing material is placed across the two brackets, and an end plate is secured to the forward end of the tunnel. The baffle defines a tunnel whose height is less than one-half of the wavelength of the energy at which the oven is operated to attenuate the leakage of microwave energy from the oven. The slab of energy absorbing material is provided to absorb any energy which does escape through the tunnel defined by the baffle plate. To clean the tunnel, all that is required is to remove the end plate, and then the slabs of energy absorbing material and the baffle plate.

14 Claims, 4 Drawing Figures



Patented May 23, 1972 3,665,141

2 Sheets-Sheet 1

FIG. 1.

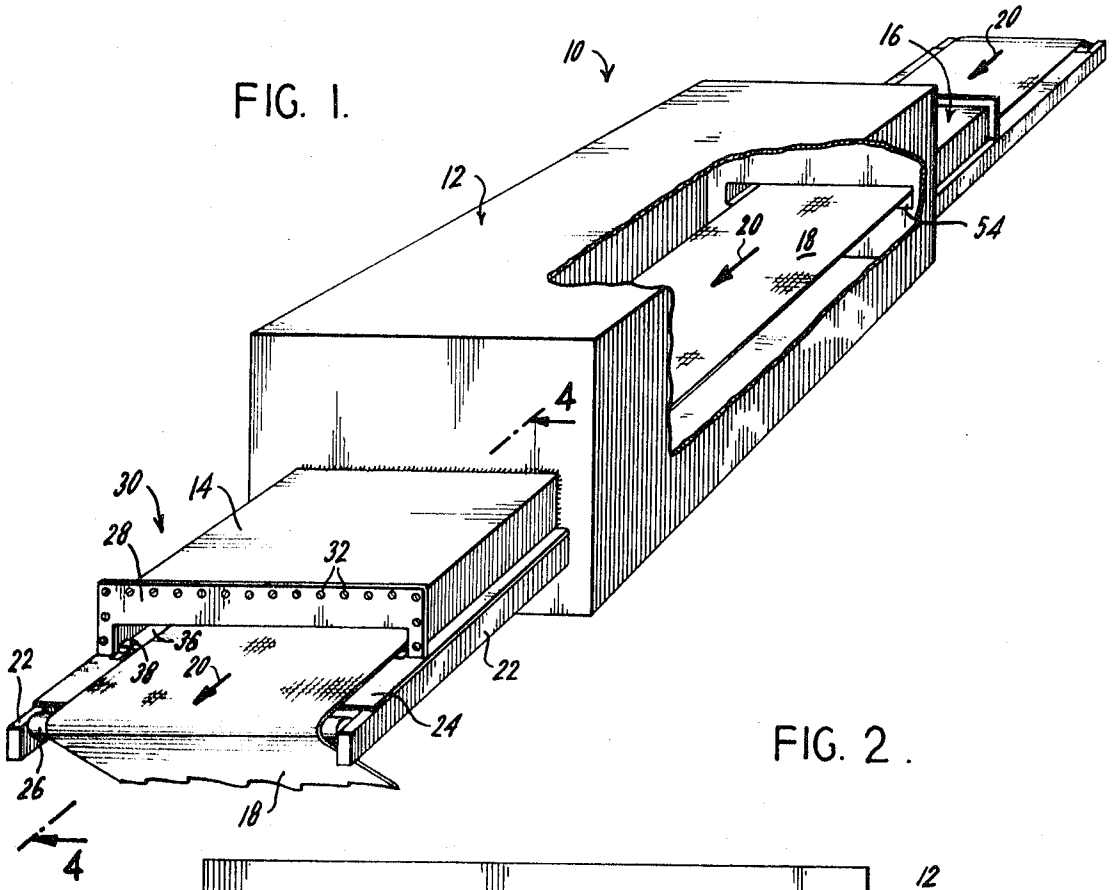
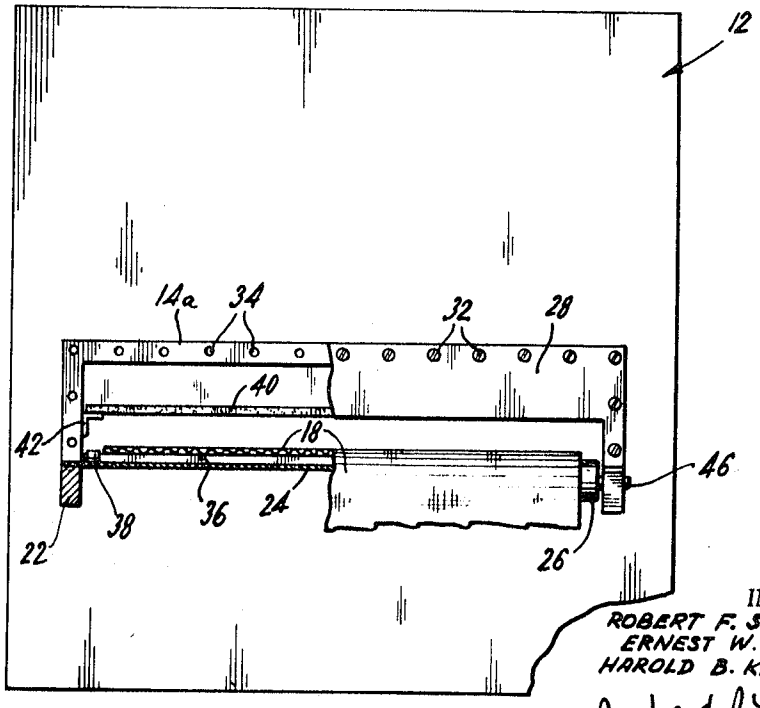
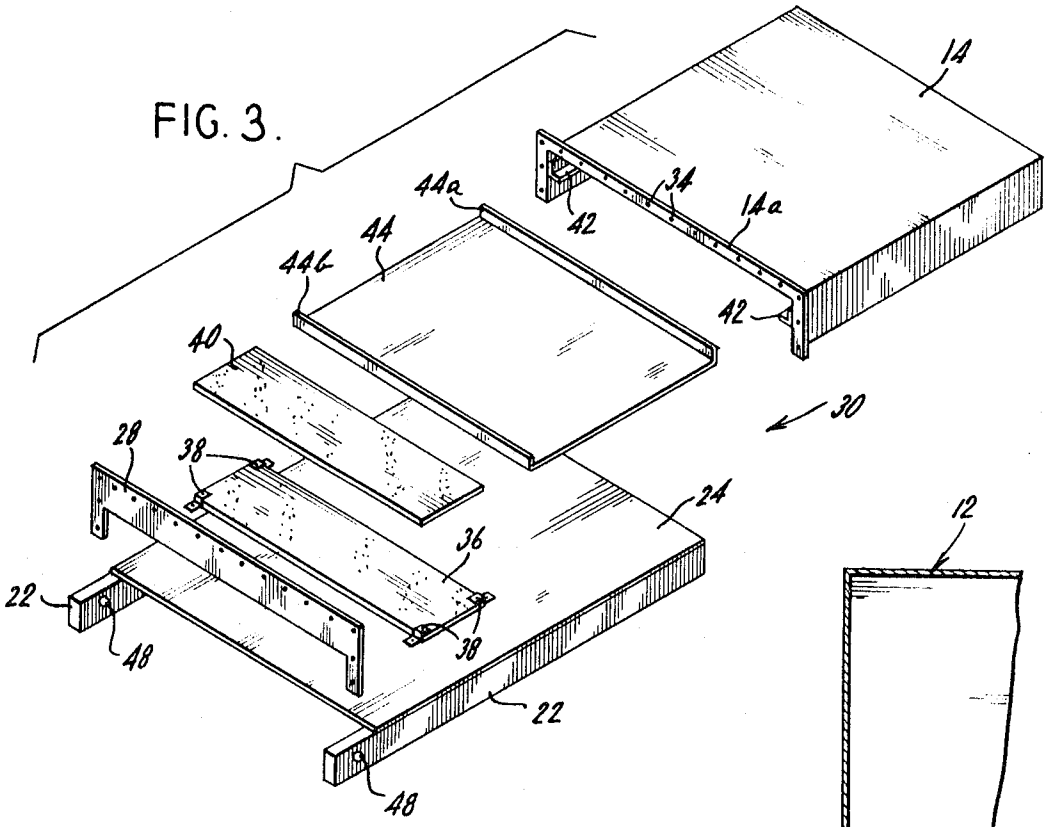


FIG. 2.



INVENTORS
ROBERT F. SCHIFFMANN
ERNEST W. STEIN
HAROLD B. KAUFMAN JR.
BY Auster & Rothstein
ATTORNEYS

FIG. 3.



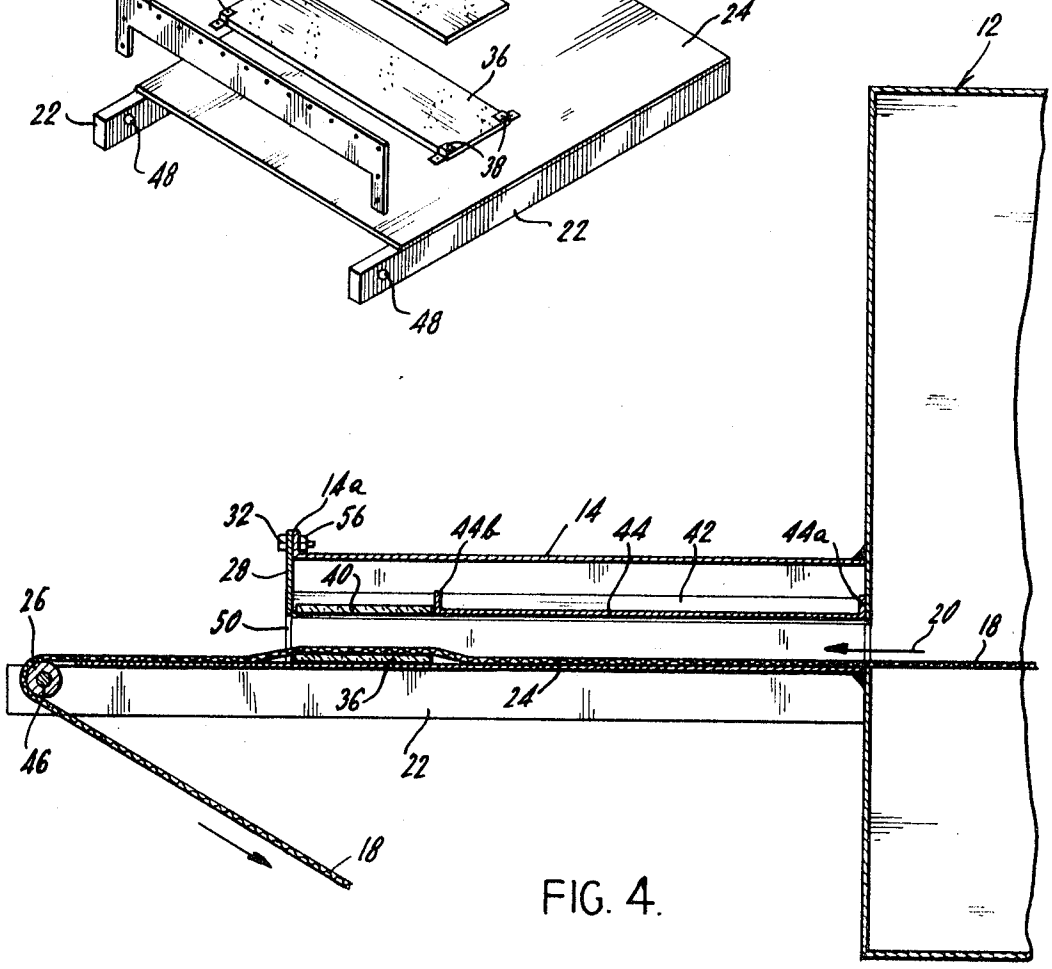


FIG. 4.

INVENTORS
ROBERT F. SCHIFFMANN
ERNEST W. STEIN
HAROLD B. KAUFMAN JR.
BY Amster & Rothstein
ATTORNEYS

END TRAP FOR MICROWAVE OVEN

This invention relates to end traps for microwave ovens, and more particularly to end traps which dissipate little energy but nevertheless can be cleaned easily.

In the operation of a microwave oven, it is generally necessary to protect observers by preventing the escape of microwave energy from the oven. In the case of the ordinary microwave oven found in a home, this is easily accomplished because the oven is completely enclosed (except for viewing ports, the designs of which are well known to those skilled in the art). But in the case of an industrial oven, in which a product to be baked is placed on a conveyor and moved through the oven, it is apparent that the oven must have at least one port through which the conveyor moves the product into and/or out of the oven. Such a port allows microwave energy to escape from the oven unless protective measures are taken.

A typical port in the prior art consists of a relatively long tunnel through which the conveyor passes. At least one inner surface of the tunnel (upper or lower) is lined with a microwave energy absorbing material such as water. Although microwave energy can escape from the oven into the tunnel, it is absorbed in the tunnel so that very little escapes to the atmosphere. Although the water absorbs microwave energy, it has been found that to be completely effective the tunnel, unless it is to be inordinately long, should have a relatively small height. Such a design suffers from two major disadvantages. First, the energy absorbing material dissipates power and increases the cost of operating the oven. Second, the small height of the tunnel makes it exceedingly difficult to clean the tunnel when cleaning is necessary.

It is a general object of our invention to provide an end trap for a microwave oven which dissipates a minimum amount of energy and also is capable of easy cleaning.

In accordance with the principles of our invention a relatively high tunnel is provided at the port of the microwave oven through which a conveyor moves. A bracket is provided on each side of the tunnel. A metallic baffle plate is placed across the width of the tunnel and supported by the two brackets at that end of the tunnel adjacent to the oven. At the other end of the tunnel (disposed away from the oven), a microwave absorbing material is placed between the two brackets. An end plate is provided for attachment to the end of the tunnel, which end plate serves to maintain the baffle plate and the energy absorbing material fixed within the tunnel.

The height of the baffle plate above the bottom of the tunnel (over which the conveyor moves) is less than one-half of the wavelength of the microwave energy within the oven. This prevents the escape of microwave energy from the oven. Any energy which is transmitted through that part of the tunnel across which the baffle plate is extended is absorbed at the open end of the tunnel by the microwave absorbing material. There is minimum energy dissipation because the baffle plate in effect defines a narrower tunnel which limits the transmission of microwave energy in the first place. The purpose of the microwave energy absorbing material is to absorb any energy which is transmitted past the baffle so that it does not escape to the atmosphere.

At the same time, this construction facilitates easy cleaning. While the height of the tunnel defined by the baffle (and the microwave energy absorbing material) is, in the illustrative embodiment of the invention, only two inches, to clean the tunnel all that is required is to remove the end plate and to then take out the microwave energy absorbing material and the baffle. When this is done, not only can these elements be cleaned external of the tunnel, but the tunnel itself can be cleaned because its height is sufficient to allow an operator to place his hand within the tunnel to clean it.

It is a feature of our invention to provide an end trap for a microwave oven which consists of a trap enclosure defining a relatively high tunnel, together with a baffle made of reflective material and an element of microwave energy absorbing material placed across the tunnel at an intermediate position therein to define a narrower tunnel height less than one-half of the microwave energy wavelength at which the oven is operated, with the baffle being disposed at that end of the tunnel attached to the oven and the microwave energy absorbing material being disposed at that end of the tunnel exposed to the atmosphere.

It is another feature of our invention, in the illustrative embodiment thereof, to place an additional element of energy absorbing material below the conveyor on the bottom surface of the tunnel at the forward end thereof to aid in absorbing the microwave energy which might otherwise escape from the tunnel.

Further objects, features and advantages of our invention will become apparent upon consideration of the following detailed description in conjunction with the drawing, in which:

FIG. **1** is a perspective view, shown partially broken away, of the illustrative embodiment of our invention;

FIG. **2** is a front view, shown partially broken away, of the apparatus of FIG. **1**;

FIG. **3** is an exploded view showing the construction of end trap **30** of FIG. **1**; and

FIG. **4** is a sectional view taken through the line **4—4** of FIG. **1**.

Referring to FIG. **1** conveyor **18** moves through oven **10** in the direction of arrow **20**. The oven itself includes an enclosure **12**, together with a source of microwave energy (not shown) coupled to it. Also, a viewing port can be provided if desired, as well as a door which can be opened to facilitate cleaning of the oven. At either end of the oven is a port **54** through which conveyor **18** passes. The height of each port is less than one-half wavelength of the microwave energy within the oven. In the illustrative embodiment of the invention this height is two inches; the donuts or other products to be baked which are placed on conveyor **18** have a height less than two inches. The mechanism for moving the conveyor is not shown inasmuch as it does not comprise a part of the subject invention.

At either end of the oven is an end trap **16**, **30**. It is to be understood that end trap **16** is similar in construction to end trap **30**, and only the latter end trap will be described in detail below.

Extending from the forward end of the oven are two bars **22**. At the end of each bar is a hole **48** (FIG. **3**) through which a shaft **46** (FIGS. **2**, **4**) is journalled. A roller **26** is carried by shaft **46** and conveyor **18** passes over the roller. A metallic plate **24**, which defines the bottom of the end trap, is attached to the two bars **22** as shown.

A tunnel-defining enclosure **14** is permanently secured to plate **24** and the forward end of the oven. The enclosure is provided with a forward flange **14***a* having a plurality of holes **34** therein. Extending lengthwise along each side of enclosure **14** is an L-shaped bracket **42**.

The elements thus far described are fixed relative to each other and are not disassembled for cleaning purposes. The height of enclosure **14**, in the illustrative embodiment of the invention, is four inches to permit an operator to place his hand and arm within the enclosure on top of plate **24** in order to clean the tunnel defined by these two elements.

At the forward end of plate **24** a sheet of microwave energy absorbing material **36** is held in place by four clips **38**. Each clip is provided with a hole through which a screw may be inserted into plate **24**. The attachment of the clips to plate **24** is not shown in the drawing although it is to be understood that any conventional mechanism for attaching the clips to plate **24** can be used. Conveyor **18** is passed over the energy absorbing material. Typically, this material can be made of Eccosorb, a high loss silicone rubber dielectric material, manufactured by Emerson and Cuming, Inc., of Canton, Mass.

In assemblying the end trap, baffle plate **44** is placed within the two brackets **42** such that lip **44***a* abuts against the front wall of the oven. A second sheet of Eccosorb material **40** is then placed between the two brackets abutting against lip **44***b*

of baffle plate **44**. After the slab of Eccosorb material is placed within the brackets, end plate **28** is attached to flange **14***a* with a series of bolts **32** and nuts **56**.

End plate **28** defines an opening **50** (FIG. 4) whose height is the same as the distance between baffle plate **44** and plate **24**. In the illustrative embodiment of the invention, this height is 2 inches which is less than half of the wavelength of the energy within the oven. (At the forward end of the end trap, the opening is slightly reduced due to the thick-ness of the slab of material **36**, typically one-quarter inch.) The tunnel of 2-inch height is sufficient to attenuate the microwave energy transmitted from the oven through the tunnel. Very little energy reaches the two slabs of energy absorbing material. However, whatever energy does reach these two slabs of material is absorbed by them so that the level of the energy which escapes through opening **50** is within safe limits.

With respect to energy dissipation, the construction of the invention is highly advantageous. The reduced height of the tunnel defined by plates **24** and **44** prevents energy modes from travelling down the tunnel from oven **12** to the opening **50**. The small height of the tunnel does not dissipate energy, but rather prevents its transmission. The energy absorbing material is provided at the open end of the tunnel to absorb any energy which does happen to be transmitted through the tunnel. Actually, when a product to be baked is placed on conveyor **18**, the product itself, as it is moved within the end trap, absorbs much of the energy which is present in the trap (that is, the first and last parts of the baking process take place within the end trap). The energy absorbing material is needed primarily when no product is on conveyor **18** to absorb the microwave energy; at this time, energy absorbing materials **36** and **40** prevent the escape of microwave energy from the oven.

At the same time, the end trap can be cleaned very easily. All that is required is to remove nuts and bolts **32**, **56** so that end plate **28** can be disassembled from flange **14***a*. With the end plate removed, plates **40** and **44** can be removed from brackets **42** and cleaned externally. At the same time, the resulting increased height of the tunnel facilitates its cleaning by an operator. Periodic cleaning is necessary to remove flour-dust build-up. Also, if energy absorbing plate **40** breaks, it can be replaced simply by removing end plate **28**.

Energy absorbing material **36** is provided to further insure that no microwave energy escapes from the end trap. Although this plate restricts the height of the end trap between plates **36**, **40** (thus limiting the height of the product to be baked), it does permit a shorter tunnel to be used since less attenuation of the microwave energy between plates **24** and **44** is required (at the expense, of course, of slightly increased energy dissipation). Slab **36** can be omitted if desired. Similarly, instead of using a solid piece of energy absorbing material **40** such as Eccosorb, it is possible to use a pan of water. The pan should allow the transmission of microwave energy through it so that it can be absorbed by the water (or other energy absorbing material such as liquid glycerine). The pan itself in such a case should typically be made of polypropylene.

One of the advantages of the arrangement of the invention is that the dimensions of pan **44**, and slabs **40** and **36**, can be varied to meet changing field requirements; in fact, different sets of the elements may be kept on hand to be interchanged as needed.

Although the invention has been described with reference to a particular embodiment, it is to be understood that it is merely illustrative of the application of the principles of the invention. For example, slab **36** can be utilized without reducing the height of the end trap simply by recessing it within plate **24** at the end of the tunnel. Also, slabs of microwave absorbing material can be placed along the sides of the tunnel above slab **36** to further prevent leakage of energy from the tunnel. Thus it is to be understood that numerous modifications may be made in the illustrative embodiment of the invention and other arrangements may be devised without departing from the spirit and scope of the invention.

What we claim is:

1. An end trap for a microwave oven having a port through which a conveyor moves comprising a tunnel enclosure attached to the exterior of said oven and disposed around said port such that said conveyor as it moves through said port moves along the bottom of said tunnel enclosure, said tunnel enclosure having a height sufficient to allow the insertion of the hand and arm of an operator for the cleaning thereof, a conducting plate extending across a portion of said tunnel and disposed adjacent to said oven above said port, said conducting plate providing a vertical clearance above the bottom of said enclosure which is less than one-half of the wavelength of the energy at which said oven is operated, an element of microwave energy absorbing material disposed adjacent to said conducting plate and extended across the width of said tunnel at the end thereof disposed away from said oven port for absorbing any microwave energy which escapes from said oven port and travels down to said tunnel past said plate, and means for releasably securing said plate and said energy absorbing element within said enclosure to permit the removal and cleaning thereof.

2. An end trap for a microwave oven in accordance with claim **1** further including an end plate detachably secured to the end of said tunnel enclosure disposed away from said oven.

3. An end trap for a microwave oven in accordance with claim **2** wherein said releasably securing means includes two brackets, each attached to an inner side of said tunnel enclosure, across which said plate and said energy absorbing element are placed.

4. An end trap for a microwave oven in accordance with claim **3** further including an additional energy absorbing element disposed at the bottom of said tunnel enclosure at the end thereof disposed away from said oven port, said conveyor being placed on top of and moving over said additional energy absorbing element.

5. An end trap for a microwave oven in accordance with claim **1** wherein said releasably securing means includes two brackets, each attached to an inner side of said tunnel enclosure, across which said plate and said energy absorbing element are placed.

6. An end trap for a microwave oven in accordance with claim **5** further including an additional energy absorbing element disposed at the bottom of said tunnel enclosure at the end thereof disposed away from said oven port, said conveyor being placed on top of and moving over said additional energy absorbing element.

7. An end trap for a microwave oven in accordance with claim **6** wherein said energy absorbing element is a slab of microwave energy absorbing material.

8. An end trap for a microwave oven in accordance with claim **6** wherein said energy absorbing element and said additional energy absorbing element are slabs of microwave energy absorbing material.

9. An end trap for a microwave oven in accordance with claim **1** wherein said energy absorbing element is a slab of microwave energy absorbing material.

10. An end trap for a microwave oven in accordance with claim **9** further including an end plate detachably secured to the end of said tunnel enclosure disposed away from said oven.

11. An end trap for a microwave oven in accordance with claim **10** further including an additional energy absorbing element disposed at the bottom of said tunnel enclosure at the end thereof disposed away from said oven port, said conveyor being placed on top of and moving over said additional energy absorbing element.

12. An end trap for a microwave oven in accordance with claim **10** wherein said energy absorbing element and said additional energy absorbing element are slabs of microwave energy absorbing material.

13. An end trap for a microwave oven in accordance with claim **1** further including an additional energy absorbing element disposed at the bottom of said tunnel enclosure at the

end thereof disposed away from said oven port, said conveyor being placed on top of and moving over said additional energy absorbing element.

14. An end trap for a microwave oven in accordance with claim 13 wherein said energy absorbing element and said additional energy absorbing element are slabs of microwave energy absorbing material.

* * * * *