United States Patent

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[54] **AIR VENTILATING AND CIRCULATING SYSTEM FOR MICROWAVE DRYERS**
5 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **34/1**
[51] **Int. Cl.** **B01k 5/00**
[50] **Field of Search** 34/1

[56] **References Cited**

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ABSTRACT: A web-drying apparatus comprising a microwave developing means formed of opposed applicators defining a passage for movement of web surfaces in closely spaced relationship to the applicator surfaces. The applicators define ridge portions which serve to concentrate microwaves on web surface areas for generating heat which results in drying action. Air-circulating and supplying means are associated with the applicators for moving air through openings in the ridges and for withdrawing air through openings defined in depressed areas located intermediate the ridges.

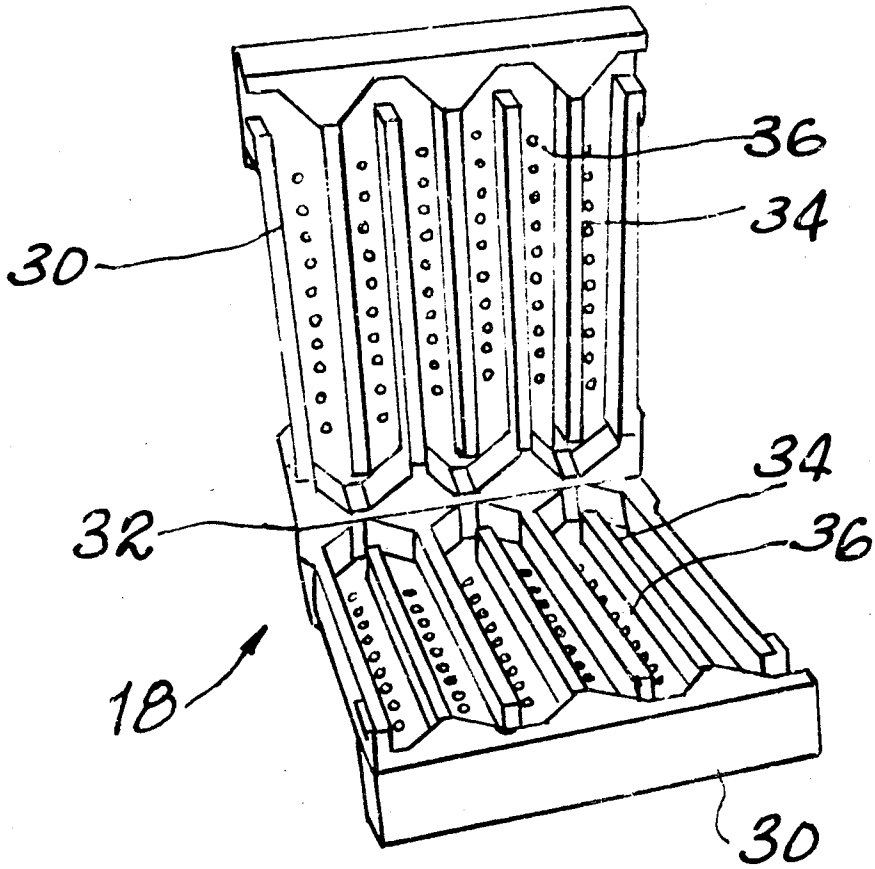


FIG. 1

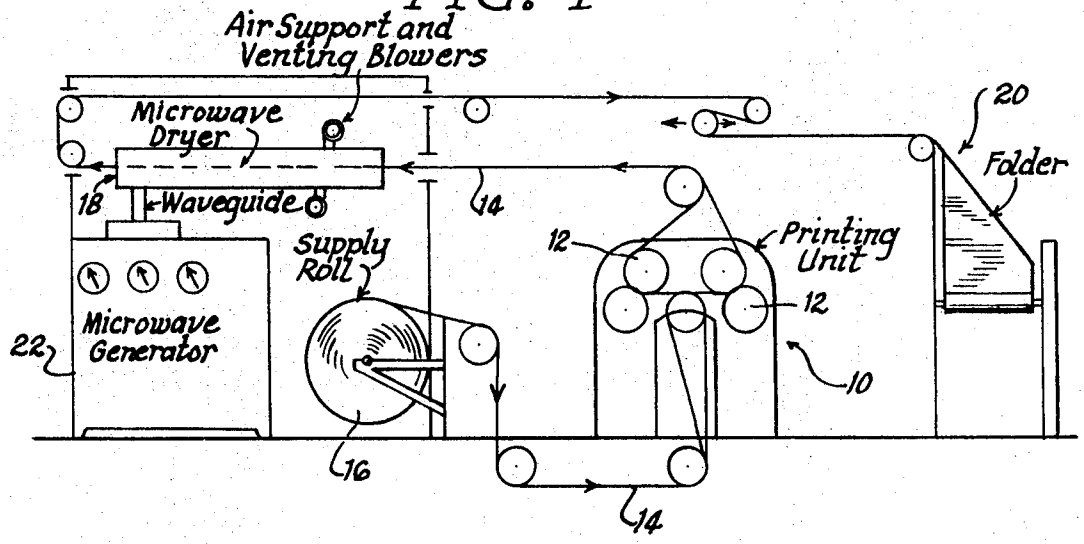
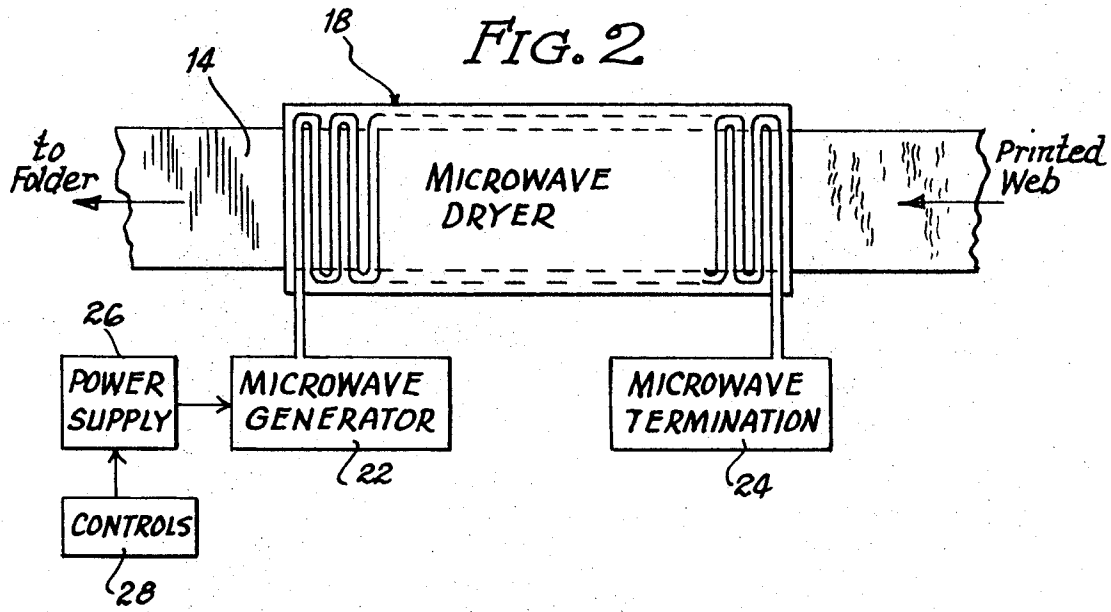


FIG. 2



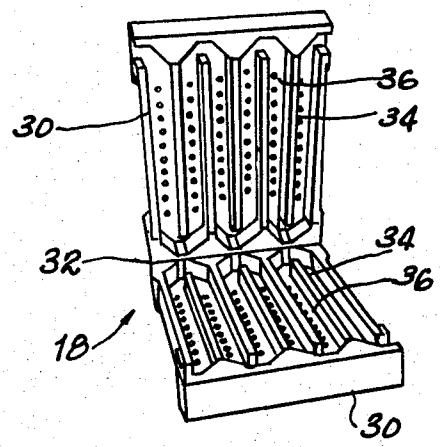


FIG. 3

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FIG. 4

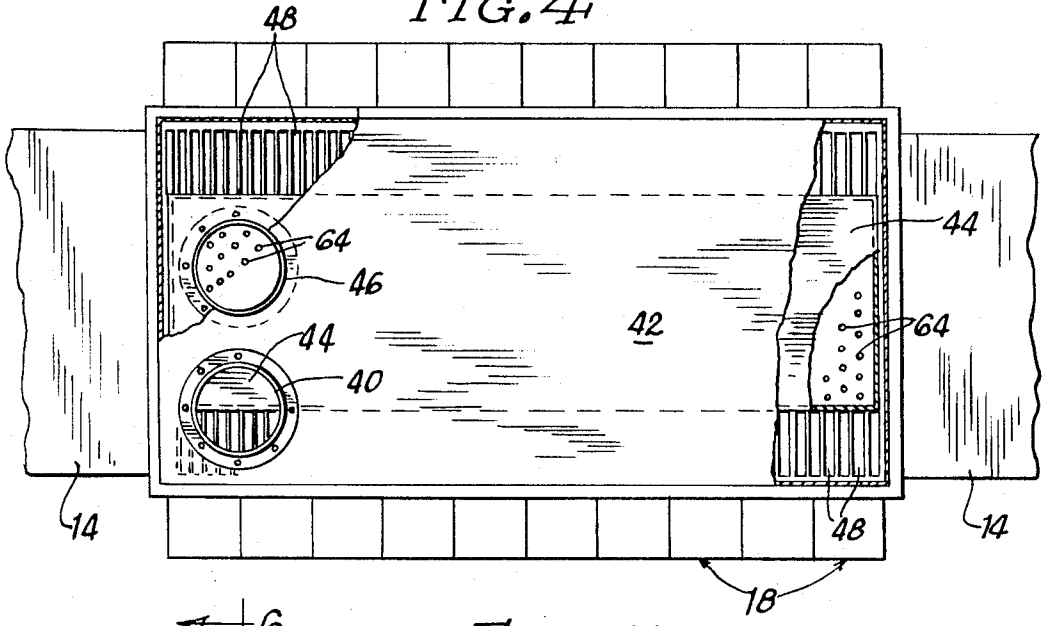


FIG. 5

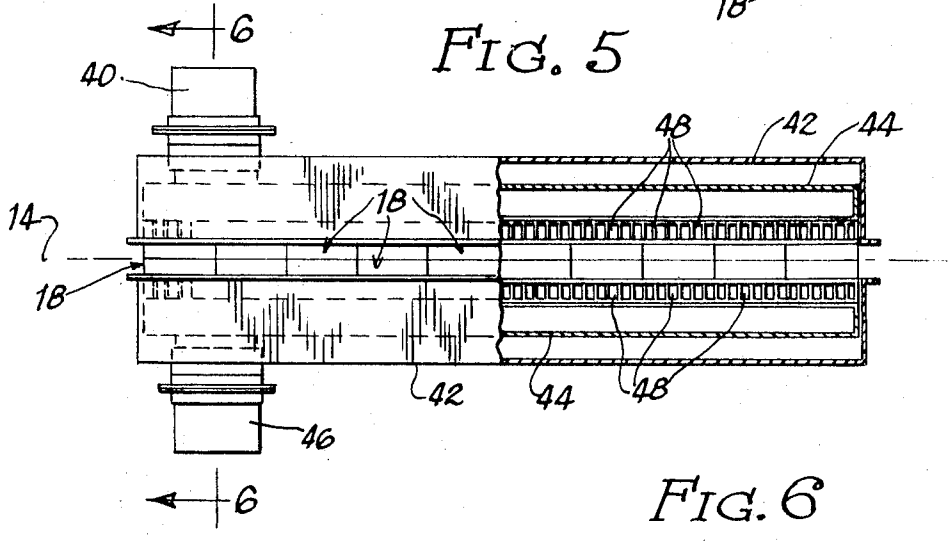


FIG. 6

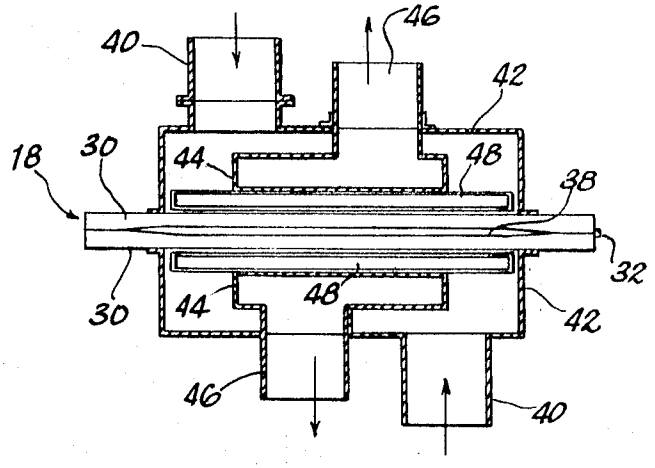


FIG. 7

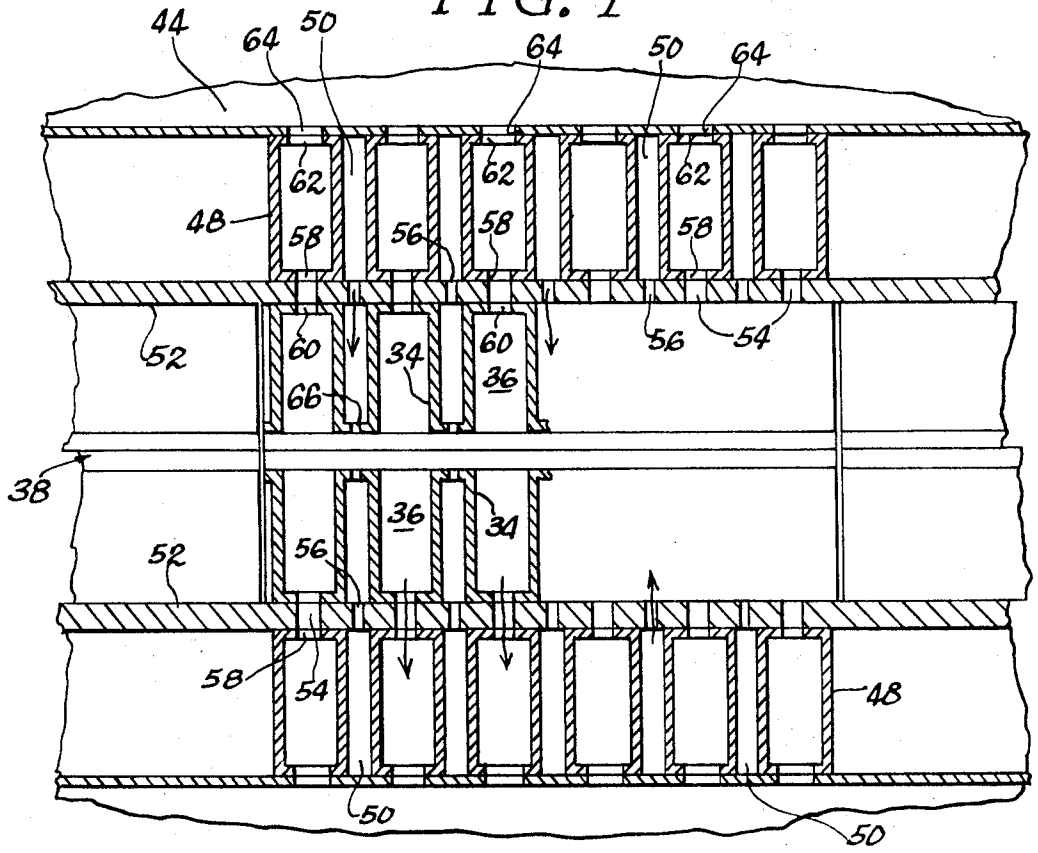
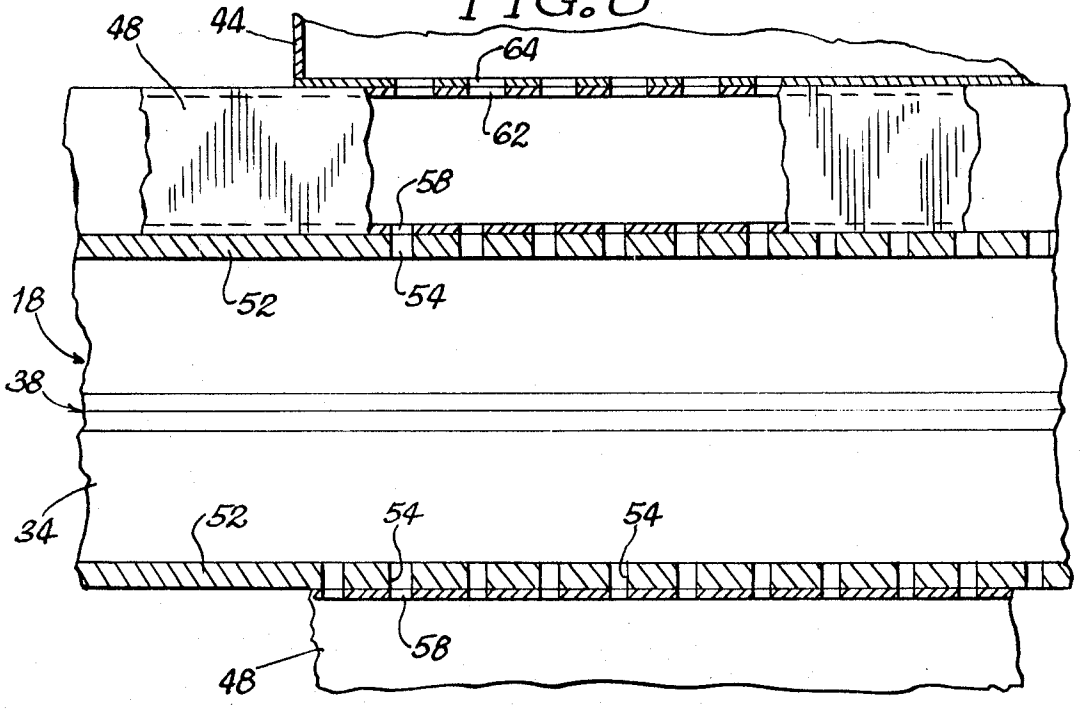

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FIG. 8


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AIR VENTILATING AND CIRCULATING SYSTEM FOR MICROWAVE DRYERS

This invention relates to a web-drying apparatus. The invention is particularly concerned with a web-drying apparatus of the type employing a microwave dryer for providing at least a portion of the web-drying function.

A microwave drying apparatus has been proposed for use in drying continuous webs. In a typical application, printed paper webs are run past microwave applicators and the ink on the webs is heated and dried by means of the microwave action. It has been recognized that the microwaves preferentially are absorbed by the ink on the moving web whereby temperature increases will occur in these selected areas to accomplish the drying action. Because of the preferential absorption, microwave drying of printed webs is recognized as having a high efficiency potential when compared with conventional heating methods.

Problems have occurred in microwave-drying systems due to the fact that the solvents which pass off during drying have been found to disrupt the operation of the microwave applicators. Specifically, the solvents tend to condense on the surfaces of the applicators, and, therefore, the operating characteristics of the applicators will change in an unpredictable fashion.

In utilizing a microwave dryer, it is desirable to locate the printed webs closely adjacent the microwave applicators for best drying results. Means must be provided, however, for preventing contact of the web with the closely spaced applicator surfaces to avoid smudging. Finally different inks exhibit various relative responses to the microwave heating effect, and means which will supplement the heat generated by the microwave system, and which are also readily controllable, are considered desirable.

It is a general object of this invention to provide a web-drying system employing microwave-drying means which can be operated in an economical and reliable fashion.

It is a more specific object of this invention to provide an air-ventiliating and circulating system for use in conjunction with a microwave web drying structure whereby undesirable solvent condensation can be avoided, smudging of the ink on web surfaces is effectively eliminated, and a highly efficient supplemental means for heating and drying is provided.

These and other objects of this invention will appear hereinafter and for purposes of illustration but not of limitation, specific embodiments of the invention are shown in the accompanying drawings in which:

FIG. **1** is a schematic illustration of a web-printing and drying system of the type contemplated by this invention;

FIG. **2** is an additional schematic illustration of the control means used in association with a microwave dryer;

FIG. **3** is a perspective view of a microwave applicator of a type suitable for use in the system of this invention;

FIG. **4** is a plan view, partly cut away, of a microwave applicator utilized in the system;

FIG. **5** is a side elevation, partly cut away, of the applicator shown in FIG. **4**;

FIG. **6** is an elevational view illustrating in section the air supply and exhaust means utilized for the microwave applicator;

FIG. **7** is an enlarged fragmentary, sectional view of the applicator structure and associated exhaust tubes; and,

FIG. **8** is an enlarged fragmentary transverse sectional view of the applicator structure and associated exhaust tubes.

The invention is generally directed to a web-drying apparatus which employs means for developing microwave energy. The microwave means consists of a pair of applicators with a passage defined between the applicators dimensioned to permit movement of a web through the passage in closely spaced relationship relative to the surfaces.

The microwave applicators comprise a plurality of spaced apart ridges located adjacent the web surfaces with wells or depressed areas defined between the ridges. A ventilating and air supply system is provided by locating air outlet openings in the ridges and by directing air through the openings into contact with the web surfaces. The exhaust openings are defined in the adjacent wells, and air exhaust means serve to withdraw the air as well as solvents passing off during the drying operation.

FIG. **1** illustrates a typical printing unit **10** which includes a plurality of printing rolls and web guide rolls **12**. A continuous web **14** is moved to the printing unit from supply roll **16**. The web **14** is then directed through microwave dryer **18** and then to a folding station **20**.

The microwave dryer **18** is typically included in a system such as shown in FIG. **2** including a microwave generator **22** and microwave termination unit **24**. The generator **22** is provided with an appropriate power supply **26** and controls **28**.

FIG. **3** illustrates the microwave unit **18** which includes a pair of applicators **30** hinged together at **32**. Each of the applicators defines a plurality of ridges or raised sections **34** with wells or depressed areas **36** defined between the adjacent raised sections.

In use, the applicators **30** are held together as shown in FIG. **6**, and the adjoining side edges are cut beck to define a passage **38**. The passage **38** extends completely through the microwave structure to permit movement of the web **14** through the structure. The transverse and vertical dimensions are such that the web, when properly supported, is maintained out of contact with the surfaces of the microwave unit. This is essential to avoid any smudging of ink which would occur if there should be any contact with solid surfaces prior to drying.

FIGS. **4**, **5**, and **6** illustrate air input and exhaust ductwork for the microwave dryer. Upper and lower air input tubes **40** direct air into the chambers **42**. These chambers are located in surrounding relationship with respect to exhaust plenums **44** and exhaust tubes **46** each communicate with an exhaust plenum.

Each exhaust plenum **44** is mounted on a plurality of elongated rectangular tubes **48**. The tubes **48** are located in spaced relationship relative to each other whereby passages **50** are defined between adjacent tubes (FIG. **7**).

The tubes **48** are mounted on plates **52** which are in turn secured to the applicators **30**. The plates **52** define a large number of circular openings **54** and **56**, these openings being located in alternating lines extending over the faces of the plates **52**.

The openings **54** in the plates **52** are aligned with openings **58** defined on one side of the tubes **48**. Additional openings **60** are located at the bottom of the wells **36** which are defined between the ridges **34** of the applicators. Accordingly, passage of air from the wells into the tubes is provided for. The opposite ends of the tubes define openings **62** which are aligned with openings **64** defined by the exhaust plenum **44**. In this manner, air present between the applicators **30** is withdrawn and moved into the exhaust tubes **46**. The exhaust tubes are preferably connected to a suitable pump for withdrawing the air. Since the air contains solvent which has passed off during drying, the air is preferably not recirculated. In order to maintain the solvent in gaseous form to keep it entrained in the air, the air should be heated to a temperature in excess of the condensation temperature of the solvent.

The openings **56** in the plate **52** communicate with the hollow interiors of the ridges **34** of applicators **30**. The ridges in turn define openings **66**, which permit passage of air into contact with the web **14** moving in the passage **38** defined between the applicators. Air introduced through the tubes **40** thus moves between the tubes **48** in the passages **50** and then through the openings **56**.

The arrangement described provides for contact of streams of air on both sides of the web **14** during movement of the web through the microwave unit while the microwaves are being directed onto the web surfaces, heat will be generated whereby solvent vapors will be exhausted along with the air introduced. By proper regulation of the air pressure, the warm

stream will serve to support the web thereby avoiding any engagement with the surface of the microwave unit.

In addition to this supporting function, the ability of the ventilating system to quickly withdraw solvent vapors is of great importance. Condensations of these vapors can seriously disturb the microwave unit operation. In addition, a condensation of evaporating ink on the paper web would result in oil-stained copy.

The system described also provides a valuable means for supplementing the heat generated by the microwave operation. Thus, the air introduced can be raised to a desirable temperature level so that the microwave unit need not bear the entire burden of supplying heat.

It will be understood that various changes and modifications may be made in the above described construction which provide the characteristics of this invention.

That which I claim is:

1. In a web-drying apparatus including means for developing microwave energy, the microwave means comprising a pair of applicators with a passage defined between the applicators, and means for moving a web through said passage, said applicators comprising a plurality of spaced apart ridges located adjacent the web surfaces with depressed areas defined between said ridges, the improvement comprising a ventilating and air supply system for said applicator, said system comprising air outlet openings defined by said ridges, air supply means for directing air through said openings and onto the web surfaces, exhaust openings defined in said depressed areas, a plurality of tubes located in overlying relationship relative to said applicators and in positions corresponding with said depressed areas, openings defined in one wall of said tubes communicating with said exhaust openings to permit withdrawal of air through said tubes, said tubes being positioned in spaced apart relationship with passages defined between the tubes, said passages communicating with hollow interiors defined by said ridges to thereby permit movement of air through said passages and into said interiors for distribution through the air outlet openings defined by said ridges, and air exhaust means communicating with said tubes for withdrawing air from between said applicators through said exhaust openings.

2. A construction in accordance with claim 1 including plate means for supporting said tubes, said plate means defining a plurality of openings, one set of said openings communicating with the openings defined by said tubes for the exhaust of air from said depressed areas, and a second set of said openings in said plate means located to provide communication between said passages defined between said tubes and said hollow interiors of said ridges.

3. A construction in accordance with claim 2 including an exhaust plenum overlying the tubes associated with each applicator and including additional openings in said tubes opposite the openings defined in said one wall for communication of said tubes with the associated exhaust plenum.

4. A construction in accordance with claim 3 including a chamber located in surrounding relationship relative to the exhaust plenum and tubes of each applicator, said air supply means being connected to each chamber.

5. A construction in accordance with claim 4 including means for heating the air before it is introduced into said chambers.