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Baardson

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[54] **WOOD AND GAS FUEL BURNER**

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[73] Assignee: **Mill Conversion Contractors, Inc.,** Hillsboro, Oreg.

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[52] **U.S. Cl.** ..... **110/8 A,** 110/7 A, 431/352

[51] **Int. Cl.** **F23g 7/00**

[58] **Field of Search** ..... 431/175, 351, 352; 110/8 A, 7 A, 102

[56] **References Cited**

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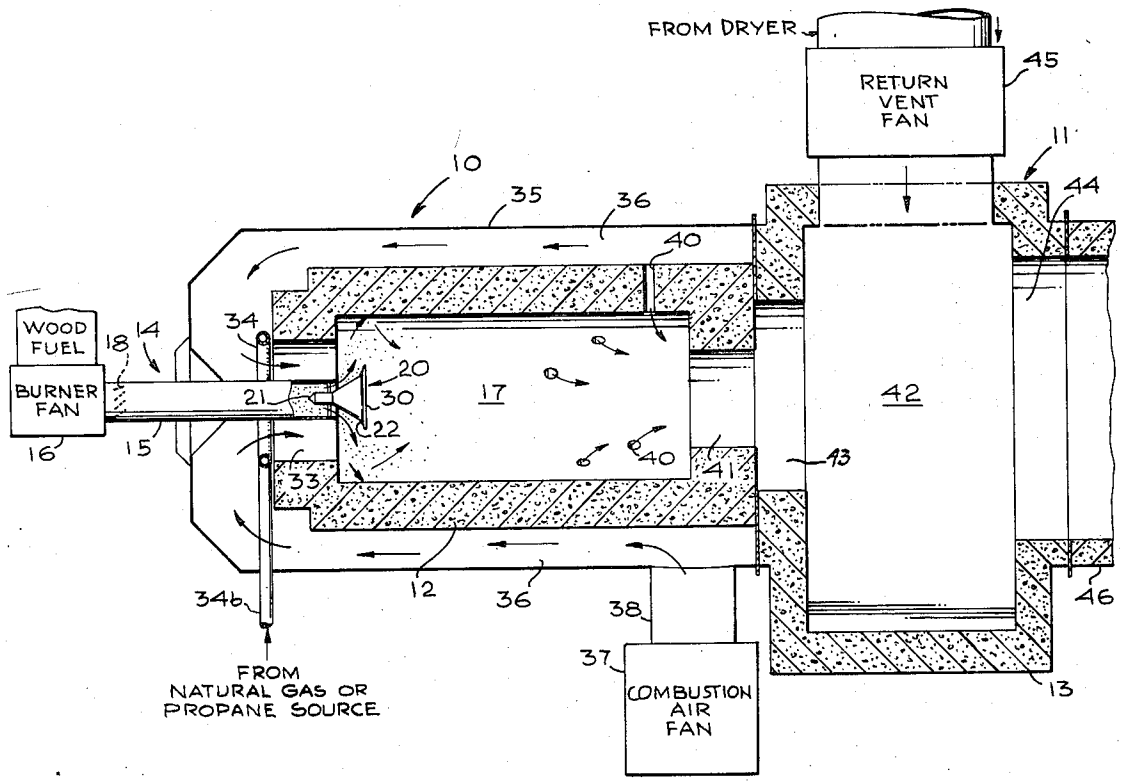
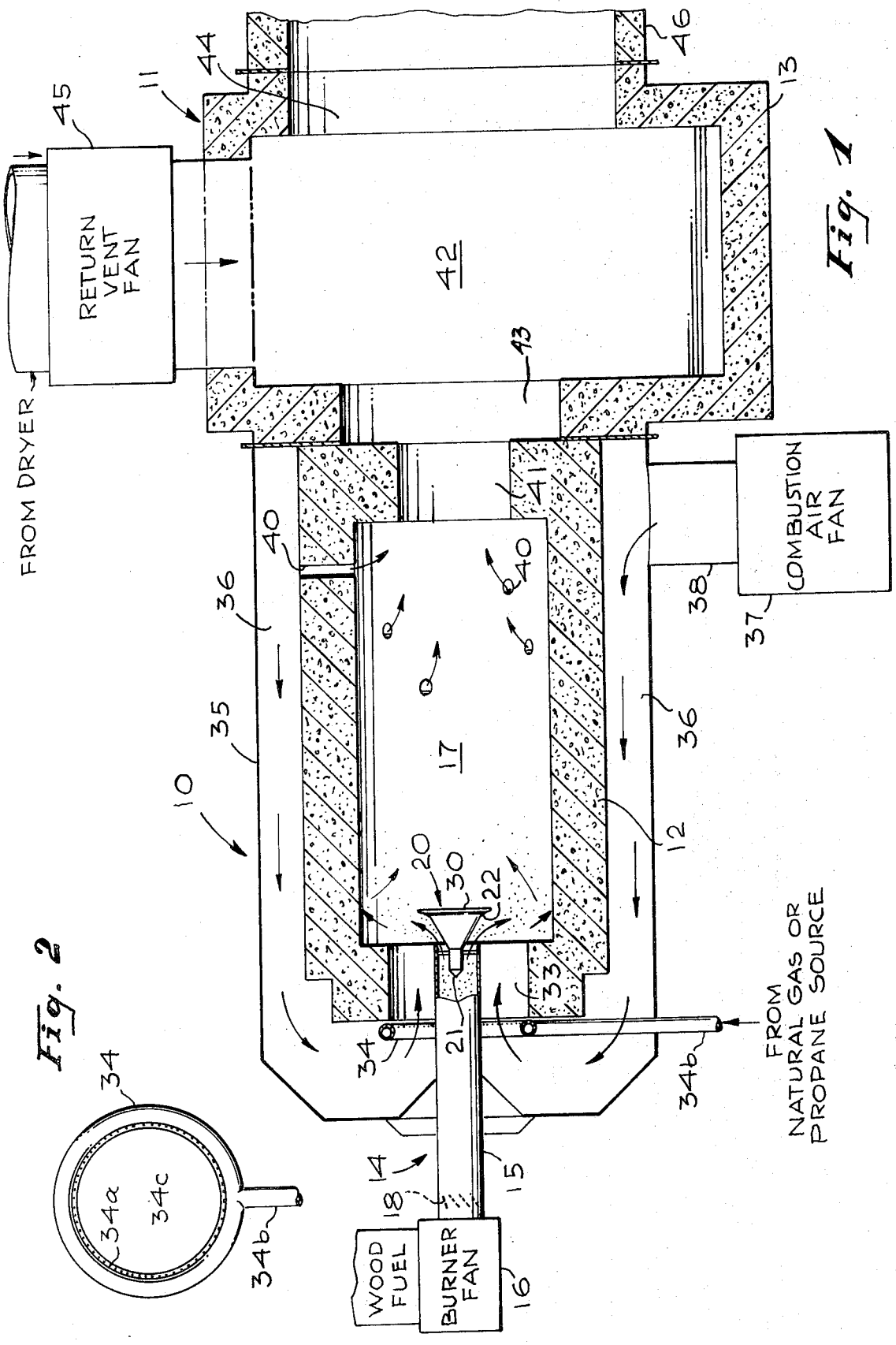
[57] **ABSTRACT**

The present invention provides a burner by means of which waste wood and the fumes emitted by drying wood can effectively be burned to not only provide additional heat energy but also to reduce atmospheric pollution. The burner basically comprises two chambers. The wood, fed in powdery form, is burned in the first chamber, the product of this combustion being passed to the second chamber where it is mixed with the fumes before being combusted a second time. A number of innovations makes this burner highly effective and useful in the lumber mill industry.

9 Claims, 4 Drawing Figures




RETURN VENT FAN
FROM DRYER
COMBUSTION AIR FAN
FROM NATURAL GAS OR PROPANE SOURCE
WOOD FUEL
BURNER FAN
42
17
10
11
12
13
14
15
16
18
20
21
22
30
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34a
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34c
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Fig. 1

Fig. 2

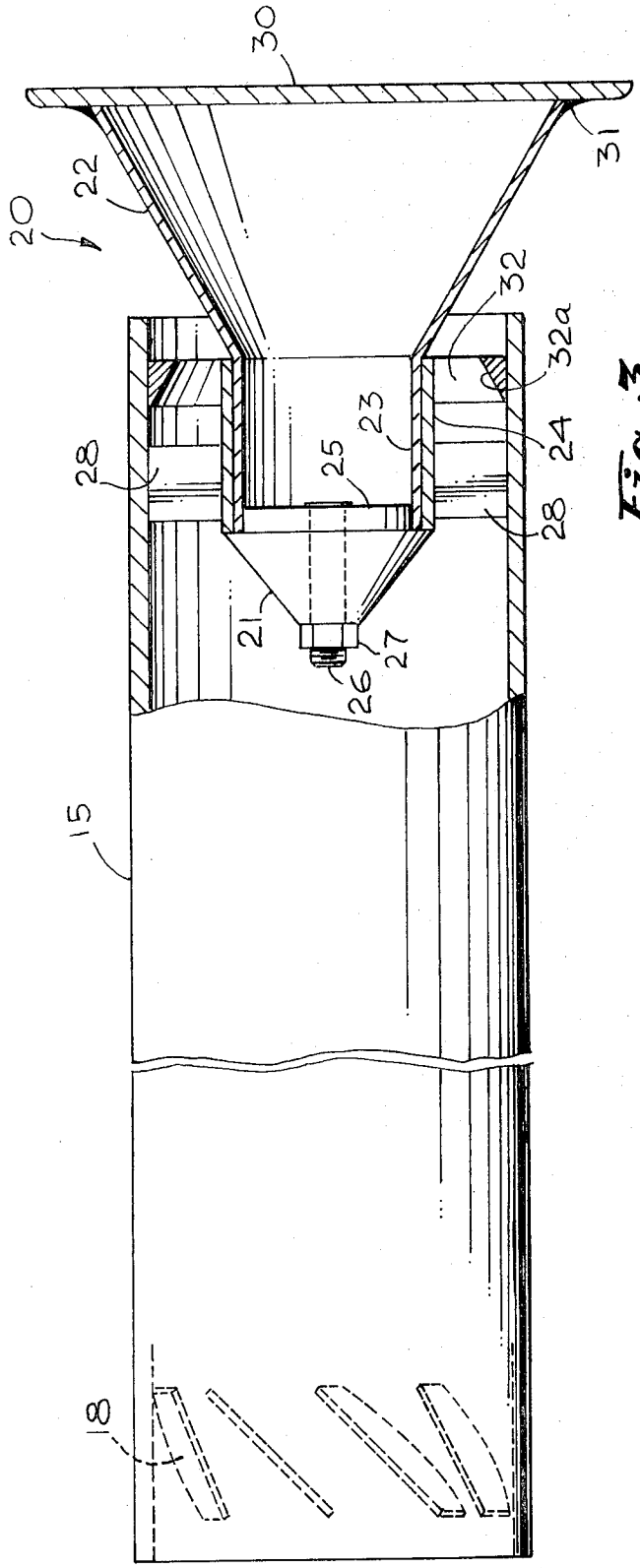

Fig. 3

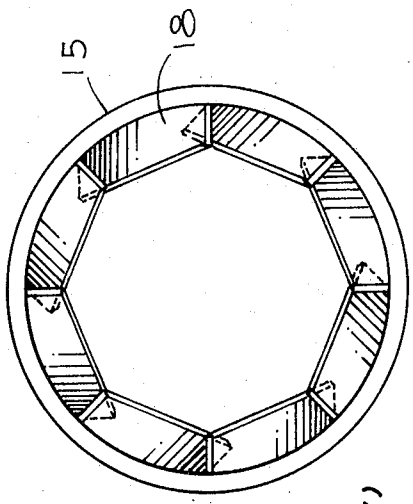

Fig. 3(a)

WOOD AND GAS FUEL BURNER

The present invention relates to the lumber mill field in general and more particularly relates to a wood and gas fuel burner for the effective utilization of wood waste materials and other by-products of the lumber mill industry.

Lumber mills generate tons of waste wood daily and not all of it can be used for barkdust, chipboard or other commercial products. More particularly, in the manufacture and processing of lumber and lumber mill products, various kinds of wood materials are developed with which little can be done and which are therefore looked upon and treated as waste. For example, in a plywood mill, the surface of the plywood is finished by sanding the plywood and, as a result thereof, there is produced a sander dust that is difficult to handle because it is stringy, balls up, has a tendency to "bridge," is difficult to measure quantitatively, presents a fire and explosion hazard, and is generally a nuisance to handle. There is also produced a substantial quantity of waste wood known as "hog fuel," so called because it has been sized by being fed through a chipper or hog. In addition, there are various other wood waste materials produced as by-products, such as bark, shavings, trimmings, sawdust, and the like. Some of the materials mentioned are usually wet or damp to one degree or another, such as the bark and sawdust, which further complicates the practical use of them. Accordingly, in the past, these materials have gone as waste wood and, in the main, have been gotten rid of by burning them in what are known as wigwam burners. Unfortunately, however, one of the effects of this type of burning has been the injection or emission into the atmosphere of large amounts of pollutants, such as, smoke and ash, various kinds of chemical emissions, uncombustible particles, and the like.

On the subject of air pollution, it should also be mentioned that in the process of drying veneer or green lumber, fumes are emitted from the wood that, in the past, have been vented into the atmosphere. These fumes are of a combustible nature but their use as a possible heat energy source has been totally wasted. Furthermore, because of the chemicals in the fumes, they have not only been unsightly, but also obnoxious and deleterious in a number of respects. Considering the large volume of these fumes that are daily vented into the atmosphere, it will be recognized that these fumes have materially contributed to what has come to be known as the air-pollution problem.

The present invention provides a burner by means of which the waste wood and the fumes can effectively be burned to not only provide additional heat energy but also to reduce atmospheric pollution. The burner basically comprises two chambers. The wood, fed in powdery form, is burned in the first chamber, the product of this combustion being passed to the second chamber where it is mixed with the fumes before being combusted a second time. The result is a pollutant-free hot gas that can be used as a heat source either to dry wood or to produce steam in a boiler system. It should be mentioned at this point that the burner of the present invention has previously been illustrated and described, but not claimed, in copending U.S. Pat. application Ser. No. 412,474 for A Wood Waste Burner System, by Andrew B. Baardson, filed Nov. 2, 1973.

It is, therefore, an object of the present invention to provide a burner in which both wood and gaseous emissions can efficiently be burned.

It is another object of the present invention to provide a burner in which waste wood and combustible gas emissions are used as a fuel.

It is a further object of the present invention to provide a burner in which both wood and combustible gases can efficiently be burned to provide substantial additional amounts of heat energy.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings in which an embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

FIG. **1** is a cross-sectional view of a burner according to the present invention and illustrates the two chambers therein wherein the wood and combustible gases are respectively burned;

FIG. **2** is a front view of one of the elements included in the construction of the FIG. **1** embodiment;

FIG. **3** is a side view, partially in cross-section, of certain wood fuel supply and dispersion apparatus included in a burner according to the present invention; and

FIG. **3**(*a*) is an end view of the FIG. **3** apparatus.

For a consideration of the invention in detail, reference is now made to the drawings wherein the construction of a burner according to the present invention is shown and, as shown therein, the burner is a two-stage structure in which a combustion chamber **10** constitutes the first stage and a blending chamber **11** the second stage. The burner is cylindrically-shaped and generally symetrical about its center line, the two chambers being lined with a refractory material, such as high alumina firebrick **12** lining the combustion chamber and castable fireclay **13** around the blending chamber.

At the input to the combustion chamber is a product deflector unit, generally designated **14,** comprising a burner tube **15** that is coupled at its input end to a burner fan **16** and at its output end to the chamber **17** in which the combustion of the wood fuel is initiated. As may be seen from the figures, particularly FIGS. **3** and **3**(*a*), the burner tube is cylindrically-shaped and has a series of dispersion vanes **18** mounted peripherally around the inside of the tube near its input end, the dispersion vanes being positioned at such an angle that the combination of combustion air and wood fuel held in suspension therein is deflected into a counterclockwise movement or rotation as it flows by the dispersion vanes into the burner tube. One angle that has been found to be suitable for said purpose is the angle of 45° as formed by the plane of each vane and the center line of the burner tube. As previously mentioned, dispersion vanes **18** are located at the input end of the burner tube.

At the output end of the burner tube and extending partially into chamber **17** is deflector apparatus, generally designated **20,** that comprises a nosecone section **21** at its forward end and a conical deflector section **22**

at its rearward end, the two conical sections being separated by a pair of concentric pipe sections **23** and **24** respectively used for housing and support purposes. Mounted within pipe **23** and abutting against nonecone section **21** is a support base **25,** a bolt **26** extending through this support base and the nosecone section as shown in FIG. **3.** A jamb nut **27** is tightly wound on the bolt so as to firmly or rigidly hold the nosecone section in place between the support base and the nut. The entire deflector apparatus is rigidly held in position with the aid of support brackets **28** which are mounted between pipe **23** and the wall of burner tube **15,** as is best shown in FIG. **3.** Thus, brackets **28** centrally fix the position of pipes **23** and **24** inside the burner tube and the pipes, in turn, aid in holding cone sections **21** and **22** in position. A backing plate **30** is mounted on and covers the base of conical section **22,** the junction between the plate and the conical section being filled in to form an annular concave-shaped fillet **31** that provides a smooth transition from the surface of the conical section to that of the plate. As will be pointed out below, fillet **31** plays an important role in the process of deflecting the wood fuel product as it passes through the burner tube on the way to the combustion chamber. Finally, completing the deflector apparatus, is a deflector ring **32** that is held in position by the wall of burner tube **15** at the junction of conical section **22** and pipe **23,** the ring being tapered or angled along its inside surfact **32***a* so as to deflect gases and wood fuel passing through it toward conical section **22.**

The entrance to combustion chamber **17** includes an entrance port **33** through which product deflector unit **14** extends toward the combustion chamber and at the input end of which there is mounted a gas ring burner **34.** The gas ring burner is illustrated in both FIGS. **1** and **2** and, as shown therein, is hollow, has openings or orifices **34***a* along its entire circular inner surface or periphery, and, by means of pipe **34***b* , is connected to a natural gas or propane source (not shown). As may also be seen from the figures, particularly FIG. **2,** the opening or passageway through the center of gas burner ring **34,** the opening being designated **34***c* , is approximately the same size or diameter as that of entrance port **33** to which it is adjacent. Accordingly, any gases flowing through ring opening **34***c* thereafter flow smoothly into entrance port **33.** The significance of gas burner ring **34** will be pointed out hereinbelow.

As previously mentioned, chamber **17** is enclosed by a wall of firebrick **12.** However, between the firebrick and the outer wall of the burner, which is also the outer wall of combustion chamber **10,** the said outer wall being designated **35,** in a passageway **36** that is connected to a combustion air fan **37** by means of duct **38.** Thus, in combustion chamber **10,** in a concentric arrangement, is chamber **17,** firebrick wall **12,** passageway **36** and outer burner wall **35.** The air provided by air fan **37** flows through passageway **36** in the direction of the arrows therein and thereafter passes through gas burner ring **34** and entrance port **33** into chamber **17.** In addition to combustion air being supplied in this manner, that is to say, through the input end of chamber **17,** air is also supplied directly to the chamber by means of channels or passageways through firebrick wall **12,** that interconnects chamber **17** with passageway **36,** there being several such channels through the wall located at different points therealong both axially and circumferentially. The channels shown in FIG. **1** are designated **40** and they are arranged in a sort of helical path around the wall of the chamber so as to produce a helical vortex type of flow pattern having a counterclockwise movement or rotation.

Finally, completing the construction of combustion chamber **10** is an exit port **41** located, as its name implies, at the output end of chamber **17.** Exit port **41** leads to blending chamber **11** and the products of combustion leaving chamber **17** pass through port **41** on their way to the blending chamber.

Blending chamber **11** is similar to combustion chamber **10** in several respects in that it also includes a chamber **42** formed by a wall of refractory material **13** and with entrance and exit ports **43** and **44,** respectively, at its input and output ends. The blending chamber and what goes on inside it constitutes the second stage of the burner and, in this regard, it is therefore coupled to the combustion chamber by means of entrance port **43** which, as the figure illustrates, is in communications with exit port **41.** Coupled to this second stage is a return vent fan **45** which, as previously indicated, feeds the combustible gases from the dryer to chamber **42.**

Considering now the operation of the burner and of chambers **10** and **11** therein, air under pressure with wood fuel in suspension therein is fed first to product deflector unit **14** where it is forced by dispersion vanes **18** into a counterclockwise rotation. In view of the forward motion of the air and wood fuel, the counterclockwise rotation produces a helical flow pattern as the air and wood fuel flow down burner tube **15.** In this regard, the wood is finely ground at this point and may be introduced into the burner at speeds of approximately 5,000 feet per minute, which is just a bit less than 60 miles per hour. Accordingly, the air and wood enter and travel down the burner tube at a fairly high speed. With respect to the size of the wood particles, these will vary in size, of course, but the maximum diameter of these particles will be in the order of five sixteenths of an inch. It should also be mentioned that among other things, dispersion vanes **18** cause the wood fuel to become evenly dispersed in the air that carries them so as to provide a uniform cross-sectional wood particle density.

The air and wood fuel combination moves down burner tube **15** in the aforedescribed manner until it reaches nose cone section **21** where the center portion of this mass of air and wood is deflected outwardly and forced to pass through the space between pipe **24** and the burner tube wall. However, it should be emphasized that the combination of air and wood continues to turn in a counterclockwise direction as it moves forward through this space. When the air and wood reaches deflector ring **32,** the outermost portion of it impinges upon deflecting surface **32***a* which forces it downwardly where, together with the other air and wood passing through this space, it impinges upon the forward part of conical section **22.** The air and wood particles, still in a counterclockwise rotational movement, move along or follow the surface of the conical section until they reach backing plate **30** and fillet **31** where the entire mass of air and wood fuel is smoothly channeled or turned outwardly toward wall **12** in chamber **17.** In the proximity of the inner surface of the wall or upon contact with the wall itself, the wood particles are ignited due to the high temperature at the wall's surface, which temperature may be in the range between

2,200°—2,400° Fahrenheit. Upon ignition, the wood particles are deflected by the wall of chamber **17** and they then move into and through the chamber as they continue and complete the combustion process. During this period of time, the wood continues to move in a helical path toward exit port **41.**

It will be recognized from what has already been said that as the air and particles of wood suspended in it emerge from the burner tube to impinge upon conical section **22,** they are joined by a mass of secondary air introduced, as previously mentioned, via passageway **36.** Secondary air is also introduced directly into the chamber via channels **40,** as was also previously mentioned. This secondary air serves a dual purpose, nemely, it insures or guarantees that the wood fuel has sufficient air for complete combustion and, therefore, total consumption although the amount of primary or conveying air is adjusted and maintained to meet this requirement and, second, it helps to control the temperature within the combustion chamber to within the desired limits. Accordingly, this secondary air plays an important role in the combustion stage of the operation. It should finally be mentioned that the gas burner ring **34** is used for start up purposes, that is to say, to bring the temperature of the combustion chamber to ignition range and that the natural or propane gas fed to the ring may be used to supplement the wood as a fuel should that be needed.

The products of combustion obtained in combustion chamber **10** pass through ports **41** and **43** into blending chamber **11** where, in chamber **42,** these products of combustion are mixed with the combustible emissions coming from the dryer. It should be mentioned at this point that while a portion of the wood fuel is consumed in the combustion chamber, another portion continues to burn as it enters chamber **42.** Accordingly, the dryer's fumes or emissions are ignited in the blending chamber and burn with the remaining wood fuel, the resultant output from the blending chamber going through exit port **44** and into other equipment coupled to the output end of the burner. It would be worthwhile to mention at this point that chamber **42** is larger than chamber **17** and, therefore, that the products of combustion expand as they enter chamber **42.** It should further be mentioned that the heat generated in chamber **17** due to the burning of the wood fuel there is more intense than the heat generated in chamber **42.** The overall effect, therefore, is that the temperature of chamber **42** is maintained between 1,200°–1,600° Fahrenheit, roughly 800°–1,000° cooler than chamber **17.**

Although a particular arrangement of the invention has been illustrated and described hereinabove by way of example, it is not intended that the invention be limited thereto. Accordingly, the invention should be considered to include any and all modifications, alterations or equivalent arrangements falling within the scope of the annexed claims.

Having thus described the invention, what is claimed is:

1. A burner for combusting wood and gaseous fuels, the wood fuel fed to the burner being in a powdery form and suspended in a stream of air, the burner comprising: first and second stages respectively having first and second chambers to which the wood and gas fuels are respectively fed; first and second means for respectively feeding the wood and gas fuels to said first and second chamber; third means for combusting the wood fuel in said first chamber; fourth means for passing the products of said combustion to said second chamber wherein it mixes with the gas fuel therein; fifth means contributing to the combustion of said mixture in said second chamber; and sixth means for moving the wood fuel through said chambers in a helical counterclockwise path.

2. The burner defined in claim **1** wherein said first means includes a deflector unit whose input end is coupled to receive the stream of air with the wood fuel suspended therein and whose output end is coupled to said first chamber, said deflector unit including a plurality of dispersion vanes mounted at its input end and positioned at such an angle as to cause said air and wood fuel to move in a counter-clockwise manner as it flows therethrough toward the output end of said deflector unit, said deflector unit further including deflector apparatus mounted at its output end to deflect said air and wood fuel outwardly toward the walls of said first chamber.

3. The burner defined in claim **2** wherein said deflector apparatus includes first and second conical sections at its forward and rearward ends, respectively, the base of said rearward conical section including structure to smoothly divert said air-suspended wood fuel radially outwardly toward the walls of said first chamber; and wherein said deflector apparatus further includes a deflector ring whose inside surface is angled to deflect any air-suspended wood fuel coming into contact with it toward said rearward conical section.

4. The burner defined in claim **2** wherein said deflector unit includes a cylindrically-shaped burner tube at whose input end said dispersion vanes are mounted and at whose output end said deflector apparatus is mounted, said dispersion vanes being distributed in a circular mode along the periphery of said burner tube and oriented at such an angle that the stream of air with the wood fuel suspended therein passing by the vanes are deflected by them into a counterclockwise rotational movement.

5. The burner defined in claim **2** wherein said burner further includes a supplementary air supply arrangement to provide additional air for combustion in said first chamber, said arrangement including a channel extending outside the wall of said first chamber and leading to the input end thereof.

6. The burner defined in claim **3** wherein said deflector unit includes a cylindrically-shaped burner tube at whose input end said dispersion vanes are mounted and at whose output end said deflector apparatus is mounted, said dispersion vanes being distributed in a circular mode along the periphery of said burner tube and oriented at such an angle that the stream of air with the wood fuel suspended therein passing by the vanes are deflected by them into a counterclockwise rotational movement.

7. The burner defined in claim **5** wherein said first chamber is cylindrically-shaped and wherein said sixth means includes a plurality of orifices through the wall of said first chamber that are located in a generally helical path therealong, said orifices intercoupling said supplementary air channel with said first chamber.

8. The burner defined in claim **6** wherein said first chamber is cylindrically-shaped and wherein said sixth means includes a plurality of orifices through the wall of said first chamber that are located in a generally heli-

cal path therealong, said orifices intercoupling said supplementary air channel with said first chamber.

9. The burner defined in claim **4** wherein the burner further includes a gas ring burner mounted at the input end to said first chamber and through which said burner tube concentrically extends, said gas ring burner being hollow, having orifices along its periphery, and having means for coupling it to a source of fuel.

* * * * *