United States Patent [19]

Grantham

[11] **3,861,865**

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[54] **DRYING SYSTEM**

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[52] **U.S. Cl.** **432/105,** 432/107, 34/133, 34/139

[51] **Int. Cl.** **F27b 7/02**

[58] **Field of Search** 34/131, 133, 134, 139, 34/130, 138; 432/105, 107, 103

[56] **References Cited**

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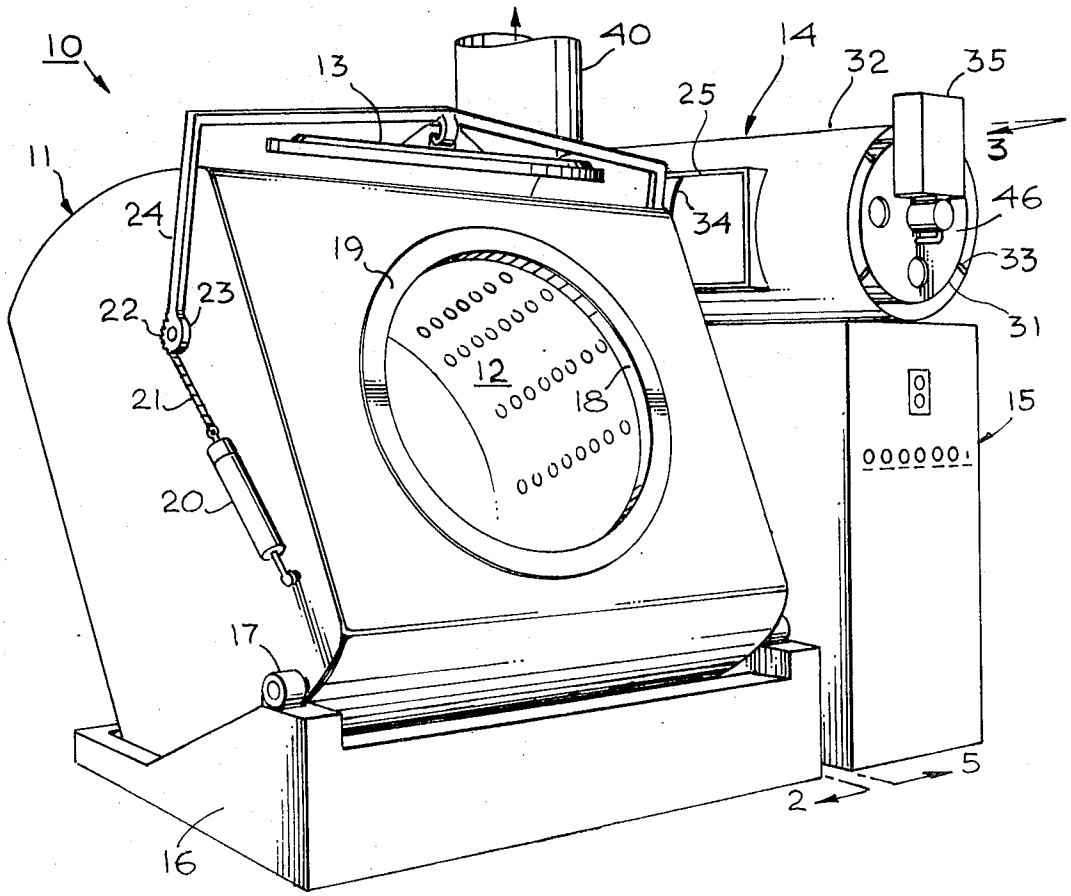
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Assistant Examiner—James C. Yeung
Attorney, Agent, or Firm—Henry M. Bissell

[57] **ABSTRACT**

An improved laundry dryer-conditioner is provided which utilizes air moving at a relatively high velocity and in a significant volume to replace the expensive fragile, heavy and short-lived refactory and other heat resistive materials, which are conventionally found in the combustion and air-heating chambers of such apparatus.

11 Claims, 5 Drawing Figures



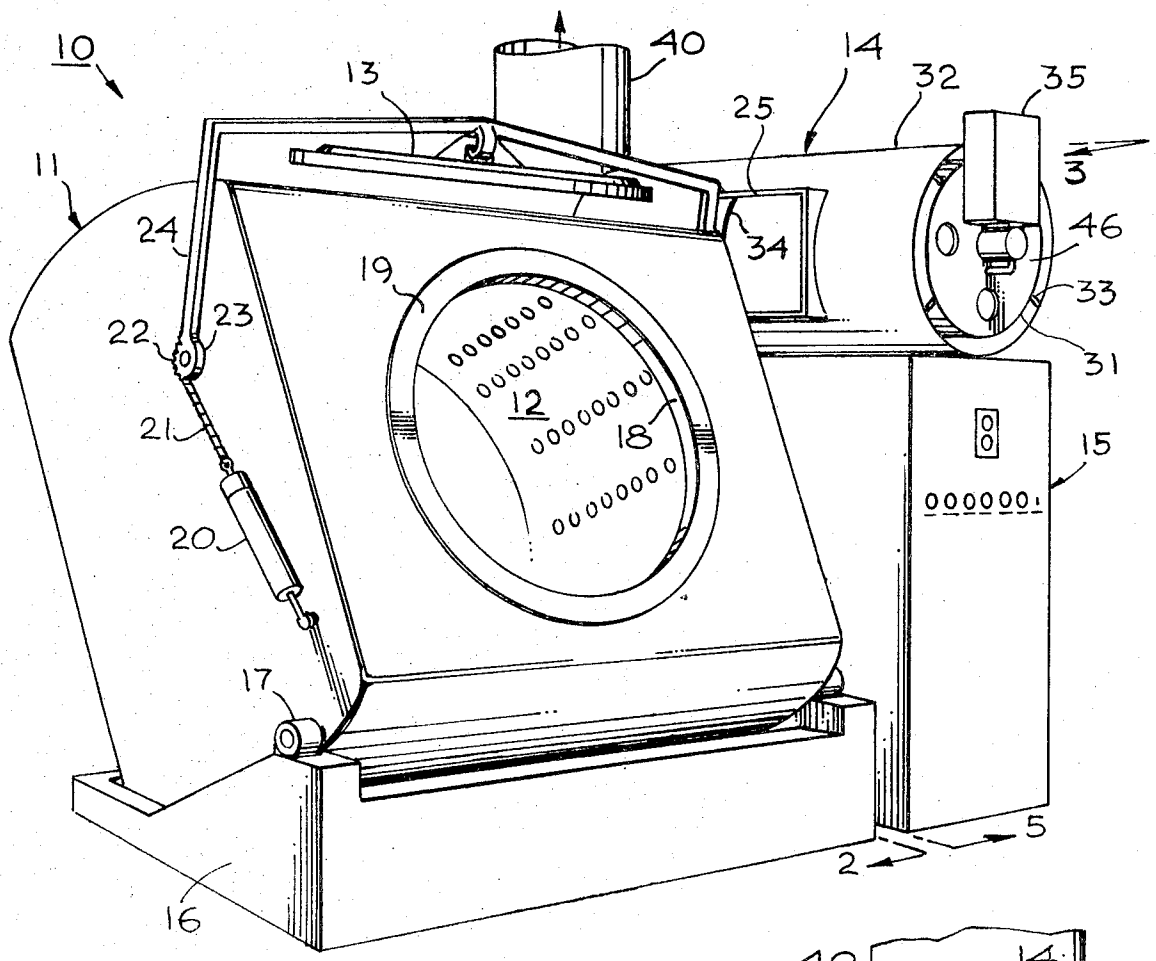


Fig. 1

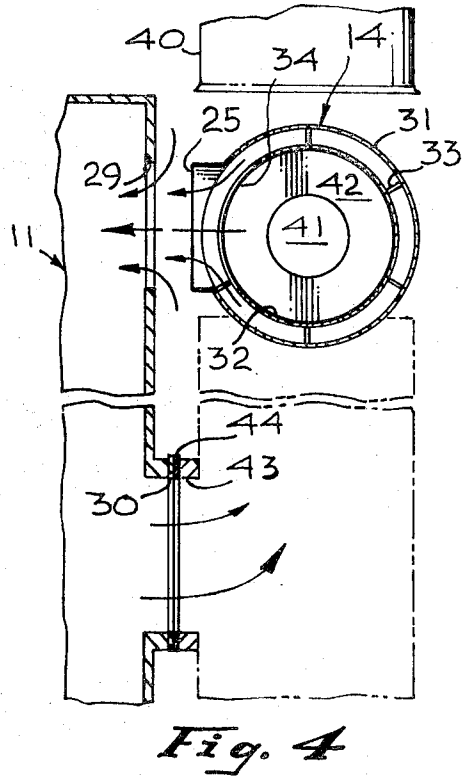


Fig. 4

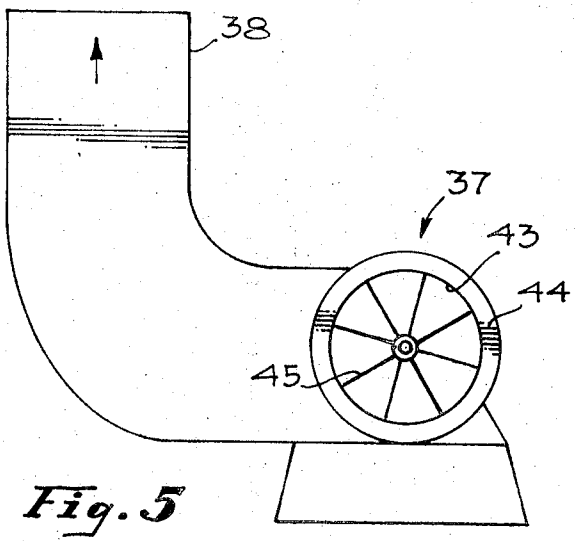


Fig. 5

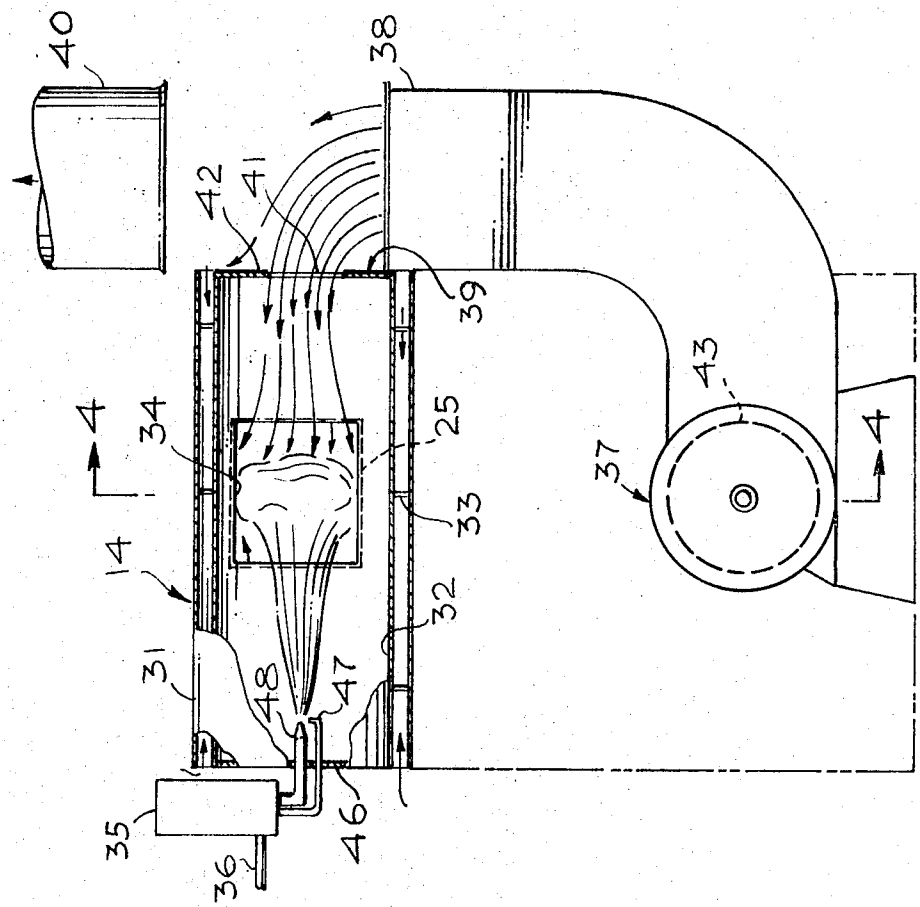

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Fig. 3

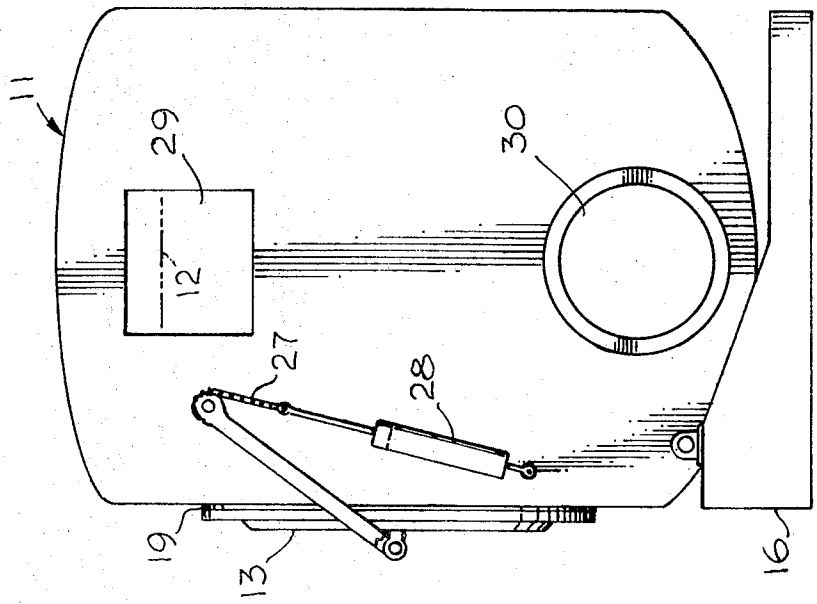

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Fig. 2

DRYING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of laundry and other article-drying equipment and, more specifically, to dryer-conditioners used in the commercial laundering industry.

2. Description of the Prior Art

An overall view of the prior art in industrial laundry dryer-conditioners, often referred to in the industry as merely "dryers," can be had by referring to my earlier-issued U.S. Pat. Nos. 2,604,313, 2,643,463 and 3,443,323. The dryers described in those patents and industrial dryers in general require large volumes of air having a temperature, in the tumbler, in the range of 300° to 350° F., in addition to providing the tumbling action to the laundry, to achieve rapid, but safe, drying.

These elevated temperatures are achieved by the burning of fuel such as natural gas, propane, butane or oil in a combustion chamber from which hot air is caused to flow into the dryer housing by appropriate air pumps or blowers. The fuel is mixed with appropriate proportions of air to give clean burning and is introduced into the combustion chamber under pressure at one end of the chamber. At the opposite end of the chamber it is conventional to have a slab of refractory material, which may weigh as much as 200 pounds and closes off the end of the chamber. Such material deteriorates with operation of the dryer and after several years must be replaced at considerable expense and loss of operating time. The weight of the slab adds to shipping costs for the dryer. In addition the slab has its own inherent initial cost. Further, it may crack during shipment, being somewhat fragile in nature.

In addition to the problems associated with the end closure of the combustion chamber, its outer walls become very hot during operation of the unit because internal temperatures of 1,700° F. may occur in the chamber. As a result it has been conventional to incur the additional cost and weight associated with wrapping the chamber with multiple layers of asbestos.

SUMMARY OF THE INVENTION

Stated succinctly, I have eliminated both the refractory end closure and the asbestos covering of the combustion chamber in a laundry dryer-conditioner by the use of high-volume, high-velocity air flowing over and through the proper regions in and about the combustion chamber. I have, in essence, created at the end of the combustion chamber remote from the fuel burner an air barrier which prevents the intensely heated air and other gases generated by the fuel burner from exiting at the end of the chamber, in the same manner as the refactory endpiece prevents such exiting in the conventional combustion chamber for a laundry dryer.

To eliminate the need for an asbestos wrapping of the combustion chamber I have provided a double-walled combustion chamber with cooling air pumped through the space between the double walls by the same air pump or blower which provides the drying air for the laundry and also provides the air barrier at the end of the combustion chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

Other aspects of the invention, along with other objects and advantages thereof, will become apparent from a reading of the detailed description which appears hereinafter, in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view, in elevation, of a dryer-conditioner system incorporating my invention;

FIG. 2 is a side view, in elevation, of a portion of the apparatus of FIG. 1;

FIG. 3 is a side view, in elevation, of the blower and combustion chamber of FIG. 1 with one combustion chamber wall partially cut away and the air-fuel mixing and introduction means simplified;

FIG. 4 is a sectional view of the combustion chamber of FIG. 3, taken along the line 4—4 of FIG. 3; and

FIG. 5 is an elevational view of the opposite side of the blower or air pump shown in FIG. 3.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

In FIG. 1, dryer-conditioner system **10** includes housing **11**; basket **12** rotatably supported within housing **11**; cover **13**, which is shown in its position removed from its placement during actual operation of the system; combustion chamber **14**; control center **15** which provides the controls for operating combustion chamber **14** and positioning housing **11** and cover **13**; and base **16** which supports housing **11** in a tiltable fashion.

Housing **11** is shown in position for the loading of laundry into basket **12**. In this loading position housing **11** is tilted backwardly by mechanical means, not shown, the axis of rotation being about journal **17** and its opposite member on the opposite end of housing **11**, not shown. In this position for loading, cover **13** is moved into a position remote from front opening **18**, which front opening is surrounded by gasket **19** for sealing of this opening during the operation of drying system **10**. Cover positioner **20** may be a pneumatic or hydraulic actuator which cooperates, through chain member **21**, with teeth **22** on gear member **23** to which arm **24** is secured. When positioner **20** receives a signal from control center **15** it pulls downwardly on chain **21** causing gear member **23** to rotate and raising cover **13** away from its position in cooperation with gasket **19** surrounding loading opening **18** in housing **11**. A similar pneumatic or hydraulic actuator may be provided on the opposite side of housing **11** shown in FIG. **2**. In this loading position hot air exit aperture **25** in combustion chamber **14** is exposed. Of course, at this time the circuits of control center **15** have extinguished the main flame in combustion chamber **14** leaving only the pilot light burning in that chamber. The internal details of combustion chamber **14** are set forth more fully and will be described more fully in connection with FIG. **3**. Similarly, the function of exhaust stack **40** will become more apparent in connection with the discussion of FIG. **3**.

In FIG. **2**, housing **11** is shown in an upright position, ready for operation of the dryer. It is to be noted that when housing **11** is in an upright position, cover **13** has been positioned in cooperation with gasket **19** surrounding loading opening **18** in housing **11**. This is accomplished by releasing the tension on chain **21** and its counterpart chain **27** through control of positioners **20** and **28**, respectively. As can be seen from FIG. **2**, housing **11** has hot air inlet aperture **29** which is positioned in alignment with aperture **25** in combustion chamber **14** when housing **11** is in its upright position for opera-

tion of the drying system. It should be noted, however, that apertures **25** and **29** are not joined by a positive seal during operation of the system. A space is provided between apertures **25** and **29** so that the air which is emerging from aperture **25** (and may have temperatures approaching 1,700° F. is mixed with relatively cool air from the environment surrounding the system. As a result, the air entering the basket **12** has a temperature approximating 500° F. The need for tempering the air exiting from the combustion chamber is recognized and discussed in my two U.S. Pat. Nos. 2,604,313 and 2,643,463.

Aperture **30** in housing **11** is provided for channeling air out of housing **11** and is positioned so that when housing **11** is oriented for operation of the system, aperture **30** is aligned with the return inlet of the air pump or blower in the system, such air pump or blower being described more fully in connection with FIGS. **3** and **5.**

In FIG. **3**, combustion chamber **14** has an outer wall **31** and an inner wall **32** separated therefrom by spacers **33** shown more clearly in FIGS. **1** and **4.** Air may enter freely from either end of combustion chamber **14** and pass through the space between outer wall **31** and inner wall **32** of combustion chamber **14.** Inner wall **32** has aperture **34** therein which communicates with hot air exit aperture **25** in outer wall **31** and with the spaces between inner wall **32** and outer wall **31.** Aperture **34** may be of the same size as aperture **25** in outer wall **31.** The fuel introduction and burning system shown in FIG. **3** is a simplified version of that indicated in FIG. **1** and comprises a fuel-gas mixing chamber **35** which receives fuel through pipe **36** and air, usually under pressure as developed by blower **37** in FIG. **1.** The chamber may also have an automatic flap valve which adjusts the air input to the mixture as the fuel flow changes. A pilot flame **47** is provided to light the air-fuel mixture issuing from jet **48** when the system is operating in the "dry" mode. All of the conventional safety features, such as automatic shut off of the fuel valve if the pilot flame is inadvertently extinguished and interlocking features which automatically shut down the system if any of the normal conditions for operation of system are departed from, are provided but need not be explained here since they are all well known in the art.

Blower or air pump **37** has the mouth of its outlet duct **38** positioned proximate to the lower side of end **39** in combustion chamber **14,** as shown in FIG. **3.** Exhaust stack **40** is also positioned adjacent end **39** of combustion chamber **14** but is spaced from outlet duct **38** by approximately the diameter of combustion chamber **14,** as shown.

In the sectional view of FIG. **4,** the combustion chamber **14** is shown with outer wall **31,** inner wall **32** spaced from outer wall **31** by spacers **33,** and the rear disk or end wall portion **42** which is a continuation of inner wall **32.** Disk portion **42** has aperture **41** therein. Because of the temperatures achieved and the corrosion which would otherwise occur, inner wall **32** and disk portion **42** may be formed of corrosion resistant material such as stainless steel, particularly if the fuel being burned is oil.

FIG. **5** shows the reverse side of the blower **37** from that shown in FIG. **3.** It is noted that an air inlet **43** is provided and that this inlet has a size and a position so as to assure alignment and communication between the inlet **43** and aperture **30** in housing **11** when housing **11** is oriented for a drying operation. A gasket **44** may be provided around the inlet **43** to assure a tight seal between inlet **43** and exhaust aperture **30** during operation of the system. Air pump **37** may be of the centrifugal variety in which case it will have blades **45** which propel the air outwardly through outlet duct **38.**

For operation of the system the appropriate button on control center **15** is pressed to bring housing **11** to an upright position and at the same time to bring cover **13** into firm contact with gasket **19** surrounding aperture **18** in housing **11.** With this positioning of housing **11,** hot air aperture **25** in combustion chamber **14** is aligned with but spaced from aperture **29** in housing **11** to permit the mixture of hot air from the combustion chamber **14** with room ambient air adjacent the apertures **25, 29** for passage into housing **11** at the proper temperature. Correspondingly, air inlet aperture **43** and blower **37** are positioned so that gasket **44** is coincident with the periphery of aperture **30** in housing **11** to permit the pumping of air out of housing **11.** With all interlocks and safety mechanisms closed, pilot flame **47** is used to ignite the fuel-air mixture emanating from jet **48** and a high temperature flame of considerable magnitude resuls. At the same time, blower **37** commences operation extracting air from housing **11,** producing a lowered pressure therein and causing an inflow of air at aperture **29** in housing **11,** part of which is hot air from the combustion chamber **14.** This hot air passes through aperture **34** in inner wall **32** and through aperture **25** in outer wall **31** into the upper portion of housing **11** from whence it passes through basket **12** and the laundry or other articles therein for exiting at aperture **30** in the lower portion of housing **11** to be re-pumped by blower **37.**

Not only does air from the combustion chamber **14** pass through apertures **34** and **25** into housing **11** through aperture **29** but, because of the differential pressure gradient across apertures **29, 25** and **34** as a result of the action of blower **37,** air is drawn through the space separating walls **31** and **32** of combustion chamber **14.** Part of that air will be at room ambient temperature, namely that part entering from front end **46** of combustion chamber **14.** Air also enters the space between the inner and outer walls from rear end **39** of combustion chamber **14** and flows between the inner and outer walls of the combustion chamber **14.** This air at room ambient temperature or at temperatures considerably below the internal temperature of combustion chamber **14** will cause cooling of the inner wall **32** of combustion chamber **14** thus protecting the inner wall against extreme temperatures while insulating the outer wall **31** therefrom. As a result, the need for wrapping combustion chamber **14** in asbestos, as is presently being done by dryer-conditioners not incorporating my invention, will be obviated. The reduced pressure within the inner walls of combustion chamber **14** as a result of the communication of apertures **34** and **25** with aperture **29** in housing **11** not only results in an overflow of air from the space between the inner and outer walls of combustion chamber **14** but also causes an inward diversion and recirculation of part of the air stream exiting from outlet duct **38** associated with blower **37.** The blast of air entering through aperture **41** in disk **42** of rear end portion **39** in combustion chamber **14** develops an effective air barrier which prevents the flame and hot gases produced at jet **48** from impinging upon disk **42** at end **39** of combustion cham-

ber **14.** The air emanating from outlet duct **38** is substantially reduced in temperature from that existing within combustion chamber **14** by reason of the heat absorption experienced in evaporating the water in the laundry within basket **12** as that basket rotates within housing **11.** A portion of the exhaust air is drawn into combustion chamber **14** through aperture **41** and into the space between inner and outer walls **31** and **32,** flowing out through apertures **34, 25** to enter housing **11** through aperture **29,** thus tending to provide a more efficient use of fuel for the drying process by partial recirculation. Air from outlet duct **38** which does not enter combustion chamber **14** either through aperture **41** or through the space between the inner and outer walls passes out of stack **40** through an appropriate lint trap, not shown.

Suitable temperature-sensing devices may be provided within housing **11** to prevent overheating of the materials being dried or laundered. Temperature sensors may be placed within housing **11** to control the flow of fuel into jet **48** and thus control the temperature of the drying air entering housing **11** through aperture **29.** As was indicated earlier, aperture **25** in outer wall **31** and aperture **29** in the outer wall of housing **11** may be spaced from each other. This will allow, as a result of the lessened atmospheric pressure at aperture **29** when the system is in operation, the inflow of room air through the space between outer wall **31** of combustion chamber **14** and the opposing wall of housing **11.**

Actual field experience with a system according to my invention has shown that, by reason of the nature of operation of the system according to my invention, the outer wall **31** of combustion chamber **14** need not be covered with asbestos as combustion chambers must be if they do not incorporate my invention, and the disadvantages previously experienced with refractory materials palced in the end of the combustion chamber in previous dryer-conditioner systems have been eliminated.

While a particular dryer-conditioner system has been shown and described herein for the purpose of illustrating the manner in which my invention may be used to an advantage, it will be appreciated that my invention is not limited thereto. Accordingly, any and all modifications, variations, or equivalent arrangements which may occur to those skilled in the art should be considered to be within the scope of my invention.

What is claimed is:

1. Apparatus for drying articles by the flow of preheated air comprising:

a housing having an air inlet opening and an air outlet opening;

means within the housing for supporting the articles to be dried;

air conduit means mounted externally of the housing having portions in alignment with the inlet and outlet openings respectively;

a combustion chamber having a flame source end, an opposed apertured end, and a discrete side opening spaced from said apertured end toward said flame source end and communicating with the conduit means aligned with the housing inlet opening; and

blower means coupled in series with the conduit means for directing air from the housing outlet opening to the vicinity of the apertured end of the combustion chamber.

2. Apparatus in accordance with claim **1** wherein the conduit means aligned with the inlet opening of the housing is spaced by a predetermined distance from said opening to permit ambient air to be drawn into said opening together with preheated air from the combustion chamber.

3. Apparatus in accordance with claim **2** wherein the combustion chamber, blower means and conduit means are arranged to draw a portion of the air exiting the housing outlet opening into the combustion chamber through the apertured end for further heating and recirculation through the housing.

4. Apparatus in accordance with claim **3** wherein the combustion chamber is configured to form an air barrier for the flame from the flame source end by means of the air flowing into the combustion chamber from the apertured end.

5. Apparatus in accordance with claim **1** wherein the combustion chamber comprises spaced-apart inner and outer walls with support means extending between the two, the walls and support means defining an inter wall space open at both ends for the flow of air therethrough.

6. Apparatus in accordance with claim **5** wherein each of said inner and outer walls includes means defining respective aligned side openings therein communicating with said conduit means in alignment with the inlet opening of the housing.

7. Apparatus in accordance with claim **6** wherein the conduit means aligned with the outlet opening of the housing further includes sealing means for establishing an abutting relationship between said conduit means and the housing at said outlet opening.

8. Apparatus in accordance with claim **3** wherein the conduit means further includes an exhaust stack portion and a conduit portion for directing air from the blower means to the exhaust stack portion, both the outlet of said conduit portion and the inlet of said exhaust stack portion being positioned adjacent the apertured end of the combustion chamber but spaced apart from each other.

9. Apparatus in accordance with claim **8** wherein the spacing between the conduit and exhaust stack portions is open to admit ambient air as drawn by the blower means through the apertured end of the combustion chamber.

10. Apparatus in accordance with claim **5** wherein the combustion chamber comprises a generally cylindrical inner wall having attached, generally closed end walls, the flame source end wall having a flame source mounted therein and extending therethrough, the opposed apertured end wall having a central aperture therein approximating one-third the diameter of the cylindrical inner wall, and a generally cylindrical outer wall open at both ends.

11. Apparatus in accordance with claim **1** further including control means for coordinating the actuation of said flame source and said blower means.

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