United States Patent [19]

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[11] **3,752,639**

[45] **Aug. 14, 1973**

[54] **WEB TREATING APPARATUS**

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[21] Appl. No.: **155,506**

[52] **U.S. Cl.** **432/59,** 34/122

[51] **Int. Cl.** **F27b 9/28**

[58] **Field of Search** 263/3; 34/110, 115, 34/122

[56] **References Cited**

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[57] **ABSTRACT**

Web treating apparatus comprises an elongated tubular core fixedly mounted between supports, the core being closed at one end and having longitudinally extending perforations, the interior of the core constituting a vacuum manifold. A drum of circular cross-section and having a perforated circumferential wall is rotatably mounted coaxially with the core. The drum is adapted to receive a continuous web wrapped about a predetermined arcuate segment of its circumferential wall. High intensity heat generators are spaced radially outwardly of the drum and are disposed above at least a substantial portion of the predetermined arcuate segment. Vacuum exhaust means draw heated air through the web and the drum and into the vacuum manifold, and means disposed within the drum direct the flow of heated air exclusively and substantially uniformly through the portion of the web which is wrapped about the predetermined arcuate segment of the circumferential wall of the drum.

12 Claims, 5 Drawing Figures

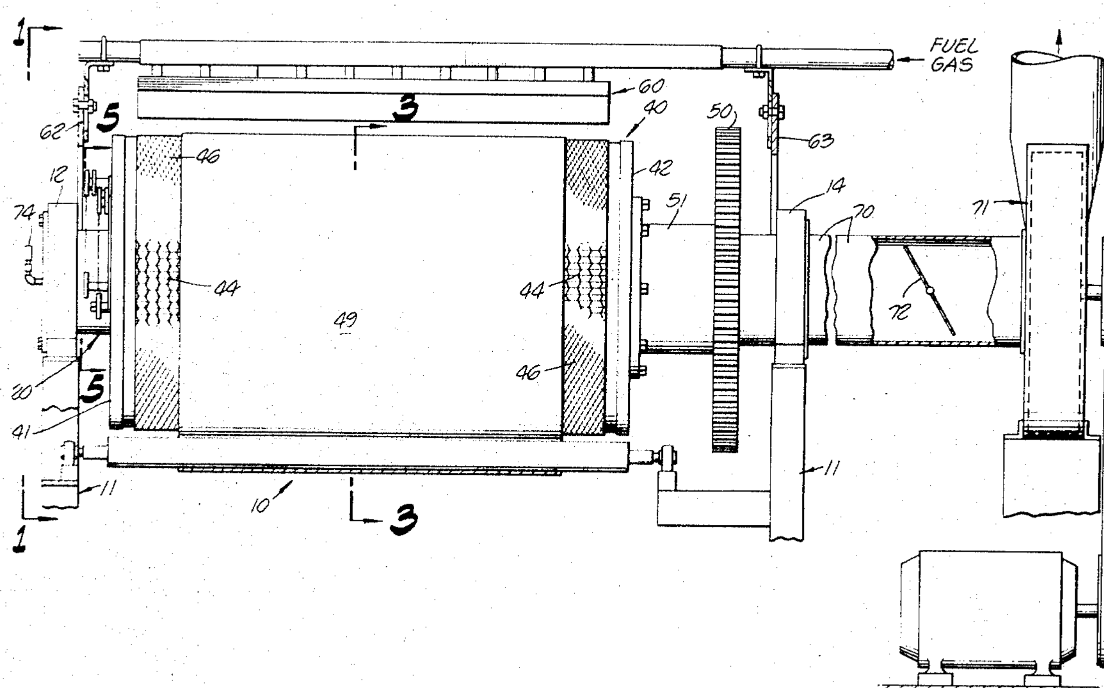
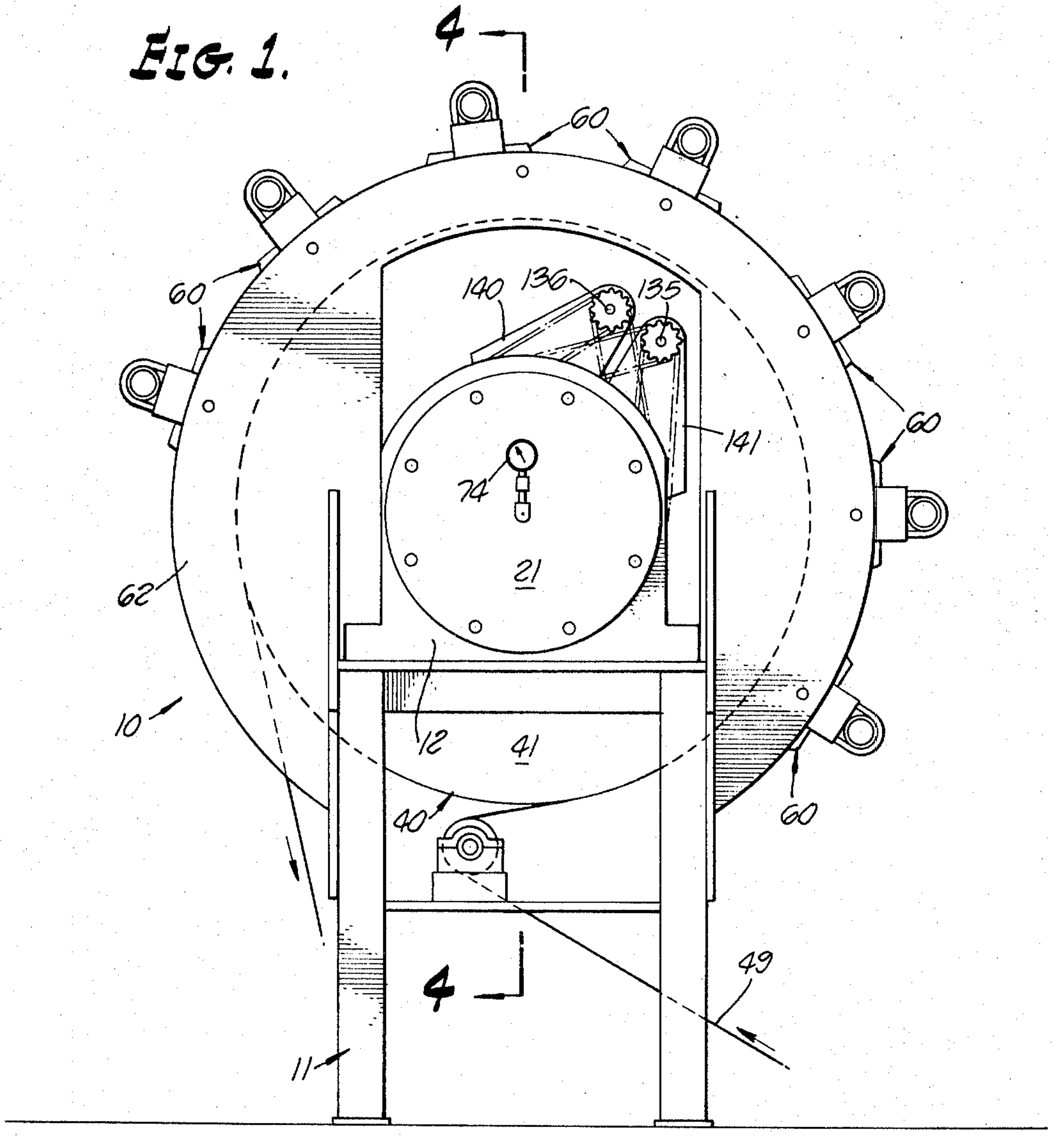


FIG. 1.



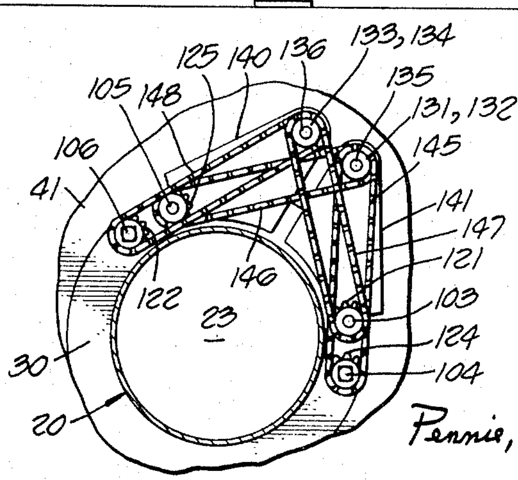


FIG. 5.

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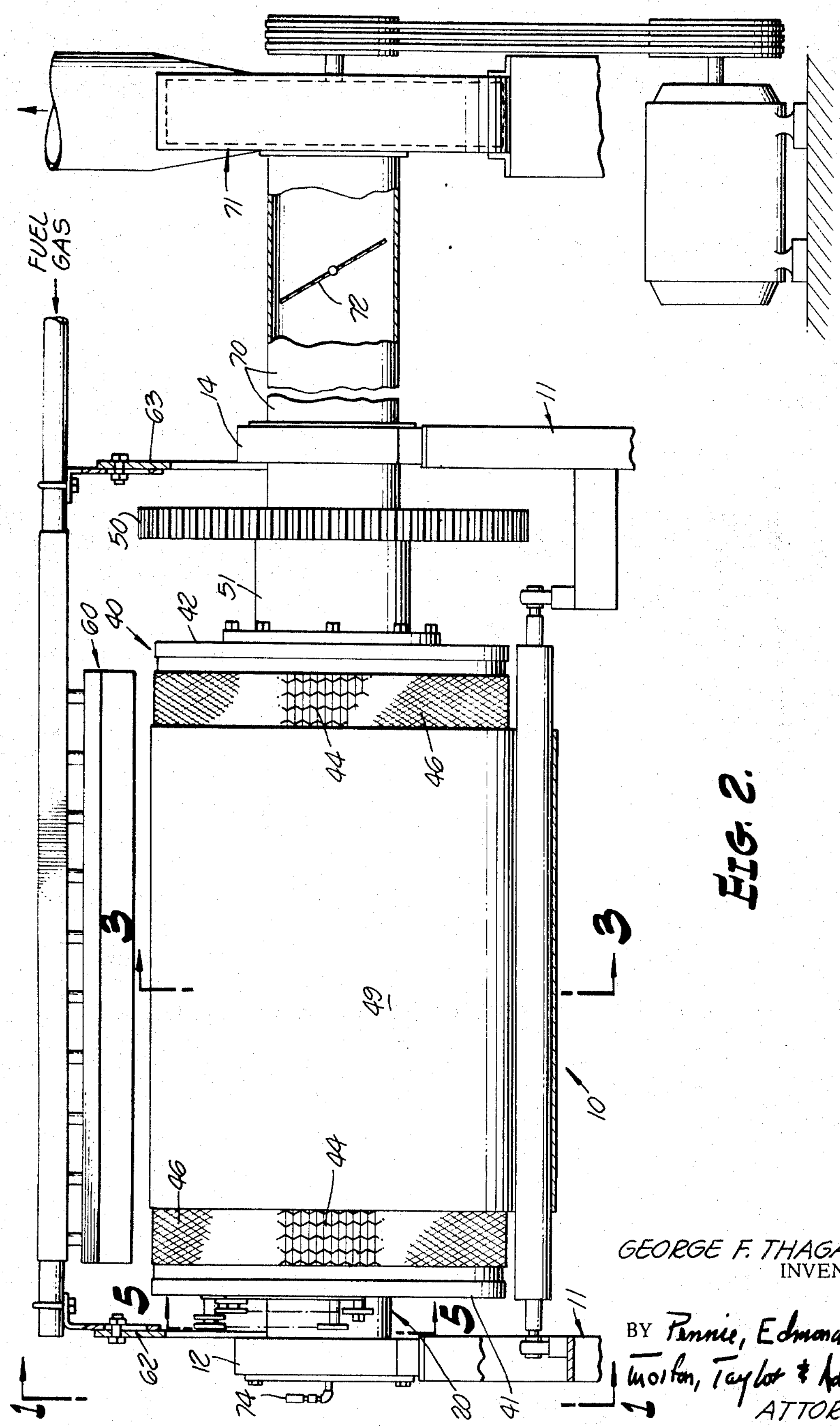

FIG. 2

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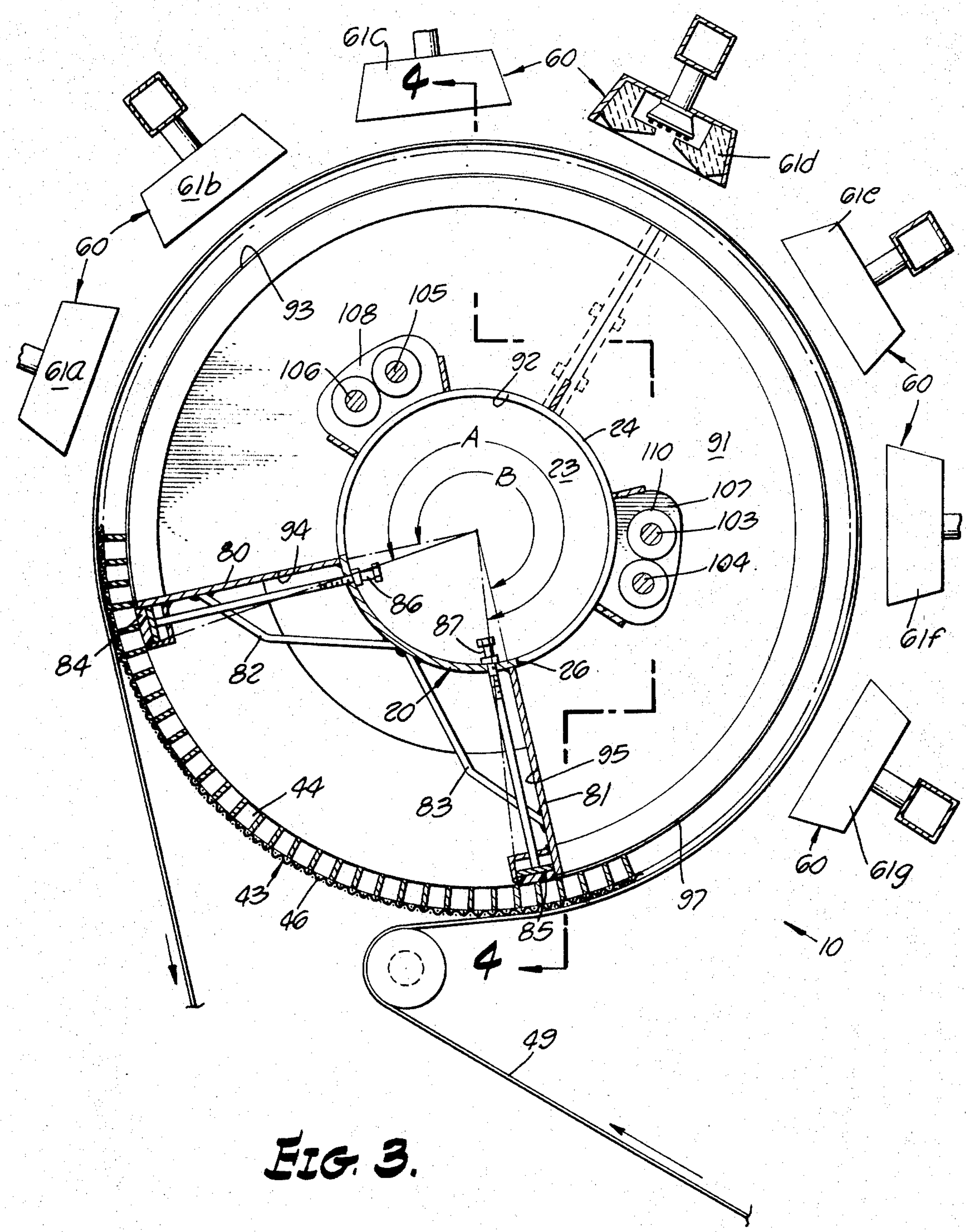

FIG. 3.

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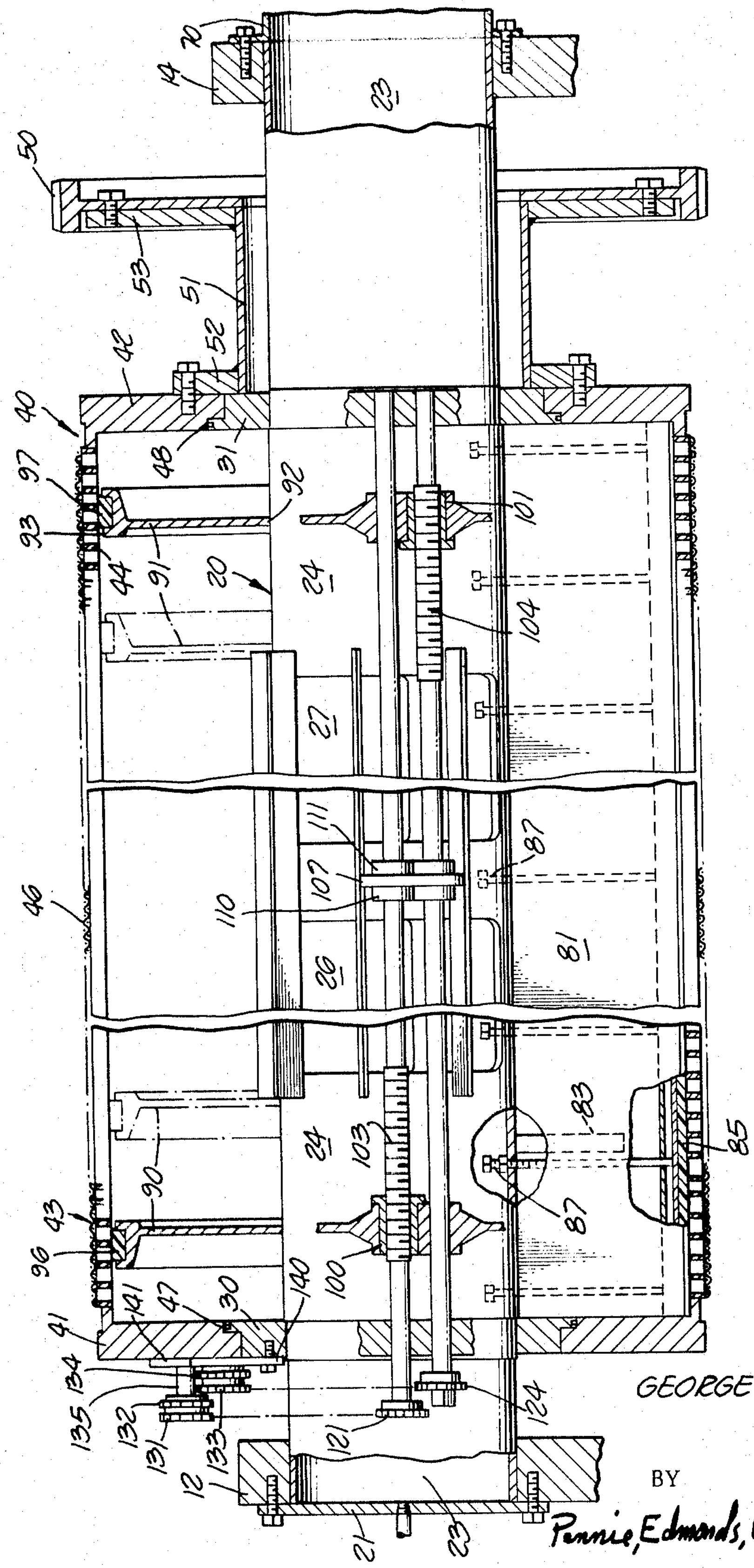

FIG. 4.

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WEB TREATING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for treating continuous webs and, more particularly, to a novel dryer for efficiently and economically removing liquids and/or vapors from web of pulp, paper or fabric.

During the manufacture of paper or other fibrous materials, the web is generally saturated with water and/or other chemical agents either during pulping or just prior to the initial screening. Thereafter, the web immediately passes through a series of operations to remove these excess liquids. During such operations, excess liquids are first drained by gravity, then by vacuum and thereafter by mechanical pressure. The final drying step is conventionally accomplished by passing the web sequentially over a series of rolls the circumferential surfaces of which are conductively heated from within, usually by steam. However, previously known dryers or "steam cans" as they are known in the art have several serious drawbacks, both technological and economic.

Because conventional dryers are notoriously inefficient, a large number of them, generally five or more, must be employed in series. In the usual configuration which has been adopted to conserve floor space, the second dryer in the series is disposed above and between the first and third dryers in a triangular fashion, just as the fourth dryer is disposed above and between the third and fifth dryers. As the web passes between adjacent dryers of such series of conventional dryers, moisture laden air or steam which is necessarily generated by the contact between the moist web and the heated dryer surface accumulates in dead-air spaces between each roll. These entrapped pockets of moist air or steam constitute a substantial hinderance to uniform and thorough drying of the web and for this reason must be dissipated and purged by blowers or other means for generating air currents of sufficient volume and force.

SUMMARY OF THE INVENTION

The web treating apparatus of the present invention comprises a frame which includes first and second spaced-apart upright support members. An elongated tubular core member which is closed at one end is fixedly mounted between the support members. The interior of the core member constitutes a vacuum manifold and a longitudinally extending portion of the circumferential wall of the core member is open to permit the entry of air into the manifold. First and second annular journals are secured adjacent either end of the core member and extend radially outwardly from the outer circumferential surface of the core member. A drum of circular cross-section includes first and second annular side walls and a perforated circumferential wall. The drum is mounted on the journals for rotation coaxially with respect to the core member and is adapted to receive a continuous web about a first predetermined arcuate segment of its circumferential wall. High intensity heat generating means are spaced radially outwardly of the circumferential wall of the drum and are disposed above at least a substantial portion of the predetermined first arcuate segment. A vacuum exhaust conduit is secured at one end in air-tight relationship to the open end of the core member and at the other end to a vacuum blower. Means are disposed within the drum for directing the flow of heated air drawn by the blower exclusively and substantially uniformly through the portion of the web which is wrapped about the first predetermined arcuate segment of the circumferential wall of the drum.

The present web treating apparatus utilizes radiant and convective heat in combination with forced air circulation through the web as opposed to the conductive heat employed by the prior art dryers. This unique concept enables the web to be more uniformly and more rapidly heated and dried than has been attainable heretofore. Because a web treated by the present apparatus is uniformly drier, its shrink characteristics are greatly improved. In general, most if not all of the required shrink may be achieved as the web passes over the drum of the present apparatus; this advantage was not attainable by the use of previously known equipment. One practical result of the achievement of superior shrink characteristics is the ability to produce increased web widths which inherently increases the yield.

Aside from the substantial advantages achieved in the production of a superior end product, the present web treating apparatus enables significant economic savings with respect to cost and maintenance. The present apparatus, as compared to prior drying equipment, is less cumbersome, smaller in size, less expensive to construct, install and operate, and less complex in operation. It requires less floor space and fewer operating personnel. The present apparatus may be employed either alone or in conjunction with presently used equipment to increase the net efficiency of the latter. Moreover, the blower exhaust from the present appatatus is ideal for pocket ventilation of the web as it passes through the conventional equipment, thus eliminating the need for the additional apparatus that would ordinarily be required.

It is specifically contemplated that the apparatus of the present invention may include means for saturating, dipping, and/or coating webs to induce more complete saturation than is presently attainable and to recover any resultant excess liquids or vapors for reuse or discharge as desired. In this alternate embodiment, the heat generating means may be dispensed with or not employed if not required during the particular saturation process.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevation of the web treating apparatus of the present invention;

FIG. 2 is a side elevation in partial section of the web treating apparatus of the present invention;

FIG. 3 is a transverse sectional view of the drum of the web treating apparatus of the present invention taken substantially along Line 3—3 of FIG. 2;

FIG. 4 is a longitudinal sectional view of the drum of the web heating apparatus of the present invention taken substantially along Line 4—4 of FIG. 3; and

FIG. 5 is a partial tranverse sectional view of the web treating apparatus of the present invention taken substantially along Line 5—5 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring particularly to FIGS, 1 and 3, web treating apparatus 10 comprises a frame 11 which includes first and second upright support members 12, 14, respectively.

As shown best in FIG. 4, an elongated tubular core member **20** is closed at one end by plate **21** which is bolted to the first upright support member **12.** The core member **20** is fixedly mounted between the support members **12, 14** and the interior of the core member **20** constitutes a vacuum manifold **23.** A longitudinally extending portion of the circumferential wall **24** of the core member **20** is open (at **26, 27**) to permit the entry of air into the manifold **23.**

First and second annular journals **30, 31,** respectively, are secured adjacent either end of the core member **20** and extend radially outwardly from the circumferential surface **24** of the core member **20.**

As shown best in FIGS. **2** and **4,** a drum **40** of circular cross-section includes first and second annular side walls **41, 42,** respectively, and a perforated circumferential wall **43.** Referring particularly to FIG. **2,** the circumferential wall **43** comprises a honeycomb construction **44.** In the present embodiment, the honeycomb cells are about 1-½ inches in diameter. It is particularly contemplated, however, that the wall **43** may be a drilled shell or may be provided with perforations in any other suitable manner. Moreover, if desired or required by the physical characteristics of the webs to be treated, the circumferential wall **43** may be covered additionally with a relatively fine mesh screen **46.** The drum **40** is mounted at its side walls **41, 42** on the journals **30, 31,** respectively, for rotation coaxially with respect to the core member **20.** Seals **47, 48,** preferably of a polyfluorocarbon plastic material, may be provided at the bearing surfaces of the respective journals **30, 31** to ensure a fluid-tight relationship between the journals **30, 31** and the respective side walls **41, 42** as the drum **40** rotates. The drum **40** is adapted to receive a continuous web **49** wrapped about a first predetermined arcuate segment of its circumferential wall **43** as defined by angle A which is illustrated in FIG. **3.**

Means for rotating the drum **40** include a drive gear **50** and a tubular adapter **51,** the gear **50** and the adapter being disposed concentrically radially outwardly of the portion of the core member **20** between the second juournal **31** and the second support member **14.** The adapter **51** includes upright flanges **52, 53.** Flange **52** is secured to the second and wall **42** of the drum **40** and flange **53** is secured to the drive gear **50.**

Referring particularly to FIGS. **2** and **3,** high intensity heat generating means **60** are spaced radially outwardly from the circumferential wall **43** of the drum **40** and are disposed above at least a substantial portion of the first predetermined arcuate segment of the circumferential wall **43** which is defined by angle A. In the present embodiment, the high intensity heat generating means comprise a plurality of spaced-apart gas-fired radiant burners, ***61a*** through ***61g,*** inclusive. Each burner extends coaxially with the drum **40** along substantially its entire length and each burner is mounted at either end on brackets **62,63** which are secured to the upright support members **12, 14,** respectively. Preferably, each burner is adjustably mounted to permit a preselection of the radial distance between such burner and the circumferential wall **43** of the drum **40,** and the heat output of each burner is adjustable. In the present embodiment, each of the burners is capable of generating about 567,000 BTU/hr and each burner may be regulated to provide as little as about one-fifth of its maximum capacity. Although gas-fired radiant burners are contemplated in the preferred embodiment, other suitable high intensity heat generating sources may be employed.

A vacuum exhaust conduit **70** is secured at one end in airtight relationship to the open end of the core member **20.** As shown best in FIGS. **2** and **4,** this may be conveniently accomplished by bolting the conduit **70** to the second upright support member **14** coaxially with and abutting the open end of the core member **20.** A vacuum blower **71** is secured to the other end of the vacuum exhaust conduit **70.** The blower **71** provides sufficient suction to draw air and entrapped moisture and/or vapors through and from the web into the vacuum manifold **23.** Although the vacuum level within the manifold **23** may be adjusted in a number of conventional ways such as by varying the speed of the blower **71** or by providing adjustable openings in the vacuum exhaust conduit **70,** the means for adjusting the vacuum level in the present embodiment comprises a rotatable damper **72** disposed transversely within the vacuum exhaust conduit **70.** The precise vacuum level may be instantly determined by reference to a vacuum guage **74** which is mounted on plate **21.**

Means disposed within the drum **40** ensure that the flow of heated air drawn by the blower **71** is directed exclusively and substantially uniformly through the portion of the web **49** which is wrapped about the first predetermined arcuate segment A of the circumferential wall **43** of the drum **40.** As shown best in FIGS. **3** and **4,** such means include first and second baffle plates **80,81** which are secured to the outer surface **24** of the core member **20** on either side of the open portion of the core member circumferential wall (at **26,27**) and which extend longitudinally along substantially the entire length of the portion of the core member **20** disposed between the journals **30,31.** Each baffle plate **80,81** extends radially outwardly with respect to the core member **20** and is braced by gussets such as **82,83** which are disposed along the length of each baffle plate **80,81.** First and second baffle plate seals, **84,85,** respectively, are coextensive with and abut the radially outermost marginal portions of the respective baffle plates **80,81.** Each baffle plate seal **84,85** is adjustable in a radial direction by set screw means **86,87,** respectively, to abut firmly the inside surface of the circumferential wall **43** of the drum **40.** Preferably, the baffle plate seals **84,85** are made of a polyfluorocarbon plastic material. The portion of the circumferential wall defined between the respective seal means **84, 85** and compassing therebetween the open position (at **26, 27**) of the circumferential wall **24** of the core member **20** constitutes a second predetermined arcuate segment which is defined by angle B. The second segment B is slightly shorter than and is disposed completely within the first segment A. In this manner leakage is prevented and the vacuum is maintained exclusively on the portion of the web which is wrapped about and in firm surface-to-surface contact with the circumferential wall **43** of the drum **40.**

The means for directing the flow of heated air further includes first and second deckle plates **90,91** which are shown best in FIG. **4.** The deckle plates **90, 91** are disposed within the drum **40** adjacent and parallel to the respective side walls **41,42.** Eack deckle plate **90, 91** is translatable axially with respect to the core member **20** and the drum **90,** or, in other words, longitudinally with respect to the baffle plates **80, 81.** As shown representatively in FIG. **3,** deckle plate **91,** which is identical to deckle plate 90, includes an inner arcuate marginal edge 92 which conforms substantially to the outside circumferential surface of the core member 20, an outer arcuate marginal edge 93 which conforms substantially to the inside circumferential surface of the drum 40, and opposite transverse marginal edges 94, 95 which conform substantially to the surfaces of the baffle plates 80, 81, respectively, which encompass therebetween the open portion (at 26, 27) of the core member wall 24. First and second deckle plate seals 96, 97, are coextensive with and are secured to the outer arcuate marginal edges of the respective deckle plates 90, 91. The deckle plate seals 96, 97 firmly abut the inside surface of the circumferential wall 43 of the drum 40. When the respective deckle plates 90, 91 are translated to positions underlying the opposite longitudinal marginal edges of the web 46 which is wrapped about the drum 40, the baffle plates 80, 81 and the deckle plates 90, 91 define therebetween a vacuum chamber which conducts the flow of heated air exclusively through the position of the web 46 which is wrapped about the first predetermined arcuate segment A of the circumferential surface 43 of the drum 40.

Each deckle plate 90, 91 includes first and second internally threaded fittings as shown best in FIG. 4, fitting 100 is associated with deckle plate 90 and fitting 101 is associated with deckle plate 91. In each instance, the second fitting of the respective deckle plates is not illustrated. Each fitting such as fittings 100, 101 receive a complementary internally threaded lead screw. For example, lead screw 103 is received within fitting 100 and lead screw 104 is received within fitting 101. The remaining lead screws 105, 106 are illustrated in cross-section in FIG. 3. Lead screw 105 is associated with deckle plate 91 and lead screw 106 is associated with deckle plate 90. Each lead screw is rotatably mounted at either end in the respective journals 30, 31 and centrally on a screw shaft support 107 or 108 which is secured to the circumferential wall 24 of the core member 20. Each lead screw is restrained from axial translation by collars such as 110, 111 which, for example, are secured to the shaft of the lead screw 103 and are disposed adjacent either side of the screw shaft support 107.

As shown best in FIGS. 1, 4 and 5, first and second lead screw control means enable the lead screws associated with each deckle plate 90, 91 to be operated simultaneously in order that the deckle plate 90 or 91 may be translated longitudinally with respect to the baffle plates 80, 81, to positions underlying the respective longitudinal marginal edges of the web 49 which is wrapped about the drum 40. In the present embodiment, each lead screw control means comprises first and second sprockets 121, 122 and 124, 125, respectively, which are secured to the ends of lead screws 103, 106 and 104, 105, respectively, adjacent the first annular journal 30. First and second sets of idler sprockets 131, 132 and 133, 134, respectively, are coaxially secured to respective stub shafts 135, 136 which are mounted on supports 140, 141, which, in turn, are secured to the first journal 30. First and second pairs of roller chains 145, 146 and 147, 148, respectively, as disposed about the idler sprockets and the lead screw sprockets. The first chain of each pair 145 or 147 is disposed about the first idler sprocket 131 or 133, and the first lead screw sprocket 121 or 124 of each set, and the second chain of each pair 146 or 148 is disposed about the second idler sprocket 132 or 134 and the second lead screw sprocket 122 or 125 of each set. Each deckle plate 90, 91 is thus translatable longitudinally with respect to the baffles 80, 81 by rotation of the proper stub shaft 135 or 136.

In operation, the web 49 is fed onto the drum 40, the degree of wrap being predetermined. In the present embodiment the first predetermined arcuate segment of the circumferential wall of the drum 40 about which the web is wrapped is about 290° and the second predetermined arcuate segment between the baffle plates 80,81 is about 270°. However, it is contemplated that the present apparatus may be constructed in accordance with the concepts disclosed herein with any suitable predetermined arcuate segments in mind.

The radial distance between the burners and the drum may be varied between about 3 to 8 inches, but it has been found that in most instances a distance of about 2 inches provides sufficient heat without damaging the web. Another factor to be considered in this regard is the angular velocity of the drum 40 which determines the dwell time of a given point on the web beneath the burners. Moreover, the vacuum level must be adjusted to provide the proper air flow without causing the web 49 to be permanently deformed or damaged from contact with the circumferential surface of the drum. In general, however, adjustment for maximum heat output and vacuum level in each instance provides optimum maintenance of the dimensional stability of the web.

In commercial runs conducted with the present apparatus which has a drum diameter of about 48 inches, 54 pound felt was run successfully with all burners disposed 2 inches from the drum surface and operating at maximum output; about a 1-½ inch vacuum was maintained when the felt was run over the honeycomb surface but it was found that the level could be raised to about 3 inches when the wire mesh screen was placed over the honeycomb; the feed rate was about 130 feet per minute. When 24 pound chip board was processed, both the burners and the vacuum level were set as before and the feed rate was about 265 feet per minute.

I claim:

1. Web treating apparatus comprising

a. a frame including first and second spaced-apart upright support members;

b. an elongated tubular core member closed at one end and fixedly mounted between the support members, the interior of the core member constituting a vacuum manifold and a longitudinally extending portion of the circumferential wall of the core member being open to permit the entry of air into the manifold;

c. first and second annular journals secured adjacent either end of the core member and extending radially outwardly from the outer circumferential surface of the core member;

d. a drum of circular cross-section including first and second annular side walls and a perforated circumferential wall, the drum being mounted on the journals for rotation coaxially with respect to the core member, and the drum being adapted to receive a continuous web wrapped about a first predetermined arcuate segment of its circumferential wall; predetermined arcuate segment of its circumferential wall;

e. means for rotating the drum including a drive gear and a tubular adapter, the gear and the adapter being disposed concentrically radially outwardly of the portion of the core member between the second journal and the second support member, the adapter having upright flanges at either end for securing the gear to the adapter and the adapter to the second end wall of the drum;

f. high intensity heat generating means spaced radially outwardly of the circumferential wall of the drum and disposed above at least a substantial portion of the first predetermined arcuate segment;

g. a vacuum exhaust conduit secured at one end in air-tight relationship to the open end of the core member;

h. a vacuum blower secured to the other end of the exhaust conduit; and

i. means disposed within the drum for directing the flow of heated air drawn by the blower substantially exclusively and substantially uniformly through the portion of the web wrapped about the first predetermined arcuate segment of the circumferential wall of the drum.

2. Web treating apparatus according to claim **1** wherein the perforated circumferential wall of the drum is of honeycomb construction.

3. Web treating apparatus according to claim **1** wherein the perforated circumferential wall of the drum is covered with a wire mesh screen.

4. Web treating apparatus according to claim **1** wherein the high intensity heat generating means comprise a plurality of spaced-apart radiant burners, each burner extending coaxially with the drum above substantially its entire length, and each burner being mounted at either end on brackets secured to the upright support members.

5. Web treating apparatus according to claim **4** wherein each burner is adjuatably mounted to permit a preselection of the radial distance between the burners and the circumferential wall of the drum.

6. Web treating apparatus according to claim **4** wherein the heat output of each burner is adjustable.

7. Web treating apparatus according to claim **1** further including means for adjusting the vacuum level within the manifold.

8. Web treating apparatus according to claim **7** wherein the means for adjusting the vacuum level comprises a rotatable damper disposed transversely within the vacuum exhaust conduit.

9. Web treating apparatus according to claim **1** wherein the means for directing the flow of heated air substantially exclusively through the portion of the web wrapped about the first predetermined arcuate segment of the drum includes first and second baffle plates disposed within the drum, each baffle plate being secured to the other circumferential surface of the core member on either side of the open portion of the core member circumferential wall and extending longitudinally along substantially the entire length of the portion of the core member between the journals, and each baffle plate extending radially outwardly with respect to the core member; first and second baffle plate seals coextensive with and abutting the radially outermost marginal portions of the respective baffle plates, each baffle plate seal being adjustable in a radial direction to abut firmly the inside surface of the circumferential wall of the drum; the portion of the circumferential wall of the drum defined between the respective seal means and encompassing therebetween the open portion of the core member circumferential wall constituting a second predetermined arcuate segment, the second segment being shorter than and being disposed completely within the first segment.

10. Web treating apparatus according to claim **9** wherein the means for directing the flow of heated air substantially exclusively through the portion of the web wrapped about the first predetermined arcuate segment of the drum further includes first and second deckle plates disposed within the drum adjacent and parallel to the respective annular side walls, each deckle plate being translatable longitudinally with respect to the baffle plates and including an inner arcuate marginal edge conforming substantially to the outside circumferential surface fo the core member, an outer arcuate marginal edge conforming substantially to the inside circumferential surface of the drum, and opposite transverse marginal edges conforming substantially to the surfaces of the baffle plates which encompass therebetween the open portion of the core member wall, and first and second deckle plate seals coextensive with and secured to the outer arcuate marginal edges of the respective deckle plates, the deckle plate seals firmly abutting the inside surface of the circumferential wall of the drum; the baffle plates and the deckle plates defining therebetween a vacuum chamber which conducts the flow of heated air substantially exclusively through the portion of the web wrapped about the first predetermined arcuate segment of the circumferential surface of the drum.

11. Web treating apparatus according to claim **10** wherein each deckle plate includes first and second internally threaded fittings, each fitting receiving a complementary threaded lead screw, each lead screw being rotatably mounted on a screw shaft support which is secured to the circumferential wall of the core member, and each lead screw being restrained from axial translation by collars secured to the lead screw shaft and disposed adjacent either side of the screw shaft support; and, first and second lead screw control means for operating simultaneously the lead screws associated with each deckle plate to translate the deckle plate longitudinally with respect to the baffle plates to positions underlying the respective longitudinal marginal edges of the web wrapped about the drum.

12. Web treating apparatus according to claim **11** wherein each lead screw control means comprises first and second sprockets secured to the end of each lead screw adjacent the first annular journal, first and second sets of idler sprockets coaxially secured to a rotatable stub shaft, each stub shaft being mounted on a support secured to the first journal, and first and second pairs of roller chains, the first chain of each pair being disposed about the first idler sprocket and the first lead screw sprocket of each set, and the second chain of each pair being disposed about the second idler sprocket and the second lead screw sprocket of each set; each deckle plate being translatable longitudinally with respect to the baffles by rotation of the respective stub shafts.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,752,639 Dated August 14, 1973

Inventor(s) George F. Thagard, Jr.

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

Title Page, Column 1, Item [76] "Pangbarn" should read --~~10024~~ Pangborn--.

Column 2, line 32 "present appatatus" should read --present apparatus--.

Column 2, line 59 "is a partial tranverse" should read --is a partial transverse--.

Column 3, line 2 "by plate" should read --by a plate--.

Column 4, lines 49 and 50, "andcompassing" should read --and encompassing--.

Column 7, line 38 "is adjuatably" should read --is adjustably--.

Column 8, line 19 "surface fo" should read --surface of--.

Signed and sealed this 29th day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents