

Nov. 28, 1950

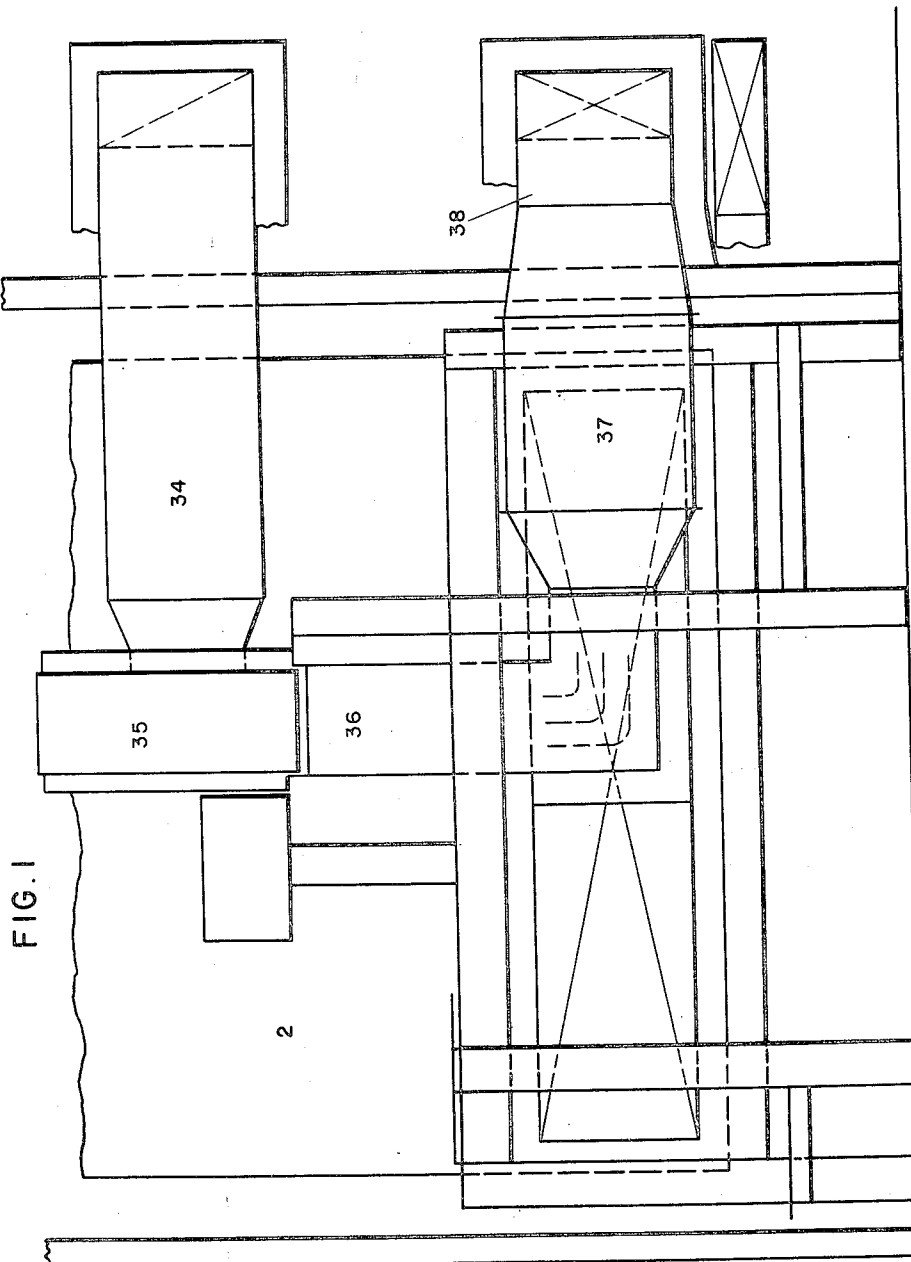
B. OFFEN

2,532,032

APPARATUS FOR DRYING WEBS

Filed Jan. 28, 1947

8 Sheets-Sheet 1



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Nov. 28, 1950

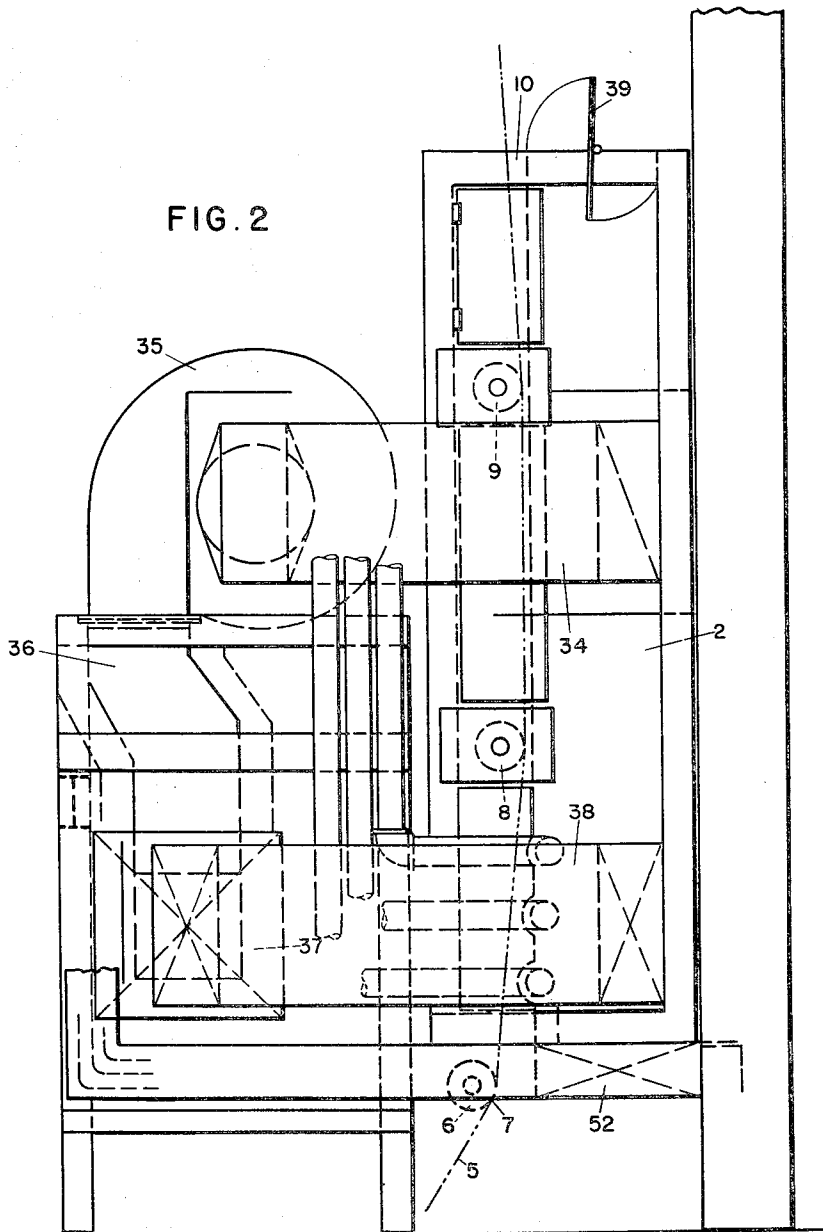
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2,532,032

APPARATUS FOR DRYING WEBS

Filed Jan. 28, 1947

8 Sheets-Sheet 2



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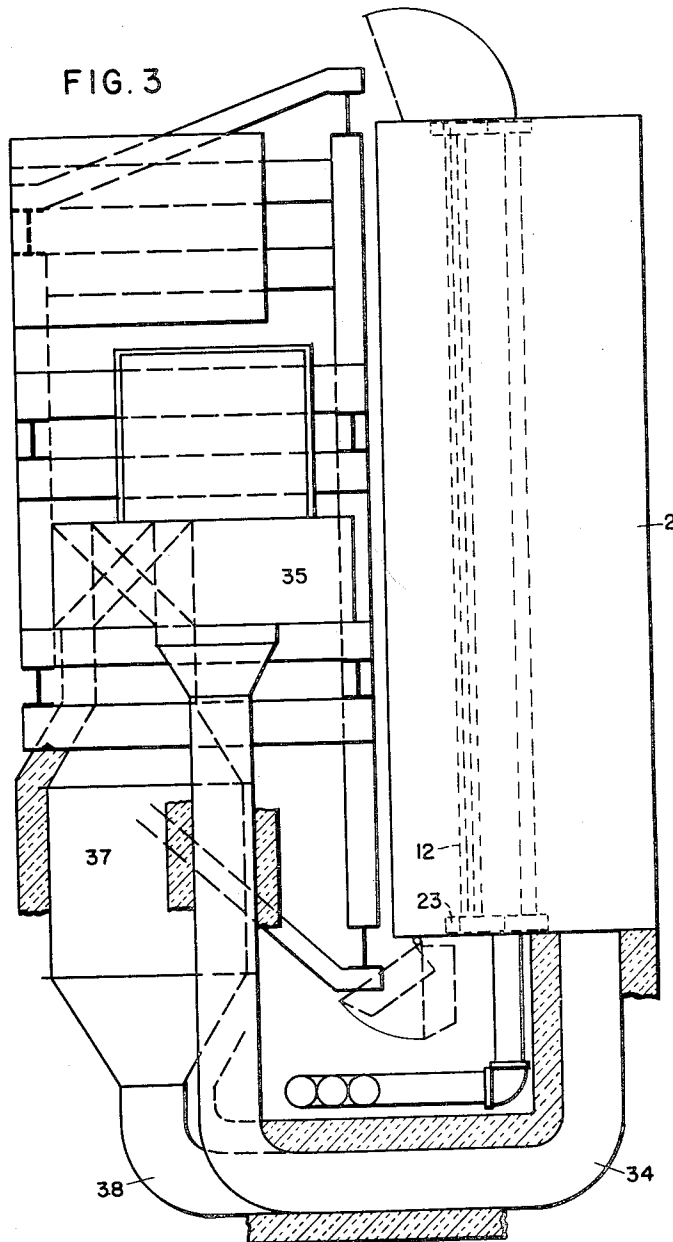
Nov. 28, 1950

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APPARATUS FOR DRYING WEBS

2,532,032

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8 Sheets-Sheet 3



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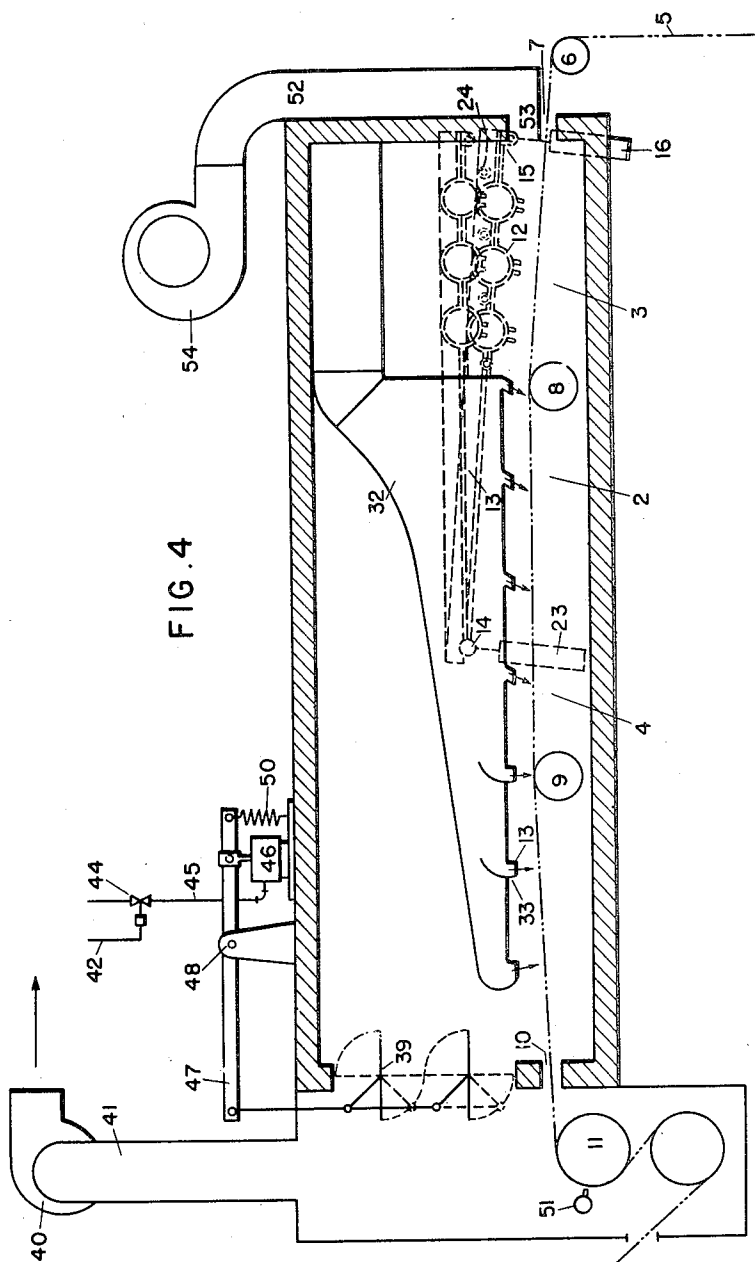
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2,532,032

APPARATUS FOR DRYING WEBS

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8 Sheets-Sheet 4



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2,532,032

APPARATUS FOR DRYING WEBS

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8 Sheets-Sheet 5

FIG. 5

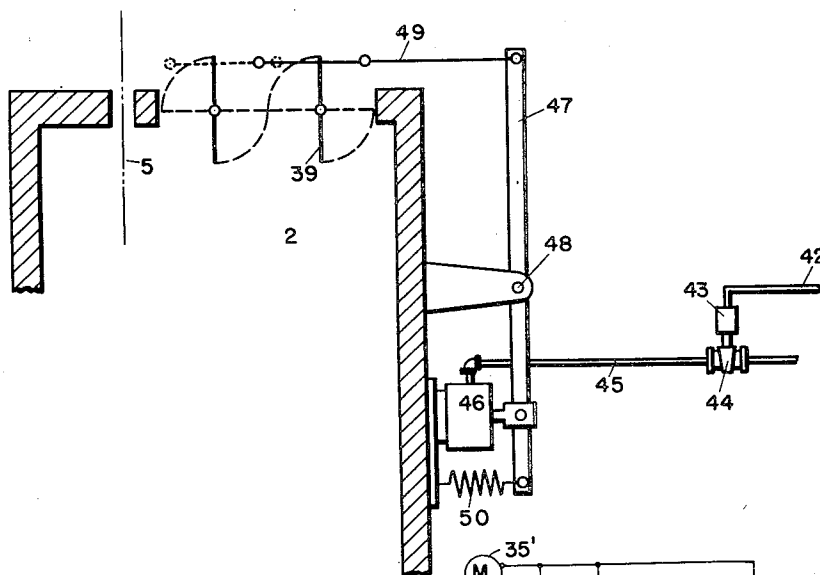
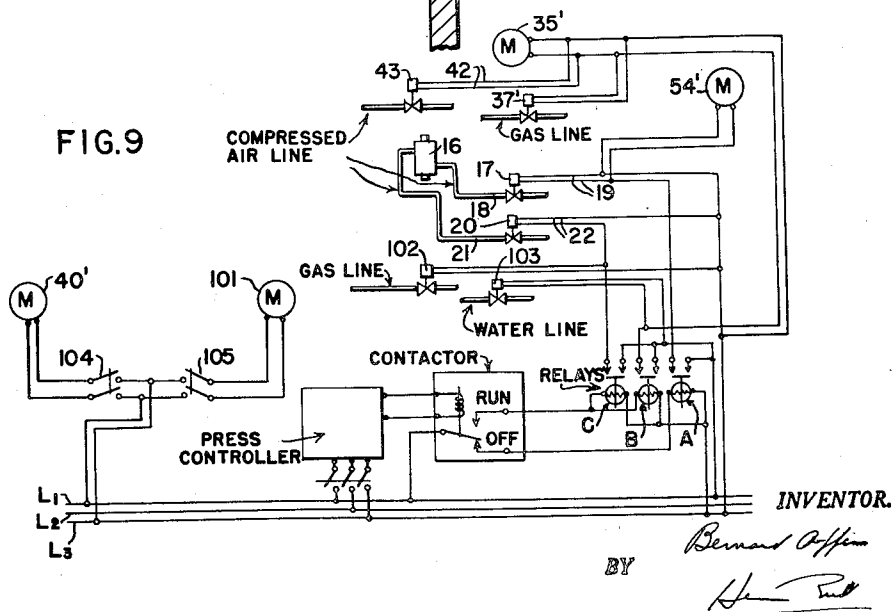


FIG. 9



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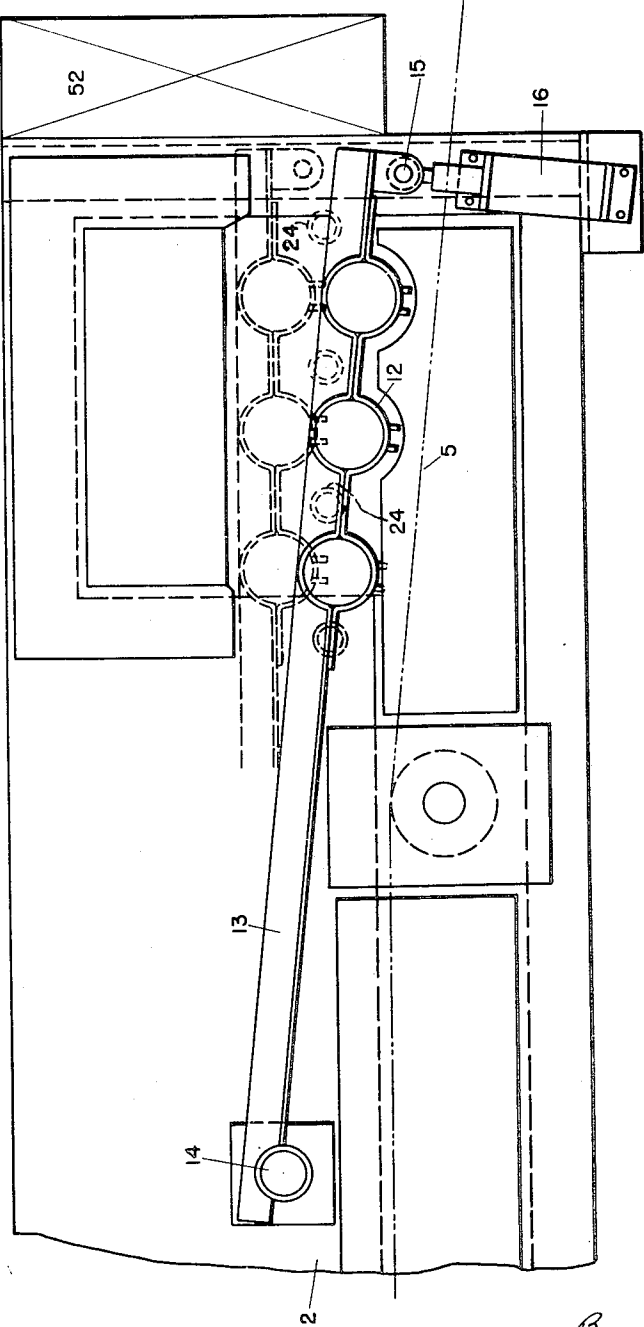
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APPARATUS FOR DRYING WEBS

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8 Sheets-Sheet 6

FIG. 6



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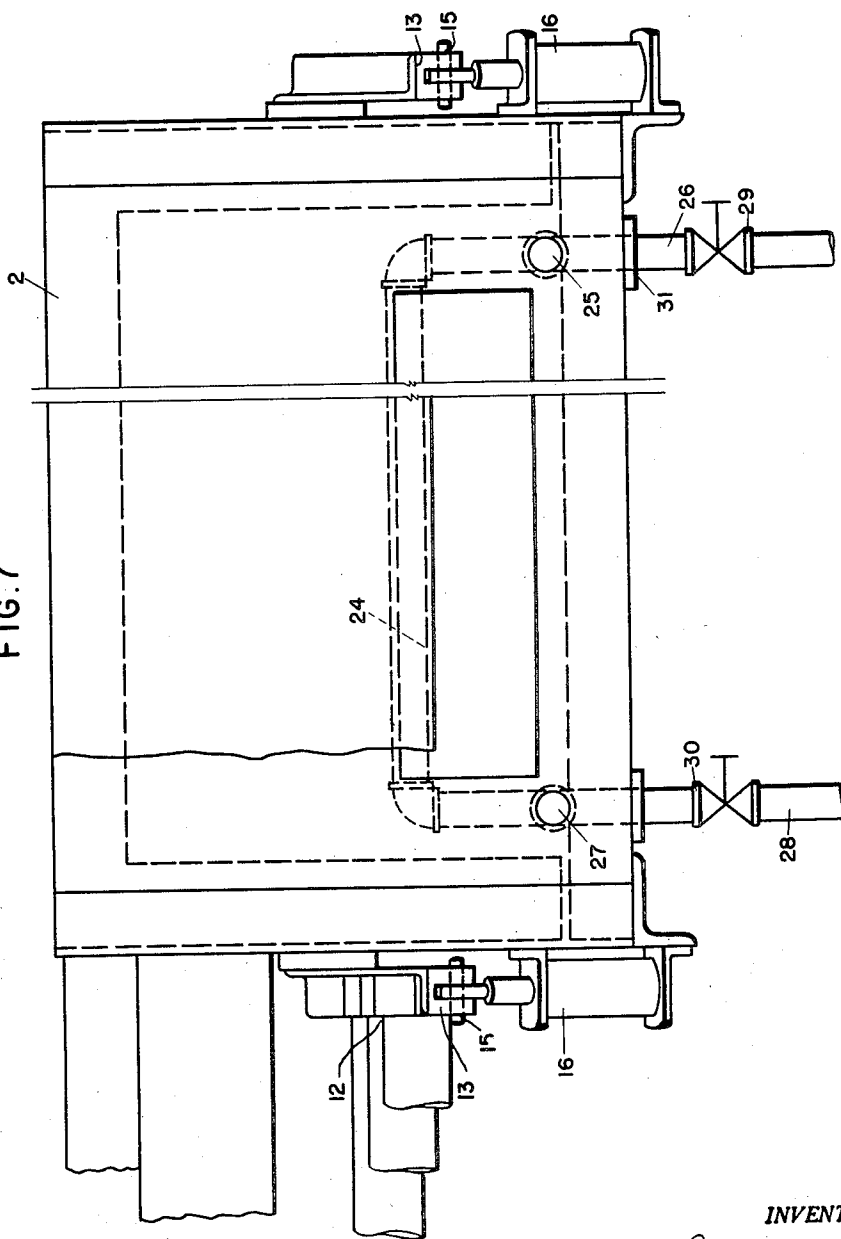
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APPARATUS FOR DRYING WEBS

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8 Sheets-Sheet 7

FIG. 7



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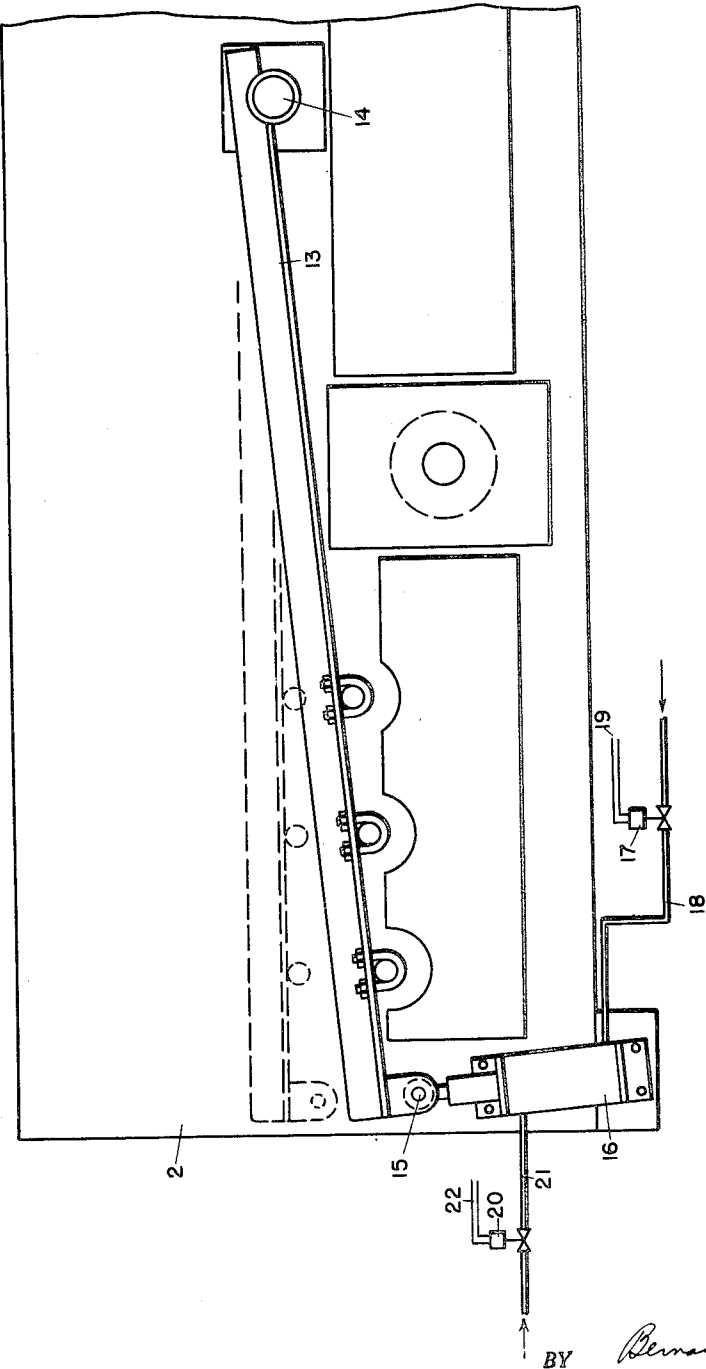
B. OFFEN
APPARATUS FOR DRYING WEBS

2,532,032

Filed Jan. 28, 1947

8 Sheets-Sheet 8

FIG. 8



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UNITED STATES PATENT OFFICE

2,532,032

APPARATUS FOR DRYING WEBS

Bernard Offen, Chicago, Ill.

Application January 28, 1947, Serial No. 724,787

17 Claims. (Cl. 34-13)

1

This invention relates to drying apparatus and more particularly to the drying of web materials such as paper, textiles, foils and the like.

A difficult problem involved in the provision of satisfactory drying equipment is to permit instantaneous stopping of the web in the dryer while avoiding damage or injury to the web from radiant heat given off by the drying means. Heretofore, it was necessary to bring the press to a slow stop to permit the dryer to cool to prevent burning of the web in the dryer. Thus, considerable delay was encountered in stopping the press with consequent waste.

The chief object of the present invention is to provide a dryer including a plurality of stages of drying for desired heat application to a web which is so arranged as to permit substantially instantaneous stopping of the web in the dryer upon shut-down of the press without injury or damage thereto from radiant heat in the dryer.

An object of the present invention is to provide new and improved mechanism for automatically moving radiant heating members away from the web when the press is stopped permitting travel of the web in the dryer to be interrupted without scorching or burning of the web.

A further object is to provide a heating system in which web material to be dried is passed through a drying chamber and is contacted by radiant heat and heated air in a plurality of stages if desired; the radiant heating means being moved away from the web and supply of heated air to the chamber being discontinued upon an interruption in the passage of the web through the dryer while relatively cold air is supplied to the chamber in contact with the web to prevent scorching or burning which might otherwise occur.

A still further object is to provide a dryer arrangement including radiant heating means adapted to be moved away from a web in the dryer when passage of the web through the dryer is interrupted and in which shield members are interposed between the web and the radiant heating members when passage of the web through the dryer is interrupted.

A still further object is to provide a method of drying a web such as freshly printed paper or the like in which the web is effectively dried during its passage through the dryer while, upon interruption in the passage of the web through the dryer, burning or scorching of the web is prevented thereby permitting substantially instantaneous stopping of the web in the dryer and preventing waste created by processes heretofore

2

known in which it was essential to decrease the speed of the web slowly to prevent damage thereto in the dryer. Other objects of my invention will be readily perceived from the following description.

This invention relates to apparatus for drying webs comprising in combination, a drying chamber, means for routing a web to be dried through the drying chamber, a plurality of burners for directing flames in the direction of the line of travel of the web, means for moving said burners toward and from the web, means for supplying heated air over a surface of the web, means for supplying relatively cold air in the chamber whenever travel of a web therein is interrupted, means for substantially discontinuing the supply of heated air to the chamber whenever travel of a web through the chamber is interrupted, and means for actuating said burner moving means to move the burners away from the web whenever travel of a web through the chamber is interrupted whereby substantially instantaneous stopping of the web may be effected without injury to the web by radiant heat from the burners.

This invention further relates to a method of drying a web in which the steps comprise passing a web through a drying chamber, directing radiant heat over the surface of the web in said chamber, directing heated air over a surface of the web in said chamber, then, when travel of the web through the chamber is interrupted, moving the radiant heating means away from the web, substantially instantaneously discontinuing the supply of heated air over the web, and directing relatively cold air over the surface of the web thereby permitting substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat.

The attached drawings illustrate a preferred embodiment of my invention, in which

Figure 1 is a view in front elevation of the dryer illustrating the means for circulating heated air through the drying chamber;

Figure 2 is a view in side elevation of the equipment shown in Figure 1;

Figure 3 is a plan view of the equipment shown in Figure 1;

Figure 4 is a diagrammatic view illustrating the passage of a web through the drying chamber and disclosing the damper arrangement and control means therefor;

Figure 5 is a diagrammatic view illustrating the control mechanism for the damper arrangement;

Figure 6 is a view in front elevation illustrating

3

the mechanism for moving the burners away from the web;

Figure 7 is a view in end elevation of the mechanism shown in Figure 6;

Figure 8 is a view in elevation of the lever actuating mechanism; and

Figure 9 is a diagrammatic view of the control circuit.

Referring to the drawings, there is shown a dryer or drying chamber 2 containing a plurality of drying stages 3 and 4 through which a web 5 of material to be dried, as from a letter press or the like, is passed. Web 5 passes over a supporting roll 6 through an opening 7 in dryer 2, through dryer 2 where it is supported by rolls 8 and 9, and leaves chamber 2 through an opening 10, passing over chilling or cooling rolls 11. Rolls 11 are cooled in any suitable manner, preferably by the passage of water therethrough, as is well known in the art, and may be formed if desired as disclosed in my copending application, Serial No. 678,519, filed June 21, 1946, now abandoned. Any suitable means, of course, may be used to forward the web through dryer 2, such means being well known in the art and preferably being synchronized with the means employed to pass the web through the press. Such means may be governed by the press controller (refer to Figure 9) to provide for immediate stopping of the web in the chamber when the press shuts down and to provide immediate starting of the web in the chamber when the press begins operation.

Within dryer 2, as best shown in Figure 4, are a plurality of burners 12 adapted to direct flames in the direction of the line of travel of web 5 through the dryer and comprising the first drying stage 3. Burners 12 serve as a preheating stage to heat the web 5 to a point (below scorching temperature) where the solvents begin to evaporate, drying of the web being completed in a second stage as hereinafter described. Burners 12 extend across dryer 2 and are adapted to apply radiant heat to web 5. Burners 12 may be of any suitable type, for example, as illustrated in my Patents Nos. 2,421,283 and 2,414,891, granted May 27, 1947 and January 28, 1947, respectively. If desired, the supply of gas to the burners may be immediately shut off when the web 5 for any reason stops and may be adjusted to provide flames of desired intensity depending on the speed of travel of the web through the dryer. Such burners permit operation with maximum safety despite the use of direct flames upon the web for providing intensive drying at high web speeds.

Suitable mechanism is provided to move burners 12 away from the web to permit substantially instantaneous stopping of the web in the press without injury or damage to the web. Such mechanism may include a lever 13 connected to burners 12. Lever 13 is pivoted or swivelled at one end as shown at 14; at its opposite end, lever 13 is pinned as shown at 15 to a pneumatic piston 16 of well known type. A solenoid valve 17 is placed in an air line 18 and is connected to the press controller (refer to Figure 9) by wires 19. When the press from which web 5 is supplied shuts down, wires 19 close a circuit to energize solenoid valve 17 to open line 18 to the passage of compressed air. The compressed air passes to piston 16, causing piston 16 to raise lever 13 to move burners 12 away from the stationary web 5 to the position shown in dotted outline. A second valve 20 is disposed in

4

air line 21 leading from piston 16 also connected to the press controller by wires 22 and serves to maintain desired air pressure upon piston 16 to place the burners 12 in operative position adjacent the stationary web.

If desired, a pneumatic piston 23 shown in dotted outline in Figure 4 and actuated similarly to piston 16 may be disposed at the opposite end of the raising mechanism to permit both ends of the mechanism to be moved away from web 5. While preferred mechanism has been illustrated for moving burners 12 away from the stationary web 5 it will be understood other suitable mechanism may be employed to move the burners away from the web when passage of the web through dryer 2 is halted.

A plurality of pipes 24 for the passage of cooling medium such as water extend across the chamber and are connected to any suitable source of supply. Pipes 24 are adapted to be disposed between the web 5 and burners 12 when the burners are moved away from the web. If there is a break in the web and the web has a tendency to throw itself in any direction or to weave, then pipe 24 will prevent web 5 from striking the flames of burners 12, and will prevent the web from scorching or burning.

The shield piping 24 (see Figures 6 and 7) is connected to a supply header 25 which in turn is connected to an inlet pipe 26. Piping 24 is also connected to a discharge header 27 which is connected to an outlet pipe 28. Valves 29 and 30 are disposed in pipes 26 and 28 respectively to vary the volume of cooling medium such as water or steam directed through shield piping 24. In order that piping 24 may be suitably disposed in dryer 2, adjusting mechanism 31 may be provided to permit piping 24 to be raised or lowered as required. It will be appreciated, of course, during operation of the dryer, piping 24 is maintained in a fixed position. If desired, of course, suitable mechanism, similar to mechanism employed for raising burners 12, may be utilized for automatically moving shield piping 24 downward when the press is stopped and for raising such piping when the press is again started.

In the second stage 4 of drying, a heated air duct 32 is provided adapted to discharge heated air through a plurality of nozzles 33 against one surface of web 5. Nozzles 33 are disposed to discharge heated air against web 5 after such portion of the web has passed through the first stage of drying (burners 12).

A return air duct 34 is connected to the second stage of drying, as illustrated in Figures 1, 2 and 3, and is connected to a fan 35 which serves to withdraw a major portion of the heated air from the second stage of drying. Fan 35 is connected by duct 36 to a gas air heater 37 which in turn, is connected to duct 32 by supply duct 38. A plurality of gas burners (not shown) are disposed in heater 37 and serve to heat the air passing therethrough. It will be appreciated fan 35 serves to draw air and products of combustion from the second stage 4 of drying, heating the air at heater 37 and again supplying the heated air through supply duct 38 to duct 32 in the second stage of drying, the air being distributed through nozzles 33 against one surface of web 5.

When the web is halted in the dryer, fan 35 may be stopped and supply of gas to the burners of heater 37 may be discontinued, thereby preventing the further supply of heated air in the burners. If desired, fan 35 may be maintained in service while the heater burners are so operated

5

as to maintain a desired minimum air temperature available thereby keeping the equipment warm to permit speedy restarting. Likewise, a suitable damper and by-pass arrangement, as shown in my copending application, Serial No. 523,073, filed February 19, 1944, now Patent No. 2,414,891, may be provided to permit fan 35 to supply additional cold air to the dryer.

While I have described dryer 2 as including two drying stages in effect a preheating stage (radiant heat application), and a second stage (hot air application) in which drying is completed, it will be understood additional stages may be added if desired. For example, two or more zones or stages of air drying may be provided each with its own temperature control; in such case, the first stage may comprise web preheating with a direct flame, the second stage being provided substantially as described while a third stage may be provided at a lower air temperature permitting final drying without risk of scorching.

At an end of dryer 2, there is a damper arrangement 39 controlled as hereinafter described. An exhaust fan 40 serves to draw a minor portion of air and products of combustion leaking from dryer 2 during normal operation. Fan 40 is connected to the second drying stage 4 by duct 41. When damper arrangement 39 is opened, air is exhausted from the dryer into the room.

Suitable control mechanism for damper arrangement 39 is shown in Figure 5. When the press, from which web 5 is fed, is in operation, wires 42 which lead to the press controller (not shown) will close a circuit to energize solenoid 43 to open compressed air inlet valve 44. The compressed air from any suitable source at a suitable pressure will pass through line 45 to damper operating bellows 46 causing the bellows to expand and, through lever 47, pivoted at fulcrum 48 and through operating rod 49, effect the closing of damper 39. When the press stops, it being understood that the web is at the same time brought to a complete stop in the dryer, the circuit to the press controller is broken, whereupon solenoid 43 is deenergized, and the compressed air shut off from bellows 46 which contracts. The action of spring 50 assures immediate opening of damper 39 to permit air from the room to enter the dryer.

If desired, as shown in Figure 4, high pressure air pipes 51, connected to a suitable source of air under pressure, may be disposed adjacent the chilling rolls 11 and serve to direct streams of air at the web as it passes over such rolls. Fumes from the dryer 2 follow the web; such fumes are composed of high boiling point solvents and consequently, there is a tendency to recondense on the chilling rolls and web. By directing streams of high pressure air at the chilling rolls and web as directed, the fumes or vapors are removed permitting a cleaner sheet to be obtained.

A cold air duct 52 (refer to Figure 4), is connected to the first drying stage 3 as shown at 53 and is also connected to a fan or blower 54. Fan 54 is connected to the press controller; when the press is about to stop, fan 54 is automatically actuated through the press controller and serves to blow cold air over the web 5 and burners 12 in the first stage of drying to protect the web against scorching when its passage through the dryer 2 is halted. Automatically, when the press is again started, fan 54 is cut out by the press controller and discontinues the supply of cold air to the first stage of drying.

6

To aid in a full understanding of the present invention, the operation of the dryer will be described. It will be understood the dryer is disposed adjacent a letterpress or similar equipment and is employed to dry the web after its passage through the press. It is desirable that the passage of the web through the dryer be coordinated with the passage of the web through the press. For this purpose, the actuating mechanism of the dryer may be connected to and actuated by the press controller.

Burners 12 are lit, the flames thereof being directed toward the line of travel of the web 5 to apply radiant heat to the web passing through the first drying stage 3 of dryer 2, fan 35 and heater 37 are placed in operation to supply heated air to the second drying stage 4 of the dryer by means of duct 32 and nozzles 33. Exhaust fan 40 is also placed in operation and serves to remove a minor portion of heated air and products of combustion leaking from dryer 2. Thus, the web 5 being drawn through dryer 2 has radiant heat from burners 12 in a first drying stage and heated air from the nozzles 33 in a second drying stage applied to one surface thereof to dry the same. After passage of web 5 through dryer 2, it is directed over chilling rolls 11 to cool the same; chilling rolls 11 are supplied with cold water to cool the surface of the same as is well known in the art. If desired, high pressure air may be blown on the rolls 11 as previously described to remove vapor or fumes from the web, thereby assuring a cleaner sheet.

Assume, however, that for some reason, passage of web 5 through dryer 2 is halted. Immediately, piston 16 is actuated to move burners 12 away from the web. Simultaneously, damper arrangement 39 is opened to permit room air to enter the dryer and fan 54 is actuated to blow relatively cold air within the first drying stage 3 over the web therein. At the same time, fan 35 may be stopped and supply of gas to heater 37 discontinued, or supply of gas to heater 37 may be greatly reduced while fan 35 is continued in operation permitting it to circulate air at a much lower temperature.

Automatically moving burners 12 away from web 5 in the first drying stage, automatically discontinuing the supply of air heated to a relatively high temperature to the second drying stage, and automatically supplying relatively cold air over the web in the first drying stage, permits substantially instantaneous stopping of the web 5 in dryer 2 without damage or injury to web 5 from the radiant heat of burners 12. This is an important feature of my invention for it permits the press to be brought to what is in effect a dead stop. There is no delay in stopping the press for it need not be slowed to permit the dryer to cool in order to avoid scorching or burning of the web. Substantially instantaneous stopping of the press is thus permitted.

Considering Figure 9, the dryer is placed in operation by manually closing switch 104 to start motor 40' actuating exhaust fan 40 and switch 105 which closes the circuit to motor 101 actuating the combustion air blower (not shown). When the contactor is in the "off" position, relay A is closed, completing the circuit to the motor 54' actuating the cold air fan 54 and solenoid valve 17 in compressed air line 18. The cold air fan 54 is in operation and valve 17 supplies compressed air to piston 16 to move burners 12 away from the stationary web.

When the contactor is in "run" position, re-

7

lay A opens the circuit to discontinue operation of motor 54' and to close solenoid 17. Relays B and C close the circuit to the motor 35' of recirculating air fan 35 and opens valve 20 to pass air to piston 16 to move the burners to "run" position. Solenoid valve 43 passes air to close dampers 39. Solenoid valves 37' and 102 in the gas lines are opened to pass gas to the burners 12 and the air heater 37. Solenoid valve 103 is also opened to pass water to chilling rolls 11.

Piping 24 for the passage of cooling medium is below the burners 12 when the burners are moved away from the web and is between the web and the burners when passage of the web through dryer 2 is halted. If there is a tendency for the web to weave, it will strike the piping and not the burners which aids in the elimination of any tendency for the web to burn in the dryer. If there is a break in the web causing the paper to throw itself wildly in any direction, piping 24 prevents the paper from striking burners 12 and, since the piping is cool, the paper will not scorch or burn.

The present invention provides a plurality of stages of drying for desired heat application so arranged as to provide automatic control of dryer operation, permitting substantially instantaneous stopping of the web in the drying chamber and permitting upon start-up of the press immediate drying action to occur in the dryer. I have not deemed it necessary to illustrate specific burner mechanism for the mechanism described and claimed in my copending applications, above referred to, may be employed with satisfactory results.

The mechanism illustrated to move the burners away from the web when the web is halted is simple and highly effective permitting the burners to be moved away from the web substantially simultaneously with the stopping of the web since such mechanism is controlled from the press controller. The supply of relatively cold air to the first drying stage occurs substantially simultaneously with the stopping of the web in the drying chamber for such mechanism is likewise actuated by the press controller. In general, the present invention provides simple and economical drying equipment arranged in a plurality of stages which may be employed effectively to dry a web after its passage through a press and which is so designated as to prevent scorching or burning of the web in the dryer if for any reason passage of the web through the dryer is halted. As pointed out above, the web may be halted substantially instantaneously, avoiding the waste heretofore encountered due to the necessity of slowing down the operation to permit the dryer to cool to avoid damage or injury to the web.

While I have described and illustrated a preferred embodiment of my invention, it will be understood my invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In apparatus for drying webs, the combination of a first drying stage, a second drying stage, means for routing a web to be dried through said drying stages, a plurality of burners in said first drying stage, for directing flames in the direction of the line of travel of the web, means for moving said burners toward and from the web, means for supplying air heated to a predetermined temperature over a surface of the web in the second drying stage, means for circulating relatively cold air in the first drying stage whenever travel of

8

a web through the stages is interrupted, means for discontinuing the supply of air heated to such temperature to the second drying stage whenever travel of a web through the stages is interrupted, and means for actuating said burner moving means to move the burners away from the web whenever travel of a web through the drying stages is interrupted whereby substantially instantaneous stopping of the web may be effected without injury to the web by radiant heat from the burners.

2. Apparatus according to claim 1 in which the burners are connected to a lever pivoted at one end, the opposite end of the lever being connected to a pneumatic piston, air being supplied to the piston whenever travel of a web through the drying stages is interrupted to move the burners away from the web.

3. Apparatus according to claim 1, in which pneumatic pistons are disposed at opposite ends of the burner moving mechanism, air being supplied to the pistons whenever travel of a web through the drying stages is interrupted to move the burners away from the web.

4. Apparatus according to claim 1 in which a plurality of shield members are interposed between the web and the burners when the burners are moved away from the web thereby preventing the web from striking the burners and consequent injury thereto upon weaving or breaking of the web.

5. In apparatus for drying webs, the combination of a drying chamber, means for routing a web to be dried through the drying chamber, a plurality of burners in the chamber disposed as a first drying stage for directing flame in the direction of the line of travel of the web, means for moving the burners toward and from the web, means for supplying heated air over a surface of the web, as a second drying stage, said chamber having an opening therein for the supply of relatively cold air in the first drying stage, means for automatically circulating relatively cold air into the chamber whenever passage of a web through the chamber is interrupted, means for automatically discontinuing the supply of heated air in the chamber whenever travel of a web through the chamber is interrupted, and means for automatically actuating said burner moving means to move the burners away from the web whenever travel of a web through the chamber is interrupted, said automatic means cooperating to permit substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat from the burners.

6. Apparatus according to claim 5 in which the burners are connected to a lever pivoted at one end, the opposite end of the lever being connected to a pneumatic piston, air being supplied to the piston automatically whenever travel of a web through the chamber is interrupted to move the burners away from the web, and a plurality of members having cooling medium passing therethrough are interposed between the web and the burners when the burners are moved away from the web thereby preventing the web from striking the burners and consequent injury thereto upon weaving and breaking of the web.

7. In apparatus for drying webs, the combination of a drying chamber, means for routing a web to be dried through the drying chamber, a plurality of burners for directing flame in the direction of the line of travel of the web, means for supplying heated air over a surface of the web, said chamber having an opening therein for

the supply of relatively cold air, a damper arrangement, and means for automatically discontinuing the supply of heated air to the chamber, opening the damper arrangement, circulating relatively cold air in the chamber, and moving the burners away from the web whenever travel of a web through the chamber is interrupted thereby permitting substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat from the burners.

8. In apparatus for drying webs, the combination of a drying chamber, means for routing a web to be dried through the drying chamber, a plurality of burners for directing flames in the direction of the line of travel of the web, a lever connected to said burners, said lever being pivoted at one end and connected at its opposite end to a pneumatic piston adapted to raise the same, means for actuating the piston whenever travel of a web through the chamber is interrupted, shield members interposed between the burners and the web when the burners are moved away from the web, means for supplying heated air over a surface of the web, said chamber having an opening therein for the supply of relatively cold air, a damper arrangement, means for opening said damper arrangement whenever travel of a web through the chamber is interrupted, means for passing relatively cold air through said opening into the chamber whenever travel of a web through the chamber is interrupted, and means for discontinuing the supply of heated air to the chamber whenever travel of a web through the chamber is interrupted, said means cooperating with the burner moving mechanism and the cold air circulating means to permit substantially instantaneous stopping of the web in the chamber without injury thereto by radiant heat from the burners.

9. In apparatus for drying webs, the combination of a drying chamber, means for routing a web to be dried through the drying chamber, a plurality of burners for directing flame in the direction of the line of travel of the web, a lever connected to said burners, said lever being pivoted at one end, a pneumatic piston connected to the opposite end of said lever, means for actuating said piston when travel of the web through the chamber is interrupted to move the burners away from the web, means for supplying heated air over a surface of the web, and means for interrupting the supply of heated air to the chamber and for supplying relatively cold air to the chamber when travel of the web through the chamber is interrupted thereby permitting substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat from the burners.

10. Apparatus according to claim 9 in which a plurality of pipes for the passage of cooling medium extend across the chamber, said pipes being interposed between the burners and the web when the burners are moved away from the web thereby preventing the web from striking the burners and consequent injury thereto upon weaving or breaking of the web.

11. In apparatus for drying webs, the combination of a drying chamber, means for routing a web to be dried through the drying chamber, a return duct connected to the chamber, a fan adapted to withdraw air from the chamber, an air heater connected to said fan, a supply duct connecting the heater and the chamber, said fan withdrawing air from the chamber, passing withdrawn air through said heater and supplying the

heated air over a surface of the web in the chamber, a plurality of burners for directing flames in the direction of the line of travel of the web in the chamber, means for moving said burners towards and from the web, said chamber having an opening therein for the supply of relatively cold air, a damper arrangement, means for opening said damper arrangement whenever travel of a web through the chamber is interrupted, means for supplying cold air in the chamber whenever travel of a web through the chamber is interrupted, means for discontinuing the supply of heated air to the chamber whenever travel of a web through the chamber is interrupted, and means for actuating said burner moving means to move the burners away from the web whenever travel of the web through the chamber is interrupted whereby substantially instantaneous stopping of the web may be effected without injury to the web by radiant heat from the burners.

12. In apparatus for drying webs, the combination of a drying chamber arranged in a plurality of stages, means for routing a web to be dried through the drying chamber, said chamber having an opening therein for the supply of cold air to the chamber, an exhaust fan adapted to exhaust a minor portion of heated air leaking from the chamber, a plurality of burners disposed in a first drying stage in said chamber for directing flames in the direction of the line of travel of the web in the chamber, means for moving said burners toward and from the web, a fan connected to the chamber by a return duct, a gas air heater connected to the fan, a supply duct connecting the heater and the fan to the chamber to permit the fan to supply air heated to a predetermined temperature to a second drying stage in the chamber, a damper arrangement, means for automatically opening the damper arrangement whenever travel of a web through the chamber is interrupted, means for automatically discontinuing the supply of air heated to such temperature to the second drying stage whenever travel of a web through the chamber is interrupted, means for automatically actuating said burner moving means to move the burners away from the web whenever travel of the web through the first drying stage is interrupted, a fan for automatically blowing cold air in the first drying stage whenever travel of a web therethrough is interrupted, and a plurality of pipes for the passage of cooling medium extending across the chamber, said pipes being interposed between burners and the web when the burners are moved away from the web, said automatic means cooperating to permit substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat from the burners.

13. Apparatus according to claim 12 in which the means for moving the burners toward and from the web comprise a lever connected to the burners, said lever being pivoted at one end, a pneumatic piston connected to the opposite end of the lever, and means for automatically supplying air to the piston to raise the lever carrying the burners therewith when passage of a web through the chamber is interrupted.

14. In a method of drying a web, the steps which comprise directing radiant heat over the surface of a web in a first drying stage, directing air heated to a predetermined temperature over a surface of the web in a second drying stage, then, when travel of the web through the stages is

11

interrupted, substantially instantaneously discontinuing the supply of air heated to such temperature over the web, moving the radiant heating means away from the web, and directing relatively cold air over the surface of the web in the first drying stage thereby permitting substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat.

15. In a method of drying a web, the steps which comprise passing a web through a chamber, directing radiant heat over the surface of the web in said chamber, directing heated air over a surface of the web in said chamber, then, when travel of the web through the chamber is interrupted, discontinuing the supply of heated air over the web, moving the radiant heating means away from the web, placing shield members between the radiant heating means and the web when such members are moved away from the web, and directing relatively cold air over the surface of the web in said chamber thereby permitting substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat.

16. In a method of drying a web, the steps which comprise passing a web through a chamber, directing radiant heat over the surface of the web in said chamber, directing heated air over a surface of the web in said chamber, then, when travel of the web through the chamber is interrupted, substantially instantaneously discontinuing the supply of heated air over the web, moving the radiant heating means away from the web, and directing relatively cold air over the surface of the web thereby permitting substantially instantaneous stopping of the web in the

12

chamber without injury to the web by radiant heat.

17. In a method of drying a web, the steps which comprise passing a web through a drying chamber, directing radiant heat over the surface of the web in a first drying stage in said chamber, directing heated air over a surface of the web in a second drying stage in said chamber, then, when travel of the web through the chamber is interrupted, automatically moving the radiant heating means away from the web, automatically interrupting the supply of heated air over the web, automatically opening a damper arrangement to permit room air to enter the drying chamber, and automatically supplying relatively cold air over the surface of the web in the first drying stage, thereby permitting substantially instantaneous stopping of the web in the chamber without injury to the web by radiant heat.

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