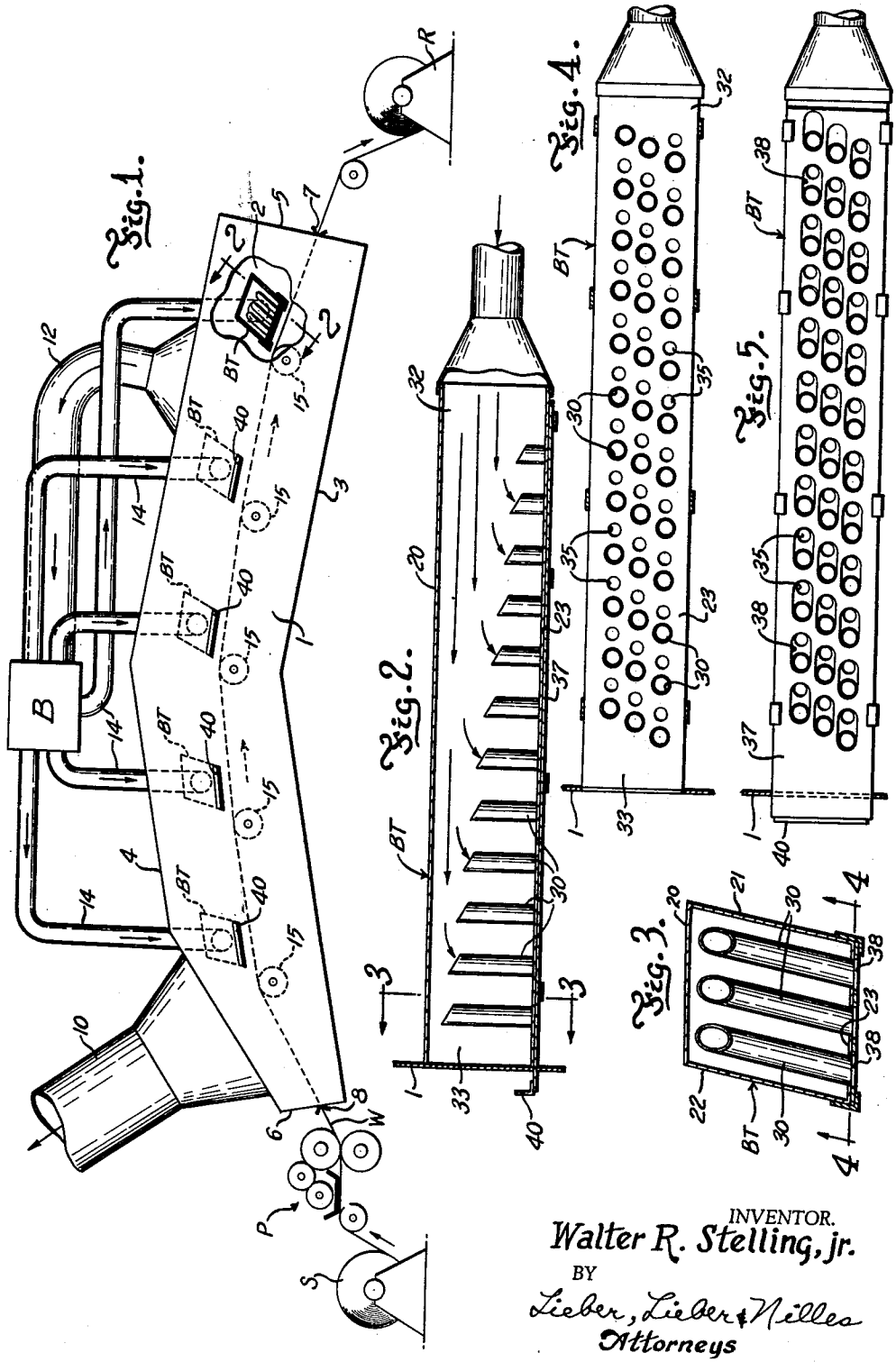
Jan. 22, 1963 W. R. STELLING, JR 3,074,179

WEB DRYER

Filed Aug. 26, 1960



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United States Patent Office 3,074,179 Patented Jan. 22, 1963

3,074,179

WEB DRYER

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Filed Aug. 26, 1960, Ser. No. 52,117
4 Claims. (Cl. 34—160)

This invention relates to dryers for rapidly moving, continuous web materials, such as are found in paper converting equipment.

In equipment where the present invention finds particular though not exclusive utility, such as in printing presses, the web moves through the printing units at a rapid rate, commonly in the neighborhood of several hundred feet per minute. It is necessary for the ink applied by one printing unit to be dry by the time it reaches the next printing unit, or by the time it reaches the rewinder or subsequent operation.

Accordingly, the present invention provides an improved drying oven for a rapidly moving web, which oven is more efficient than dryers heretofore used.

More specifically, the present invention provides a highly efficient blast tube assembly for a dryer, which assembly produces a direct and localized air blast that impinges forcefully and at an effective and efficient angle on the rapidly moving web. Stated otherwise, the air blast delivered by this improved tube assembly is at an angle generally in opposition to the direction of web travel, and provides a defined path of air which impinges hard and evenly over a localized area of the web. The result is an effective "lifting" of the solvents and an even temperature and drying effect.

Another aspect of the present invention provides a dryer of the above type in which the velocity of the air being delivered may, if desired, be reduced without a reduction in the volume of air delivered.

These and other objects and advantages of the invention will appear as this disclosure progresses, reference being had to the accompanying drawings, in which;

FIGURE 1 is a schematic diagram of an elevational view showing a dryer made in accordance with the present invention, and used in a simple printing operation, certain parts being shown as broken away or in section for clarity in the drawings;

FIGURE 2 is a sectional view of one of the distribution tubes, the view being taken along line 2—2 in FIGURE 1, but on an enlarged scale;

FIGURE 3 is a sectional view taken along line 3—3 in FIGURE 2;

FIGURE 4 is a bottom view of one of the tubes, the view being taken along the line 4—4 in FIGURE 3, but on a reduced scale, and

FIGURE 5 is a bottom view of one of the tubes and showing the shutter plate.

Referring in greater detail to the drawings, the flexible web W of material to be printed, such as paper or the like, is pulled from the conventional supply roll S, moves through the coating head or printing unit P where it is coated or printed in the known manner. After the printing fluid is applied to the web, it passes through a drying tunnel T where drying of the web occurs in accordance with the present invention. After leaving the tunnel the web may be rewound in a roll by a conventional rewinder R.

The tunnel T is of the type in which a negative pressure is maintained and includes side walls 1 and 2, a bottom wall 3 and a top wall 4. It also includes rear end wall 5 and a front end wall 6, all of these walls being secured together to form an enclosed tunnel chamber. The end walls 5 and 6 have, respectively, a discharge slot 7 and an entry slot 8 through which the web moves. The tunnel

is maintained under a negative pressure and for this purpose the exhaust conduit 10, which may exhaust directly to the atmosphere, removes the air and fumes from the tunnel faster than air is supplied to the tunnel.

Air is supplied through the blast tubes BT which are spaced along the length of the web as it moves through the tunnel. As shown there are five such blast tubes utilized in the illustration shown but of course any number, as required or desired, may be employed.

A certain amount of air is also removed from the tunnel by means of the recirculation duct 12 which is located adjacent the discharge end of the tunnel. Conduit 12 acts to remove a portion of the air adjacent the discharge end of the tunnel, where air is fairly free of solvents, and directs this air into the gas-fired burner B for reheating. In this manner the heated air from burner B delivered through conduits 14 to the blast tubes consists of a certain amount of fresh air and the remainder being recirculated air. A certain fuel economy is thus effected by utilizing and reheating a portion of the air from the tunnel.

As the web moves through the tunnel it passes over a series of conventional idler rolls 15. In the illustration shown a single tunnel is utilized between the printing unit P and the rewind unit but of course a similar tunnel may be used between adjacent printing units of an in-line printing press arrangement.

As the construction of each of the blast tubes is substantially identical, reference will be made only to one.

The blast tubes consist of a top wall 20, side walls 21 and 22 and the bottom wall 23. It will be noted that these walls are secured together to form a generally diamond-shaped cross section, the lower, discharge wall 23 of which is positioned generally parallel to that portion of the adjacent web. In practice, a distance of about one inch of the discharge wall 23 from the web has proved to be very satisfactory. As previously mentioned the conduits 14 lead from the burner to one end of the blast tubes, while the other end of the blast tubes are closed, for example, as by abutting against the tunnel side wall 1.

As the web moves rapidly through the tunnel at a speed of, for example, 400 feet per minute, it creates a curtain of air which moves along with it. In order for the air blast to be most effective in drying the web and lifting the solvents therefrom, the air is initially directed in a direction generally against the direction of web travel as follows. Within each of the diamond-shaped blast tubes BT is a series of spaced apart rows of tubes 30 as clearly shown in FIGURE 4. There are three such rows of these tubes shown, each row consisting of 14 or 15 tubes, although any suitable number may be utilized as needed. These tubes are secured at their discharge lower end to the discharge wall 23 of the blast tube and have their upper ends extending into the blast tube and cut at an angle inclined to the direction of air supply. The heights of the tubes 30 are also graduated and increase from the entry end of the tube 32 towards the rear end of the tube 33. In this manner each tube acts to deflect a certain portion of the air rushing over it and directs the air through the tubes and discharge wall 23 and against the web. The air is evenly distributed over the length of the blast tube as the air moves into it from the supply conduit 14.

It should be noted that the tubes 30, as well as side walls 21 and 22, are inclined toward the web at an angle opposite to the direction of web travel, as clearly indicated in FIGURES 1 and 3. The angle of these tubes 30 together with the diagonal shape of the blast tube BT thereby acts to direct a well-defined path of air at an angle in opposition to direction of web travel. As the discharge side 23 of the blast tube assembly is disposed a uniform distance, approximately one inch, away from

the moving web, an even and hard impingement of the air against the web is effected for the entire width of the assembly as well as for its entire length. The air is distributed evenly against a localized area of the web directly under the blast tube assembly. Thus, a particularly even drying temperature of the web in this area is provided.

By means of the diamond-shaped blast tube assembly, a plenum action is provided in the assembly such that the air pressure built up within the assembly is evenly and forcefully directed at an angle to the direction of the web movement. As previously indicated, as the web moves through the tunnel it pulls a path or curtain of air along with it. As the blast of air delivered by the tubes is at an angle generally in opposition to this web movement, by the time this air blast penetrates this curtain of moving air and reaches the web it has been deflected slightly. The resultant direction of force of the air blast is generally at right angles to the web by the time it reaches the web, and the direction of travel of the air blast from the blast tubes to the web is indicated generally by the curvilinear arrows in FIGURES 1 and 3. In other words by the time this blast of air impinges on the web, it is moving generally in a right angle direction thereto.

The resulting blast of air as it impinges normally on the web is particularly hard and forceful and is very effective in lifting the solvents from the web and promoting even and rapid drying.

Means are also provided for reducing the velocity of the air blasts for operation on certain types of materials or for use with certain printing fluids. This means comprises a series of secondary air holes **35** in the discharge side of the blast tube which are spaced between the tubes **30**. A shutter plate **37** contains a series of slots **38** which are elongated so that when the secondary holes **35** are to be utilized, the elongated slots **38** have uncovered both apertures **35** and the tubes **30**, but may close or open the secondary apertures **35** as desired by shifting the shutter plate **37** by its protruding handle **40**. Handle **40** may consist of an upturned portion at the end of the shutter which protrudes through the side wall **1** of the tunnel. The shutter is held tightly against the discharge wall **23** of the blast tube assembly by means of the clips **41** secured to opposite lower sides of the assembly and which extend under the plate **37** to hold it in slideable engagement with the wall **23**. By means of the secondary air inlets, the velocity of the air blast may be reduced while still maintaining the same volume of air flow.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

What is claimed and desired to be secured by Letters Patent is:

1. In an enclosed drying tunnel for drying a web moving rapidly therethrough, a blast tube assembly having an air inlet end and extending into said tunnel in a direction which is generally transverse to said web, said blast tube assembly comprising, a pair of said walls, a discharge wall arranged generally parallel to the web and closely adjacent thereto, a series of tubes extending from said discharge wall and into said blast tube assembly where they terminate in free ends, said tubes being spaced apart from another, and succeeding tubes being of a greater height as they are located in a direction away from said inlet end, said free ends being inclined so as to catch air coming from said inlet end and deflect it through said discharge wall and against said web, said side walls and said tubes being inclined toward said web at an acute angle opposite to the direction of web movement.

2. In an enclosed drying tunnel for drying a web moving rapidly therethrough, a blast tube assembly having an air inlet end and extending into said tunnel in a direction which is generally transverse to said web, said blast tube assembly comprising, a pair of side walls, a discharge wall arranged generally parallel to the web and closely adjacent thereto, a series of tubes extending from said discharge wall and into said blast tube assembly where they terminate in free ends, said tubes being spaced apart from another, and succeeding tubes being of a greater height as they are located in a direction away from said inlet end, said free ends being inclined so as to catch air coming from said inlet end and deflect it through said discharge wall and against said web, said side walls and said tubes being inclined toward said web at an acute angle opposite to the direction of web movement, a series of secondary air openings in said discharge wall, and means for closing said secondary openings.

3. In an enclosed drying tunnel for drying a web moving rapidly therethrough, a blast tube assembly having an air inlet end and extending into said tunnel in a direction which is generally transverse to said web, said blast tube assembling being of generally diamond-shaped cross section and comprising, a pair of side walls, a discharge wall arranged generally parallel to the web and closely adjacent thereto, a series of rows of tubes extending from said discharge wall and into said blast tube assembly where they terminate in free ends, said tubes of each row being spaced apart from another, and succeeding tubes being of a greater height as they are located in a direction away from said inlet end, said free ends being inclined facing said inlet end so as to catch air coming therefrom and deflect it through said tubes and discharge wall and against said web, said side walls and said tubes being arranged in parallelism and inclined toward said web at an angle whereby said assembly directs an even air blast in a direction generally opposite to the direction of web travel.

4. A blast tube assembly for a web drying tunnel and adapted to extend into said tunnel in a direction which is generally transverse to said web, said blast tube assembly comprising, an inlet end, a pair of side walls, a discharge wall for positioning parallel to the web and closely adjacent thereto, a series of tubes extending from said discharge wall and into said blast tube assembly where they terminate in free ends, said tubes being spaced apart from another, said tubes increasing in height as they are located in a direction away from said inlet end, said free ends being inclined so as to catch air coming from said inlet end and deflect it through said discharge wall and against said web, said side walls and said tubes being inclined upwardly from said discharge wall in the direction of web movement.

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