



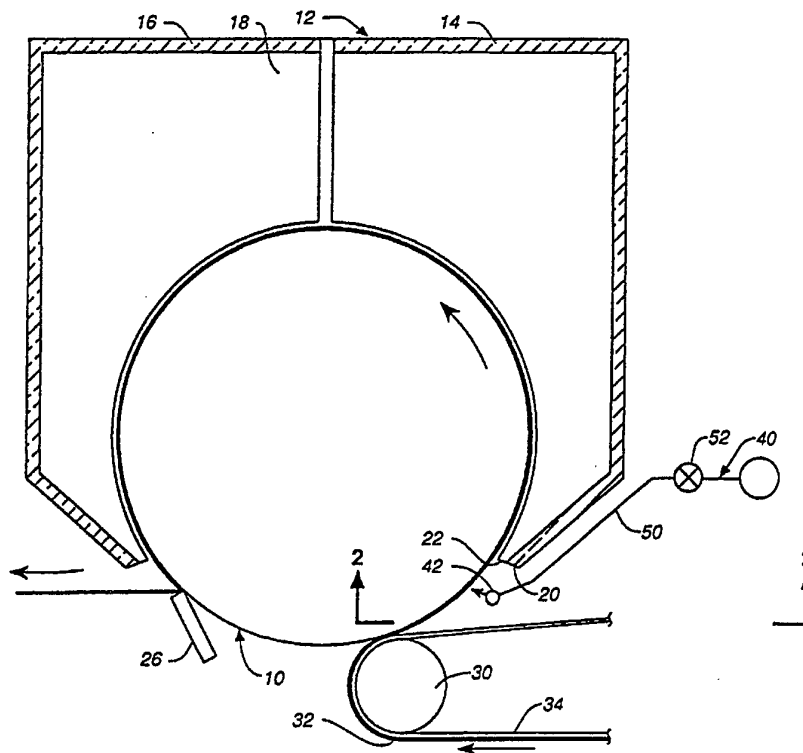
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(54) Title: SYSTEM FOR REDUCING BLISTERING OF A WET PAPER WEB ON A YANKEE DRYER

(57) Abstract

Blistering of a wet paper web (32) upon a yankee dryer drum (10) is controlled by directing compressed dry air toward the wet paper web (32) in the space between a pressure roll (30) external of the yankee dryer hood (12) and the entry opening (22) between the dryer hood (12) and the yankee dryer drum (10). The flow of compressed air is controlled so that the air flow can be modified across the full width of the wet paper web (32).



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- 1 -

**SYSTEM FOR REDUCING BLISTERING
OF A WET PAPER WEB ON A YANKEE DRYER**

TECHNICAL FIELD

5 This invention relates to the art of drying
paper webs. More particularly, the invention
encompasses an apparatus and a method for reducing
blistering of a wet paper web caused by heating of the
wet paper web by a yankee dryer drum.

BACKGROUND ART

10 Yankee dryers have been used for many years
to dry wet paper webs during the paper making process.
Typically, the wet paper web is delivered to and
pressed into engagement with the rotating dryer drum
with the outer cylindrical surface of the dryer drum
15 delivering the wet paper web to a dryer hood
associated with the dryer drum. The dryer drum is
heated internally by steam or the like so that the
outer surface thereof is maintained at a high
temperature. After entering the dryer hood the wet
20 paper web is also subjected to heat on the outer
surface (air side) thereof.

A yankee dryer is typically used to produce
tissue creped from the yankee dryer drum after passage
through the hood. Tissue on a yankee dryer drum will
25 blister when the surface of the dryer drum transfers
heat to the sheet too rapidly. The sheet is ruined
and operation is disrupted while the problem is being
corrected.

- 2 -

Blistering tends to occur in one spot rather than across the entire web. Yankee dryer coating, felt cleanliness and wear, basis weight and yankee dryer condensate removal all can effect blistering.

5 The machine operator typically attempts to resolve matters by reducing the yankee dryer drum steam pressure and increasing hood temperature. Air side drying, that is drying induced at the outer web surface, is considerably more expensive than steam
10 side drying, that is drying caused by the heated dryer drum as applied to the inner sheet surface. Thus, the common practice of reducing the yankee steam pressure and increasing hood temperature results is a poor one from the standpoint of economizing. This is
15 aggravated by the fact that the machine operator customarily allows himself a wide safety margin so that the problem does not show up during speed changes or other transient conditions on the machine. On drying limited machines blistering can result in
20 reduced production.

A search of the prior art located the following United States patents: 1,698,818, issued January 15, 1929, 1,830,287, issued November 3, 1931, 3,213,858, issued October 26, 1965 and 4,665,631,
25 issued May 19, 1987.

None of the above-identified patents addresses the problem of blistering of a wet paper web on a yankee dryer drum.

U.S. Patent No. 3,212,858, however, does
30 disclose a drying drum wherein a slurry of tobacco is deposited on the drum and formed into a self-supporting sheet or film. A forced air supply jet is provided for directing a stream of air toward the slurry web on the dryer drum to keep water vapor

- 3 -

pressure down and prevent boiling while a dispersion is still in liquid form. The air impinges on the dispersion immediately after forming on the drum surface to accelerate the drying rate. The patent provides a general suggestion to the effect that the method can be used for the preparation of sheet material from dispersions or slurries other than tobacco.

The forced air jet of U.S. Patent No. 3,213,858 is not disclosed with particularity; however, it appears that the jet uniformly and continuously directs compressed air along the full length of the dryer drum, that is along the full width of the slurry film. There is no teaching of employing a plurality of air jets which are independently controlled to direct air to selected different incremental width portions of the slurry. Also, the air stream in the patent is for the purpose of cooling the dispersion at the point of contact between the roll applying the dispersion to the drum and the drum. This will not solve the problem of blistering in the zone between the applicator roll and the exhaust hood shown in the patent.

U.S. Patent No. 1,830,287 discloses a drum for heating paper wherein a mantle is provided over a portion of the drum and air is supplied thereto to assist in the drying of the paper. The air may be pre-heated to about the same temperature as the air leaving the chamber. The device supplies air to the drum by utilizing a manifold. There is no teaching that the apparatus can be utilized for blister control or prevention.

U.S. Patent No. 1,698,818 is directed to a device for moistening paper by use of steam. A steam

- 5 -

in one or more isolated spots of the web rather than across the entire web.

The structural combination of the present invention includes a yankee dryer including a
5 rotatable heated dryer drum having an outer cylindrical surface and a dryer hood partially encompassing the dryer drum and having a hood interior and a hood wet end defining an opening with the dryer drum outer cylindrical surface communicating with the
10 hood interior.

A pressure roll is provided forming a nip with the dryer drum for pressing a wet paper web against the dryer drum outer cylindrical surface at a nip location exterior of the dryer hood and spaced
15 from the opening. The dryer drum delivers the wet paper web in the machine direction into the hood interior through the opening upon rotation of the dryer drum.

Air applicator means extends along the
20 length of the dryer drum in the cross-machine direction and defines at least one air outlet for directing a flow of dry air toward the wet paper web between the nip location and the opening prior to delivery of the wet paper web into the hood interior
25 by the dryer drum to promote movement of moist air away from the wet paper web and reduce blistering of the wet paper web caused by heating of the wet paper web by the dryer drum.

The air applicator means includes a
30 plurality of air nozzle segments disposed side-by-side along the length of the dryer drum in the cross-machine direction. The air nozzle segments are for directing incremental air flow portions toward

- 6 -

different incremental width portions of the wet paper web.

The invention also encompasses a method of reducing blistering of a wet paper web at a yankee
5 dryer including a rotatable dryer drum having an outer cylindrical surface and a dryer hood partially encompassing the dryer drum and having a hood interior and a hood wet end defining an opening with the dryer drum outer cylindrical surface communicating with the
10 hood interior. The wet paper web is pressed by a pressure roll against the dryer drum outer cylindrical surface at a nip location exterior of the dryer hood and spaced from the opening. The dryer drum delivers the wet paper web in the machine
15 direction into the hood interior through the opening upon rotation of the dryer drum.

The method includes the steps of positioning a plurality of air nozzles between the pressure roll and the opening in substantial alignment in a cross-
20 machine direction adjacent to the dryer drum and extending along the length of the dryer drum.

The paper web is observed along the width of the paper web to detect the formation of blisters in the paper web caused by heating of the wet paper web
25 by the dryer drum as the wet paper web is delivered by the dryer drum between the pressure roll and the opening.

Compressed dry air is selectively passed through the air nozzles to direct flow of compressed
30 dry air to incremental width portions of the wet paper web between the pressure roll and the opening wherein blistering is detected to impinge upon the web, cause air turbulence at those incremental web portions to promote evaporation, and cool the web to reduce

- 7 -

blistering of the wet paper web caused by heating of the wet paper web by the dryer drum.

Other features, advantages, and objects of the present invention will become apparent with
5 reference to the following description and accompanying drawings.

- 8 -

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a schematic side view of a yankee dryer, a pressure roll and air applicator means constructed in accordance with the teachings of the present invention; and

Fig. 2 is a schematic, sectional, partial view of the structural combination of the present invention as taken along the line 2-2 in Fig. 1.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the drawings, a yankee dryer includes a heated dryer drum 10 having an outer cylindrical surface and a dryer hood 12 including a wet end hood segment 14 and a dry end hood segment 16.

The dryer hood 12 partially encompasses the dryer drum as is conventional and has a hood interior 18. The hood wet end 20 defines an opening 22 with the dryer drum outer cylindrical surface which communicates with the hood interior.

A pressure roll 30 forms a nip with the dryer drum for pressing a wet paper web 32 against the dryer drum outer cylindrical surface at a nip location exterior of the dryer hood and spaced from the opening 22. The wet paper web 32 is transported to the nip location by a moving felt 34. Rotation of the dryer drum in the direction of the arrow shown in Fig. 1 delivers the wet paper web in the machine direction into the hood interior through opening 22.

The above-described structure is of a conventional nature and configuration. Also conventional is the fact that the interior of the hood

- 9 -

is heated by suitable means and the fact that the drum itself is heated, for example by steam being introduced into the interior thereof. For purposes of simplicity and due to the fact that such heating schemes are well known in the art they have not been
5 illustrated. A creping blade 26 removes the sheet from the drum.

Blistering of a wet web on a yankee dryer drum essentially occurs in the space or area between
10 the hood wet end 20 and the nip location as defined by pressure roll 30 and yankee dryer drum 10. Blistering will not occur in the hood due to the fact that high velocity heated air in the hood interior impinges on the web during drying. Also as stated previously, the
15 blistering normally does not occur in a uniform manner across the width of the wet paper web but rather in zones, spots, or increments of the width.

To address and solve the problem the present invention calls for the placement of air applicator
20 means extending along the length of the dryer drum 10 in the cross-machine direction for directing a flow of dry air toward the wet paper web 32 between the pressure roll nip location and opening 32 of the dryer hood prior to delivery of the wet paper web into the
25 hood interior by the dryer drum. The dry air impinges on the web, causes air turbulence at the web to promote evaporation, and cools the web to reduce blistering of the wet paper web caused by heating of the wet paper web by the dryer drum.

30 The air applicator means is illustrated in diagrammatic fashion and is designated by reference numeral 40. The air applicator means includes a plurality of air nozzle segments 42 disposed side-by-side along the length of the dryer drum in the cross-

- 10 -

machine direction. As indicated by the arrows, the air nozzle segments 42 are for the purpose of directing incremental air flow portions toward different incremental width portions of the wet paper web 32. The precise nature of the air nozzle segments is a matter of choice. For example, the actual nozzle exits may be in the form of slits or apertures. In the arrangement shown, the air nozzle segments have a bar-like configuration. However, each air nozzle segment, if desired, may be a separate individual nozzle with a single nozzle opening.

Control means is provided for independently controlling the flow of air out of each of the plurality of air nozzle segments whereby air directed to incremental width portions of the wet paper web can be selectively varied. It is to be understood that the paper web is observed to determine if and where blistering is occurring. If blistering is not a problem air flow can be cut off to all of the nozzle segments. If, however, blistering is detected, the appropriate nozzle segments corresponding to that particular width portion of the paper web will be exposed to compressed air and air directed toward the wet paper web at the trouble spot or zone to solve the problem.

The disclosed air applicator means includes a manifold 44 having an interior which is selectively brought into communication with a suitable source of pressurized air (not shown), a pressure regulating valve 46 being utilized to control such communication.

A plurality of distributor pipes 50 extend from the manifold 44 to the air nozzle segments 42. The means for controlling flow from the manifold to the air nozzle segments may simply comprise a manually

- 11 -

or remotely actuatable valve 52 in operable association with each distributor pipe.

Hoods are conventionally retractable so that they can be moved relative to the dryer drum.

5 Preferably, the air applicator means is affixed to the hood whereby retraction of the hood will cause corresponding movement of the air applicator means. A flexible hose segment 53 may be incorporated in the air supply line to facilitate retraction.

10 The method of the present invention includes the step of positioning a plurality of air nozzles between the pressure roll and the opening 22 in substantial alignment in the cross-machine direction adjacent to the dryer drum 10 and extending along the
15 length of the dryer drum.

The paper web is observed along the width of the paper web to detect the formation of blisters in the paper web caused by heating of the wet paper web by the dryer drum as the wet paper web is delivered by
20 the dryer drum between the pressure roll and the opening.

Compressed dry air is selectively passed through the air nozzles to direct air flow of compressed air to incremental width portions of the
25 wet paper web between the pressure roll and the opening wherein blistering is detected. The dry air impinges on the web, causes air turbulence at the web to promote evaporation and cools the web to reduce blistering of the wet paper web caused by heating of
30 the wet paper web by the dryer drum.

- 12 -

CLAIMS

1. Apparatus comprising, in combination:

a yankee dryer including a rotatable heated dryer drum having an outer cylindrical surface and a dryer hood partially encompassing said dryer drum and having a hood interior and a hood wet end defining an opening with said dryer drum outer cylindrical surface communicating with said hood interior;

a pressure roll forming a nip with said dryer drum for pressing a wet paper web against said dryer drum outer cylindrical surface at a nip location exterior of said dryer hood and spaced from said opening, said dryer drum delivering said wet paper web in the machine direction into said hood interior through said opening upon rotation of said dryer drum; and

air applicator means extending along the length of said dryer drum in the cross-machine direction and defining at least one air outlet for directing a flow of dry air toward said wet paper web between said nip location and said opening prior to delivery of said wet paper web into said hood interior by said dryer drum to impinge said dry air on said wet paper web,

- 13 -

cause air turbulence at the wet paper web to promote evaporation, and cool the wet paper web to reduce blistering of said wet paper web caused by heating of said wet paper web by said dryer drum.

2. The apparatus according to Claim 1 wherein said air applicator means includes a plurality of air nozzle segments disposed side-by-side along the length of said dryer drum in the cross-machine direction, said air nozzle segments for directing incremental air flow portions toward different incremental width portions of said wet paper web.

3. The apparatus according to Claim 2 wherein said air applicator means includes control means for independently controlling the flow of air out of each of said plurality of air nozzle segments whereby air directed to incremental width portions of said wet paper web can be selectively varied.

4. The apparatus according to Claim 3 wherein said air applicator means includes a manifold operably associated with said plurality of air nozzle segments to deliver compressed air to said plurality of air nozzle segments, said control means comprising valve means for separately controlling compressed air

- 14 -

flow from said manifold to said plurality of air nozzle segments.

5. The apparatus according to Claim 4 wherein said air applicator means additionally comprises a plurality of distributor pipes leading from said manifold, each of said plurality of distributor pipes connecting said manifold to a single air nozzle segment, said valve means comprising a valve operatively associated with each of said distributor pipes to control compressed air flow therethrough.

6. A method of reducing blistering of a wet paper web at a yankee dryer including a rotatable dryer drum having an outer cylindrical surface and a dryer hood partially encompassing said dryer drum and having a hood interior and a hood wet end defining an opening with said dryer drum outer cylindrical surface communicating with said hood interior, said wet paper web being pressed by a pressure roll against the dryer drum outer cylindrical surface at a nip location exterior of said dryer hood and spaced from said opening, and said dryer drum delivering said wet paper web in the machine direction into said hood interior

- 15 -

through said opening upon rotation of said dryer drum,
said method comprising the steps of:

positioning a plurality of air nozzles between
the pressure roll and the opening in substantial
alignment in the cross-machine direction adjacent to
said dryer drum and extending along the length of the
dryer drum;

observing the paper web along the width of the
paper web to detect the formation of blisters in the
paper web caused by heating of the wet paper web by
the dryer drum as said wet paper web is delivered by
the dryer drum between the pressure roll and the
opening; and

selectively passing compressed dry air through
said air nozzles to direct flow of compressed dry air
to incremental width portions of said wet paper web
between said pressure roll and said opening wherein
blistering is detected to impinge on the wet paper
web, cause air turbulence at the wet paper web to
promote evaporation, and cool the wet paper web to
reduce blistering of the wet paper web caused by
heating of said wet paper web by the dryer drum.

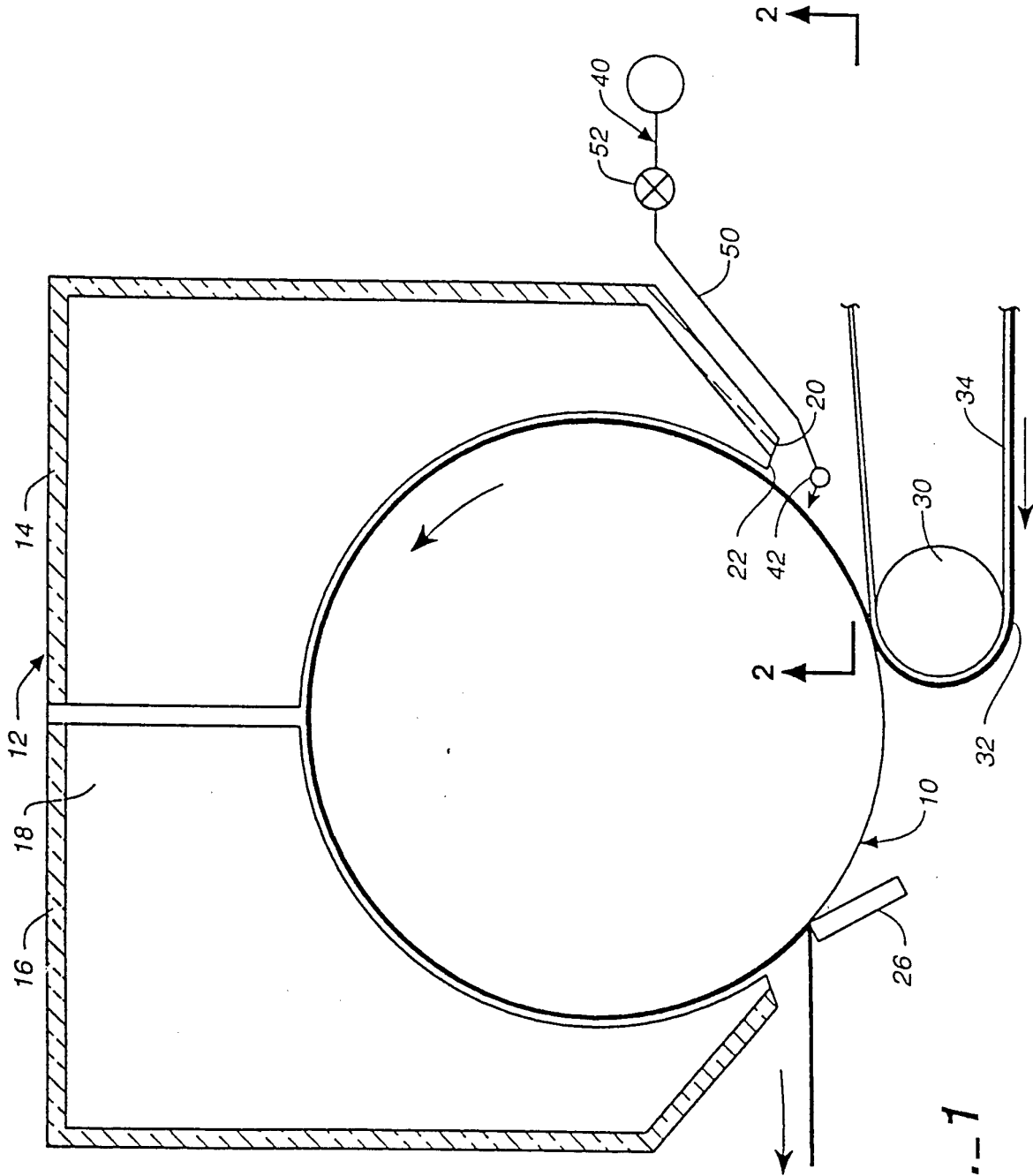


FIG.-1

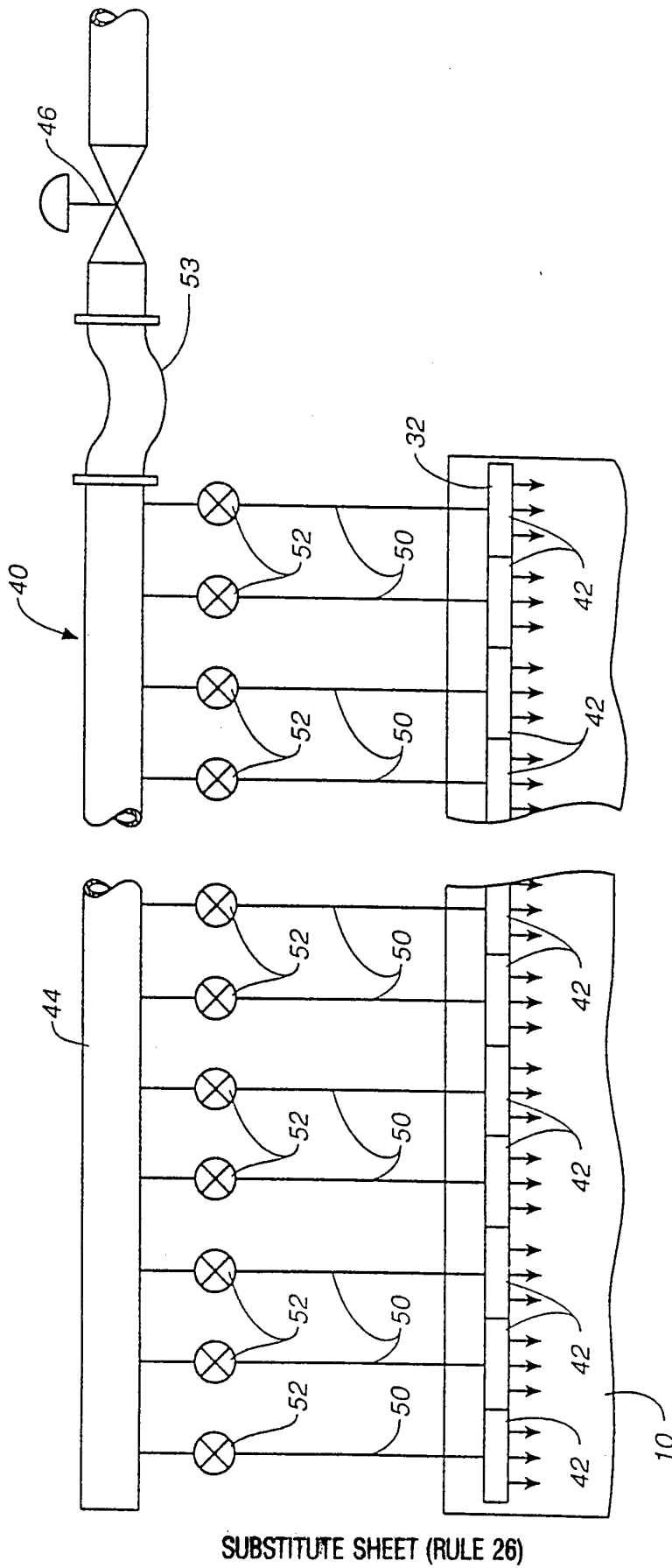


FIG.-2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/13978

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) :D21F 5/18; F26B 25/16 US CL :162/290, 315, 206, 207; 34/122, 123 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 162/290, 315, 206, 207, 359, 111, 116, 117; 34/122, 123, 124, 419, 454 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, 4,413,427 (VILLALOBOS ET AL.) 08 NOVEMBER 1983, col. 2, lines 57-68 and col. 3, lines 1-55).	1-6
Y	US, Re. 28,459 (COLE ET AL) 01 July 1975, col. 12, lines 59-64.	2-6
Y	US, 4,074,441 (HELVERSON ET AL) 21 February 1978, col. 6, lines 4-26.	3-6
Y	US, 3,808,700 (KRAUS) 07 May 1974, col. 3, lines 60-67.	4-6
Y,P	US, 5,385,644 (HANNUS ET AL.) 31 January 1995, col. 5, lines 16-48.	1-6
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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