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Rodwin et al.

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[45] **Aug. 7, 1973**

[54] **SONIC DRYING OF WEBS ON ROLLS**

[75] Inventors: **Stephen Anthony Rodwin**, Montreal; **John Gilbert Descary**, Lachine, both of Quebec, Canada

[73] Assignee: **Dominion Engineering Works, Limited**, Quebec, Canada

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[21] Appl. No.: **86,571**

[30] **Foreign Application Priority Data**

Nov. 7, 1969 Canada 66921

[52] **U.S. Cl.** **34/69**, 34/115, 34/122, 34/124, 34/155

[51] **Int. Cl.** **F26b 19/00**

[58] **Field of Search** 34/18, 23, 69, 90, 34/114, 122, 155, 158, 115, 119, 124

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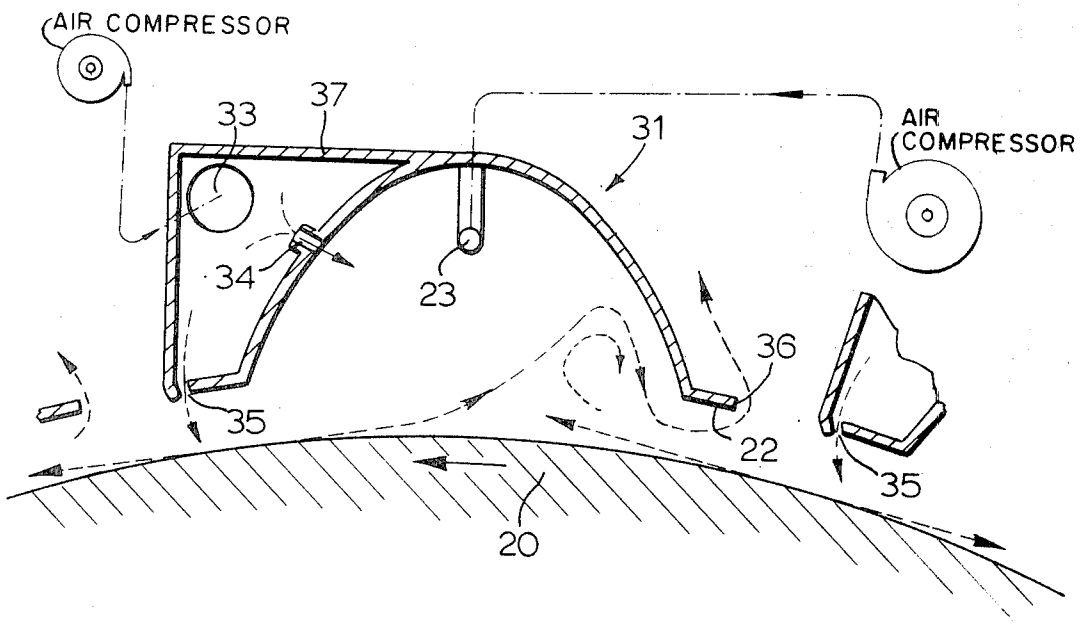
Primary Examiner—Carroll B. Dority, Jr.

Attorney—Raymond A. Eckersley, Frank L. Neuhauser, Oscar B. Waddell and Joseph B. Forman

[57] **ABSTRACT**

Sonic drying as applied to conventional dryer rolls involves the provision of stem jet whistles spaced along trough-like reflectors, preferably of eliptic cross-section profile, with provision of low pressure secondary air to sweep displaced moisture clear of the travelling web.

20 Claims, 10 Drawing Figures

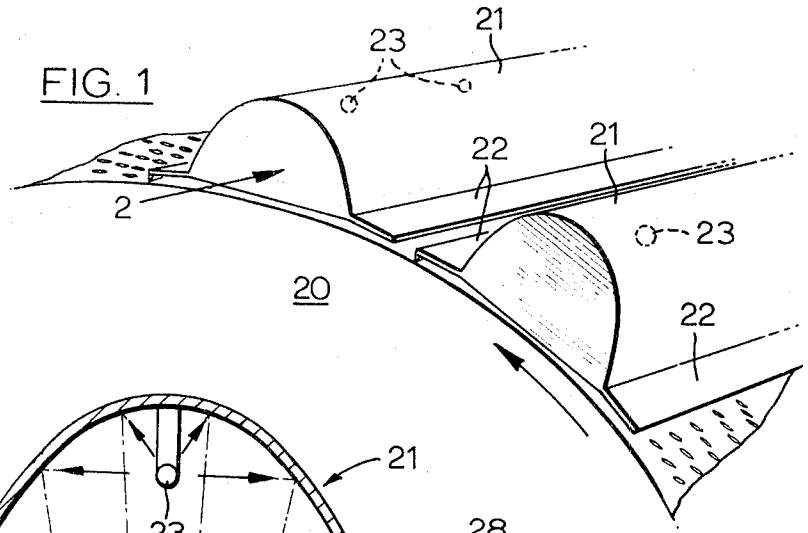


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SHEET 1 OF 3

FIG. 1



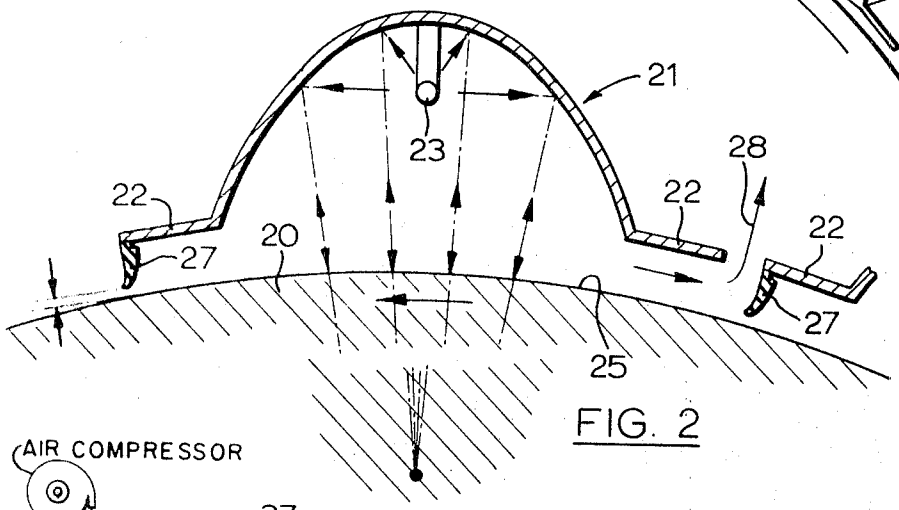


FIG. 2

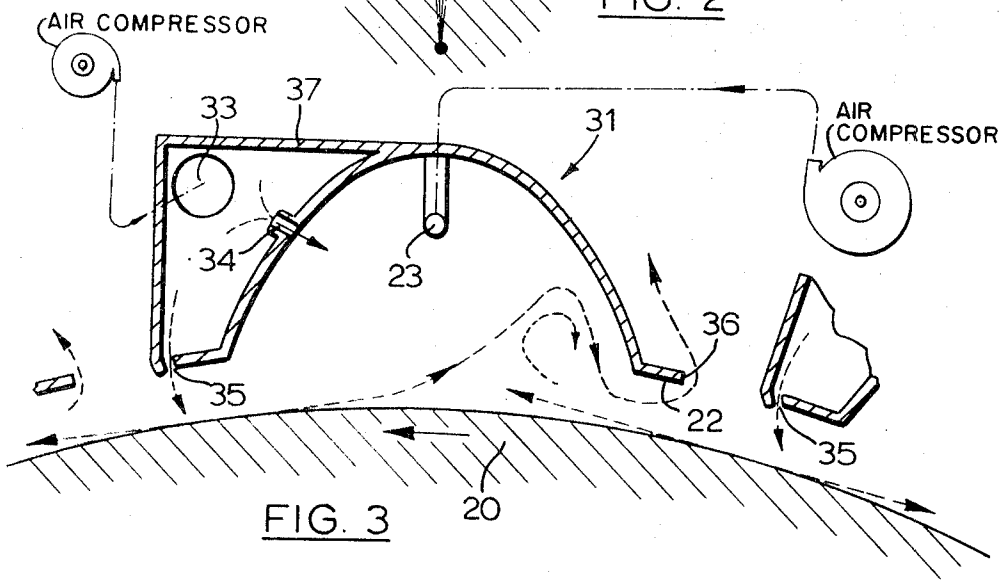


FIG. 3

INVENTOR.
STEPHEN A. RODWIN
J. GILBERT DESCARY

BY

R. Q. Eckersley

Patent Agent

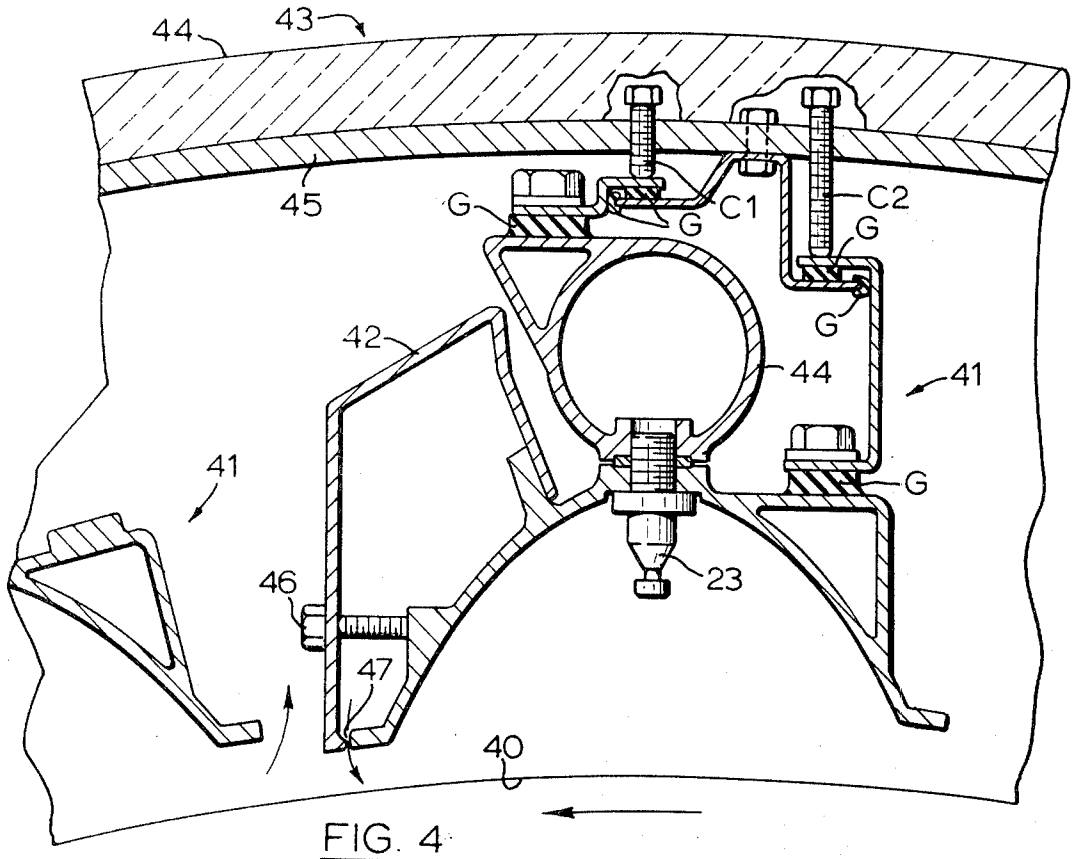


FIG. 4

FIG. 6

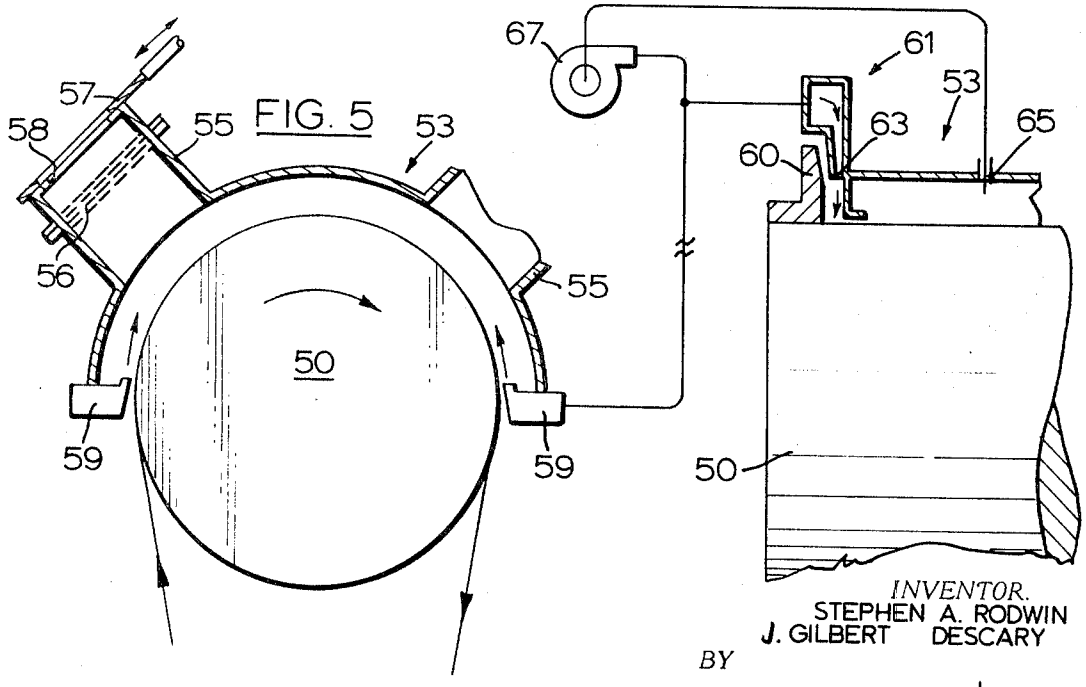


FIG. 5

INVENTOR.
STEPHEN A. RODWIN
J. GILBERT DESCARY

BY

R. E. Eckersley
Patent Agent

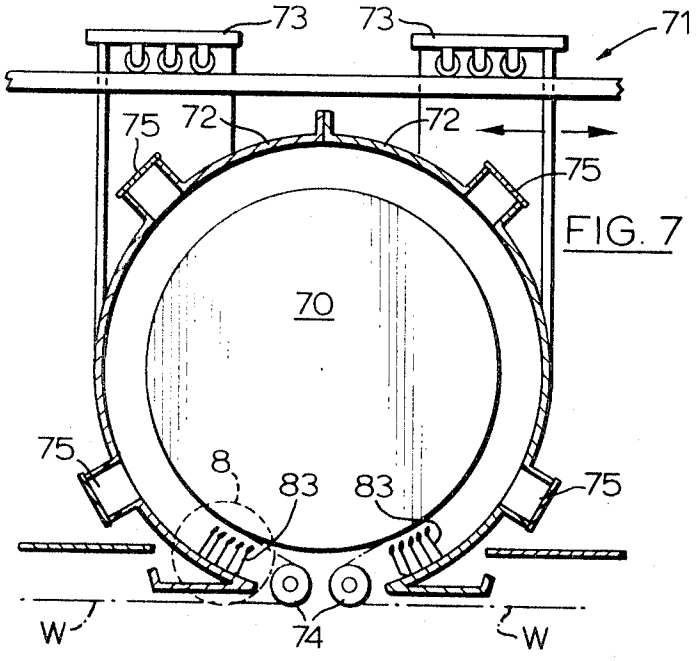


FIG. 7

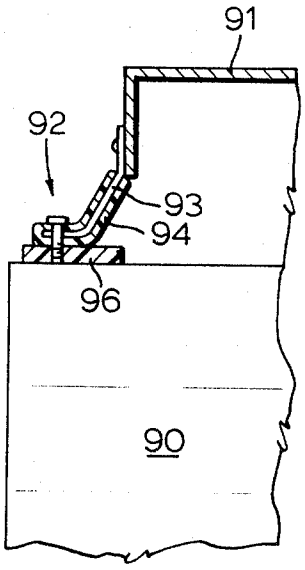


FIG. 9

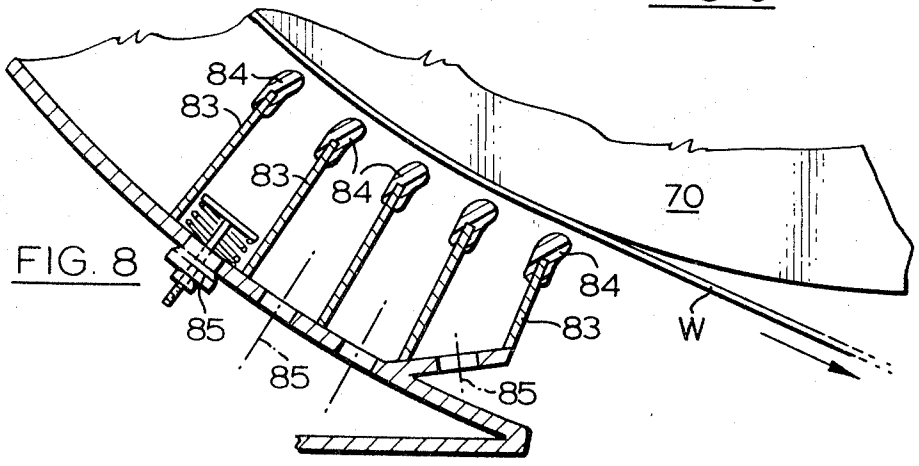


FIG. 8

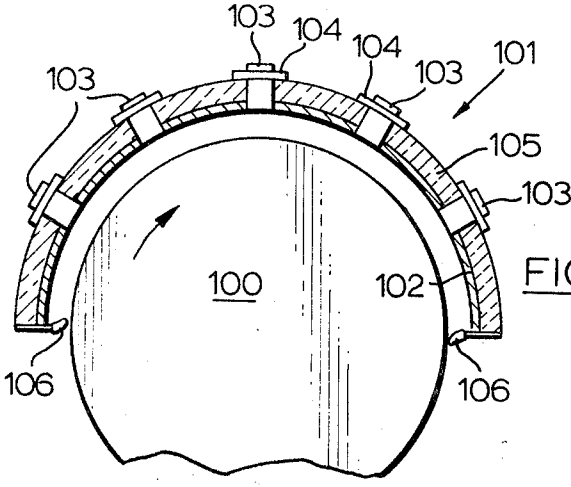


FIG. 10

INVENTOR.
STEPHEN A. RODWIN
J. GILBERT DESCARY

BY

Patent Agent

SONIC DRYING OF WEBS ON ROLLS

This invention is directed to a web drying apparatus, and in particular to a paper dryer using sound generators to provide dislocation of moisture relative to the paper web.

In copending application in the U.S. Ser. No. 46,979 and now U.S. Pat. No. 3,694,926, S. A. Rodwin et al., filed June 17, 1970, there are disclosed web drying arrangements suitable for two sided sonic drying of a paper web, having sonic or sound generators to provide dislocation of moisture relative to the web boundaries.

The practical use of sonic generators for web drying is dependent on efficient utilization of the generated sound energy and the supply of a sufficient quantity of gas at suitable temperature, psychometric conditions and velocity to effectively remove moisture dislocated from the web boundary. In the case of dryers using sound generators such as stem jet whistles or slot type transducers acting against a convexly curved web, as in the case of a paper web on a dryer roll, it has been found that trough-like sound reflectors having a plurality of point sources of sound, spaced therealong provide satisfactory control of sound intensity distribution. The cross-section profile of such reflectors, particularly for dryer rolls of relatively small radius tends towards an elliptical form.

The present invention provides a form of sound reflector profiled to give effective sound utilization in relation to a curved or an arcuate web support surface such as a dryer roll.

It has been found that the drying characteristics of a sound source appear to be optimized by the provision of a reflector arrangement providing incident longitudinal sound beams directed substantially normal to the surface of the web being dried. The reflector is positioned and is of a form to direct sound reflected from the web back to the sound center. The total length of the "beam" from the sound center of the generator to the reflector surface and thence to the web surface may be made equal to an integer multiple of the half wave length of the paramount sonic frequency of sound generated measured in the plane of the sound source, for enhanced efficiency of operation. By suitably spacing the whistle sound generators to avoid mutual interference, this relationship is still sensibly valid for the interventing spans of reflection between individual sound sources. The provision of intermediate baffles between these sources may also be used.

In the case of a web passing over a cylindrical surface or surfaces of determined radii of curvature, operating with sound of impressed frequency resulting in only slightly varying wave length of the resonated air, inpinging in mositure dislocating relation against the web, the use of an elliptical reflector having one focal point at the sound center and the other focal point at the center of curvature of the support surface, and having the abovedefined wave length relationship, provides effective sound utilization. Such an arrangement produces reinforcement of the sound field by reflected energization from the web surface.

In the case of larger rolls, in the order of ten feet diameter and greater, the elliptical form of reflector profile can be of reduced significance, and other forms ranging from elliptical to parabolic may suffice. However, reflector sound beaming requirements still apply.

While specific laboratory work has been carried out using stem jet whistles as the sound source, it is contemplated that the present invention may also be practiced using slot-type sound generators extending substantially parallel with the dryer roll main axis, in combination with elongated trough type sound reflectors wherein the reflector section profile is in accordance with the above principles.

In operating a multi-row dryer having a plurality of adjacent rows of sound generators, it has been found advantageous to operate alternate rows as differing frequencies, to provide damping of web vibration and thus enhance the apparent coefficient of friction to increase cross-machine restraint of the web by better frictional contact with the drum.

The present invention thus provides web drying apparatus for reducing the moisture content of a web, comprising: web support means having a curved surface to receive a travelling web for passage thereover; sound generating means positioned from the surface on the side remote from the center of curvature thereof to provide longitudinal sound waves directed substantially normally of the web surface; and sound reflector means cooperating with the sound generating means located outwardly thereof relative to the curved surface and having substantially elliptical cross section contour in a plane normal to the main axis of the curved surface, with focal points substantially at the sound center of the sound generating means and the center of curvature of the curved web support surface, whereby in operation sound from the generating means is reflected substantially normal to the support surface, and sound reflected away from a travelling web is returned to the sound center, to enhance the reflective sound field at the web surface.

In the operation of sonic drying arrangements utilizing stem jet whistles of relatively high efficiency, wherein an effective sound field may be obtained by providing three or four whistles per square foot of web area, it may be necessary or advantageous to provide enhancement of the quantity of resonated air in addition to whistle exhaust air impinging on the web surface, to improve psychometric conditions and to effect boundary layer sweeping. In this case additional low pressure air, preferably at a temperature not too different from issuing whistle air, and suitably distributed in the process area, is resonated by mixing with whistle air, to permit a reduced number of whistles per square foot of paper by substituting low pressure air for a portion of high pressure air.

While the following disclosure is made in relation to an adaption of a modified conventional dryer section having one or more dryer cylinders adapted for sonic moisture dislocation, it will be appreciated that the primary benefits of the subject invention may also be obtained in use with a through drying arrangement such as a suction roll.

As an alternative to the use of a rotatable roll or cylinder it is contemplated that the subject invention may also be used in relation to a moving or fixed curved backing surface such as provided for the web by felts or netting or other conveyor type means.

Air-activated sound generators, particularly stem jet whistles having convergent or convergent-divergent nozzles of suitable design are particularly insensitive to back pressure conditions. Thus pressure conditions within the sonic chest may be varied, and used effec-

tively to facilitate optimum paper web runability without unduly affecting sound generation.

In addition to the application of static over-pressure by restricting the escape of air from beneath the sonic chest, incident whistle air may be used as the source of the overpressure. Thus in open or unpressurized sonic chests the contact pressure of the web against the drum is enhanced by the action of the sound field, while in pressurised sonic chests selected over-pressures, in the range 0.2–0.4 psig, as for newsprint, provides paper hold-down forces in the range conventionally achieved by the provision of drying felts. This contact pressure is considerably in excess of the web hold down forces normally encountered in capped drying hoods of the impingement type.

The use of the subject invention, by eliminating the need of drying felts allows substantial savings in capital and production costs.

In operation by selective control of axially spaced zones or individual sound generators and/or by controlling low pressure sweeping air, it is possible to exercise effective transverse moisture profiling relative to the width of the web, by way of local variations of the supply or intensity level of resonated air. It has also been found that characteristically the drying rate of a wet web exceeds that of a less wet web for a given sound field. This characteristic produces substantially automatic moisture profiling, within certain limts, as the drying rate of a wet spot exceeds that of adjacent dryer portions of the web, and the spot may thus be virtually eliminated automatically. In addition, however, provision for control of the sound field in a cross machine direction makes possible additional moisture profiling of the web, achieved by modifying the action of or shutting down selected whistles or groups of whistles effected with or without suitable control of the additional, low pressure air flow.

Use of sonic drying in combination with an existing dryer section of conventional type increases the overall drying rate of the section and permits mill speedup and/or improved moisture control.

Sonic drying operates by removing moisture primarily by mechanical action, thus occasioning greatly reduced rates of evaporative web temperature drop in the dryer section. However, as drying rates increase with web temperature, in the first stages of the dryer section heating means for rapidly raising web temperature can be beneficial. To offset any evaporative cooling and provide optimum web temperatures for drying, additional rather short intermediate web heating process sections may be used. The compact geometry of sonic chests is conductive to permitting the intorduction of intermediate web reheating segments, preferably at the start of sonic drying zones, so that high utilisation may be made of the major arc of a large roll. Thus on a single roll having a large wrap angle and high roll utilization, it is readily possible to arrange a web heating segment or segments to effect optimum web temperature control.

The raising of the web temperature can be effected by the use of retarding atmosphere with or without sonic enhancement, as set forth in copending application Ser. No. 886,904 S.A. Rodwin, filed Dec. 22, 1969 and now abandoned.

In order to transport moisture displaced by sound energy from a travelling web, it is necessary to effectively ventilate the boundary of the web while avoiding rewetting. Owing to the relatively small quantity of air supplied by the whistles, it is often advantageous to provide additional low pressure resonated air for adequate ventilation of the web boundary. In addition, control over the flow quantity and psychometric conditions of this additional air provides a wide range of control over web drying conditions and the psychometric conditions of the exhausted moist air from the sonic chest, while web rewetting may thus be virtually eliminated.

An effective supply of air resonated by mixing to remove the air exhaust with its moisture in a direction against the motion of the web, and to greatly reduce the passage of a moisture-laden web boundary into subsequent sound troughs, is achieved by an inclined air curtain at the downstream edge of the respective reflector trough, thus providing a forced sweeping of the web boundary by the air mixture.

The addition of low pressure sweeping air in this fashion economically enhances the action of whistle air in moisture transportation and removal, while the sweep air is also itself energized into forced resonance within the sound trough, providing a unified effective sound field.

The air curtain fulfills also the function of isolating the reflector exhaust from the web boundary by providing layers of fresh air at the boundary to substantially inhibit any rewetting there.

While the foregoing is directed to primary sonic drying areas immediately under the sound reflectors, the use of secondary process areas of sonic drying also is contemplated. Thus by providing between adjacent sound troughs extended reverberating walls suitably spaced from the web, and providing air exhaust outlets therefrom, further advantage can be taken of the sound energy present in the exhaust stream for improved energy utilization while the requirement for sound insulation of the immediate reflector zones may be somewhat reduced.

The efficiency of drum dryer arrangement is enhanced by providing an optimum web wrap angle arrangement, whereby the relative effect of leakage losses at web entry and exit are minimized.

Certain embodiments of the present invention are described, reference being had to the accompanying drawings, wherein:

FIG. 1 is an isometric sketch view of one end of a dryer drum showing a typical pair of sound reflectors;

FIG. 2 is a section taken in the direction of arrow 2 in FIG. 1;

FIG. 3 is a section view similar to FIG. 2 of another reflector embodiment;

FIG. 4 is a further embodiment similar to FIG. 3;

FIG. 5 is a section view of a dryer roll having a 180° sonic chest mounted thereover;

FIG. 6 is a section of the FIG. 5 embodiment taken parallel with the roll main axis to show an end seal detail;

FIG. 7 is a section view of a roll and hood installation of large wrap angle;

FIG. 8 is an enlarged detail of the portion 8 of FIG. 7 showing a transverse seal detail;

FIG. 9 is a diametral section detail of an alternative hood end seal relative to the dryer roll; and

FIG. 10 shows a simplified dryer hood embodiment.

Referring to FIG. 1, there is shown the relationship of a dryer roll 20 of radius "R" to a pair of sonic reflectors 21 with a sound sources 23 arranged for the full

roll width, each elliptic reflector 21 having reverberating walls 22 attached thereto, thus extending the useful process area.

In FIG. 2 will be seen the elliptical cross-sectional profile of the reflectors 21, having sonic generators 23 so mounted therein to provide substantially normal impingement of longitudinal sound waves to the surface 25 of the web, with reflection therefrom being concentrated at the generator 23 in sound field reinforcing relation. Similarly, the reverberating walls 22 are so spaced from and parallel with the surface of the drum 20 to optimize the sound field. Extruded rubber or plastic edge seals 27 serve to maintain air pressure beneath the reflector 21 and also to doctor-off the saturated boundary layer of moist air adjacent the web surface, resulting from the sonic field. This forces the bulk of the outgoing air to exhaust in a direction opposite to the motion of the web. The air exhausts through opening 28 between adjacent reflector troughs.

Sound propagation and reflection follows sound beams 24 in a cross section perpendicular to roll axis through sound sources 23.

Referring to the embodiment of FIG. 3, in addition to the sonic generator 23 air also is supplied to the reflector 31 by way of a duct having an air connection 33 for the provision of secondary low pressure air thereto.

A slot 35 with or without a series of apertures 34 admits some secondary air in the form of throw jets within the reflector 31 which is immediately resonated by mixing to supplement the air quantity supplied by the whistles 23. An air doctor effect is provided by the inclined slot 35 which extends for the width of the roll 20 and causes turbulence and air circulation in a direction opposite to roll rotation. The mixed resonated moist air is hence forced to leave the reflector space 39 by way of the forward edge 36 of the upstream reverberating wall 22 in the direction opposite to roll rotation. The curtain jets 35 produce also a runoff flow along the web towards the upstream reflector adjacent to 31 which inhibits the web against rewetting on passage through the exhaust areas.

In addition to supplying secondary air, the duct or manifold 37 serves to structurally stiffen the sonic reflector 31, which is illustrated as being of elliptical section.

Referring to the FIG. 4 embodiment, certain working constructional details are given, showing sound insulation provisions, extruded reflector sections and air supply to stem jet whistles. Thus a silencing hood 43 having sound insulation 44 applied to hood structural member 45 contains a plurality of sonic reflectors 41 suspended therefrom. Each reflector 41 has a plurality of stem jet whistles 23 threadedly mounted in flow connection with an air supply manifold 44. A secondary air supply manifold 42 is provided with spaced adjustment studs and nuts 46, or equivalent capscrews, whereby the width of the air doctor slot 47 may be adjusted for cross machine balance and overall flow adjustment. The form of sealing and silencing gaskets, indicated generically as G, provide anti-vibration mounting and assembly of the individual portions of the reflector 41 as shown. A simply adjusted mounting arrangement comprising a triad mount with a central securing bolt member and opposed adjustable capscrews C1, C2 in balanced thrusting relation permits precise positioning and tilting adjustment to the reflector 41, so that canting of the reflector 41 may be selectively effected to provide relative adjustment of the radial clearance between the drum 40 and the leading and trailing edges of the reflector 41. The flanking capscrews C1, C2 serve also to retain and seal the assembly.

It will be seen that the subject arrangement provides a multi-function assembly capable of adjustment to provide high performance capability, which is readily fabricated, assembled and adjusted, being particularly adapted to accept differential expansion due to thermal changes and/or gradients.

Referring to FIGS. 5 and 6, in relation to FIG. 4, the sonic chest or hood 53 includes air exhaust provision and hood edge seals and hood end seals. Thus there is shown the air exhaust provision from the hood that embodiments such as that of FIG. 4 require. The hood 53, within which may be mounted a plurality of sonic reflectors of the types shown in FIGS. 1, 2, 3 or 4, is provided with centralized exhaust ports 55, each having sound absorbing filters 56 therein and an adjustable damper 57 in sliding relation with the exhaust port 58 to permit control of pressure and flow conditions within the hood 53. The hood 53 also is provided with proximity edge seals 59 blowing inwardly of the hood 53 to minimize leakage therefrom in the areas of web entry and exit in order to avoid high velocity outdrafts over the web which can be detrimental.

Similarly, in FIG. 6 is shown an end seal arrangement of convenient proximity type for the drum 50 of FIG. 5, the dryer roll or drum 50, having annular end flanges 60 thereon in cooperating relation with hood manifolds 61, having semi-annular nozzles 63 to provide peripheral end curtains of pressurized air in sealing relation with hood 53. The sealing air is shown as being extracted at 65 from the hood interior and pressurized by blower 67 to supply both the hood end seals 61 and the hood edge seals 59.

In the embodiment of FIG. 7 there is shown a split hood arrangement 71 having hood halves 72, 72 supported by bogies 73 roller mounted on suitable support beams. The drum 70 provides a large web wrap angle by way of guide rolls 74, encompassing about 320° angle of the drum 70.

The moveable hoods 72 may be readily moved away from the drum 70 for the purpose of rethreading the web in the event of breakage. As in FIG. 5, a plurality of centralized exhaust ports 75 is provided having similar silencing and throttle air flow control means, not shown. A different form of edge seal at 8, is shown in greater detail in FIG. 8. Edge partitions 83 adjacent the oncoming and offgoing guide rolls 74 are each provided with a gasket 84, usually extruded of a suitable material such as silicone rubber in view of the high temperature environment to provide practically acceptable close radial edge clearances from the surface of web W. The rate of outward air leakage through the radial clearances is controlled by adjustable spring loaded relief valves 85, only one of which is shown in detail. These valves 85 permit incremental staging of the total pressure drop across the seal assembly 8, to limit the outflow velocity therepast over the web and to reduce exhaust quantities in the web areas. The gaskets 84 are of sufficient radial extent and flexibility to permit the passage of local chunks of compacted paper therepast in the event of web breakage, without damage to the seal, while being of sufficient stiffness to withstand a pressure differential which might be in the order of 2 inches of water gauge. The embodiment of FIGS. 7 and

8 does not require blower power for operation of proximity seals per FIGS. 5 and 6 and is hence more economical.

Referring to FIG. 9, this shows a simplified form of chest and seal 92, having the chest 91 spaced from the drum 90. A plurality of spaced spring elements 93 molded into a skirt 94 maintains a semi-annular resilient seal strip 95, having a low friction plastic liner 96 in sealing relation with the end of drum 90. Alternative to a contact seal liner seal clearance with the seal pressure being set at a value as just to balance the internal pressure, thus permitting small leaks and to provide lubrication by air.

Referring to the embodiment of FIG. 10, as an alternative to the hood embodiments of FIGS. 4 and 5, there is provided a modified sonic hood or chest 101 of simplified type suitable for conditions where only moderate air pressures are required and noise abatement requirements are less stringent. A reinforced sheel 102 carries process equipment (not shown), and has a series of exhaust tubes 103 which serve also to attach grommets 104 for securing sound insulation 105 to the chest 101. Within the tubes 103 may be mounted baffle means, not shown, to transform sound pressure into heat, comprising discs or of slightly compacted metal chips of non-corrosive type, suitable for the purpose. The heat transformation thus provides further heated process fluid for use in the dryer hood economy. Resilient edge seals 106, similar to the individual seals 83 of FIG. 7, provide sufficient sealing of the hood, Air pressure levels in the order of 0.75 to 1.5 inches of water gauge are contemplated with this arrangement.

While the illustrated embodiments relate to trough type reflectors, it will be understood that individual reflectors of appropriate section profile may be substituted where convenient and sufficient control of sound field uniformity may be exercised. The use of supplemental reflectors of limited axial extent having limited fields of action, for additional wet streak control is contemplated

While the preferred form of sound reflector for particular cooperation with a cylindrical or curved dryer surface of determined radius of curvature is the elliptical reflector profile, it will be understood that as the radius of web curvature increases, the theoretical profile approaches the parabolic shape with parallel sound beams perpendicular to the web. Thus for larger radius web curvatures, reflectors of differing sections such as trough reflectors of parabolic section or horn type round or trough reflectors with sound reinforcing chambers assembled in rows in mutual staggered relation, may provide satisfactory sound beaming.

In the operation of sonic dryers, limiting of the sound field energy not to exceed 10 watts per square centimetre may be required by paper chemistry for the avoidance of sonolysis. Variation of average sound energy levels provide a variation in drying rates. However, with staggered whistle arrangements from row to row, an evened out sound action after each process section and at the reel can be forecast.

In the provision of low pressure air the use of fresh hood air mixed with moist recirculated process return air, usually in the percentage range of 20 to 50 percent fresh air is proposed for purposes of economy, care being taken to provide a mixture of suitable psychometric quality for drying. As an example, using three or more whistles per square foot of web area within a suitable trough reflector mutually spaced substantially at centre distances which are a multiple of half wave length of the paramount whistle frequency, in certain applications a significant eveness and enhancement of average sound field intensity is achieved, due to improved integration of sound action of the individual whistles. The provision of low pressure secondary air beneath a sonic reflector enhances the resonating field, while the air requirements for the sonic generators may be correspondingly reduced. Effective mixing may be achieved for air flow rates of whistle air to secondary air in the ratio range 1:0.5 to 1:1. The sound loss arising from such mixing is in the order of half a decibel, in a sound field of the order of 160 db, which is not readily detectible with standard instrumentation. The use of division pieces in the trough reflectors located between individual whistles serves to reinforce the trough structure and assist in maintaining dimensional stability, while sound interference patterns can be improved, especially when closer whistle spacing is desired.

A typical arrangement using a five foot diameter drum involved whistles spaced at 7 inch centres in an elongated unpartitioned trough extending in the cross-machine direction receiving air at 27 psig at 350°F, at a nominal frequency of 16 kiloherz, the mass flow of whistle air being 120 lbs. per hour per square foot. A suitable cross sectional profile for the reflector is an ellipse of about 5.8 inches opening and about 2.5 inches height.

While the temperature conditions within the sound path can vary, to produce effective changes in wave length, the maintenance of the exciting frequency imposes an impressed frequency in the sound field, due to inertia forces, so that frequency is maintained substantially constant at the predetermined paramount value.

The use of alternate reflectors operating respectively at different frequencies such as 14,500 cycles/sec in one trough reflector and 16,000 cycles/sec in the next adjacent reflector tends to dampen web vibration and promote web transverse stability, especially at higher web speeds.

The use of additional fan means within or outside the sonic chests is contemplated for secondary air movement in boundary flow displacing relation.

While forms of troughlike sound reflectors have been shown having reverberating apron portions to provide secondary drying areas, particularly at the leading edge thereof, the use of reflector forms without such aprons is also contemplated.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Web drying apparatus for reducing the moisture content of a pervious web by the dislocation of moisture therefrom, comprising: web support means having a substantially curved surface to receive a web for passage in surface supported relation thereover; a plurality of mutually spaced air actuated sound generating means positioned from said surface on the side remote from the center of curvature thereof to provide sound waves directed longitudinally towards the surface and substantially normal thereto and forming a sonically energized zone of substantially uniform intensity, the actuating air exhausting from said generating means being directed in moisture displacing relation towards the outer surface of said web; sound reflector means adjacent said sound generating means located outwardly thereof relative to said curved surface, having

a cross section contour whereby in operation sound from said generating means is reflected towards said surface to enhance the sound field at the surface, and said sound reflector means comprising at least one elongated trough reflector extending in the cross machine direction and parallel with the main axis of curvature of said web support surface, having a plurality of point sound generators in mutual spaced relation therein to provide in operation sound propagation transversely to the web.

2. Apparatus as claimed in claim 1 wherein said web support means comprises a cylindrical roll.

3. Apparatus as claimed in claim 2 wherein said sound generating means comprises stem jet whistle means having gaseous fluid supply means connected thereto exhaust from the whistle means being directed in operation to pass towards said support surface in impinging relation against a web supported thereon.

4. Apparatus as claimed in claim 1 wherein said substantially curved surface comprises a rotary dryer roll of a paper drying section, said sound generating means having energizing gaseous fluid supply means connected thereto gaseous fluid from the sound generating means passing in impinging relation towards said surface, and exhaust means to receive the gaseous fluid together with moisture entrained therewith for removal from the surface of a said web.

5. Apparatus as claimed in claim 4, together with gas supply means to provide low pressure air within said sound field for resonation relative to the web to transfer sound energy thereto.

6. Apparatus as claimed in claim 4 including a heated dryer drum having said sound generating means mounted within a sound insulating hood spanning an arc of said drum.

7. Apparatus as claimed in claim 4 wherein said sound generating means comprises a plurality of stem jet whistles in spaced array, to form a plurality of rows of whistles spaced about a portion of the periphery of said support means, the respective whistles of adjacent rows being in mutual staggered relation.

8. Apparatus as claimed in claim 4 wherein said sound generating means operates in a predetermined range frequency and wave length, said reflector means and sound generating means being positioned mutually and in relation to said curved surface such that sound is beamed to the reflector from the sound center of said generating means and reflected substantially normal to said web surface, the distance thus travelled by the sound being substantially an integer multiple of one half of said wave length.

9. Web drying apparatus for reducing the moisture content of a web, comprising: web support roll means to receive a web for drying on passage over the curved surface thereof; sound generating means positioned from said surface on the side remote from the centre of curvature thereof to provide sound waves directed longitudinally towards the surface; sound reflector means comprising a plurality of reflectors in side-by-side relation extending axially in relation to the drum for substantially the full width thereof, being of trough-like cross section, said sound generating means consisting of a plurality of stem jet whistles in spaced relation located along the length of said reflectors to provide an axially overlapping field of sonic energy at the web surface, means to supply air to said whistles in sound energizing relation therewith, the air in operation impinging on the surface of a said web to displace moisture therefrom.

10. Apparatus as claimed in claim 9 wherein said roll is perforated, having means to draw air therefrom whereby percolation of air through a said web in moisture entraining relation is obtained, and web adherence to the roll surface is promoted.

11. Apparatus as claimed in claim 10 including secondary air supply means to provide low pressure air resonated by mixing, in web impinging relation whereby the mass flow of the air mixture between said reflectors and said roll surface is substantially increased.

12. Web drying apparatus as claimed in claim 10 wherein a said reflector means includes a reverberation skirt extending from one edge thereof substantially parallel to the outer surface of said roll and spaced therefrom to provide a sound reverberation zone therewith.

13. Web drying apparatus as claimed in claim 9 wherein a said sound reflector means, comprising at least one flexible blade means extending towards the surface of a said web in boundary wiping relation therewith to promote removal of moisture-containing boundary air.

14. Web drying apparatus for reducing the moisture content of a web, comprising: web support means having a substantially curved surface to receive a web for passage thereover; sound generating means consisting of point generators arranged in mutual spaced relation located within at least one elongated trough reflector extending in the cross-machine direction to provide sound waves directed longitudinally towards the web surface, the cross section contour of said trough reflecting sound from said generators towards said surface to enhance the sound field thereat, and an air supply manifold extending substantially the full axial extent of the reflector having nozzle means connected therewith to direct an air jet against the web within a process area extending between the reflector and the web support means.

15. Apparatus as claimed in claim 14 wherein said nozzle means is located adjacent one edge of said reflector and comprises a slit-like inclined nozzle to provide an air doctor in relation to the boundary layer of a travelling web, for exhaust displacement oppositely to the web motion.

16. Apparatus as claimed in claim 2 wherein said reflector is located relative to said web support surface to provide concentration of reflected sound waves at said point sound generators whereby said sound field is intensified.

17. Apparatus as claimed in claim 2 wherein said sound reflector means is of eliptical cross section contour, to provide direction of longitudinal sound waves normal to said roll surface.

18. Apparatus as claimed in claim 4 wherein said sound generating means comprises a plurality of stem jet whistles in spaced array to form a plurality of rows of whistles spaced about a portion of the periphery of said support means, the frequency of operation of at least one row differing from the frequency of operation of an adjacent row whereby paper vibration is reduced and runability of the web is enhanced.

19. In a web drying section having a rotatable dryer roll to carry a web on the peripheral surface thereof for drying, gas energized sonic means to enhance drying, having sound generating means positioned on the out-

side of said roll to provide sound waves directed longitudinally towards the roll peripheral surface, to dislocate moisture from the web boundary; contoured sound reflector means adjacent the sound generating means located on the side thereof remote from the roll to reflect sound toward the roll surface to enhance the sound field thereat, gaseous fluid means connected in energizing relation with the sound generating means, and air curtain means directing an air curtain in web impinging relation to promote sweeping of the web boundary layer relative to the direction of web travel.

20. Web drying apparatus for reducing the moisture content of a web, comprising: a web supporting dryer roll to receive a web for passage over the curved peripheral surface thereof; air activated sound generating means positioned outwardly from said roll surface to provide sound waves directed longitudinally towards the surface; sound reflector means adjacent said sound generating means located outwardly therefrom relative to said roll having a cross-section contour to reflect sound from the generating means to enhance the sound field at the drum surface in operation, air supply duct means to supply secondary air in by-pass relation with said sound generating means, to mix with air emitted by said sound generating means, a hood defining an enclosure mounted in sound attenuating and air flow control relation over a portion of said roll, including hood edge sealing means consisting of a plurality of spaced flexible baffle members adjacent the hood edge and extending axially parallel therewith, and air release control damper means intermediate at least some of the baffle members to provide controlled leakage therebetween.

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