Nov. 29, 1966 A. J. SCHREGENBERGER 3,287,821

CONVEYING AND TREATING APPARATUS

Filed Sept. 30, 1963 4 Sheets-Sheet 1

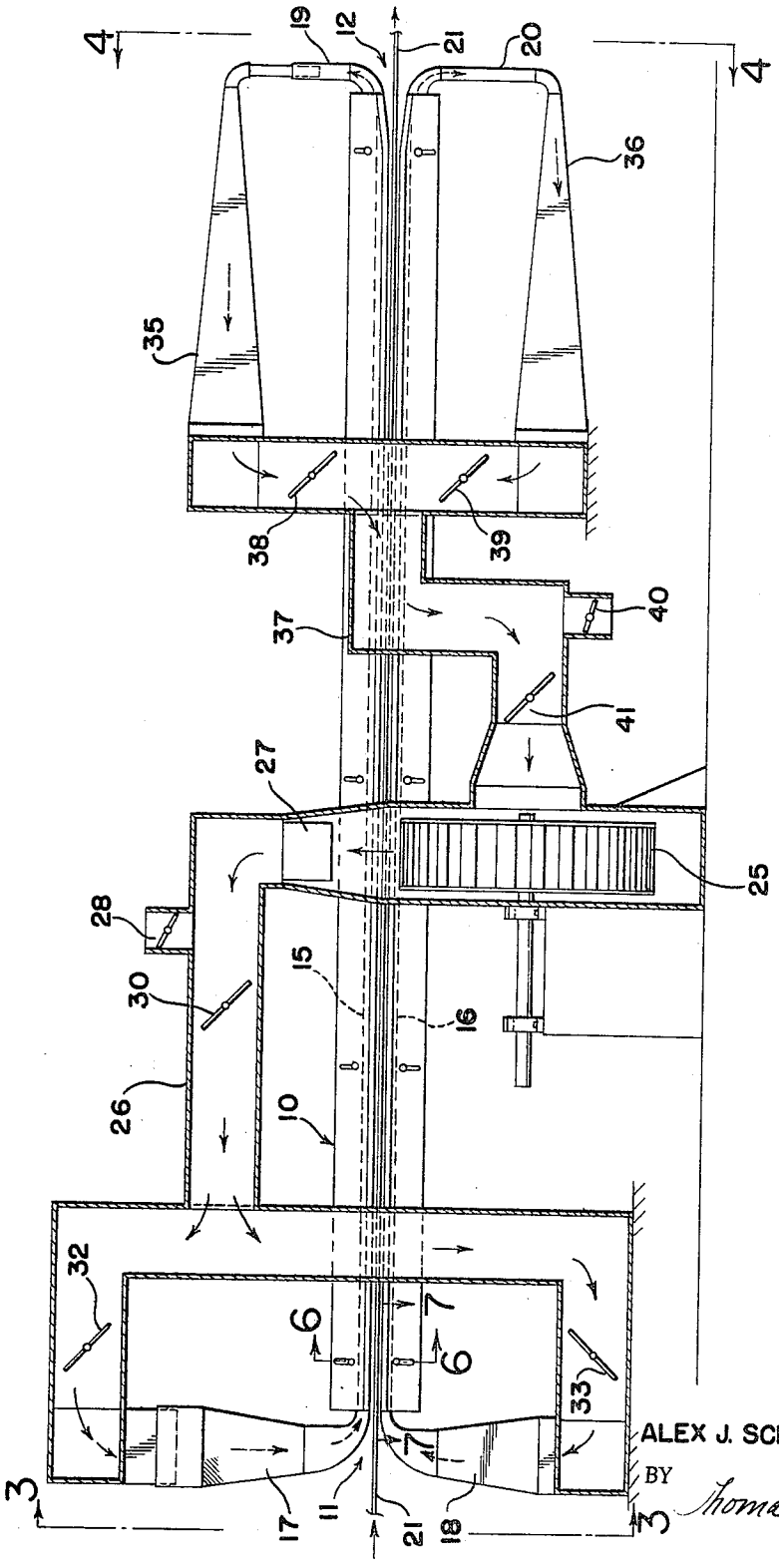

FIG. 1

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CONVEYING AND TREATING APPARATUS

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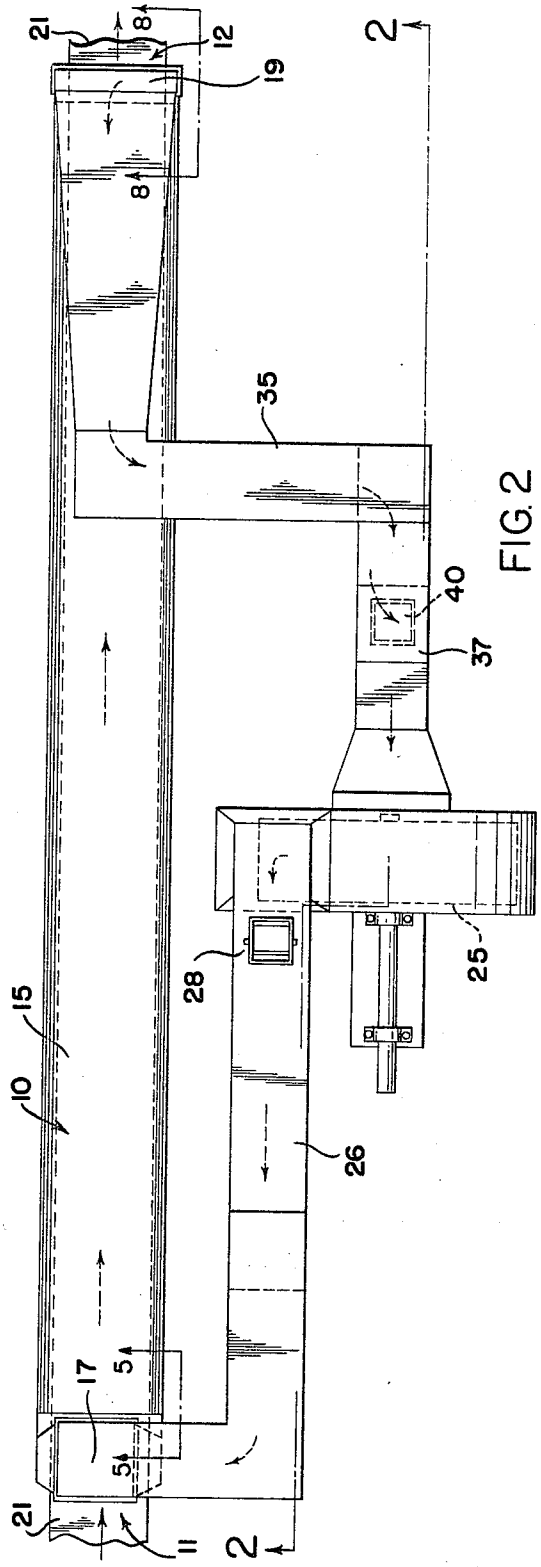
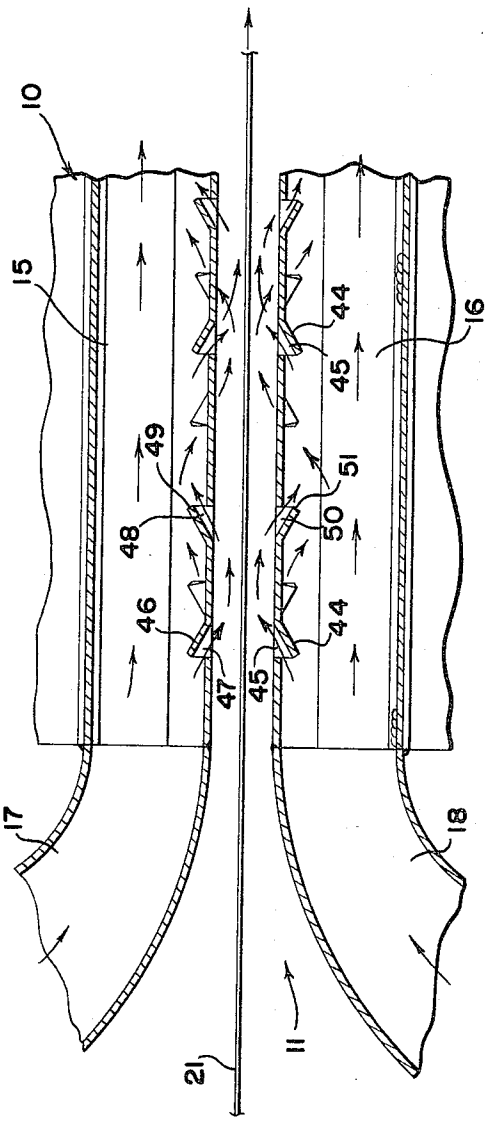


FIG. 2

FIG. 5



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CONVEYING AND TREATING APPARATUS

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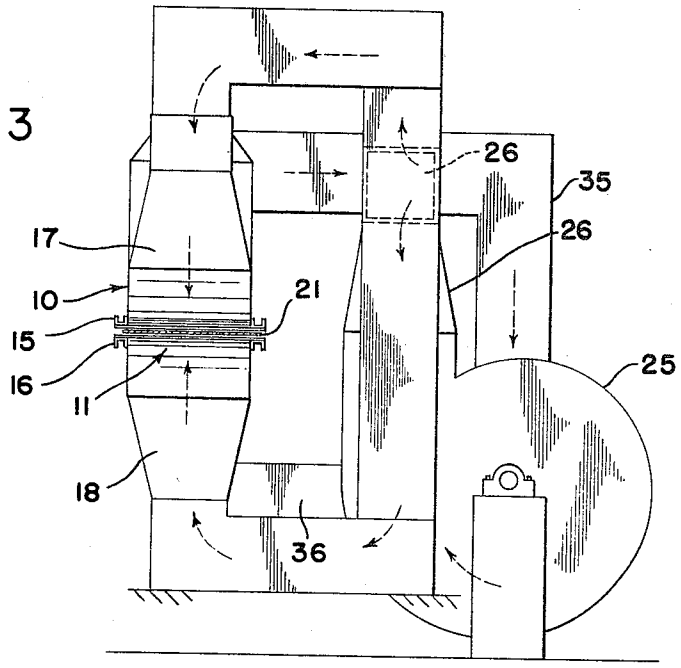
FIG. 3



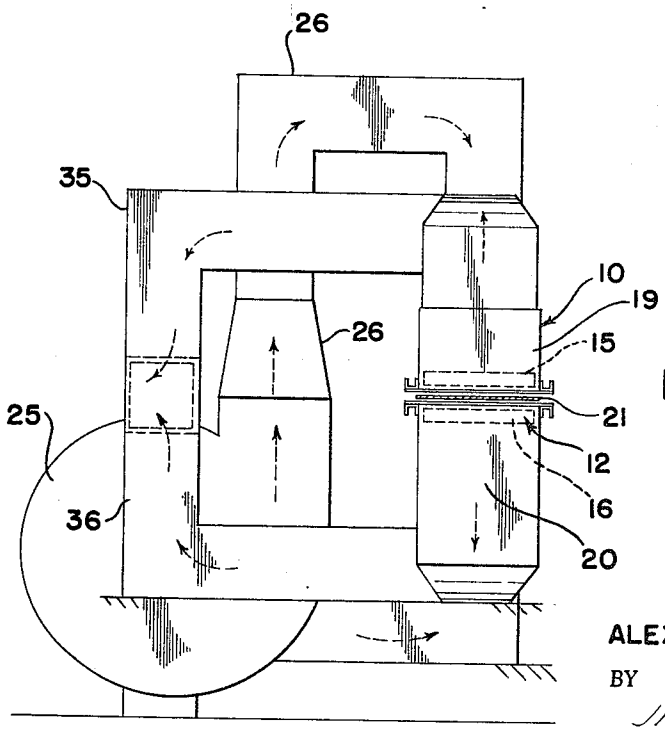


FIG. 4

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CONVEYING AND TREATING APPARATUS

Filed Sept. 30, 1963 4 Sheets-Sheet 4

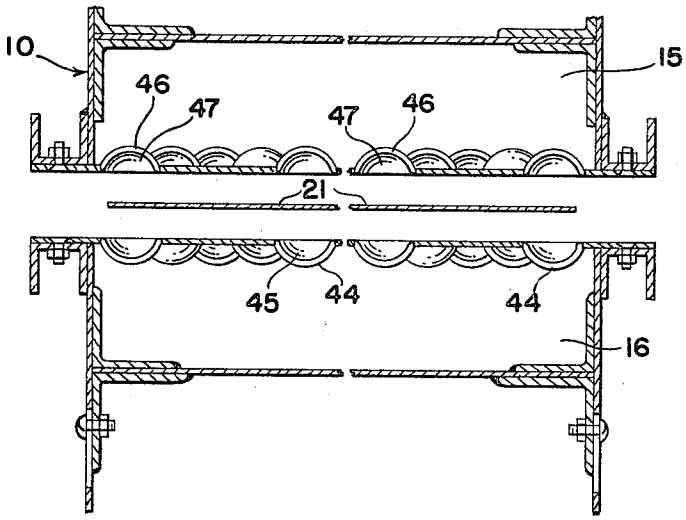


FIG. 6

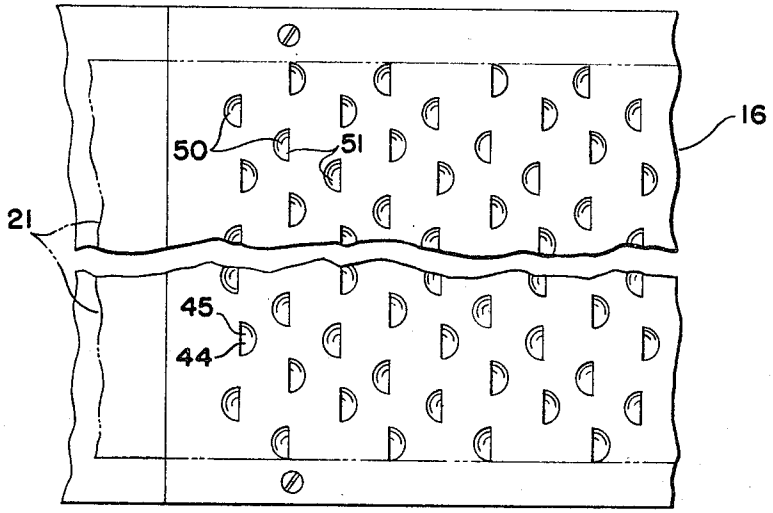
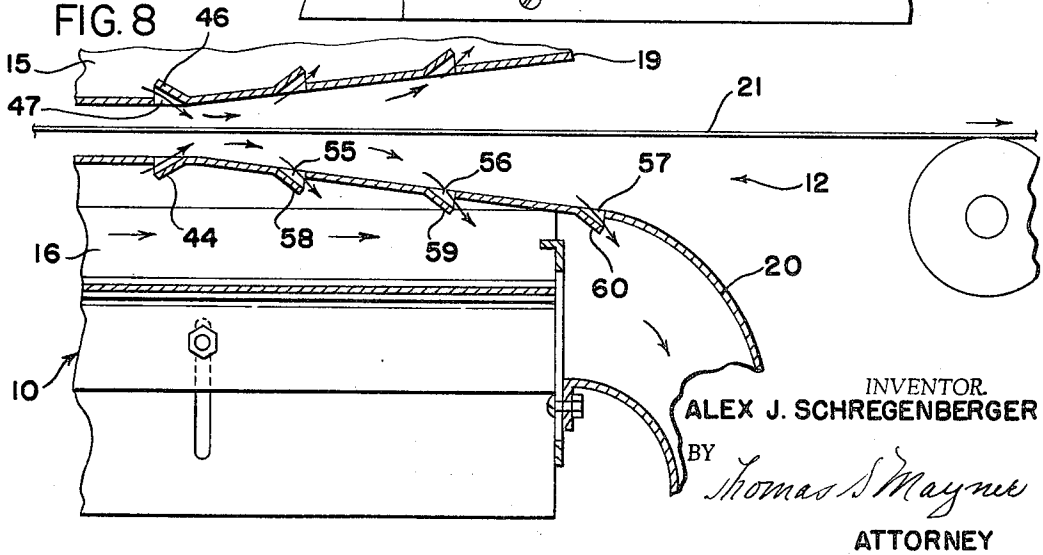


FIG. 7

FIG. 8



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3,287,821

CONVEYING AND TREATING APPARATUS

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Filed Sept. 30, 1963, Ser. No. 312,586
3 Claims. (Cl. 34—156)

This invention relates to an apparatus for the treatment of web materials while being air-borne therethrough and, more particularly, to apparatus having a plenum of simplified construction adapted to heating, cooling or otherwise processing of previously wet treated, coated and/or printed materials for an interval of time during which they are supported by a cushion of flowing gaseous fluid such as air, the air being supplied for treatment and returned to the same plenum.

It is advantageous and desirable to dry, fix, set or reduce a treated or coated web of paper or of a textile material, or of lightweight metal without injury to the web or to an applied treatment. This is generally done by air-conveying the material for over a necessary or required distance without frictional support or any physical contact that would tend to injure the web or the applied treatment. A web material that has been air-conveyed and simultaneously treated during its travel through such an apparatus is generally more uniformly and thoroughly treated than by methods requiring physical support. And whatever shrinkage or change in size that will occur while being air floated and conveyed will be in all directions; the final result is a totally relaxed and stable web product.

The present invention provides for an improved treating and air-conveying apparatus wherein the web is floated or supported by a great many air jet streams at points occurring at a frequency so as to minimize undulation or possible vibration that may injure the web material or a surface applied treatment. The air support is provided in the direction of travel of the web urging it forwardly and, where the air is heated and used for drying, or heating, it is substantially recovered and reused. The recovery of once used air is simply and automatically effected by the terminal structure of the surface of the plenum. Advantageously, the plenum interior is open and clear for its entire length, simulating a rectangular unobstructed conduit for the continuous flow of a gaseous fluid therethrough.

Furthermore, support for the web moving through the apparatus can be one-sided or it can be two-sided depending on web treatment as to whether a single or opposing plenum is required. Air emitted from each plenum is returned thereto only to be emitted again in the direction of travel of the web. The outward surfaces of the opposing plenums advantageously are flat and continuous, the plenum air openings for impingement or web support and for return being positioned flush therein. The flush construction is advantageous in that the web material will not meet any obstruction which could keep it confined in the event of a break.

The mentioned improvements and further embodiments are fully described hereinafter, illustrated in detail in the accompanying drawings in which:

FIGURE 1 is a view in side elevation, in partial section, of the web conveying apparatus;

FIGURE 2 is a plan view of the air treating and conveying apparatus;

FIGURE 3 is a schematic end view of the web inlet side of the apparatus of FIGURE 1 taken along lines 3—3 thereof;

FIGURE 4 is, likewise, an end view of the web exit end of the apparatus of FIGURE 1, taken along lines 4—4 thereof;

FIGURES 5 and 6 are sectional details, in elevation and transverse planes, of the air inlets and exhausts of the opposing plenum surfaces taken on lines 5—5 of FIGURE 2 and 6—6 of FIGURE 1;

FIGURE 7 is a sectional plan view of the surface of a plenum, showing the indented air inlets and exhausts taken on line 7—7 of FIGURE 1; and

FIGURE 8 is an end section of a plenum at the web exit showing air re-entry into the air pump system, taken on line 8—8 of FIGURE 2.

Referring now to the drawings and to FIGURES 1 to 4 thereof, a longitudinally extending rectangular chamber **10** having a web inlet **11** and exit end **12** has positioned therein two opposing box-like plenums **15, 16.** Each is connected at their ends to divided air supply inlets **17, 18,** upper and lower respectively, and air exhaust returns **19** and **20** also upper and lower respectively of an air supply system. A web **21** is introduced into the inlet **11** then it is urged forwardly between the plenum faces **15, 16** toward its exit **12** by air coming from within each opposing plenum through a plurality of equi-spaced, semi-circular apertures, the angle of the impinging air jets and their return being in the direction of web **21** travel.

Web advancing and treating air is supplied through an air supply system having an air fan **25,** itself being supplied from the surrounding area, from recovered air from within the apparatus itself and through dampers in the system. The supply fan forces such air into an initial common conduit **26** then to split take-off conduits **17, 18** supplying upper and lower plenums **15, 16.** The air which may be heated to a desirable temperature by an interposed heater **27** positioned in conduit **26** for a specific drying or fixing treatment is being passed on through a regulating damper **30** thence through volume regulating dampers **32** and **33** in connecting diverging plenum supply conduits **17, 18,** each separately supplying their respective plenums **15, 16.** The additional dampers **32, 33** are provided to control the volume of the flowing air and to regulate velocities to the respective plenums **15, 16.** Damper **28,** located in conduit **26** between the fan **25** and damper **30,** serves to exhaust a controlled amount of the air to keep the concentration of the vapors added to the air during the treating process at a desired level.

While some air is lost with the web **21** emerging out from between the plenums **15, 16** yet a substantial portion of it is recovered at about the exit **12** being returned by separate conduits **35, 36** joined to the plenum exhaust terminals to a common conduit **37** thence back to the air fan or blower **25** for recirculation. Again, the volume of recovered air for admixture is controlled by individual dampers **38, 39** in the respective recovery conduits **35, 36.** Fresh air may be added through a damper **40** and the mixture fed to the fan **25** through inlet damper **41.** As indicated, the dampers control the supplemental air to the fan for admixture with recovered air in accordance with requirements for recirculation.

The air circulating system as shown in FIGURES 1–4 contains one central blower or fan **25** which generally will prove sufficient for the treatment of a web of paper or other material for over a distance of about 20 feet or so. Beyond such a nominal distance another blower desirably would have to be interposed.

The compact arrangement shown in FIGURES 1–4 also is advantageously economical, being designed about the improved plenum chambers **15, 16.** The plenums are simple, elongated, rectangular chambers with their surfaces being die-cut inwardly to provide jet-like air outlets and inlets. The diametrically opposed openings comprising inlets (upstream flow) and outlets (downstream flow) for the air in the plenums for the support of a web,

are part of the same and continuing plenum surface. This construction is shown in detail in FIGURES 5, 6 and 7. Air in the plenums flows outwardly over inward indentations or scoops **44**, through apertures **45** formed when the metal was die-cut, to impinge against the traveling web **21** maintaining it aloft, and over scoops **46** and through apertures **47** also against the web **21** of the plenums **15** and **16** respectively. Since only a portion of the plenum air is being forced out through openings **45**, **47**, the air in the plenums themselves is flowing therethrough being at all times supplemented by external air and by the return of plenum air upon its deflection by the web, through plenum return openings **48**, directional lip **49**, return openings **50** and directional scoops **51** of plenums **15** and **16**. Since the air in the plenums **15** and **16** moves at a relatively high velocity from the entering end, conduits **17** and **18**, toward the leaving end, conduits **19** and **20**, a suction develops downstream of the directional lips **49** and **51** effecting the removal of the air from the web into plenums **15** and **16** through openings **48** and **50** to join the flow therein to be again forced out through further similar outlets, and back in through inlets. Thus, the flow of web supporting air is in the form of an undulating stream, the frequency of web impingement being based on the number of air outlets and inlets in the plenum surfaces.

Some of the air of necessity is exhausted to the atmosphere but a substantial portion is recovered and returned to the blower for reuse. Recovery is further assisted by a terminal consecutive plurality of plenum air return inlets. Referring to FIGURE 8, the lower terminal plenum face, as well as the opposing upper plenum face, has several air return openings **55**, **56**, **57** and return scoops **58**, **59**, **60** for pulling in air. Opposing plenum faces at about the exit end, containing said return openings, are inclined at a shallow angle away from the web, effecting an increasingly higher static pressure between the web and the plenum faces due to a decreasing air velocity parallel to the web and effecting a decreasingly lower static pressure in the plenums **15** and **16** due to an increasing air velocity inside said plenums. The flowing air (indicated by arrows) upon supporting the moving web **21** partly escapes to the atmosphere along the web **21** but a substantial portion is pulled back into the plenum through the mentioned openings **56**, **57**, **58** due to the steadily increasing pressure difference between the exterior and the interior of the plenum. If the web treating air was heated to effect drying, or ink fixing on the web, its return for recirculation reduces the heat input into the system. Upon prolonged operation the system becomes stabilized, additional air and heating requirements becoming nominal. For longer treating by floating requirements, an additional air supply system of the nature herein described can be added, the two being coordinated to maintain stable floating conditions.

What is claimed is:

1. Apparatus for supporting, conveying and meanwhile treating a web passing therethrough by a gaseous medium comprising, a circulating gas system including a blower, conduit means for the gaseous medium from said blower, conduit means returning said gaseous medium to said blower, opposing plenums positioned in said system between said conduits through which said gaseous medium flows dividedly and uninterruptedly, said web passing between the faces of said opposing plenums, a plurality of openings in the faces of said plenums made by perforation thereof each having the perforated sections angled as directing deflectors for directing the flow of said gaseous medium against said web in the direction of its travel, and a further plurality of perforate openings in the same plenum face and each also having the perforate sections angled as deflectors for redirecting web deflecting gaseous medium into said plenum and into said gas supply system for recirculation.

2. Apparatus for supporting, conveying and meanwhile treating a web passing therethrough by a gaseous medium comprising, a circulating gas supply system including a blower, conduit means for the gaseous medium from said blower, conduit means returning said gaseous medium to said blower, a plenum positioned in said system between said conduits through which said gaseous medium flows uninterruptedly, said web passing through the apparatus over said plenum, a plurality of openings in the face of the plenum having deflectors for directing the flow of said gaseous medium against said web in the direction of its travel, and a further plurality of openings in the same plenum face also having deflectors for redirecting web deflected gaseous medium into said plenum and into said gas supply system, the directing and redirecting deflectors are within the plenum interior and are part of the plenum face being angled upwardly for directing gas flow against a running web and angled downwardly into the plenum interior for redirecting gas flow into said plenum thence into said gas circulating system.

3. In apparatus characterized in claim **2** where the plenum has an additional consecutive plurality of openings having downwardly angled deflectors for redirecting gas into the plenum interior at about its end.

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