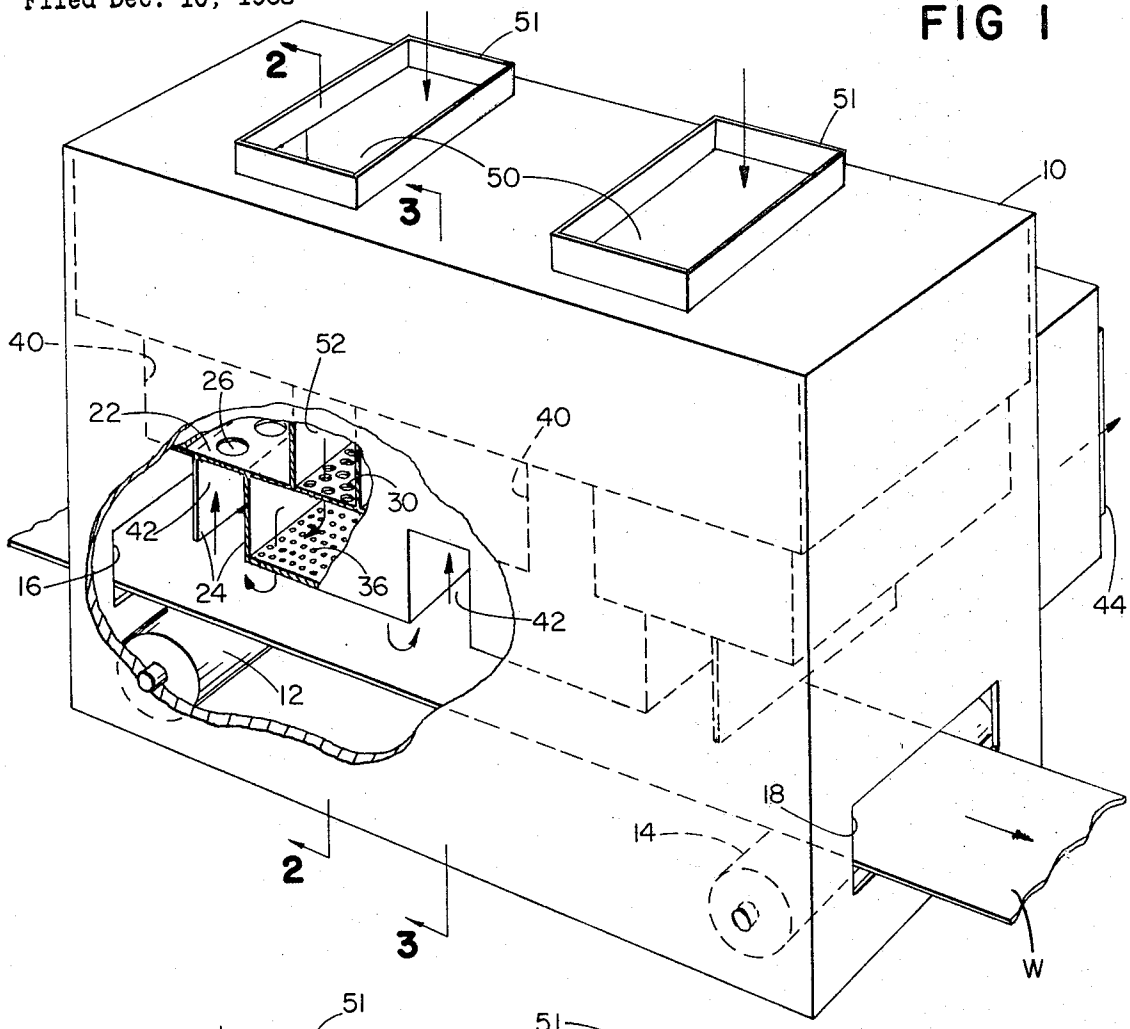
Aug. 25, 1970 E. C. BROWN 3,525,164

APPARATUS FOR GASEOUS TREATMENT OF MOVING WEBS

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FIG 1



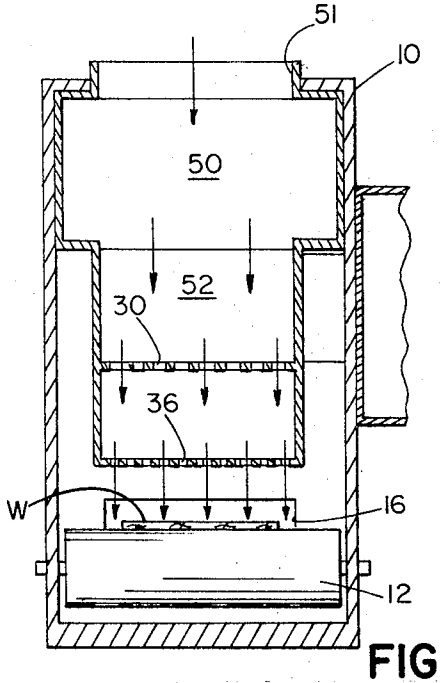


FIG 2

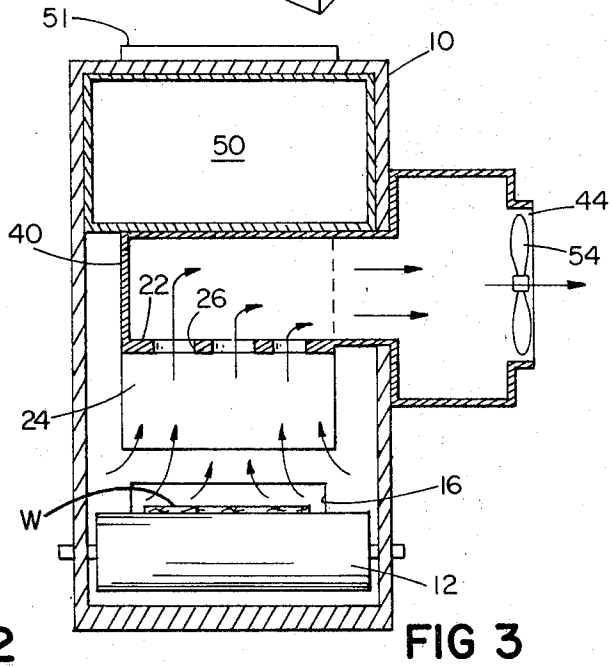
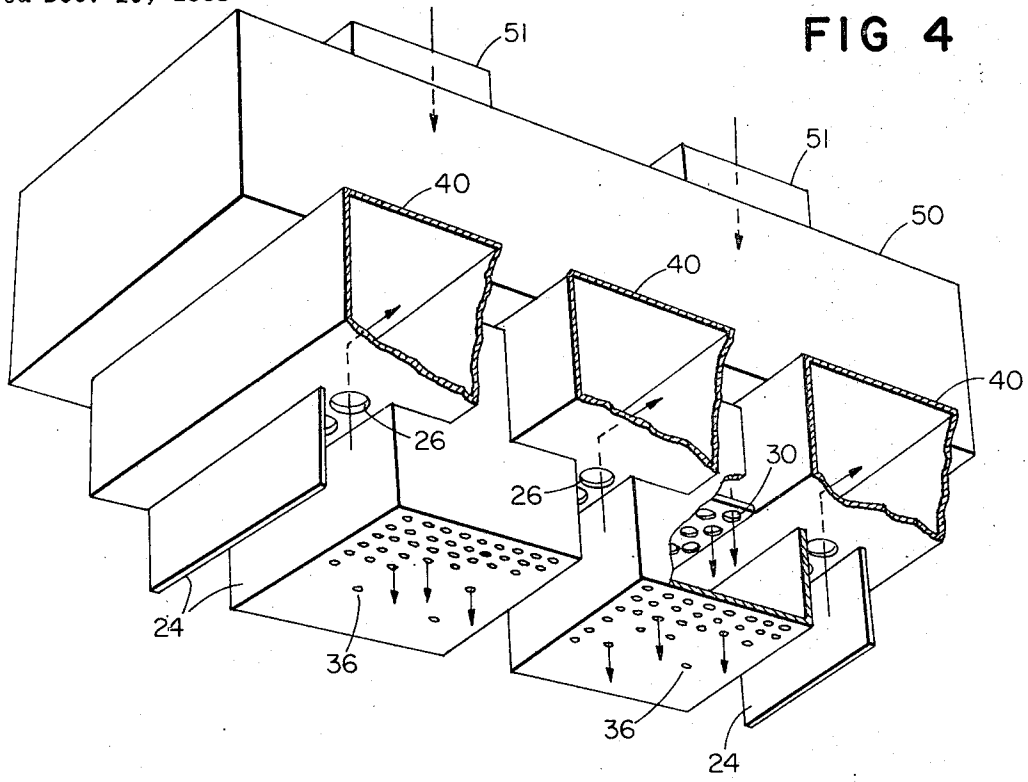


FIG 3

APPARATUS FOR GASEOUS TREATMENT OF MOVING WEBS

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FIG 4



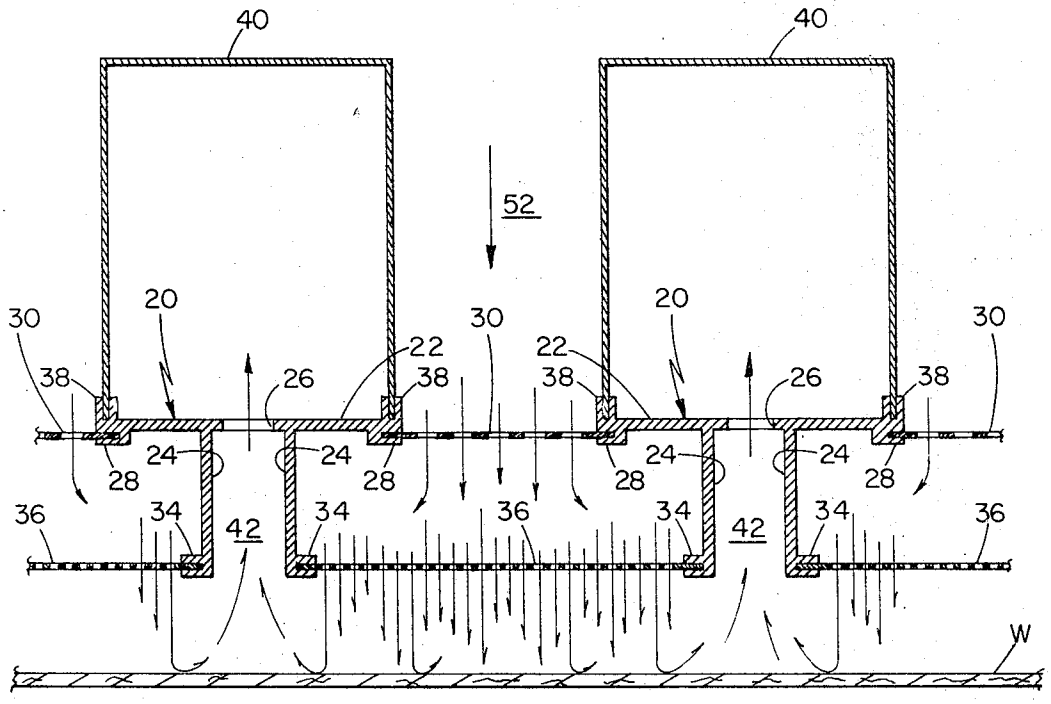


FIG 5

United States Patent Office 3,525,164
Patented Aug. 25, 1970

3,525,164

APPARATUS FOR GASEOUS TREATMENT OF MOVING WEBS

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Filed Dec. 10, 1968, Ser. No. 782,620
Int. Cl. F26b 23/00
U.S. Cl. 34—155 10 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for gaseous treatment of moving webs has a plenum embracing parallel spaced exhaust cross-headers with the spaces between the cross-headers forming outlet passageways from the plenum leading to lower level perforate distributing heads between which are vertical exhaust passageways leading to the exhaust cross-headers so that air impacting on the moving web is drawn away from the moving web before moving transversely through the cross-headers to discharge points beyond the edges of the moving web.

This invention relates to apparatus useful in the gaseous treatment of moving webs, as for drying wet coatings applied to a sheet material.

Some coatings, for example, those applied to non-porous substrates in the manufacture of photographic film are so thin and fragile that drying the coatings with any substantial forced draft directed towards the coating tends to disperse the coating and fails to produce desired even coating. Yet contact of the material to be dried with a gaseous drying medium having movement relative to the coated surface is desired in order to speed up the drying operation as much as is possible so long as the coating dries uniformly in an even coat, for the greater the quantity of gas contacting the material per unit of time the faster the drying.

The difficulty is that, as the velocity of a gaseous drying medium is reduced to prevent disruption of the coating, so much of the potential energy comes to be derived from turbulence alone (it being impossible because of skin and other effects to have truly laminar flow) that the flow is not uniform cross-sectionally. Energy derived from turbulence is dispersed randomly as distinguished from energy derived from static pressure which is dispersed evenly. In some applications then the slight static pressure required for low velocity gas movement contributes so little energy that the total force applied to the medium barely exceeds the force which would anyway be present due to turbulence alone. The result is that the velocity of gas movement varies at different points of impact on the web causing non-uniform drying over the surface area.

In a structure such as is shown and described in my Pat. No. 3,398,466, for example, if the velocities at the slots **39** are reduced below 500 feet per minute, most of the potential energy is derived from turbulence, and there is such little control of the exhausting gases in the spaces around the plenum **12** that a web being treated receives impacts at randomly varying velocities and uniform drying across the web is not achieved.

The present invention provides an air distributing structure which is particularly useful in drying moving webs which can tolerate only very low velocity gaseous impact, e.g., at velocities below 500 linear feet per minute, although the structure can be useful for operations at higher velocities. By using cross-headers within a plenum for exhausting the gases rather than cross-headers outside the plenum for the ingoing gas, I have found that so much better control of the exhaust gases is secured as to eliminate random variation in velocity of low velocity gas at impact, at least so far as can be determined from finished dried products. Accordingly, I expose a distributing head to the static pressure of a gas in a plenum which embraces a series of spaced exhaust cross-headers. Additionally, in accordance with this invention, a resistance distributing head in the form of a perforated plate is placed across each plenum outlet passageway between the exhaust headers and these passageways then communicate with lower distributing heads in the form of perforated plates which are less open than the upper plates.

In this manner the pressure in the plenum may be considerable while the pressure between the plates is less and such as to produce a very gentle low velocity draft of extremely evenly distributed impact with much increased velocity at the ingress to the exhaust headers.

The structure is also much simplified because tubes, such as are used in U.S. Pat. No. 3,398,466 are no longer required,

Apparatus in accordance with the present invention is shown in the drawings wherein:

FIG. 1 is a perspective view of the apparatus with one wall broken away to illustrate internal features;

FIG. 2 is a transverse cross-sectional view taken through a passageway in the apparatus of FIG. 1, leading downwardly from a plenum;

FIG. 3 is a transverse cross-sectional view taken through an exhaust passageway in the apparatus of FIG. 1 leading upwardly to an exhaust header;

FIG. 4 is a perspective enlarged view of some portions of the apparatus in an upwardly tilted position; and

FIG. 5 is a longitudinal cross-sectional fragmentary view showing the construction of the composite bottom wall of the plenum.

The apparatus includes an enclosure **10** through which may be carried, as on appropriate rollers **12** and **14**, by virtue of conventional inlet and outlet openings **16** and **18**, respectively, a web or film W of coated material to be dried.

Superposed over the web is an air distributing system which, for convenience, will be described from the bottom up and as best can be seen in FIG. 4. A series of transverse one-piece members **20** are supported in spaced relation across the enclosure above the path of the web W. Each member **20** includes a horizontally extending portion **22** having perpendicularly disposed appendages in the form of a pair of spaced parallel vertical walls **24** spaced inwardly from the side edges of the member **22**, one on each side of a row of openings **26** through the portion **22**.

Both side edges of members **22** have slots **28** formed therein into which may be inserted, between each member **20**, a perforated plate **30** connecting the members **20** together.

Vertical walls **24** also terminate at the bottom in enlargements in which similar slots **34** are provided into which may be inserted intervening perforated plates **36** connecting the bottoms of the adjoining walls **24** of adjacent members **22** together.

Lastly, one-piece members **20** have on their upper faces vertical slots **38** extending along each side thereof for receiving inverted U-shaped housings **40** forming with the portions **22** crossheaders communicating through openings **26** with exhaust passageways **42** formed between each pair of walls **24**.

As shown in FIG. 3, the cross-headers **40** lead to an outlet **44** disposed beyond the side edge of the path of the travelling web to be treated.

The enclosure **10** above and surrounding the cross-headers **40** thus forms a plenum **50** having top inlets **51** and communicating with the spaces **52** forming vertical passageways between cross-headers **40**.

A fan or other conventional air mover **54** is placed in the cross-header outlets **44** to create a differential pressure between air in plenum **50** and in the cross-headers **40** thereby creating air flow from plenum **50** down through vertical passageways **52**, through apertured plate **30**, through apertured plate **36** against the web W, the air then travelling longitudinally of the web symmetrically to and up the exhaust passageways **42** between walls **24**, through openings **26** and into the cross-headers **40**.

The configuration of the bottom wall of the plenum can thus be described as being a series of hollow boxes connected together in staggered relation in upper and lower rows, the upper row boxes being defined by walls **40** and **22** and the lower row boxes by walls **24** and intervening upper and lower plates **30** and **36**. The bottom walls **22** of the upper row boxes have openings **26** and both top and bottom walls **30** and **36** of the lower row boxes have openings therein, being perforated.

The perforations in plate **30** are larger than those in plate **36** but plate **36** may have, for example, 22.5% open area and plate **30**, 90% open area in a construction wherein the passageways **52** are 3 inches wide and the exhaust passageways **42**, 1 inch wide. This gives a five to one ratio of total open area between the upper plate **30** and the lower plate **36**. Accordingly, in operation, if the pressure in the plenum is of the order of .25 to .76 inch water column, the static pressure between the plates will be of the order of .01 and .03 inch water column. The exhaust gas at openings **26** may then have a velocity of 2300 to 4000 feet per minute with an intake at plate **30** of about 2000 to 3500 feet per minute. This provides a flow from plate **36** in the order of between 72 and 126 cubic feet per minute where the passageways **52** and **42** are five feet long transversely of the apparatus.

It is to be understood that in some cases where extremely low velocities are not required, the plate **30** may be dispensed with entirely and of course it will be understood that by virtue of the slot construction for insertion of the plates **30** and **36**, they may be readily replaced with plates having varying open areas and/or size of perforations depending upon the type of operation desired. In the form shown, the apertures **26** are ¾ inch in diameter, the apertures in plate **30**, 3/32 inch in diameter and the apertures in plate **36**, 1/16 inch in diameter. Also, the slots in the members **20** are not essential to the invention since the plates may be otherwise supported, nor is it essential that the members **20** be of one piece construction, though when they are and are fabricated by extrusion, assembly is conveniently simple.

What is claimed is:

1. Apparatus for gaseous treatment of moving webs comprising

walls forming a plenum,

one of the walls of said plenum being a horizontally extending composite wall which includes:

spaced transverse vertical walls forming therebetween an outer aligned row of parallel vertical passageways,

a series of spaced hollow cross-headers, each spanning the inner end of an alternate passageway of said row and having intake openings communicating therewith and having an end outlet for discharging air outside of said plenum,

said headers forming therebetween inner extensions of the intervening vertical passageways in said outer row, and forming therewith outlet passageways from said plenum,

a series of perforate plates, each spanning one of said outlet passageways for distributing gas passing therethrough, and

means for maintaining a differential lower pressure in said headers than in said plenum to draw gaseous fluid continuously from said plenum through said outlet passageways against a web passing beneath said composite wall, around free edges of said vertical walls into the alternating outer vertical passageways and thence through said intake openings into the cross-headers and thence to said cross-header outlets for discharge outside said plenum beyond the path of said moving web.

2. Apparatus as claimed in claim **1**, wherein said cross-headers are wider than said alternate outer row passageways and said plenum outlet passageways have narrow inner portions between said headers and wider outer portions between said vertical walls.

3. Apparatus as claimed in claim **1**, wherein said perforate plates lie in a single plane intersecting the outer ends of said plenum outlet passageways.

4. Apparatus as claimed in claim **1**, wherein said series of perforate plates include an outer and an inner plate spanning each plenum outlet passageway.

5. Apparatus as claimed in claim **4**, wherein the perforations in said inner plates are larger than the perforations in said outer plates.

6. Apparatus as claimed in claim **2**, wherein said series of perforate plates include outer plates lying in one plane across said wider outer portions of said plenum outlet passageways and inner plates lying in a different plane across said narrow portions of said plenum outlet passageways.

7. Apparatus for gaseous treatment of moving webs comprising

walls forming a plenum,

one of the walls of said plenum being a horizontally extending composite wall which includes

a series of hollow boxes connected together in staggered relation in upper and lower rows, the boxes in each row being spaced from one another longitudinally of said plenum,

the bottom walls of the boxes in said upper row having openings therein communicating with the spaces between the boxes in the lower row,

the top walls of the boxes in the lower row having openings therein communicating with the spaces between the boxes in the upper row,

the bottom walls of the boxes in the lower row being perforated,

and means for maintaining a differential lower pressure in said upper row of boxes than in said plenum to draw gaseous fluid continuously from said plenum through said lower row bottom wall perforations against a web passing beneath said composite wall and then away from said web through said openings in the bottom walls of the upper row boxes into said upper row boxes and then laterally through said upper row boxes for discharge beyond the path of said moving web.

8. Apparatus as claimed in claim **7**, wherein said boxes in the upper and lower rows symmetrically partially overlap one another.

9. Apparatus as claimed in claim **7** wherein the openings in the top walls of the boxes in the lower row are perforations in the portions of said top walls lying between said boxes in the upper row.

10. As a composite plenum wall, a series of one-piece structural members arranged in parallel spaced relation, and

perforated plates extending between said members,

each of said one-piece members comprising:

an elongated plate having a series of medially aligned openings,

a pair of parallel spaced legs extending from one side of said plate normal to said plate, one on each side of said series of openings, but spaced inwardly from the longitudinal side edges of said plate,

said legs including portions defining oppositely outwardly facing slots extending along the marginal bottom edge portions of said legs slidably receiving

and supporting one edge of adjacent perforated plates, and

marginal edge portions of said plate defining a pair of parallel slots on the opposite side of said plate from said legs and facing away from said plate for receiving the bottom edges of an inverted U-shaped housing to form cross-headers for conveying gas passing upwardly through said openings transversely and outwardly of a plenum of which said composite wall forms one wall.

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EDWARD J. MICHAEL, Primary Examiner