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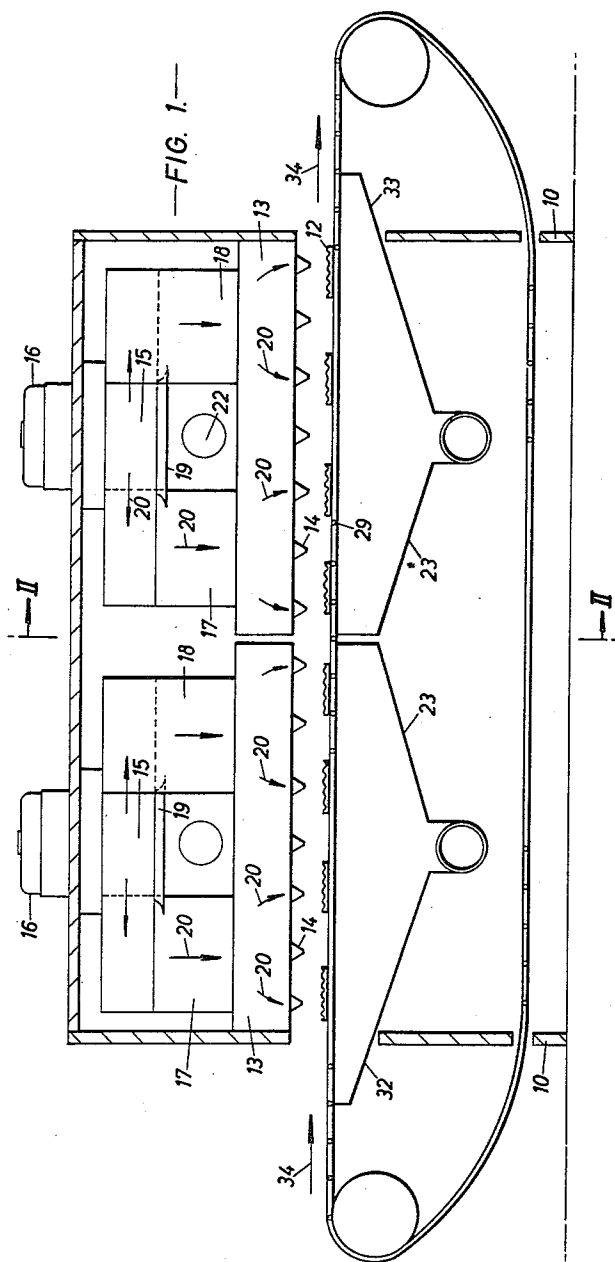
M. D. JEPSON

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GASEOUS RESTRAINT OF CONVEYED ARTICLES

Filed Feb. 18, 1959

3 Sheets-Sheet 1



Inventor

Michael Denis Jepson

By

Mead, Browne, Schuyler & Beveridge
Attorneys

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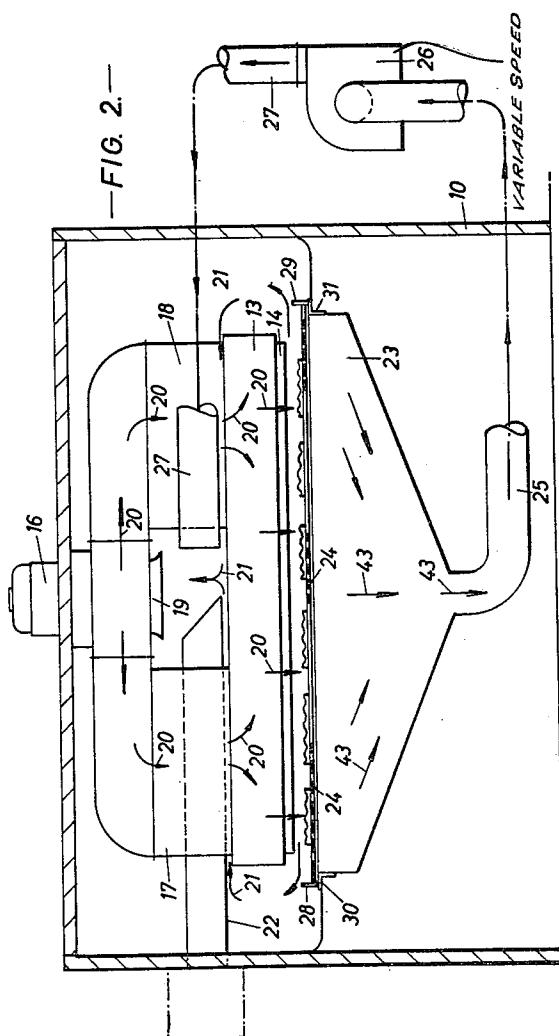
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By

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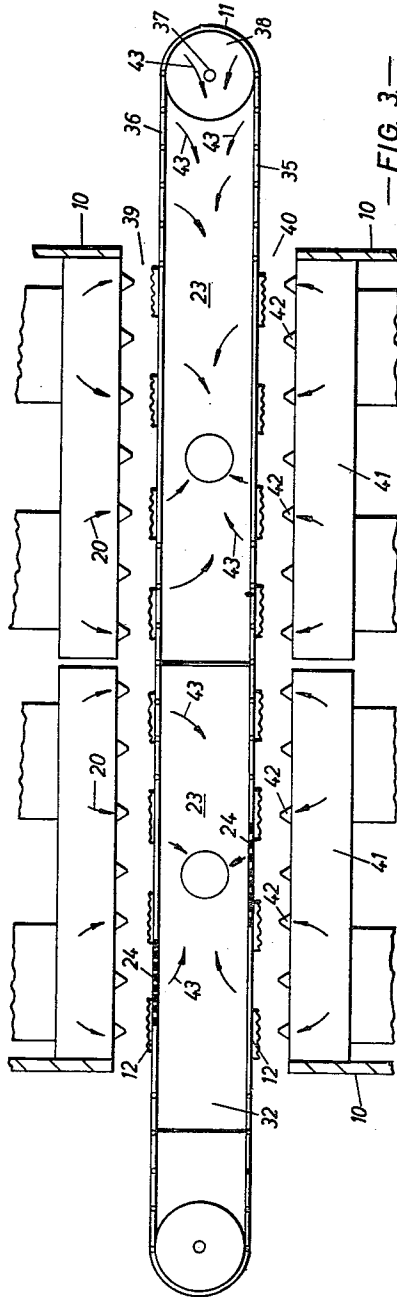
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GASEOUS RESTRAINT OF CONVEYED ARTICLES

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3 Sheets-Sheet 3



Inventor

Michael Denis Lepson

 B_y

Mead, Browne, Schuyler & Beveridge
Attorneys

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3,096,162

GASEOUS RESTRAINT OF CONVEYED ARTICLES
Michael Denis Jepson, Ilkley, England, assignor to The
Spooner Dryer & Engineering Co. Limited, Ilkley,
England

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2 Claims. (Cl. 34—33)

The present invention relates to a method of and ap-
paratus for thermally treating in succession a plurality
of discrete light-weight articles such as moulded pulp
articles.

It is well known to thermally treat materials for pur-
poses such as drying by transferring heat thereto by con-
vection by directing a plurality of streams of heated
gaseous medium towards the material so as to impinge
thereon at high velocity whilst the material is moved
along a given path.

Such a process is eminently suitable for the thermal
treatment of substantially continuous strip or web ma-
terial such as, for example, textiles, but practical diffi-
culties arise in the application of such a process to light
weight articles such as moulded pulp articles, in that the
articles are often displaced from their given path by the
impingement of the high velocity streams.

The present invention envisages providing a perforate
conveyor for light-weight articles to be subjected to ther-
mal treatment and establishing a pressure drop across the
conveyor so as to resist displacement of the articles when
subjected to the impingement of high velocity streams
of gaseous medium.

Thus, according to one feature of the present inven-
tion a method of thermally treating discrete light-weight
articles, such as moulded pulp articles, on a perforate
conveyor, comprises directing a plurality of streams of
heated gaseous medium towards articles on the conveyor
so as to impinge the articles at high velocity, and estab-
lishing a pressure drop across the conveyor with the
pressure at the side of the conveyor remote from the
articles thereon lower than the pressure at the article-
side of the conveyor.

In the method of the present invention when applied
to the drying of moulded pulp articles the drying is
effected by evaporation due to the impingement of the
high velocity streams. There is comparatively little or
no removal of water in liquid phase by the suction ef-
fected by the pressure drop across the conveyor. Care
should be taken that the pressure drop across the con-
veyor is sufficient to retain the articles in place on the
conveyor but is not excessive. Excessive suction may
cause the articles, particularly paper pulp articles, which
are very weak in their wet state, to become distorted and
may even cause the articles to be flattened on to the con-
veyor.

In order that gaseous medium may be directed on to
said articles at a substantial rate, and yet only a small
pressure drop be maintained across the conveyor, it is
necessary for some of the gaseous medium so directed
to be withdrawn from the same side of the conveyor as
articles thereon.

Thus, according to another feature of the present in-
vention, a method of thermally treating discrete light-
weight articles, such as moulded pulp articles, on a per-
forate conveyor, comprises directing a plurality of streams
of gaseous medium towards articles on the conveyor so
as to impinge the articles at high velocity, withdrawing
at the article-side of said conveyor gaseous medium so
directed and circulating said withdrawn gaseous medium
in an endless path of which a portion is occupied by said
streams, imparting heat to said gaseous medium before

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directing it towards said articles, and withdrawing gas-
eous medium from a zone at the side of said conveyor
remote from said articles to establish a pressure drop
across said conveyor.

The invention includes apparatus for thermally treat-
ing a plurality of discrete articles, said apparatus com-
prising a perforate article-receiving conveyor for convey-
ing articles along a given path, at least one pressure cham-
ber spaced from said conveyor with said given path there-
between and having a plurality of nozzles for the dis-
charge of streams of heated gaseous medium at high ve-
locity towards said conveyor and articles thereon, at least
one suction chamber disposed with an open face thereof
adjacent said conveyor at least in the region of said pres-
sure chamber and on the opposite side of said conveyor
to said given path, means including said pressure cham-
ber and said nozzles, but excluding said suction chamber,
defining a substantially enclosed endless path, means for
circulating gaseous medium along the said endless path,
means for imparting heat to said gaseous medium so cir-
culated, and means for withdrawing gaseous medium
from said suction chamber to establish a pressure drop
across the perforate conveyor.

The pressure chamber, and part of the suction cham-
ber may be disposed within an outer casing through which
the conveyor passes said casing in part defining said
endless path. The suction chamber preferably extends
outside the casing in the regions of entry and exit of
articles on the conveyor so that articles can be subjected
to the pressure drop across the conveyor before they are
subjected to the streams or jets. Gaseous medium with-
drawn from the suction chamber can also be mixed with
the gaseous medium circulated in said endless path. The
gaseous medium can be circulated by a circulating fan
and the gaseous medium can be withdrawn from the
suction chamber either by the same fan or by a separate
suction fan. If the same fan is used both to withdraw
gaseous medium from the suction chamber and to recir-
culate some of the gaseous medium after discharge from
the nozzles, means for throttling the flow of the gaseous
medium withdrawn after discharge by the nozzles will
be necessary in order to establish a pressure drop across
the perforated conveyor. If a separate suction fan is
used for extracting gaseous medium from the suction
chamber the gaseous medium so withdrawn can be added
to the gaseous medium circulated in said endless path
either upstream or downstream of the circulating fan.
The means for heating the gaseous medium circulated
in the endless path may be in the form of a heat ex-
changer to which a hot fluid such as steam may be sup-
plied from an external source or may be an electric
heater or may comprise a burner for the combustion of
fuel the products of combustion therefrom being added
to and intermingled with the gaseous medium circulated
in the endless path to impart heat thereto. If the heater
is in the form of a burner it is preferable for the fan
withdrawing the gaseous medium from the suction cham-
ber to discharge into the endless path upstream of the
location of the burner which may be conveniently situ-
ated near the inlet of the circulating fan, since in this
way the temperature of the gaseous medium passing
through the circulating fan for given operating condi-
tions can be less than would arise if the gaseous medium
withdrawn from the suction chamber were discharged
downstream of the circulating fan.

The conveyor may conveniently be in the form of
flat surfaced perforated metal sheeting connected at its
ends to a pair of sprocket chains running on chain guides
through the apparatus. The degree of perforation of the
perforated sheet may conveniently be in the range of 20
to 40% of the surface area.

It is found in practice that satisfactory operation can be achieved with only a slight pressure drop across the perforated conveyor, for example a pressure drop of up to 1 inch water gauge (at 60° F.) will enable a large range of articles to be retained on the conveyor and satisfactorily to withstand the impingement of the high velocity jets of gaseous medium without becoming thereby displaced to any marked degree relatively to the conveyor. Satisfactory operation has been achieved, for example, when a static pressure of approximately 2 inches water gauge (at 60° F.) obtains in the pressure chamber and a pressure drop of about a ¼ inch water gauge across the conveyor and with the static pressure in the region of the article receiving surface of the conveyor effectively equal to atmospheric pressure. Such conditions are suitable for the drying of light weight moulded pulp articles weighing for example less than 30 gms. each, using air as circulated gaseous medium.

The invention will be further described by way of example with reference to the accompanying diagrammatic drawings in which:

FIG. 1 is a longitudinal elevation of one form of apparatus according to the present invention and with one side removed for the purpose of illustration,

FIG. 2 is a transverse section along the line II—II of FIG. 1, and

FIG. 3 is a detail longitudinal elevation of a modification.

The apparatus illustrated in the drawings comprises a main framework and casing 10 through which there extends one pass of a perforated conveyor 11 for receiving articles 12 to be treated. Disposed above the path of the conveyor 11 are one or more pressure chambers 13 having along their lower surfaces a plurality of downwardly directed nozzles 14.

The embodiment illustrated in the drawings is a two stage apparatus having two such pressure chambers but it will be understood that the invention is not limited as to the number of pressure chambers and may include any number of stages according to the treatment required.

Each pressure chamber 13 has associated therewith a fan 15 driven by an electric motor 16 and is connected by ducts 17, 18 to the outlet of such fan. Inlet 19 of the fan 15 communicates with the interior of the casing 10 so that air discharged by the fan 15 passes through the ducts 17, 18 into the pressure chamber 13 whence it is discharged through nozzles 14 towards the conveyor and articles thereon, the path of such air being illustrated diagrammatically by the arrows 20. Air can then be withdrawn from between the pressure chamber 13 and the conveyor 11 as illustrated by the arrows 21 and pass to the inlet 19 of the fan 15 which can thus circulate at least part of the air along an endless path. For heating the circulated air there is disposed adjacent the inlet 19 of the fan 15 a burner indicated diagrammatically at 22 in which fuel is combusted so that the products of combustion therefrom are introduced into and mingle with the circulated gaseous medium which is heated thereby.

Disposed beneath the path of the conveyor 11 in the region of each pressure chamber 13 is a suction chamber 23 in the form of an open topped chamber upon which rests a perforated article-receiving portion 24 of the conveyor 11. The suction chamber 23 communicates through a conduit 25 with the inlet of a suction fan 26 having an outlet which communicates through a duct 27 with the interior of the apparatus casing 10.

Withdrawal of air from the suction chamber 23 as illustrated by arrows 43 establishes a pressure drop across the perforated article-receiving portion 24 of the conveyor.

The conveyor 11 comprises a pair of sprocket chains 28, 29, running on guide rails 30, 31 and driven in any suitable manner (not shown). The article-receiving portion 24 of the conveyor is in the form of a perforated metal sheeting. In practice it is found that satisfactory

results can be obtained if the extent of the perforations amount to approximately 20 to 40% of the surface area. Part of the or a suction chamber 23 extends outside the casing 10 in the region of entry of articles as at 32 and in the region of exit of articles as at 33.

In operation the conveyor 11 is set in motion with its upper pass moving in the direction indicated by the arrows 34, the fans 15, 26 operate and fuel is ignited at the burners 22. Articles to be treated are placed in succession upon the conveyor and thereon conveyed through the apparatus. When the pass of the conveyor 11 on which the articles are received comes over the suction chamber part 32 the articles are subjected to the pressure drop across the conveyor and can thereby be retained on the conveyor. When the articles come beneath the pressure chambers 13 they are subjected to the impingement of high velocity jets or streams of heated air from the nozzles 14, and on their undersides, through the perforations in the article receiving portion 24, they continue to be subjected to the reduced pressure existing in the suction chambers 23 which serves to enable the articles to be retained on the conveyor without becoming disturbed or displaced to any marked extent by impingement of the high velocity stream. The apparatus of the present invention is eminently suitable for the treatment of moulded pulp articles such as food trays and which are light in weight; for example moulded pulp food trays weighing in the region of 5 to 30 grammes can be treated when the fans 15 and 26 are operated to produce a static pressure of about 2 inches water gauge (at 60° F.) in the pressure chamber 13 and a vacuum of about ¼ inch water gauge in the suction chambers 23, with the static pressure inside the casing 10 adjacent the sides of the conveyor 11 effectively equal to atmospheric pressure.

For the thermal treatment of moulded pulp articles it is preferable for the conveyor 11 to have a substantially flat surface thereby enabling such articles to be dried without any substantial buckling. However, the conveyor 11 may alternatively have a wire mesh article-supporting portion 24.

In the embodiment shown a separate suction chamber 23 is provided beneath each of the pressure chambers 13 but it will be understood that a single suction chamber may extend beneath more than one pressure chamber. If more than one suction chamber is provided each may communicate with a suction fan 26 individual thereto or alternatively any number of suction chambers can communicate with such a fan which may return air withdrawn from the suction chambers into the casing at more than one point.

The embodiment illustrated in FIGS. 1 and 2 is a single pass apparatus in that articles are received at one end and are discharged at the other. It should be desired that articles should be received and discharged at the same end of the apparatus the suction chamber or chambers 23 can also be open bottomed and the lower pass 35 of the conveyor 11 can lie thereagainst as illustrated in FIG. 3 so that articles after passing through the apparatus along the upper pass 36 of the conveyor can be guided thereon around conveyor turning device 37 and carried back beneath the lower pass 35 on which they are retained by the action of the reduced pressure in the suction chamber 23. Articles can be retained on the conveyor from one pass to the other by extending the suction chamber 23 as at 38 so that a pressure drop exists across the conveyor from where it emerges from the casing at 39, around the turning device 37 and until and beyond where it re-enters the casing at 40. Alternatively a continuous moving felt may be arranged adjacent the conveyor 11 from near its point of emergence 39 to near its point of re-entry 40 to sandwich articles between the felt and the conveyor.

If further treatment is desirable, or to shorten the length of the apparatus for given treatment conditions,

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further pressure chamber or chambers 41 and nozzles 42 with associated fan or fans and heaters (not shown) can be provided beneath the pass 35 to direct streams or jets of heated gaseous medium upwardly on to the articles.

By means of the apparatus of the present invention and by applying suction to the underneath of the article receiving portion of the conveyor, light weight articles which would be prone to being upset or displaced when high velocity streams of heated air impinged upon them, can be conveyed through the apparatus and dried therein without becoming substantially displaced relatively to the conveyor. This is of advantage when such an apparatus is used in combination with moulding apparatus for producing moulded pulp articles at one end and a receiving or packing appliance at the other end, as a substantial degree of registration between the articles and the conveyor can be maintained through the apparatus, thereby facilitating the design and operation of the receiving or packing equipment. Moreover, by using a conveyor with a substantially flat article-receiving surface such articles can be dried without any marked buckling and a measure of flatness can be imparted to their undersides during drying.

We claim:

1. In a method of thermally treating light-weight moulded pulp articles; the steps of traversing the articles on a perforate conveyor, withdrawing gaseous medium from a suction zone at the side of said conveyor remote from said articles to establish a pressure drop across said conveyor, directing a plurality of streams of gaseous medium towards articles on the conveyor so as to impinge the articles at high velocity when opposite said suction zone, withdrawing at the article side of said conveyor

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gaseous medium so directed and circulating said withdrawn gaseous medium along an endless path of which a portion is occupied by said high velocity streams, imparting heat to said gaseous medium before directing it toward said articles, adding gaseous medium withdrawn from said suction zone to gaseous medium in said endless path, and adjusting the rate of withdrawal of said gaseous medium from said suction zone to be sufficient to restrain said articles from displacement on said conveyor by said high velocity streams.

2. The method set forth in claim 1 wherein said gaseous medium withdrawn from said suction zone is mixed with gaseous medium in said endless path at a point before heat is imparted thereto.

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