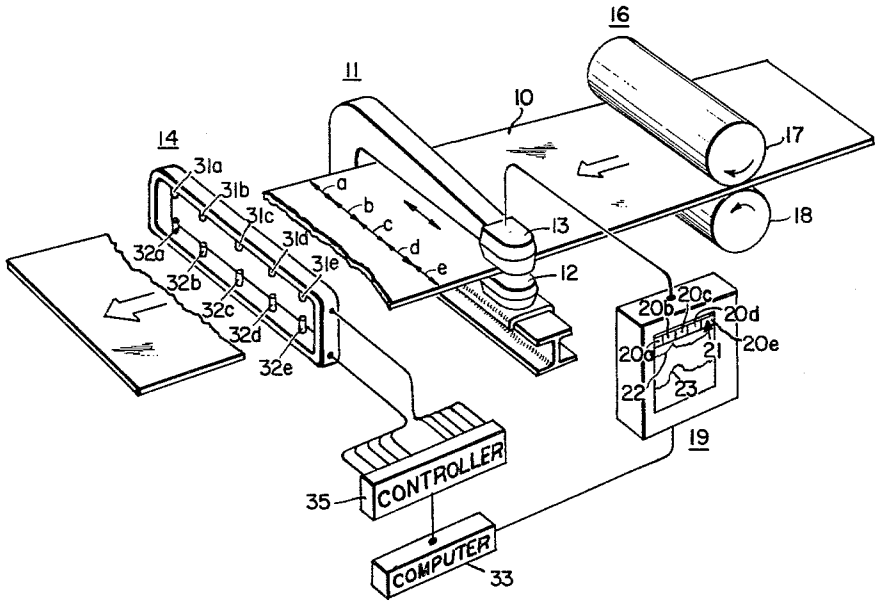
Nov. 2, 1965 N. A. HUFFMAN 3,214,845

MOISTURE MEASURING AND SELECTIVE DRYER CONTROL SYSTEM

Filed May 24, 1961



INVENTOR

Neil A. Huffman

By Anthony D. Cennamo

ATTORNEY

United States Patent Office 3,214,845 Patented Nov. 2, 1965

3,214,845

MOISTURE MEASURING AND SELECTIVE DRYER CONTROL SYSTEM

Neil A. Huffman, Birmingham, Ala., assignor to Industrial Nucleonics Corporation, a corporation of Ohio

Filed May 24, 1961, Ser. No. 112,347
5 Claims. (Cl. 34—48)

This invention relates to measuring and controlling systems utilized in process manufacturing and particularly to method and means for correcting the moisture profile drying in the manufacture of fibrous materials.

In a typical industrial process such as a wallboard or hardboard sheet making process, the essential steps are the preparation of the pulp material in a form which will permit the formation of a continuous sheet of material; the formation of the sheet, such as on a screen or wire; coarse removal of moisture from the resulting sheet of fibrous material; and the final moisture removal sections. More specifically, hardboard material is produced on a paper-type machine with a head box and a Fourdrinier dryer. From the headbox the mat which is approximately one inch thick enters into a couple of rolls which act as presses to form a mat approximately ¾" thick. The material then moves along a conveyor where it is cut into 12 foot lengths and on into an oven where it passes through for about one and one-half hours to drive out the remaining moisture. At a point after the presses the sheet is approximately 50 to 55% moisture; and after the sheet leaves the oven, it has approximately 0 to 5% moisture.

The oven is generally heated with gas burners and, due to openings along both sides thereof, the temperature in the center is considerably warmer than along the edges where cool air may enter. For this reason, a material of uniform moisture content entering the oven would dry out considerably more in the middle than on the edges. Depending upon the time the material was left in the oven, one of two things would happen: either the material would come out of the oven with the edges wet and the center dried correctly, or the edges would be dried correctly and the center would be over-dried, or perhaps even burned. It is of importance, therefore, that the operator know what the moisture profile is across the sheet of material prior to its entry into the oven. If the moisture profile is known, the heat load can be manually distributed in the oven to correspond to the edges of the sheet or conversely, the moisture in the sheet material may be adjusted to conform to the heat load through the ovens. Manual control, however, is never sufficiently accurate for modern day industrial processes. Furthermore, in this particular process the moisture across the profile of the sheet is not uniform and is continually varying. Therefore if the moisture profile of the sheet were calculated it would in all probability be changed by the time manual adjustment were made.

The present invention teaches the drying of headboard sheet material that overcomes the problems mentioned above. The preferred embodiment is operative in combination with the oven section of the machine in such a way that the control of the oven heaters is continuously matched for the moisture condition existing in the profile of the material produced. The heaters in the oven section are selectively controlled at that portion of the width of the material requiring more or less drying being produced. In this way the moisture content across the entire width of the sheet material is controlled to produce a sheet of uniform moisture as it passes from the oven section.

It is accordingly a primary object of the present invention to provide a new and improved method and means of controlling the moisture drying process in the formation of hardboard sheet material.

It is another object of the present invention to control the moisture drying process in the formation of hardboard sheet material by the selective control of the final drying section.

It is a further object of the present invention to provide method and means of controlling the moisture drying process in the formation of hardboard sheet material that is readily adaptable with little or no changes to the conventional processes.

Other objects and features will become apparent from the following detailed description of my invention taken in conjunction with the single figure drawing showing a preferred embodiment as adapted to a conventional hardboard sheet material process.

Referring now to the figure, in the hardboard sheet material making process the sheet of material **10** emerges from a dryer section **15** comprising the drums **17** and **18**. The paper passes into an oven mounting local upper heating devices **31***a*, **31***b*, **31***c*, **31***d*, and **31***e*, and lower heating devices **32***a*, **32***b*, **32***c*, **32***d*, and **32***e*, spaced laterally across the width of the hardboard sheet **10**. The sheet prior to entering the oven passes through a measuring apparatus **11** comprising moisture responsive elements **12** and **13**. The measuring apparatus **11** is so disposed relative to the moving sheet of material that it may be traversed laterally to obtain information on the relative moisture content at all points across the width of the sheet of moving material. A number of devices are suitable for this detector. One of these is a beta radiation absorption gauging system disclosed in U.S. Patent 2,909,660. In this instance, the variations in indicating the mass per unit area across the width of the sheet of paper may be interpreted to be the result of moisture content variations. Another means of performing this measurement is a dielectric measuring apparatus which is responsive to changes in the capacitance of the measured material as it is traversed across the width. Preferably the moisture measuring system most ideally suited to my invention is that disclosed in Serial No. 41,975 filed July 11, 1960, now Patent No. 3,155,900, for "Measuring System." In that system the variations in the resulting signal from the measuring device are again interpreted to result from variations in the moisture content independent of mass at various points across the width of the sheet of material. This interpretation is based on the fact that variations in moisture content contribute of the order of 40 times as much variational signal to the detector output as would corresponding variations in the amount of pulp material in the sheet. Numerous other detecting devices could be adapted for this use; among them, those depending on infrared reflectance and absorptivity. It is to be emphasized here that the output of the moisture responsive device does not have to be of any particular accuracy with regard to absolute readings of the value of moisture existing at any one region of the sheet. Rather, all that is required is that the detecting device be able to signal what regions of the sheet have an average moisture content greater or less than other regions.

A readout of the indications of the moisture responsive detector is shown in the recorder apparatus **19** which contains the scale **20** on which the width of the sheet of paper has been arbitrarily divided into the regions **20***a*, **20***b*, **20***c*, **20***d*, and **20***e*. The marking device **21** which may be the recording pen of a self-balancing X–Y potentiometer traces the indication of the profile data developed by the measuring device **11**. The trace **22** is represented to occur

at a later time than the trace 23. Traces 22 and 23 represent sequential recordings of the output of the moisture responsive detector in its sequential traverses across the width of the sheet of paper. Regions 20*a*, 20*b*, 20*c*, 20*d*, and 20*e* correspond, therefore, to regions of the sheet 10*a*, 10*b*, 10*c*, 10*d*, and 10*e*. Alternatively, the recording system illustrated in U.S. Patent No. 2,909,660 to Frank Alexander may be adapted to indicate moisture reading with profile position.

The output of the recorder 19 is fed to a computer 33 whereas in turn the output of the computer 33 is applied to the heater controller 35. This controller selectively actuates one or more of the auxiliary heating devices mounted on the frame 14, and shown as upper heaters 31*a*, 31*b*, 31*c*, 31*d*, and 31*e*, and lower heaters 32*a*, 32*b*, 32*c*, 32*d*, and 32*e*, mounted transversely to the process. These heating devices may be gas burners in an oven, air jets or other known heating devices that may be selectively controlled.

In operation the moisture responsive device 11 generates profile information such as that represented by trace 23. The signal from the computer 33 actuates the heaters through the heater controller 35 to apply the proper degree and duration of local heat to the moving sheet. The computer 33 may be one conventionally available or may simply comprise circuitry capable of signal comparison and operative to produce a voltage for a duration dependent upon the degree of moisture deviation. Controller 35 also is conventionally known and would preferably be of the proportional type such as that disclosed and utilized in the U.S. patent to Donald E. Varner, No. 2,895,888.

In the illustration of the preferred embodiment wherein the edges of the hardboard would retain a greater percentage of moisture, the intensity and duration of the heaters 31*a*, 32*a*, 31*e* and 32*e* would be greater than the heaters in the central area. There may be instances where for some reason or other in the process the moisture content of the sheet as it enters the dryer may have wetter or dryer streaks. Since the moisture content is converted into a relative signal the heater in the oven corresponding to the streak area would be controlled accordingly.

The use of the above cited controlled localized heating of regions in the oven or final dryer section across the profile of the moving sheet produces a sheet having a uniform moisture characteristic across its width. Accordingly a uniform physical characteristic is imparted to the sheet material and the need of an attendant is eliminated.

Although certain and specific illustrations are given, it will be apparent to those skilled in the art that modifications may be made without departing from the true spirit and scope of the invention.

I claim:

1. In a manufacturing machine for processing a length of a fibrous material, having a drying section having an input side and an output side with a series of selective drying means spaced across the width of said material, each of said means affecting the moisture condition of said material at a portion of said width, said portion being substantially less than the total extent of said width, the improvement of uniformly drying said sheet comprising means for moisture gauging said material, means for mounting said gauging means on said input side of said drying section, traversing means associated with said mounting means for causing said gauging means to scan said material across said width thereof, computer means connected to said gauging means for generating a signal indicative of said moisture condition at the traversing point of measurement, controller means connected between said computer means and said selective drying means for utilizing said moisture indicative signal to control the effectiveness of said drying means at the portion of said sheet width corresponding to said traversing point of measurement.

2. In a manufacturing machine for processing a length of a fibrous material, having a drying section having an input side and an output side with a series of selective drying means spaced across the width of said material, each of said means affecting the moisture condition of said material at a portion of said width, said portion being substantially less than the total extent of said width, the improvement of uniformly drying said material comprising, gauging means for determining the moisture across the width of said material, means for mounting said gauging means on said input side of said drying means, computer means connected to said gauging means for generating a signal indicative of each of said portions of said material, controller means connected between said computer means and said selective drying means for utilizing said moisture indicative signal to control the effectiveness of said drying means at the portion of said material corresponding to said moisture gauged width portion.

3. In a manufacturing machine for continuously processing a laterally extended length of a fibrous material, having a final drying section having an input side and an output side with a series of selective drying means spaced across the width of said material, each of said means affecting the moisture condition of said material at a portion of said width, said portion being substantially less than the total extent of said width, the improvement of uniformly drying said material comprising means for moisture gauging said material, means for mounting said gauging means on said input side of said final drying section, traversing means associated with said mounting means for causing said gauging means to cyclically scan said material across said width thereof, computer means connected to said gauging means for generating a signal indicative of said moisture condition at the traversing point of measurement, a continuous chart recording means, means for connecting said signal to said recorder to indicate the moisture of said material at any given point of traverse, and controller means connected between said computer means and said selective drying means for utilizing said moisture indicative signal to control the effectiveness of said drying means at the portion of said material width corresponding to said traversing point of measurement.

4. In a hardboard manufacturing machine having a sheet forming section and a final dryer section having an input side and an output side and including a plurality of adjustable selective drying means positioned across said sheet to affect the moisture content of a discrete portion of said sheet width in accordance with the output of said drying means, the improvement comprising means mounted adjacent said input of said final dryer section for determining the variations in moisture across said sheet entering said final dryer section, and means for adjusting the output of each of said selective drying means in accordance with the measured moisture content of said sheet at the discrete portion associated with said drying means.

5. In manufacturing apparatus for continuously processing a laterally extended sheet of fibrous material, said apparatus having a final dryer section having an input side and an output side and including a series of selective drying means spaced across the width of said sheet, each of said means affecting the moisture condition of said material at a portion of said width, said portion being substantially less than the total extent of said width, the improvement for uniformly drying said sheet comprising means mounted adjacent said input side of said final dryer sections for measuring the variations in moisture across the width of said sheet entering said final dryer section, a computer connected to said measuring means for generating a signal indicative of the variations of said moisture from a desired value thereof and controller means connected between said computer and said selective drying means for utilizing said moisture indicative signal to control the effectiveness of said drying means at the portion of said sheet associated with said selective drying means.

(References on following page)

5

References Cited by the Examiner

UNITED STATES PATENTS

2,346,437	4/44	Krogh	34—48
2,659,048	11/53	Zabel	324—65
2,874,482	2/59	Haltmeier	34—48
2,909,660	10/59	Alexander	250—83.4
2,919,495	1/60	Underhay	34—160

6

References Cited by the Applicant

UNITED STATES PATENTS

2,355,391	8/44	Nelson et al.
3,040,807	6/62	Chope.

PERCY L. PATRICK, *Primary Examiner.*

BENJAMIN BENDETT, NORMAN YUDKOFF, *Examiners.*