March 22, 1955 H. M. DAVIS 2,704,453

METHOD OF ANALYZING A WEB OF PAPER

Original Filed Feb. 23, 1949

Fig. 1.

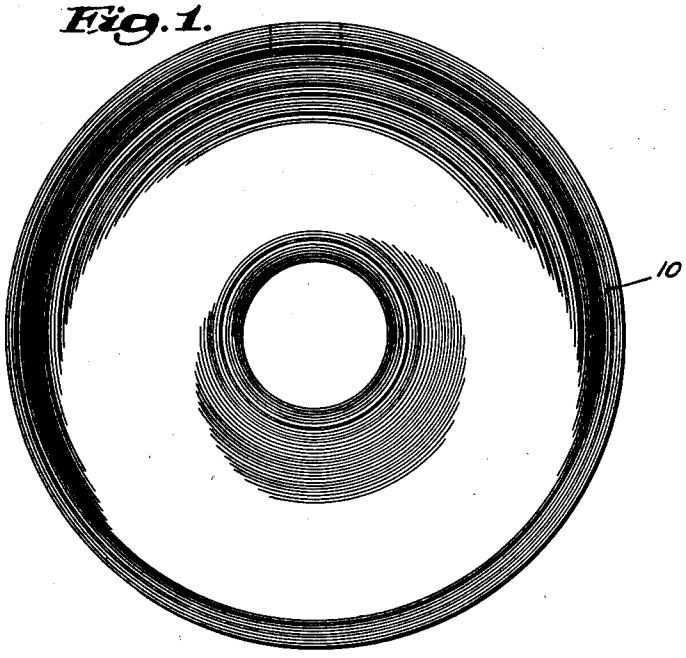


Fig. 2.

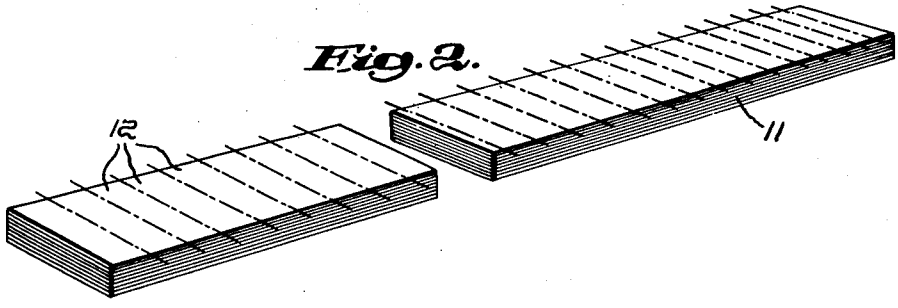


Fig. 4.

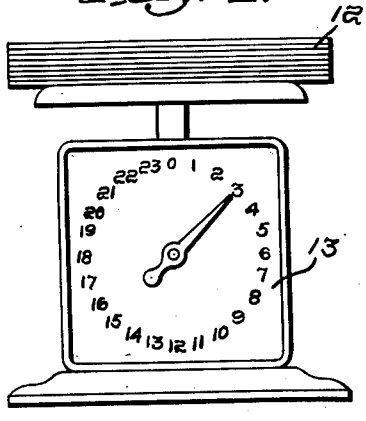
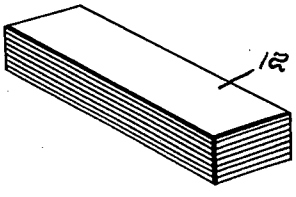


Fig. 3.



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United States Patent Office 2,704,453 Patented Mar. 22, 1955

2,704,453

METHOD OF ANALYZING A WEB OF PAPER

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Original application February 23, 1949, Serial No. 77,763, now Patent No. 2,608,912, dated September 2, 1952. Divided and this application August 27, 1952, Serial No. 306,643

2 Claims. (Cl. 73—159)

The present invention relates to the manufacture of paper wherein a stream of an aqueous wood pulp suspension is flowed out of a head box upon a moving screen or wire to form thereon a web of pulp. The web of pulp is subsequently processed, as by drying and calendering, to produce a web of paper. This application is a division of my application, Serial No. 77,763, filed February 23, 1949, now Patent No. 2,608,912, dated September 2, 1952.

During my extensive research, I have used the following method of selecting samples of the web of paper to determine the action of the paper making machine. In working with a Fourdrinier machine producing a web 132 inches wide, I divided the web into 22 tracks each six inches in width and determined the changes in basis weight which took place in each track. For example, assuming the machine was running at a speed of 550 feet per minute, a piece of paper 72 feet long in the longitudinal direction of the web represented the action of the paper machine during a period of eight seconds of machine running time. By cutting this piece transversely of the web to form six pieces each 12 feet long, I obtained six pieces each representing 1⅓ seconds of machine running time. By cutting each of these pieces in the longitudinal direction of the web to form 22 pieces each 6 inches wide, I obtained six samples each representing the action taking place in 1⅓ seconds of machine running time in each of the 22 tracks into which I divided the web. The basis weight of each sample was determined by weighing.

Employing this method of sampling I found that permanent heavy and light streaks lengthwise of the web of paper were present for mile after mile and caused a variation in basis weight across the web up to three pounds. In this specification, I refer to the heavy streaks as "hills" and to the light streaks as "valleys." I also found that there is a reoccurring cycle of basis weight variations in all longitudinal lines of the web, each cycle corresponding to about 5 seconds of machine running time. I also found a third type of basis weight variation, which is a flash but random variation, in which from two to nine tracks combine for about one second to change basis weight in the same direction but not necessarily by the same amount in each track. Both of these flash variations are equally evident in 8-second tests of 72 feet of paper and in many hours of tests sampled once an hour.

These three types of basis weight variation have led those skilled in the art to erroneous interpretations of the action of paper making machines. It has been common practice to make certain adjustments in the paper making machine, such as adjustment of the slice in the Fourdrinier machine, as dictated by the visual appearance of the flow on the wire and based upon samples selected periodically from the finished paper. The most common sampling practice has been to tear four separate laterally spaced pieces from the end of a reel and trim each to measure 24 by 36 inches.

No set of samples obtained by this common method of sampling furnished accurate information as to the true character of the web of paper being produced. Thus, the portion of the width of the web represented by each sample might contain a high hill or a deep valley or both but no sample indicated this because it gave only the average basis weight of this portion of the web, e. g. the average of the hills and valleys. Furthermore, no

set of samples represented the average basis weight of any longitudinal portion of the web formed during any one completed cycle of almost instantaneous changes in basis weight which reoccur and are completed about every 5 seconds.

Based upon this information, the character of the stream of aqueous pulp suspension was controlled by adjustment of the paper making machine to control the character of the web produced. It is obvious that at times and places adjustments were made when they should not have been made and at other times and places no adjustment was made when one should have been made. In view of this and in the light of my discoveries previously mentioned, it is obvious why paper manufacturers concluded that the profile of the web continually changes and never follows a substantially fixed pattern. It is equally obvious that paper produced under such conditions would vary greatly in basis weight.

The present invention provides a method for sampling the web of paper whereby the true character of the profile of the web may be accurately determined. In the practice of the invention, the web is considered as composed of a plurality of narrow longitudinally adjoining tracks. A plurality of pieces of paper are selected from each track to obtain an average of each of the cycles of about five seconds duration. Thus, the average basis weight of the pieces selected from each track is representative of the basis weight of the paper in each track.

In the practice of the invention I have found it convenient and practical to sever a plurality of the outer convolutions of a reel of paper transversely along two spaced parallel lines extending across the entire width of the web and thereby obtain a set of a plurality of superimposed pieces of paper. The average basis weight of these pieces of paper is representative of the basis weight of the web. Then, a measure may be obtained of the relative basis weight of each of narrow adjoining portions of this set of pieces of paper in the transverse direction of the web. One way of obtaining this measure is by severing the set of pieces of paper along spaced lines in the longitudinal direction of the web to obtain a group of a plurality of samples of paper from each of a plurality of narrow adjoining longitudinal portions of the web and then weighing each of the groups.

The invention is illustrated further by the following description in conjunction with the accompanying drawing: in which,

Fig. 1 is an end elevational view of a reel of paper;

Fig. 2 is a perspective view, partly broken away, of a set of a plurality of superimposed strips of paper formed by severing a plurality of the outer convolutions of a reel of paper along spaced parallel lines extending across the width of the reel;

Fig. 3 is a perspective view of one of a plurality of multiple samples of paper formed by cutting the set illustrated in Fig. 2 along the dot and dash lines of Fig. 2; and

Fig. 4 is a front elevational view of a weighing instrument having a multiple sample of paper positioned thereon for weighing.

In the practice of the present invention, the paper making machine is looked upon as producing a plurality of narrow longitudinal strips or tracks which nevertheless are integral and taken together make up the entire width of the web. Consequently, it is necessary to obtain a measure of the relative basis weight of each of such strips or tracks. In order to obtain a true indication of the exact nature of the profile of the web being produced, the interpretation should be based upon the average of a number of samples in each track. In practice I take advantage of the fact that the samples from the four or five outer convolutions of an ordinary reel cover all phases of the five second reoccurring cycles of variations in basis weight. The number of convolutions to be sampled and the length of each sample may be suited to fit the conditions in any mill. I prefer to take a sample from each of the eight outer turns of the reel but a smaller or greater number may be em-

ployed, the essential being to obtain an average which is representative of the average of each of the reoccurring cycles of 5 to 8 seconds duration.

One method of practicing the invention is illustrated in the accompanying drawing. Thus, the eight outer convolutions of a reel of paper **10** are cut along parallel lines, as indicated by the dotted lines in Fig. 1, spaced 18 inches apart and extending across the entire width of the reel. This produces a set **11** of eight superimposed pieces of paper as indicated in Fig. 2. A measure of the relative basis weight of each adjoining longitudinal track of the web may be obtained by cutting the set **11** along parallel lines spaced 6 inches apart and extending in the longitudinal direction of the web as indicated by the dot and dash lines in Fig. 2. This produces a plurality of multiple samples 12 each containing eight superimposed sheets 6 by 18 inches which equals the area of the common 24 by 36 inch (24/36 500) sample and may be weighed on the customary ream scales **13** as illustrated in Fig. 4. The eight sheets in each sample **12** averages the flash variations in basis weight in the longitudinal track of the web from which it was taken. Consequently, by comparing the weights of the samples **12**, a measure of the relative basis weight of the paper in each track is obtained. If the edges of the reel have been trimmed, the edge samples will be slightly less than 6 inches wide and their weights may be adjusted by interpolation.

In this method of sampling, the size of the samples may be changed to adapt them to be weighed upon any customary ream scales. Thus, instead of samples 18 inches long, longer or shorter samples may be used so that the combined area of the eight sheets in each multiple sample is such that it may be weighed on any available ream scales.

I claim:

1. In the manufacture of a web of paper wherein a stream of an aqueous pulp suspension is deposited upon a moving screen, the method for determining the character of the web being produced which comprises severing a plurality of the outer convolutions of a reel of paper transversely of the reel along two spaced parallel lines extending across the entire width of the web to obtain a set of a plurality of superimposed pieces of paper equal to the number of said convolutions severed, severing said set of pieces of paper along spaced lines in the longitudinal direction of the web to obtain a group of a plurality of samples of paper from each of a plurality of narrow adjoining longitudinal portions of the web of equal width, the combined width of said portions being substantially equal to the width of the web, and weighing each of said groups thereby separately determining the average basis weight of each of said portions.

2. In the manufacture of a web of paper wherein a stream of an aqueous pulp suspension is deposited upon a moving screen, the method for determining the character of the web being produced which comprises severing a plurality of the outer convolutions of a reel of paper transversely of the reel along two spaced parallel lines extending across the entire width of the web to obtain a set of a plurality of superimposed pieces of paper equal to the number of said convolutions severed, and measuring the relative average basis weight of narrow adjoining portions of said set in the transverse direction of the web.

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