Nov. 24, 1964 C. F. GILBO 3,157,915

CONTROL DEVICE

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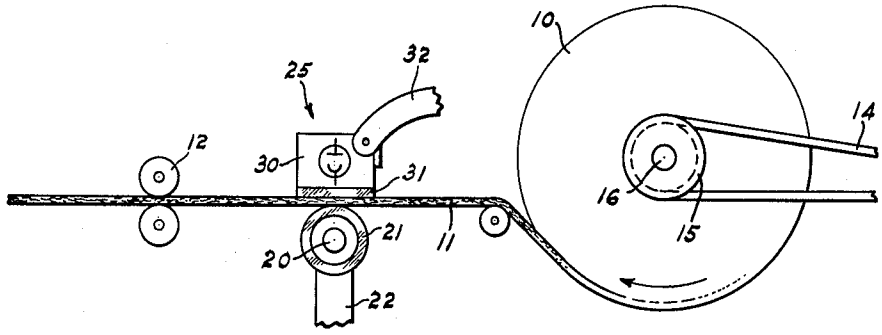

Fig. 1

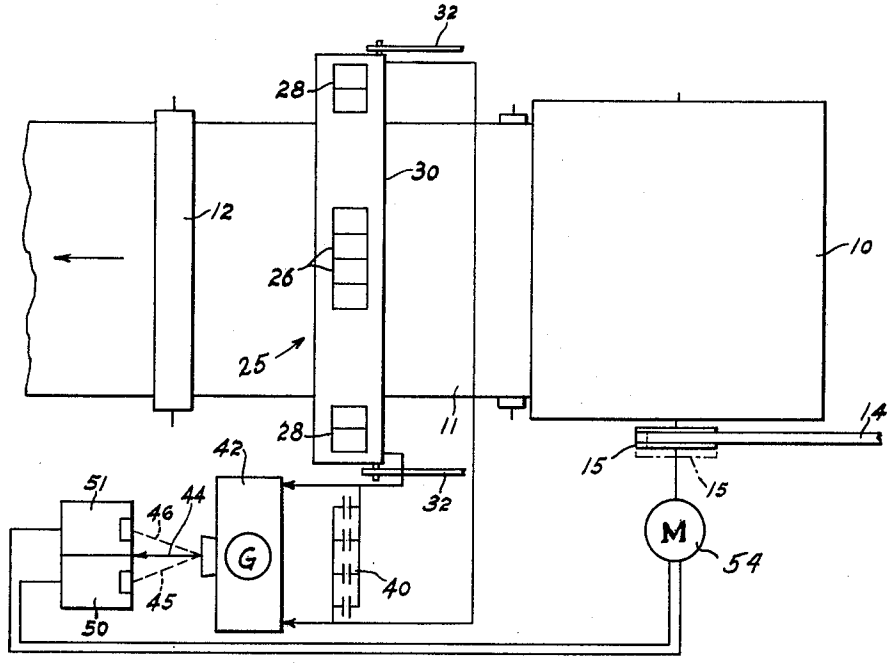

Fig. 2

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CONTROL DEVICE

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This invention relates to carding machines and more particularly to apparatus and a method for effectively controlling the density and thus the weight per unit length of a web emanating from the rotary doffer of a carding machine.

For many years substantial effort has been put forth in attempting to provide automatic means for controlling the output of carding machines. Uniformity of product is the goal. However, heretofore no commercially acceptable apparatus has been provided to achieve this end. In the absence of a control mechanism, the weight per unit length of a web leaving a carding machine may vary fifteen percent and more; and it is necessary for an operator to manually correct such variation.

In the hat making industry it is conventional to provide a double cone to receive the web from the carding machine. By rotating the cone the web becomes wrapped around it, and the web is allowed to wrap until a given number of wraps is attained. Then the product is split to form two separate conical workpieces which are removed from the double cone to permit the forming of subsequent workpieces. Each workpiece is manually weighed. If it is too light, material is added to bring it up to standard. If it is too heavy some of the web wrap is picked off to remove the excess. In a given day, the total of excess manually removed may run ten percent, not counting that which has been removed from one workpiece which is too heavy and placed on another workpiece which is too light. Such material is fed back into the machine for further carding.

Without the weighing of each workpiece and the manual addition or removal of material, workpieces of satisfactory uniformity could not be produced heretofore. A variation of fifteen percent, or even half that much, is unsatisfactory, first, because the variation in quality of the final product will render it commercially unacceptable, and secondly, the loss in raw material through excess use will render the manufacturing process unprofitable. In recent years, because of inflation, increased competition with products imported from other countries and other factors, the accurate control of product output has become even more important. In many areas of the industry in which carding machines are employed, a workpiece weight variation in excess of four percent is too great and not commercially acceptable.

Heretofore, it has been attempted to automatically control the output of a carding machine by radiation apparatus. Such apparatus has been unsuccessful because the equipment available is very costly and, more important, it has been unable to lower the variation in product output to commercially acceptable limits. Known apparatus operates on the theory that carding machines produce a substantially homogenous web, which is incorrect. The condition of a web in a given area is not necessarily representative of the condition of the web in another adjacent area.

Furthermore, radiation apparatus requires clean, substantially uniform conditions to produce a desired result for an adequate period of time. However, around a carding machine lint, dust and other matter is prevalent and the efficiency of a radiation source and detecting means incorporated into the machine will be adversely affected in a short time. Auxiliary devices may be provided for periodically cleaning the equipment. However, such devices add cost to the apparatus. Moreover, suitable cleaning apparatus is very difficult to provide. For example, an air stream could be used to clean lint off a detector. However, such air can do damage to the thin, fragile, tenous web coming from the carding machine.

A major object of this invention is to provide automatic apparatus and a method for controlling the density of a web emanating from the doffer of a carding machine, the weight of the end product being held to a variation within about two percent.

Another object of this invention is to provide web density control apparatus which is relatively low in cost.

Another object of this invention is to provide control apparatus and a method of the character described by which past as well as present variations in web density contribute to the control of a rotary doffer.

Another object of this invention is to provide apparatus and a method by which web variations are integrated to provide a steady, even control of doffer speed as contrasted with apparatus which provides quick, sharp speed changes responsive to each and every web density variation encountered.

Another very important object of this invention is to provide apparatus which will operate efficiently, effectively and continuously.

A further object of this invention is to provide web density control apparatus which is not rendered inoperative, or less efficient, by lint and the like around the carding machine.

A still further object of this invention is to provide fully automatic apparatus of the character described which wholly obviates the necessity for an operator to control the weight of workpieces formed from the web.

Other objects of this invention will be apparent hereinafter from the specification and from the recital in the appended claims.

In the drawing:

FIG. 1 is a generally diagrammatic side elevation of the output section of a carding machine having control apparatus associated therewith constructed according to this invention; and

FIG. 2 is a plan view of FIG. 1 and showing diagrammatically the components of the apparatus for controlling the output of the machine.

Referring now to the drawing by numerals of reference, 10 denotes the rotary doffer of a conventional carding machine and from which a web 11 emanates.

Associated with the doffer is conventional mechanism, not shown, which delivers the wool, cotton, fur, mohair, flax, alpaca, or other fibers thereto; and when it is stated hereafter that the speed of the doffer is controlled, it will be understood that the speed of the mechanism associated therewith is simultaneously and correspondingly controlled.

Web 11 is thin, delicate, tenuous, fragile, and film-like. It may be of various widths, depending on the size of the machine. In the hat making industry the web is about twenty-five inches wide. Because of its nature, radiation may be passed through the web. However, any physical disturbance of the web as it comes from the machine is undesirable. Drawing or pulling on the web to vary its density might break the web. However, the web is sufficiently strong that suitable tensioning rolls 12 may be employed to sustain the web as it comes from the doffer.

Doffer 10 is driven from a source of power, not shown, through an endless belt 14 extending around a variable sheave 15 connected to a shaft 16 of the doffer. As will be readily understood, by opening or closing the sheave the speed of the doffer can be varied. Also, as is well known to those skilled in this art, if the speed of the doffer is increased the thickness or density of the web

emanating therefrom will lessen. Conversely, when the doffer speed is decreased the density of the web will increase.

In order to regulate the density, thickness or weight per unit length of web **11** the apparatus of this invention is provided. It comprises radiation projection means **20** which may be a fluorescent lamp or the like to produce light of substantially uniform intensity and project it upwardly through web **11** from the underside thereof. Lamp **20** is disposed in a clear, glass-like member or tube **21** mounted on supports **22**. As shown in FIG. 1, the upper periphery of member **21** has direct contact with the underside of web **11**. This is done so that the member will be continuously wiped clean of lint by the web as it moves overhead whereby the intensity of the light projected up through the web is not impaired.

Positioned above web **11** in vertical alignment with lamp **20** is a transducer **25** comprising radiation detection or measuring means in the form of a plurality of interconnected barrier layer photoelectric cells **26** which are adapted to receive light projected through the web. There are also provided pairs of reference cells **28** at each side of the web which receive light direct so that any variations in the intensity of the light from lamp **20** can be noted whereby the control mechanism can be kept in proper adjustment. The photocells are mounted in an enclosure or box **30** impervious to light except for a glass-like member **31** which faces the top surface of the web. Enclosure **30** is mounted on arms **32** which position member **31** in physical contact with the top of web **11** whereby the web continuously wipes the member clean.

Connected across the output of the transducer is an integrating device **40** comprising condenser means in the form of a bank of condensers. The capacity of the condenser means is variable by adding or removing condensers from the bank of condensers. The photocells of the transducer are connected in a null balance circuit (bridge) and when the web weight is correct there is zero output. However, if the density of the web increases, the light projected to the photocells will decrease. Conversely, if the density of the web decreases, the light projected to the photocells will increase. Web density changes will thus produce a current or potential that varies plus or minus from zero, as the case may be.

The bank of condensers integrate the output of the transducer, considerable variation in output being required to produce a material variation in the potential of the condensers. Past output of the transducer contributes to the control provided as well as the output, or lack of it, at any given moment as the web moves by. Thus, while the photocells along the width of the web note density variations at a plurality of points and average the results, thereby giving a transverse component, the integrating device brings in a longitudinal factor and thereby provides integrated measurements over a period of time.

Suitably connected to integrator **40** is a galvanometer **42** of the optical type having light-ray indicator means. The galvanometer is balanced with the rest of the apparatus so that when the density of the web is correct, and the potential of the integrator is stable, the light-ray points center, as indicated by the arrow **44**. However, if the potential of the integrator drops, the galvanometer light-ray will swing over to position **45** at one side of center; and if the integrator potential rises, the indicator will swing to the other side of center to position **46**.

Mounted for actuation by the galvanometer light-ray are light responsive relays **50** and **51** connected to a reversible electric motor **54** connected to variable sheave **15**. Relay **50** causes motor **54** to run in one direction and relay **51** causes it to run in the opposite direction. Sheave **15** is thereby opened or closed as the case may be to speed-up or slow-down the speed of the doffer **10**.

The photocells, condensers, galvanometer, relays, reversible motor, sheave and various connections are all

standard, commercially available items. Equivalent items can be provided in the combination described. Further, after a particular machine has been equipped with the described control device and the whole system brought into control, then one condenser having a capacity equal to the sum of the bank of smaller ones may be used.

As previously stated, if the density of web **11** is correct as it passes between the light source and the transducer, the light directed to the photocells will be of correct intensity and the output of the transducer will be zero. If, at a given moment, an area of the web is too thin, one of the cells will receive excess light. At the same time, another adjacent area may be correspondingly too thick and another cell will receive too little light. However, the variations will be balanced out and the output of the transducer will remain zero even though web variations are occurring. The overall density and thus the weight per unit length of the web is the test and not the density in one small area.

In like respect, variations in output of the transducer at any given instant are disregarded. It is the integrated output over a period of time which produces an effect upon the galvanometer to bring about a speed change of the rotary doffer. Radical, sharp, instantaneous corrections in doffer speed are not made. The density of the web is regulated slowly through integrated variations. The end result is a degree of control of the web of the carding machine which has not been approached heretofore. Average density variations of about two percent or even less have been regularly achieved. Thus, the end product is of desired, uniform quality and an operator is not required for the machine.

Further, in view of the integration system employed, inexpensive components may be used in the apparatus. Costly amplifiers, servo-mechanisms, delicate speed control devices and the like can be dispensed with. Thus, the apparatus can be provided at low cost.

In view of the continual cleaning of the glass-like members of the light source and transducer, the efficiency of the mechanism remains high even after long use. Lint from the web, dust and other material cause no particular problem.

While this invention has been described in connection with a specific embodiment thereof, it will be understood by those skilled in this art that it is capable of many modifications, variations, and adaptations. This application is intended to cover any variations and uses which come within known or customary practice in this art or as fall within the scope of the invention and the limits of the appended claims.

Having thus described my invention what I claim is:

1. Apparatus for automatically controlling the density of a web emanating in a generally horizontal ribbon from the rotary doffer of a carding machine wherein the web is of such character that radiation may pass therethrough comprising, in combination, a lamp disposed beneath said web and projecting light upwardly therethrough, a first glass-like member disposed between said lamp and said web, means mounting said first member in direct contact with the underside of said web, a transducer comprising a plurality of connected photocells disposed transversely of said web to receive light passing through the web from said light projecting means, an enclosure for said photocells including a second glass-like member disposed between said photocells and the web, means mounting said enclosure with said second glass-like member in direct contact with the top of said web, said web sweeping across both glass-like members and thereby keeping them clean of lint, condenser means connected across the output of said transducer and the potential of which varies according to present and past output of the transducer, a galvanometer connected to said condenser means and having an optical indicator responsive to variations in potential of said condenser means, speed regulating means connected to said doffer,

and means interconnecting said galvanometer and said speed regulating means to operate the speed regulating means responsive to actuation of said indicator.

2. Apparatus for automatically controlling the density of a web emanating from the rotary doffer of a carding machine wherein the web is of such character that radiation may pass therethrough comprising, in combination, means projecting radiation through said web from one side thereof, a transducer comprising a radiation responsive means disposed at the opposite side of said web to receive radiation passing through the web, signal modifying means which reduces the effect of instantaneous variation in transducer potential, a galvanometer connected in circuit with said signal modifying means and having a light ray indicator which moves in response to the signal output of the signal modifying means, speed regulating means connected to said doffer, and light responsive means, connected to the speed regulating means, which senses change in position of the light ray indicator and controls the speed regulating means.

3. Apparatus for automatically controlling the density of a web emanating from the rotary doffer of a carding machine wherein the web is of such character that radiation may pass therethrough comprising, in combination, means projecting radiation through said web from one side thereof, a transducer comprising a radiation responsive means disposed at the opposite side of said web to receive radiation passing through the web, the radiation responsive means being arranged in a null balance bridge circuit, signal modifying means which reduces the effect of instantaneous variation in transducer potential, a galvanometer connected in circuit with said signal modifying means and having a light ray indicator which moves in response to the signal output of the signal modifying means, speed regulating means connected to said doffer, and light responsive means, connected to the speed regulating means, which senses change in position of the light ray indicator and controls the speed regulating means.

4. Apparatus for automatically controlling the density and thus the weight per unit length of a web emanating in a generally horizontal ribbon from the rotary doffer of a carding machine wherein the web is of such character that radiation may pass therethrough comprising, in combination, a lamp disposed beneath said web and projecting light upwardly therethrough, a first glass-like member mounted between said lamp and said web and in direct contact with the underside of the web, a transducer comprising a plurality of connected photocells disposed transversely of said web to receive light passing through the web from said lamp, an enclosure for said photocells including a second glass-like member mounted between said photocells and said web and in direct contact with

the upper side of the web, said web sweeping across both glass-like members and thereby keeping them clean of lint, condenser means connected across the output of said transducer and the potential of which varies according to present and past output of the transducer whereby average light variations over a period of time are obtained, speed regulating means connected to said doffer, and means interconnected between said condenser means and said speed regulating means for varying the speed of said doffer responsive to the average light variations.

5. Apparatus for automatically controlling the density and thus the weight per unit length of a web emanating from a textile machine responsive to the rotation of a rotary element, wherein the web is of such character that radiation may pass therethrough comprising, in combination, means projecting radiation through said web from one side thereof and across a substantial portion of the width of the web, a transducer comprising radiation responsive means disposed at the opposite side of said web and across a material portion thereof to receive radiation passing through the web, condenser means connected to said transducer to continuously receive the output therefrom and the potential of the condenser means varying according to present and past output of the transducer whereby radiation variations are averaged over a period of time, speed regulating means connected to said rotary element, and means interconected between said condenser means and said speed regulating means and responsive to variations in the potential of the condenser means for controlling the operation of said speed regulating means.

6. Apparatus for automatically controlling the density and thus the weight per unit length of a web as recited in claim 5 wherein said radiation projecting means comprises a light of substantially uniform intensity and said transducer comprises photo sensitive means at locations across the web.

References Cited in the file of this patent

UNITED STATES PATENTS

2,105,715	Birch	Jan. 18, 1938
2,466,615	Rusca et al.	Apr. 5, 1949
2,633,738	De Boisblanc	Apr. 7, 1953
2,679,746	De Boisblanc	June 1, 1954
2,795,012	Gibson et al.	June 11, 1957
2,805,449	Martin	Sept. 10, 1957
2,885,660	Hecox et al.	May 5, 1959
2,950,508	Locher	Aug. 30, 1960
2,964,803	Robinson	Dec. 20, 1960

FOREIGN PATENTS

500,240	Belgium	Jan. 15, 1951