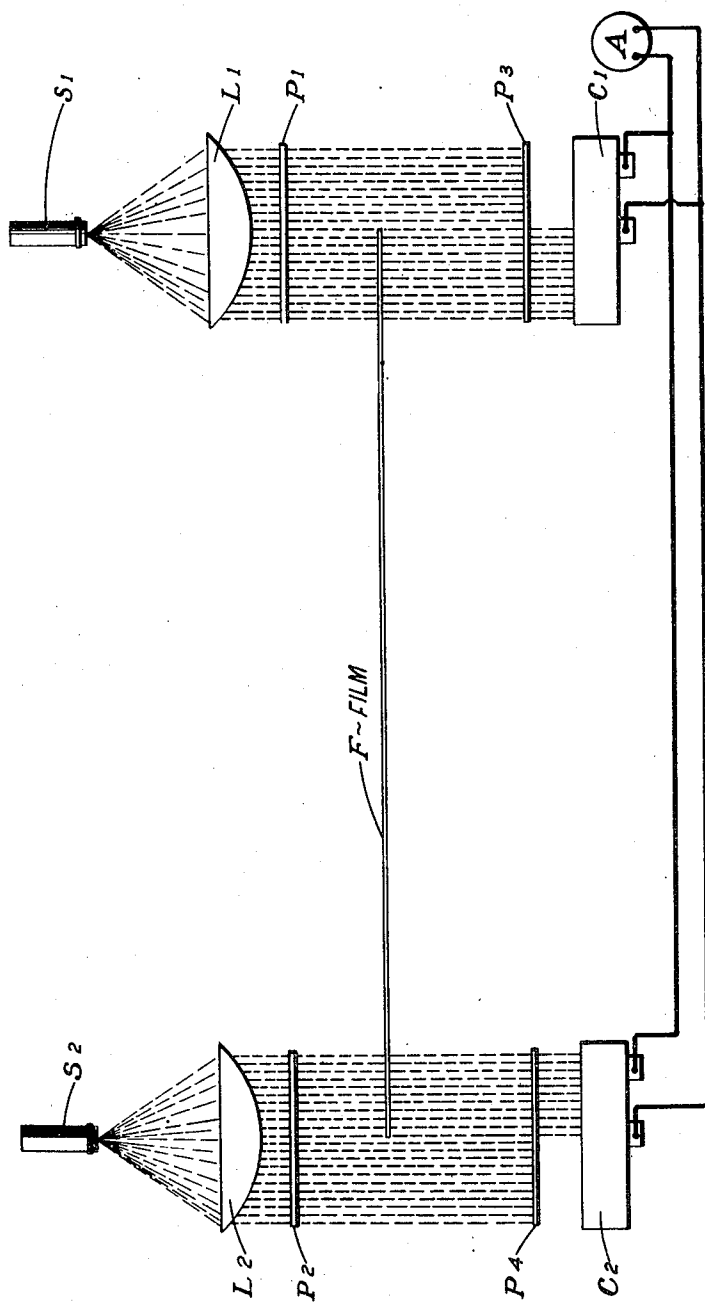


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POLARIZED LIGHT SYSTEM FOR DETERMINING VARIATIONS
IN THE WIDTH OF A WEB OF TRANSPARENT FILM
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POLARIZED LIGHT SYSTEM FOR DETERMINING VARIATIONS IN THE WIDTH OF A WEB OF TRANSPARENT FILM

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1 Claim. (Cl. 88-14)

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This invention relates to the manufacture of film, and more particularly to means for measuring variations in width of continuous, traveling webs of transparent birefringent film.

In the manufacture of transparent birefringent film from synthetic materials such as regenerated cellulose, cellulose acetate, cellulose nitrate, polyvinyl alcohol, rubber hydrochloride, etc., the film is customarily cast in continuous lengths of relatively great width, and the dried film is collected or wound on a mill roll. Thereafter, to eliminate the edge "bead" which forms during the casting operation and to convert the wide film into a plurality of films of lesser widths, the film from the mill roll is generally passed through a slitting machine. To properly adjust the slitting knives of the slitting machine, particularly with a view to reducing waste incident to eliminating the edge "bead," it is desirable to know beforehand the maximum variation in the width of the film so that the knives can be set to sever the bead without at times cutting off with the bead appreciable widths of good film. Film width gauges heretofore employed, operating on purely mechanical principles, have not proven satisfactory either because they do not measure film width accurately irrespective of the unavoidable side sway of traveling film, or they have been so complicated in construction and operation as to be commercially impractical.

The principal object of my invention, therefore, is to provide a simple and inexpensive means for accurately and continuously gauging the width of a traveling web of transparent birefringent film before it is collected on the mill roll.

Another object is to provide a means for gauging the width of a traveling web of transparent birefringent film, which means is continuous and instantaneous in action and accurate in the extreme.

A still further object is to provide a means for continuously gauging film width independent of side sway of the traveling web of film.

These and other objects will more clearly appear from the following description which is to be read with reference to the accompanying drawing wherein the figure is a diagrammatic illustration of a preferred arrangement of apparatus for gauging film width in accordance with the principles hereinafter described.

The above objects are accomplished by my invention which, briefly stated, comprises passing each edge of the traveling web of transparent birefringent film to be measured through a beam of plane polarized light the two beams being pro-

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duced by identical optical systems disposed at the edges of the web and aligned in a direction parallel to the transverse axis of the web, each system consisting of a source of light of constant intensity and two separated polarizers set to extinction and between which the edge of the web travels, and continuously measuring, and preferably recording, the amount of light transmitted by the system of polarizers by reason of the birefringent film intersecting the two beams of plane polarized light. Any variation from a predetermined total response will be a measure of the variation of the width of the web of the film, independent of film sway.

Referring now to the drawing in which like reference characters indicate like parts, two identical optical systems are mounted in transverse alignment at the edges of the traveling transparent birefringent film *F*. These systems consist of light sources *S*₁ and *S*₂ of constant intensity, collimating lenses *L*₁ and *L*₂ for directing the light to form broad uniformly illuminated fields, polarizing devices *P*₁ and *P*₂, e. g., Nicol prisms or other polarizers for converting the light from the collimating lenses to plane polarized light whose electric vector is at 45° to the machine (i. e. longitudinal) and transverse directions of the film, a second set of polarizers *P*₃ and *P*₄ set for extinction with *P*₁ and *P*₂, respectively, and photoelectric cells *C*₁ and *C*₂ positioned to receive any light transmitted by polarizers *P*₃ and *P*₄. The electric output of cells *C*₁ and *C*₂ is measured by any suitable means such as a recording ammeter *A*, calibrated to read directly in units of length.

The operation of this arrangement is as follows: Since polarizer *P*₃ is set for extinction with polarizer *P*₁, and polarizer *P*₄ is set for extinction with polarizer *P*₂, it is obvious that no plane polarized light will be transmitted to photoelectric cells *C*₁ and *C*₂, and so long as the beams between *P*₁ and *P*₃, and *P*₂ and *P*₄, respectively, are not interrupted no response will be obtained from the cells *C*₁ and *C*₂. However, in operation the edges of the transparent birefringent film *F* pass through, and hence intercept, a portion of each beam and convert the light in the intercepted portion of the beam from plane polarized light to light of different polarization (e. g., elliptically polarized light in the case of birefringent regenerated cellulose film), which light passes through polarizers *P*₃ and *P*₄ to energize cells *C*₁ and *C*₂. The extent to which cells *C*₁ and *C*₂ will be energized will depend, of course, upon the amount of light transmitted by the polarizers *P*₃ and *P*₄ which, in turn, will depend upon the area of film

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intercepting the beams. The response of cells C₁ and C₂ is thus a function of the area of film passing through the beams of plane polarized light, which area is, of course, directly related to the width of the film. The system is calibrated so that a given total response from the cells represents a web or film of predetermined width. Any deviation from this total will, therefore, represent a variation in the width of the film, and, as stated previously, it is desirable that the instrument A recording the total response from the photoelectric cells be calibrated to record the variation directly in terms of suitable units of length.

In its course of travel through the casting machine and to the mill roll, the film, on occasion, for one reason or another, tends to sway or weave from one side to the other. This action, however, has no effect on the accuracy of the measurements made in accordance with the principles of my invention, for it will be obvious that as one edge portion of the film shifts out of one beam of polarized light, due to film sway, an equal amount of film will move into the other polarized beam of light whereby the total response from the two photoelectric cells remains unchanged. An increase or decrease in the total photoelectric response therefore truly signifies, in every instance, an actual proportionate increase or decrease in the width of the web of film.

In the preferred arrangement above described, the response or energy output of each photoelectric cell fluctuates in accordance with the area and intensity of the beam transmitted thereto by the adjacent polarizer. In some instances, however, it may be desirable to render the photoelectric cells responsive to fluctuations in intensity only, and this may be accomplished by adding a condensing lens between the polarizer and the photoelectric cell and focusing the light to a spot on the cell. Additional modifications, such as the use of color filters, masks to eliminate stray light and/or to correct the response of the cell to a straight-line relationship, retarding plates, and other applicable optical accessories, and the substitution of photometric devices for the photoelectric cells, as well as other obvious variations are within the purview of my invention.

By reason of the practice of the method and apparatus of my invention, it is now possible to secure at minimum cost an accurate and constant measurement of the width or width variation of a traveling film in a casting machine, coating tower, or the like, whereby the operator is enabled at a glance to determine at what points the slitting knives of the slitting machine should be set to eliminate edge "bead" with a minimum loss of film and to slit the film to best advantage.

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Inasmuch as variations in the width of film are generally caused by faulty operation of the casting hopper, the present invention affords a continuous check on the operation of the hopper and by observing fluctuations in film width the operator is enabled to judge the need for adjustment and to make the adjustment as soon as the need arises, with the result that a film of more uniform quality is produced.

In contrast with previous devices for the purpose, an outstanding advantage of the present invention resides in the fact that the film width is gauged independently of the sway or weaving of the film from side to side on the machine, and this desideratum is accomplished without resort to complicated mechanical arrangements which are expensive to manufacture and difficult to maintain in operation.

As many apparently different embodiments of the invention can be made without departing from the spirit and scope thereof, it is to be understood that said invention is not to be restricted save as set forth in the appended claim.

I claim:

Apparatus for gauging width variations in a web of transparent birefringent film traveling in a fixed path which comprises two identical optical systems disposed at the two edges of the path of travel of the web on a line parallel to the transverse axis of the path of travel of the web, each of said systems comprising a light source, the light sources being of equal and uniform intensity, a first polarizing means aligned with said light source for converting light from said light source to a beam of plane polarized light, a second polarizing means disposed to receive the beam of light from said first polarizing means and set for extinction with said first polarizing means, and a photoelectric cell disposed to be energized by light transmitted by said second polarizing means, said first and second polarizing means being further so disposed that the path of travel of the web passes therebetween and intercepts transversely a part only of said beam, and means for measuring collectively the responses of the photoelectric cells, variations in said total response being a measure of the variation in the width of the web of film.

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