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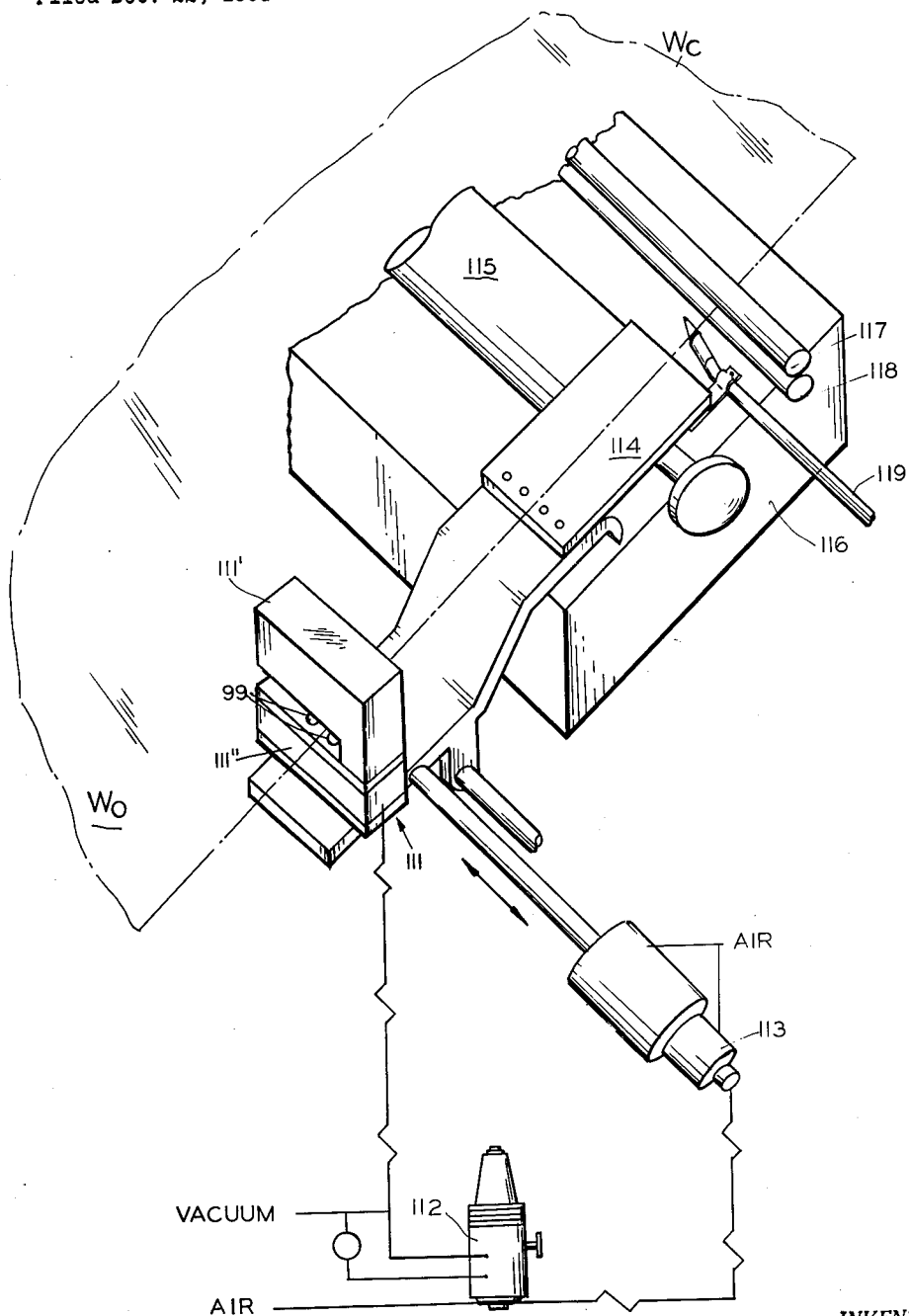
H. A. KAHN ETAL

3,032,006

WEB TREATMENT

Filed Dec. 22, 1958

2 Sheets-Sheet 1



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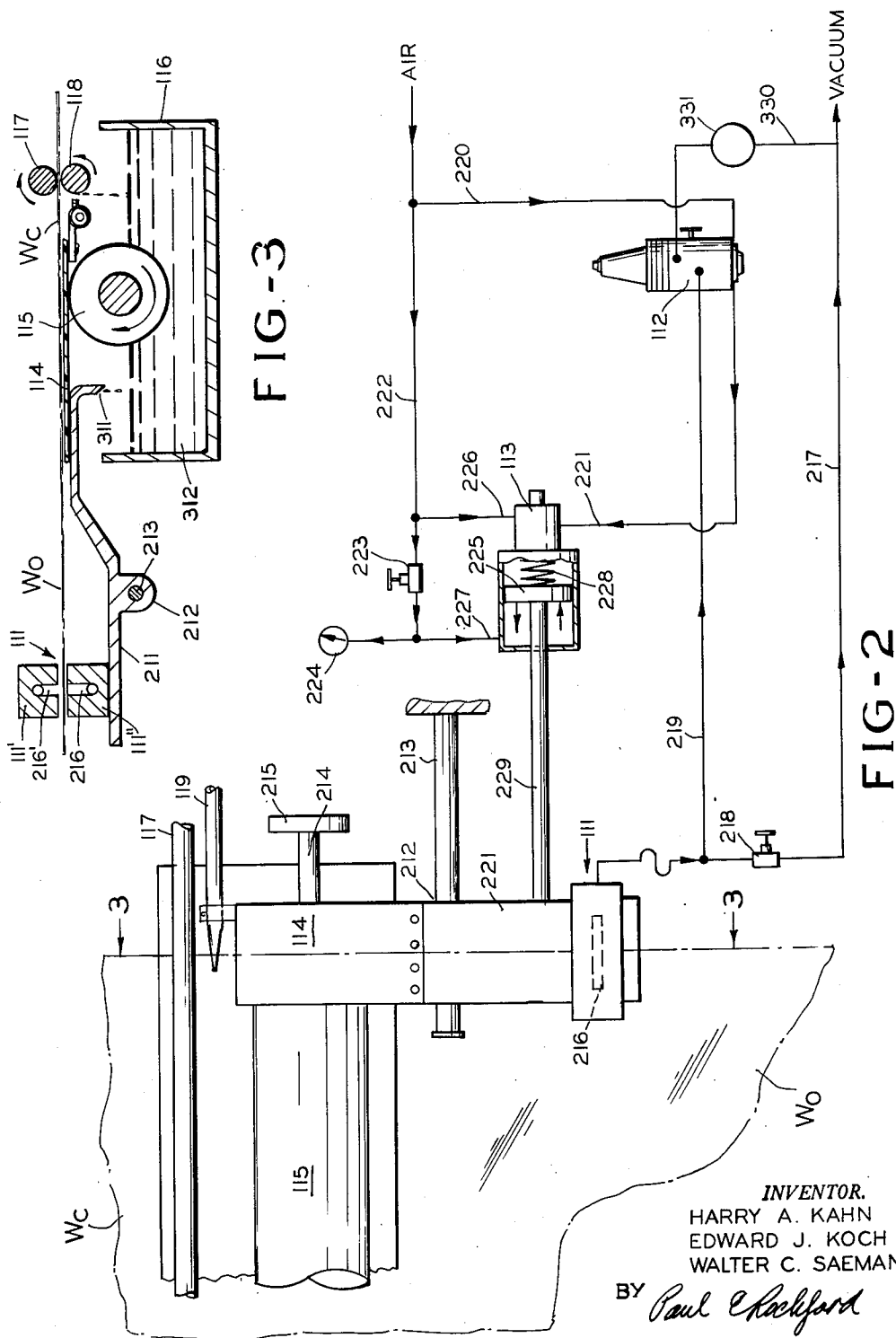
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WEB TREATMENT

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6 Claims. (Cl. 118-8)

This invention relates to a process and apparatus for coating a web, and more particularly, to a process and apparatus for restricting the application of a coating to a web near its edge.

Heretofore, in coating a web such as a web of cellophane, polyethylene, polypropylene, polyethylene terephthalate, rubber hydrochloride, etc., it was common practice to apply the coating by using an applicator roll, then subsequently to pass the coated web between pinch rolls to squeeze off the excess coating fluid and then to cure the coating. The customary applicator roll normally applied an excess of coating to the web. The pinch rolls, through which the web subsequently passed, then adjusted the thickness of the coating by squeezing excess coating material off the web. The coated web was then passed through a curing stage.

One of the difficulties that heretofore existed in the process recited above pertained to the step of squeezing off the excess coating. In this step the excess coating fluid tended to spread out in the nip of the pinch rolls. The liquid contained in said nip spread laterally and flowed over the edge of the web, thereby wetting the outer edge of the pinch rolls. Occasionally, the coating material, upon drying, fouled the rolls. Since the coating thickness is predicated on the maintenance of precise and fixed dimensions on the pinch rolls, it is necessary to keep the pinch rolls clean. Any coating material which adheres to the roll surface changes the thickness dimensions and by such changes, the coating thickness and texture is affected.

Although it was known that fouling of the pinch rolls surface could be prevented by maintaining a narrow width of uncoated web on each of its edges, this could not be effected because of the lack of a suitable control. This is particularly so where a narrow margin of a small fraction of an inch must be maintained on a web traveling at speeds up to two hundred feet per minute and higher.

The prior art reveals that several means of control were attempted but these means were not found to be as successful as desired. One example of a remedy that was attempted was an applicator roll whose length was shorter than the width of the web being coated. In use, however, this system was replete with difficulties in that it required very precise positioning of the web with respect to the applicator roll to prevent the off-center application of the coating. Width variations in the web caused this positioning to be extremely difficult, if not impossible, and on such occasions, particularly when the total width of the web was suddenly reduced, the liquid was able to flow over the edge of the web. If sufficient latitude be left to account for these width variations in the web, an excessive amount of uncoated web on each side results and, therefore, increases the amount of "necessary" scrap.

Another example of a remedy that was attempted is seen in U.S. Patent 1,826,698 in which an applicator roll larger than the width of the web was used. A staggered arrangement of doctor blades wipes off the excess coating fluid located near the edge of the web and the web is then passed through pinch rolls. In practice, however, this remedy is also not as successful as it may seem because width variations in the web necessitate edge scraping large areas on each side. Due to the fact that large

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areas are scraped, a large amount of scrap results. Where no large allowance is provided, the doctor blades occasionally do not sufficiently remove the fluid, or else do not even come in contact with the web near its edge and, hence, only an improper wiping can result.

An object of this invention is to provide an improved method and apparatus for coating film. A further object of this invention is a method and apparatus for coating a web which automatically applies the coating only to the desired center area portion of said web. A still further object of this invention is a method and apparatus which automatically prevents coating material applied to one side of a web from flowing onto the uncoated side during the coating operation. Another object of this invention is a method and apparatus which automatically prevents undue waste of the coating and the web material by reason of the fact that the coating is applied only to the useful area of the web. A further object is to apply a fluid coating so as to leave a substantially uniform narrow band of uncoated web at each longitudinal edge. Other objects will in part, be pointed out, and in part, become apparent to those skilled in the art upon reading the following detailed disclosure.

It has now been found that to accomplish the objects enumerated above, the coating fluid should be applied only to the central portion of a web by the use of automatically adjustable web edge shields so that upon subsequent doctoring treatment the excess coating fluid will not flow over the edge of the web. More particularly, this invention utilizes an applicator roll which is wider than the web to be coated but application of the coating composition to the edge surfaces of the web is prevented by the use of thin flexible edge shields. These shields are automatically adjustable depending upon the width of the web and are of such composition that the coating fluid does not adhere, corrode or otherwise foul the shields and are of such physical characteristics that they do not wrinkle, distort or otherwise interfere with the passage of the web over the applicator roll.

The shield is fastened to a movable arm actuated by a cylinder or other suitable operating means and positioned through the action of a sensing device which detects the position of the edges of the web and which is also fastened to the movable arm.

If the web edges shift position due to a general position shift of the web, or to dimensional changes in the web, or to wrinkling, the shields over the ends of the applicator roll shift in a substantially identical manner to maintain a substantially uniform clearance between the edges of the web and the edges of the applied coating composition. Therefore, the application of the coating fluid is limited to only a centrally located portion of the web so that upon subsequent spreading by the pinch rolls the composition spreads only laterally for a distance less than the entire width of the film. To further insure against undue lateral spreading, air jets located on the applicator side of each edge of the pinch rolls may be used. These may also be made automatically adjustable by mechanically coupling them to the movable shield assembly. Thus, in spite of the occurrence of position shifts, width changes, wrinkles or other similar phenomena, a centrally located coating may be applied regardless of the width of the web.

The invention can be more aptly described by reference to the accompanying drawings, in which:

FIGURE 1 discloses a pictorial view of an embodiment of a device that may be used for this invention,

FIGURE 2 discloses a detailed plan view of the edge detector and shield positioning device used in the embodiment shown in FIGURE 1, and

FIGURE 3 discloses a side elevational view of the edge

detecting and shield positioning devices shown in FIGURE 2 taken on line 2'-2'.

In FIGURE 1, web W_0 is shown with an edge passing through an edge detector 111. This edge detector relays the signal indicating the exact position of the edge of the web to a controller 112. Depending upon the needs of the situation, such as for example, a shifting of the edge of the web or of the shield, the controller activates the positioner 113 which in turn moves the edge detector and the shield 114 in a movement lateral to the web by coordinating the signal indicating the exact position of the web with respect to the shield so that a predetermined amount of edge material is shielded from the applicator roll 115. Thus the web W_0 will only be coated in a predetermined central area of its surface. In FIGURE 3, the applicator roll 115 is shown having its lower edge portion dipped into an applicator pan 116 while its upper edge coats the web. The coated web is then passed through a series of pinch rolls 117 and 118 which aids in controlling the amount of coating composition on the film to that which can pass through the nip of the pinch rolls. Excess coating from the pinch rolls falls back into the applicator pan.

To prevent undue lateral spreading of the coating composition over the edge of the film, an air jet 119 located at each edge is used. It is to be understood, however, that this air jet may not be required if a very specific control can be had over the manner and degree of area coated. It may also be made automatically adjustable by mechanically coupling it with the movable edge detecting and shielding device. A coated web W_c is shown emerging from the treatment between the pinch rolls having a coating thereon which is disposed centrally upon the face of the film.

In FIGURE 2, which shows a top plan view of the edge detector and shield device, as well as the applicator roll and also a detailed view of the controller and positioning devices, the edge detector is shown as a pressure sensitive type edge indicating gauge. This detector 111 is shown mounted upon holder 211 which also is used for the purpose of holding shield 114. This holder has a joint 212 capable of sliding in a movement lateral to the edge of the web upon slide 213. This slide is mounted upon the web manufacturing or handling machinery at a point and in such fashion that a minimum of vibrational and other extraneous forces will be transmitted to the edge detector and shield device sliding thereon. Slide 213 is of such length that it will take into account large width variations of the web being manufactured or handled.

The uncoated web W_0 is shown passing over this edge detector and shield holder 211 and coming into contact with the unshielded surface of applicator roll 115 in passing over it. The applicator roll obtains its coating from applicator pan 116 as it revolves about its axle 214 driven by pulley 215.

The edge detector 111, as shown in the figures, is of the pneumatic type. Preferably it operates responsive to the change in flow of gas at relatively low velocity and relatively low pressure above atmospheric. In addition it is preferably capable of a proportional response to a change in gas flow. This feature is particularly desirable where the web moves at high linear velocity as will be more fully pointed out below.

As the edge of the web W passes over opening 216 in the edge detector 111, a variation in the pressure in the process line 219 occurs, the pressure being regulated from an outside source, by means of conduit 217 having valve 218. This variation in vacuum is detected by controller 112 which may operate on the pneumatic "null" balance principle described in the September, 1945, issue of Instruments Magazine (page 598). A source of constant pressure, preferably below atmospheric, is supplied to the controller by conduit 330 having regulator 331, in order to maintain a desirable reference pressure level.

In the system shown, when a variation in pressure occurs, the controller activates the positioner by varying the amount of air pressure supplied to the positioner through conduit 221. This activating pressure is also supplied from an outside source, in this case, through conduit 220. This positioning is accomplished by means of the diaphragm and nozzle arrangement in the controller as discussed in the cited article appearing in Instruments Magazine. Additional pressure, needed for rapid movement of the piston 225 of the positioner, is supplied through conduit 222, this line being provided in addition with valve 223, gauge 224 and branch lines 226 and 227.

When a movement toward the center of the web is required, the air pressure on the spring side of the piston 225 of the positioner 113 is increased in response to greater gas flow through controller 112. If movement away from the center of the web is required, the air pressure on both sides of the piston is changed toward a balanced pressure so that spring 228 may cause such movement.

A more detailed discussion of the positioner can be seen in an article appearing in the September, 1951, issue of Product Engineering (page 151). For transmitting the force of movement of the piston 225 to the edge detector and shield holder, connector rod 229, which connects the piston to the holder, is used. For the rapid movement of this detecting and shielding combination which is necessary when the edge of film detected is traveling at high rates of speed, in excess of one hundred feet per minute, the construction must be light in weight. The device has been found to be suitable for tracking the edge of a cellophane web traveling at a linear velocity of over two hundred feet per minute and in continuously shielding about one quarter inch of each edge of the web although the position of each edge varied by as much as three times this distance.

In FIGURE 3 there is shown a detailed side view of the edge detector and shield device taken on line 2'-2' of FIGURE 2. As shown, the web W_0 passes between the jaws of the detector 111'' and 111' and past edge detector 111, and then across the shield 114. It is to be noted that the width dimensions of the shield are over-exaggerated in the view shown. The edge detector is mounted upon holder 211 which has slidable joint 212 so as to be able to slide upon axle 213. The holder 211 is also used for the purpose of supporting shield 114 which is also mounted to its body.

The holder 211 is provided with a drip spout 311 for the purpose of facilitating easy return of excess coating solution, deposited upon the shield, to the body of coating composition 312 contained in the applicator pan 116.

Coating composition is constantly applied to the web W by means of applicator roll 115. Coated web W_c is that portion of the web to the right of the wall 115. After contacting the roll, it is passed through pinch rolls 117 and 118 where the coating composition is spread laterally. Excess coating falls from the pinch rolls back into the applicator pan.

In operation, the web W_0 is fed to the apparatus to pass its edges through a set of edge detectors to indicate the position of each edge of the web. Each detector sends a pressure signal which indicates the position of the edge of the web to a controller which in turn activates a positioner. The positioner moves the edge detector and shield combination mounted on holder 211 in a lateral movement as required, either to or from the edge of the web.

The shield position relative to the web edge may be adjusted for the purpose of shielding a certain distance in from the edge of the web, either before or during the coating operation. Once this is done, the web as it passes over the applicator roll, is coated only in the central portion of its surface, and hence movement through and treatment by the pinch rolls 117 and 118 will effect only a lateral spreading of the coating. The shield position adjustment is such that the spreading will not cause

movement of coating composition beyond a point removed from the edge of the web. This prevents undue fouling of the pinch rolls as well as undesired coating of the underside of the web.

To further effect a desired control of the spreading of the coating, air jets 119 may be located at each edge of the web on the applicator side of the pinch rolls. These may be made automatically adjustable by mechanically coupling them to the adjustable edge detecting and shield positioning device.

While a specific embodiment of an apparatus that may be used in this invention has been shown, it is to be understood that other variations and modifications may be made in the apparatus without departing from the spirit and scope of this invention.

The edge detector used in place of the type shown above may consist of an air jet type detector in which a plurality of air jets are disposed in an array laterally across the edge of the film. These jets can thus be directed across and against the edge of the film so as to impinge in part upon a nozzle or receiver opening or openings on the other side of the web. Thus, shielding, by the edge of the web, of some of the jets will give an indication of the position of the edge of the web. One essential feature of the subject device and method is that it is capable of detecting the exact position of the web edge and not simply whether it is shielded or not. Thus, the detection and correction of the extent of shielding is continuous rather than intermittent. This, in addition to a light weight construction and proportional response to change in web position, is essential to tracking and reliably masking a narrow margin of each edge of the web simultaneously. Such reliable masking is required to minimize the formation of a waste uncoated edge region of large dimensions and at the same time to avoid fouling of the apparatus beyond the roll 115.

For the controller, the type used in the embodiment shown above is of the pneumatic control relay type. The particular apparatus used was manufactured by the Moore Company of Philadelphia, Pennsylvania, and is known as the Moore Nullmatic M/F No. 68WT17. Obviously, other control relays may also be used, either in conjunction with the variations of the edge detector disclosed above or with other modifications embodying the same principles but not here disclosed. Besides this pneumatic control relay, one may also use an electronic circuit type relay in which a signal from the edge detector is picked up, converted to a proportional electrical signal, and utilized to activate the positioner. The signal from the edge detector, depending upon whether it is used directly in the pneumatic form, or converted proportionally to an electrical form, would have to be provided for accordingly. It is preferred to use the pneumatic signal to generate a proportional response for reliability and economy of operation.

The positioner shown in the embodiment of the drawings is made by the Curoflow Corporation of Philadelphia, Pennsylvania. It is to be understood, however, that other shield positioners may also be used.

The signal transmitting means between the edge detector, controller, and positioner may be either pneumatic, electrical, or mechanical, depending upon the needs of the situation.

With respect to the shield, it may be constructed of any material which is unaffected by the coating composition and may be flat or curved to an extent depending upon the needs of the situation. One material in particular is a plastic known as Teflon, or more technically, polytetraethylfluoroethylene. Other materials such as hard rubber sheeting, relatively stiff vinyl sheeting, etc., may also be used.

While a detailed description of this invention has been provided, it is realized that those skilled in the art may make modifications and adaptations of the process and apparatus described without departing from the spirit and scope of the invention. This application is a continua-

tion in part of the application, Serial Number 456,114, filed September 15, 1954, and now abandoned.

Among the alternative modes of practicing the invention are the following:

The detector for the edge of a web which is not subject to large lateral displacement relative to the detector may be fixed rather than movable. It may be for example positioned at a web edge location which just precedes the surface at which the web is to be contacted. A plurality of orifices such as orifices 99 of FIGURE 1 adapted to deliver gas to a corresponding set of orifices not shown in gas receiving means may be used with such a detector as for example in the opposing jaws 111' and 111'' of the edge detector 111 of FIGURE 1. One particularly advantageous arrangement of orifices in a detector jaw is one having a longitudinal as well as a lateral separation, for example, in the rectangular platforms, forming the inner and opposing surfaces of the detector jaws, the orifices may be located along a diagonal of the rectangle or along a line which crosses a line approximating the average position of the web edge, at a relatively small angle of the order of ten degrees. When the orifices are so positioned, a closer control may be maintained over the location of the web edge because the orifices have a closer lateral position than when they are aligned along a line normal to the web edge. This longitudinal spacing increases the efficiency and accuracy of edge detection in addition because it materially reduces the flow of gas between orifices which are not positioned in direct alignment.

The avoidance of the lateral flow of gas in passing between the jaws of the detector is important in reducing the tendency of the device to give inaccurate readings. Such flow can result in a pressure reading above or below that which accurately indicates the true position of the web.

Where rapid lateral movement of a web must be detected in order to make rapid corrective adjustments in an apparatus, an elongated slit or row of orifices aligned normal to the web edge are satisfactory for dispensing and receiving a flow of gas between two jaws of a detector.

Where the control must be of a finer order, or where other factors may interfere with the normal operation of the detector, alignment of two sets of orifices along a diagonal or along a line which is set at a small angle to the web edge is preferred. Factors which can interfere with pneumatic web edge detection are excessive flutter of the web edge, curve or other distortion of the web edge and the like. These faults can be accurately determined as indicated above.

In an alternate scheme for edge detection, the range of proportional pneumatic signals subject to faults as described above is minimized by restricting the pneumatic signal to a narrow range of film deviation defined by two sets of orifices in opposed jaws of the detector head. In this instance the detector head generates a 3-level pneumatic signal indicative respectively of a film position in which both jets are obstructed; a position in which only one jet is obstructed; and a position in which neither jet is obstructed. By spacing the jets close together with respect to the edge of the film the head may be made very sensitive to small film deviations. However, in view of the narrow spacing of the jets the head must thereupon be made movable and made to follow the film in order to be adaptable to wider range of edge deviations without sacrificing either sensitivity or reproducibility of the pneumatic signal.

Since many examples of the foregoing procedures and articles may be carried out and made, and since many modifications can be made in the procedures and articles described without departing from the scope of the subject invention, the foregoing is to be interpreted as illustrative only, and not as defining or limiting the scope of the invention.

We claim:

1. Apparatus for limiting contact of the edge of a moving web with a surface brought into contact with the web which comprises a relatively thin light weight continually movable shield disposed between said web edge and said surface, said shield being mounted for continual lateral movement with respect to said web edge by a continual positioning means, pneumatic web edge detecting means mounted for lateral movement with said shield to continuously detect the web edge position before said surface is contacted by said web, and means for activating said positioning means continually responsive to a signal from said detecting means.

2. The apparatus of claim 1 wherein the response of said positioning means is proportional to the magnitude of the signal received.

3. The apparatus of claim 1 wherein the pneumatic web edge detecting means produces a signal proportional to the lateral displacement of said web with reference to said detecting means.

4. In a continuous web coating apparatus comprising a source of coating composition, an applicator roll adapted to rotate to transfer said coating continuously from said source to a continuous web passing into contact with the upper surface of said roll, the improvement which comprises shields capable of lateral reciprocal motion and interposed at both ends of said roll between said roll ends and the edges of said web to prevent transfer of said composition to said web edges, separate automatic means for the lateral positioning of each of said shields responsive to changes in the lateral positions of said web edges, each such automatic means comprising a sensing means attached to one of said shielding means for simultaneous lateral movement therewith by a positioning means, said sensing means comprising a housing adapted to be evacuated, the upper surface of said housing being provided with a laterally disposed elongated slit opening adapted to admit gas to said housing, the pressure in said housing being detected by a pressure sensing element adapted to detect pressure proportionately above and below a null pressure, means for positioning said sens-

ing and shielding means laterally of said web edges responsive to a change in pressure in said housing above said null pressure to advance said shielding and sensing means toward said web edge, and acting responsive to a change in pressure below said null pressure to retract said means away from said web edge.

5. The apparatus of claim 4 wherein the response of said positioning means is proportional to the change in pressure detected.

6. Web edge tracking apparatus for detecting the edge of a web comprising a detector head mounted for lateral movement relative to the edge of a moving web, positioning means for moving said head responsive to signals from said detector, said head having two jaws extending outwardly therefrom and disposed to provide two opposing faces between which a web edge may move, said faces having therein two sets of orifices aligned approximately perpendicular to said edge to permit a flow of two jets of gas between said jaws, pressure sensitive means in said detector for detecting three pressure levels indicative respectively of a film position in which both jets are obstructed, a position in which only one jet is obstructed, and a position in which neither jet is obstructed, said positioning means being adapted to move said detector to bring said edge into lateral registry between said sets of orifices.

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