SECTIONAL DRIVE APPARATUS FOR CONTINUOUSLY FEEDING AN ELASTIC MATERIAL

INVENTORS

ARNOLD A. ENNEPER

ANTHONY R. WIERZBA

ATTORNEYS
SECTIONAL DRIVE APPARATUS FOR CONTINUOUSLY FEEDING AN ELASTIC MATERIAL

Arnold A. Enneper and Anthony R. Wierzb, Green Bay, Wis., assignors, by mesne assignments, to International Paper Company, New York, N.Y., a corporation of New York

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7 Claims

ABSTRACT OF THE DISCLOSURE

A plurality of sectional drives feed a web of elastic material along a predetermined path of travel during which successive operations are performed upon the web. The sectional drives operate to move the web through the various operating stations at respective linear speeds, the respective speeds being adjustable relative to one another, thereby controlling the tension in the web at various stations so that a given length of web has a predetermined mass at various stations to provide an accurate registration of various operations on the web.

This invention relates to an apparatus for feeding a web of stretchable material and performing successive operations thereupon.

The present invention is described in connection with an elongated, continuously traveling web of creped tissue on which is carried an absorbent pad of fibrous material. The pad and web are formed into a pleated disposable diaper by a number of operations performed in registry. During formation of the diaper, the pad and web stretch to various degrees and, unless this stretch is compensated for, the various operations performed on the pad will be out of registry. In the illustrated form of diaper, which is substantially similar to the diaper shown in the co-pending application of James A. Murphy, Ser. No. 494,573, filed Oct. 11, 1965, and entitled, "Disposable Diaper," now U.S. Pat. 3,430,629, the creped tissue web is folded about the pad by folding shoes, and then the covered pad is pulled through additional shoes which fold and pleat the pad. Pulling the pad through folding shoes generates considerable friction and resistance to movement and results in stretching of the web and pad at each of the shoes. Stretching is less severe at other stations, for instance, at embossing stations where embossing rolls have a rolling contact with the pad and have a tangential speed which is approximately the same as the pad travel speed. Thus, the pad may stretch or contract during its different portions of its travel, making registry of operations difficult.

For example, the last operation performed is that of severing the pad into individual diapers, and this cut must be accurately located with an end seal for the diaper lest a diaper have only a small width of seal or no seal at all. Moreover, due to changes in raw materials, ambient conditions or the like, it has been observed that the amount of pad stretching or tension in the pad changes from time to time, and a fine compensation is needed to compensate for these changes in order that the desired degree of accuracy be assured.

Accordingly, a general object of the invention is a synchronized drive for feeding, folding, embossing and severing a pad of elastic material to form disposable diapers.

Other objects and advantages of the invention will become apparent from the detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a diagrammatic view of an apparatus for making a disposable diaper and for carrying out the present invention;

FIG. 2 is a plan view of a speed control device and a sectional drive used in the apparatus of FIG. 1; and

FIG. 3 is an enlarged longitudinal view of a sectional drive shown in FIG. 2.

As shown in the drawings for purposes of illustration, the invention is embodied very generally in an apparatus 11 for producing in form a diaper 13 which 15 have longitudinally extending pleats 15 disposed along the longitudinal side edges of the diaper and extending between the ends of the diaper at which are formed transversely extending end seals 17. As will be explained, the preferred diaper has an outer envelope formed of several plies of creped tissue wrapped about an internal absorbent pad 21 of absorbent wood pulp, the latter serving to absorb the fluids discharged by the diaper wearer.

To facilitate understanding, a general description of the method of forming the diaper 13 will now be described. Initially, a first or carrier web 23 travels through a station 25 (FIG. 1) at which wood pulp is deposited by an air laying apparatus to form the longitudinally extending absorbent pad 21 in the center of the web 23. The wood pulp pad is approximately 3/4 the width of the carrier web 23, and as this web leaves the air laying station 25, a pair of conventional forming shoes 27 fold one side of the web 23 inwardly to form a flap over the pad and then fold the other side of the web to overlie the first flap. The shoes thus fold the web 23 to enclose the pad in an envelope of creped tissue. The enclosed pad moves forward to receive another envelope as the second web 29 of creped tissue is folded about the pad by shoes 31 at a web folding station 32.

In the illustrated embodiment of the invention, a reinforcing strip 33 formed of several plies of creped tissue is placed on the web 29 prior to its being folded about the pad. The reinforcing strip is disposed at the location of the subsequently formed end seals 17 for the diaper so that it may encircle the wearer's waist and receive fasteners such as safety pins.

The diaper pad continues to move forwardly, that is, to the left as viewed in FIG. 1, to a station 35 at which the transverse end seals 17 are formed at longitudinally spaced distances, e.g., every 156 inches. In this instance, the end seals 17 are in the form of embossing bars 45 which extend transversely across the diaper pad between its longitudinally extending edges 36. To form the end seals, a pair of embossing rolls 37 are rotated in timed sequence by a line shaft 39 through a gear box 41 to bring an embossing bar 43 into position to emboss the pad generally centrally of each reinforcing strip 33. The embossing bars 43 exert sufficient pressure to glassine the web and pad fibers together.

From the embossing rolls, the covered pad moves forwardly to a first fold station 44 at which a set of shoes 45 make first pleat folds 47 by folding the longitudinally extending edges 36 of the diaper web 23 to one side and one over the other. At the next operating station, namely, a tacking station 46, these first pleat folds 47 are tacked at small spots to the underlying pad at locations generally midway between the end seals 17. Thus, the folds 47 at the center of the diaper are held in the folded condition when the ends of the folds open as the diaper is spread laterally to encircle the wearer's waist. To tack the lower pleat folds 47 to the unfolded portion of the pad thereon, it is preferred to employ embossing rolls 49 which carry peg embossing bars 51 to form spot or peg embosses 53 at which the fibers in the pleats are glassined to the fibers in the underlying pad. The peg embossing rolls 49 are also driven from the line shaft 39.
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through a right angle gear box 41 to rotate in timed relationship to the end emboss rolls 37.

After the pleat folds 47 are tucked, the diaper pad moves downstream to another set of saw blades 65 which fold the pad edges 36 inwardly over the inner fold 47 and thereby provide a second or upper fold 57 along each side edge of the diaper pad. The pleated pad then passes through a set of calendering rolls 59 which flatten the pleats to retain their shape. From the calendering rolls, the now pleated pad travels forward to a severing station 35, which includes an orbitral saw device 63 which has saw blades 65 for severing the pad through the center of each end seal 17 to form the individual diapers. Since the reinforcing strips 33 are generally centered on the end seals, they are severed in half and provide reinforcement at both diaper ends.

Apparatus for making a disposable diaper in a process becomes quite long, e.g., 50 ft., and travel speeds are quite fast, for example, 300 f.p.m. During travel at these speeds, the spacing between end seals 17 may vary due to pad elongation or contraction, but the severing cut should be accurately located within about ¼ inch distance of the center of each end seal. However, unless some counterbalance is provided, the position of the center of the end seal may shift much more than that in the longitudinal direction due to changes in amount of tension in the diaper. It will be appreciated that there is considerable friction generated at each of the shoes 27, 31, 45 and 55 and that this friction causes the pad to stretch and elongate during each of the folding processes. After stretching at a folding station, the pad may contract to recovery slightly prior to the next operation, depending upon how the pad is transported. This localized stretching and/or contracting changes the pad length for a given mass unit, i.e., the number of grams of material per diaper, and interferes with a number of dimensional relationships desired to be maintained, for example, centering of the embossed end seal 17 on the reinforcing strip 33, making the tacking embosses 53 mid-way between the end seals, and severing the diaper through the center of the end seals 17.

In accordance with the present invention, the pad of elastic material is fed by sectional drives which not only move the pad through the respective sections of the machine at a predetermined linear speed but also control the tension in the pad in the respective sections. Thus, the pad is tensioned to provide a given length for a predetermined number of grams of pad material at those stations at which operations may be accurately located relative to a previous or subsequent operation.

To achieve this controlled tension and length per mass unit, individual sectional drives 69 are associated with various operating stations to grip the diaper pad and to tension it while conveying it forwardly through the apparatus. The tension in the pad is changed by adjusting the speed of one sectional drive relative to an adjacent sectional drive. Herein, the drives 69 are in the form of opposed feed belts 70 (FIGS. 2 and 3) driven through variable speed devices 71 from the line shaft 39. These variable speed devices permit the speed of one sectional drive to be adjusted relative to adjacent upstream or downstream sectional drive. For example, tension can be increased and the pad stretched between two drives by increasing the speed of a downstream sectional drive relative to speed of an adjacent upstream sectional drive. On the other hand, the pad tension and length can be reduced by adjusting a downstream sectional drive to run slightly slower.

Referring now to a detailed description of the illustrated apparatus, each of the sectional drives 69 operates in timed relationship to operation of the saws 65 at the severing station 61. At the severing station, the pad is gripped in the nip of a pair of upper and lower slotted feed belts 73 and 74 which are driven at a constant predetermined linear velocity, e.g., 300 f.p.m., which is, in this instance, the nominal speed for the pad travel. Each of the saw blades 65 is driven through an orbital path and becomes effective along the line path to move into a space between belt slats to engage and to sever the pad as the blade travels forwardly with the pad. That is, each blade 65 progressively moves across the pad to sever it while also traveling forwardly. A detailed description of the preferred orbital saw mechanism is in copending application of Arnold A. Emenep, Harvey I. Spencer and Anthony R. Weirzba, Ser. No. 648,007, entitled, "Cutting Apparatus," filed June 22, 1967.

The pad held in the nip of the slotted feed belts 73 and 74 at the severing station 61 extends rearwardly and into the nip of feed belts 70 of the sectional drives 69. With the pad gripped in the nips of these sets of feed belts, the linear speed of the feed belts 70 is adjusted slightly from the nominal linear speed for the pad at the slotted belts and thereby exerts either a slight retarding or additional propelling force on the pad relative to the propelling force of the feed belts 70 extending to and from the pad. The illustrated feed belts 70 are trained about and driven by drive rolls 81 at their forward ends and are trained about suitable idler rolls 83 at their rearward ends. Driving shafts 85 for the driving rolls 81 extend to a common gear box 87 which is driven by an input shaft 89 from a variable pitch sheave 91 which is driven by a V-section belt 93 trained about a driving sheave 95 fixed to the line shaft 39. By turning a control nut 97 (FIG. 2) on a supporting shaft for the variable pitch sheave, at least one of its separable flanges 99 is moved axially of the shaft to cause its tapered belt engaging walls 101 to shift the belt radially and thereby change the diameter of its pitch circle, all in a conventional manner. In this manner, the speed of the driving shaft 85 and driving rolls 81 are varied which, in turn, varies the linear speed of the belts 70 engaging the pad. The pad is gripped in the nip of the belts with sufficient pressure to prevent relative sliding between the pad and belt. Therefore, the portions of the pad within the nip of the belts travel at the linear speed of the belts.

For the purpose of providing a low pressure nip and easy entry for the diaper pad between the pull belts 70, it is preferred that the facing runs 103 of the belts (FIG. 3) be spaced apart by a distance greater than the pad thickness at the upstream mouth for the belts and then converge slightly in the downstream direction to grip the pad. To provide a low pressure grip, these runs are backed by a series of rollers 105 rotatably mounted on shafts 107 journaled in longitudinally extending slide frames 109 (shown in FIG. 2, but omitted from FIG. 1). The pressure rollers are disposed opposite one another with the driving rolls 81 for the belts are slightly offset from each other at the discharge end of each sectional drive. Preferably, the lower belt of each sectional drive extends upstream as far as possible so that the pad is supported substantially throughout its length of travel. To this end, each of the lower pull belts 70 extends beneath the forming shoes at a preceding one of the folding stations to assist in overcoming the frictional drag resulting from a folding operation.

The slotted belts 73 and 74 also constitute a sectional drive, the speed of which is controlled by a common gear drive 111 (FIG. 1) connected between its driving rolls 113 and the line shaft 39. A suitable source of driving power, such as a motor 115, supplies sufficient torque to drive the saw and the line shaft 39 in concert. The drive shaft 39 and the geared connections between the drive shaft and the respective rotating embossing rolls at the various stations results in high speed, finely timed operations, which if the pad were substantially right would maintain the desired registry between various operations on the pad.

It will be appreciated that the change of the tension at one station results in a changing in tension of those
stations immediately upstream of it. More specifically, the changing of the belt speed for one sectionalized drive 69, such as that at the severing station 61, also affects the tension of the portion of the pad immediately upstream of it since its speed is now changed relative to the upstream feeding speed. For example, an increase in pad tension caused by slowing down the linear speed of the belts 70 at the severing station 61 will cause a slight pad accumulation at the entrance to its nip due to the pad issuing at a rate from the adjacent upstream sectional drive that is greater than the rate it is being accepted. If this results in loss of registry, the operator will also make a similar suitable adjustment for the speed of the belts 70 at the first folding station 44 by adjusting the variable sheave 91 at the station 44 while observing the position of the peg embosses 53 until they are again substantially intermediate the end seals 17. Since the pad is now traveling from the sectional drive at the end embossing station 35 at a speed faster than it is being accepted by the sectional drive at the first fold station 44, the speed of the sectional drive at the cross embossing station 35 is reduced accordingly by adjusting the pitch diameter of its sheave 91. As an aid to understanding the invention, a brief description of the operation of the apparatus will be made. The pad is gripped and pulled through the various operating stations by a series of spaced sectional drives 69, each having a nip at which the pad is gripped and pulled forward. Each of the sectional drives operates from and at a nominal speed as determined by the common drive shaft 39 for the operating mechanisms, such as the end and tack embossing rolls and the orbital saw mechanism. Because the pad is long and formed of an elastic material, the pad will elongate during the folding operations, which exert considerable frictional drag at localized areas along the length of the pad. The amount of elongation varies from time to time with changes in ambient conditions and with changes of the material forming the diaper. When such changes occur, the final cut and the various embosses which are being performed at relatively high speeds may get out of registry.

To bring such operations back into alignment and particularly to make sure that the severing cut by the saw blades 65 is centered in the embossed end seal 17, the speed of the sectional drive 69 immediately prior to the severing station is adjusted to increase or decrease the amount of tension in the pad by changing its feeding speed relative to the fed speed of the slotted belts 73 at 5. As the pad is gripped in the nips of these respective drives, the pad between the drives receives either an increase in tension or a decrease in tension. A change in tension also causes a change in length of a pad for a given mass as it moves through the severing station for the given operating speed, which is nominally 300 f.p.m.

As a consequence of the changing of the feeding speed for these sectional drives at the severing station, there is also a change in tension between them and the upstream sectional drive or drives. Thus, it is usual practice to adjust the speed of the other upstream sectional drives to maintain the relationships between the drives.

From the foregoing, it will be seen that the present invention is particularly useful for feeding elongated webs of elastic material and provides a manner in which the tension can be controlled so that a given length for a mass unit may be maintained in each operating station having a nip, which must register with a previous or subsequent operation on the elastic material. The apparatus is relatively simple and easy to control and, once it is adjusted, operates successfully for a considerable period of time. The speed control devices permit operation while the machine is in operation at high speeds, which allow the operator to exert a very fine adjustment of the web tension.

While a preferred embodiment has been shown and described, it will be understood that there is no intent to limit the invention by such disclosure but, rather, it is intended to cover all modifications and alternate constructions falling with the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In an apparatus for making disposable diapers by performing a series of operations in registry on an elongated continuously moving pad of stretchable material, the combination comprising means at a first station to form end seals at predetermined longitudinally spaced intervals along said pad and extending transversely thereacross, means at a subsequent station to sever said elongated pad while the latter is continuously moving to form individual diapers, means to drive said end seal forming means and said severing means in timed relationship to each other, and a separate feed means for continuously moving and feeding said pad through each of said end seal forming means and said severing means and for separately controlling the tension in said pad at at least one said end seal forming means and said severing means so that substantially the same length for a unit mass of said pad travels through the end seal forming means and said severing means during each operation thereof, whereby said registration is performed in registry with said end seals and substantially centrally thereof.

2. An apparatus in accordance with claim 1 in which said feed means includes a first pair of opposed moving surfaces defining a first nip for gripping said pad at said subsequent station and for pulling said pad forwardly and further includes a second pair of opposed moving surfaces defining a second nip for gripping said pad at a location upstream of said first nip, and in which said feed means includes an adjustable speed control means for at least one said pair of moving surfaces to permit adjustment of its linear speed.

3. The apparatus of claim 2 in which endless feed belts are disposed above and below the pad and have the opposing surfaces for driving said pad and tensioning the pad.

4. The apparatus of claim 2 in which said feed means includes a line shaft extending between said end seal forming means and said severing means for operating them in concert, and in which said speed control means is disposed between said line shaft and one said said pair of opposed moving surfaces to permit adjustment of its linear speed.

5. An apparatus in accordance with claim 4 in which said speed control means is in the form of a variable pitch sheave, the pitch of which can be adjusted while the apparatus is running to vary the speed of one driving nip relative to the speed of the other driving nip.

6. In an apparatus for making a disposable diaper by continuously feeding a web of creped tissue along a predetermed path through a series of operating stations, said apparatus comprising apparatus at an air laying station for depositing a layer of fibrous material in the form of an absorbent pad on said web, means for folding the longitudinal side edges of said web at a web folding station to overlie said pad and thereby provide an envelope therefor, a first sectional drive for pulling said web and said pad continuously through said web folding station, means at an embossing station for embossing transversely extending end seals at longitudinally spaced intervals on said envelope pad, means at an inner fold station to fold the side edges of the pad inwardly toward one another, a second sectional drive for exerting a pulling force on said folded pad to feed the same forwardly in a continuous manner, means at a tacking station for tacking said inner fold to said underlying portion of said pad substantially midway between the respective end seals, means at an outer fold station for folding said longitudinal edges back on themselves to form an outer fold for said diaper, a third sectional drive for pulling the now pleated pad forwardly to feed the same in a continuous manner, means
at a severing station for severing the pleated pad into individual diapers, and a fourth sectional drive at said severing station for feeding said pad forwardly in a continuous manner, driving means operating said embossing, tacking and severing means in concert, and adjustable speed control devices for respective ones of said sectional drives whereby their speed may be adjusted relative to the speed of adjacent sectional drives so that the tension in the pad can be adjusted between drives to maintain a predetermined length of pad per mass unit through the respective operating stations at which operations are performed in registry upon said continuously moving pad.

7. The apparatus of claim 6 in which the sectional drives are each in the form of a pair of endless belts disposed on opposite sides of said diaper pad with the diaper pad being gripped by a nip between the belts.

8

References Cited

UNITED STATES PATENTS

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<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor</th>
<th>Classification</th>
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<tbody>
<tr>
<td>3,361,041</td>
<td>1/1968</td>
<td>Grob</td>
<td>156—202X</td>
</tr>
<tr>
<td>3,370,328</td>
<td>2/1968</td>
<td>Hilton</td>
<td>156—202X</td>
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<tr>
<td>3,430,629</td>
<td>3/1969</td>
<td>Murphy</td>
<td>128—284</td>
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BENJAMIN A. BOREHELT, Primary Examiner
J. J. DEVITT, Assistant Examiner

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