

May 8, 1945.

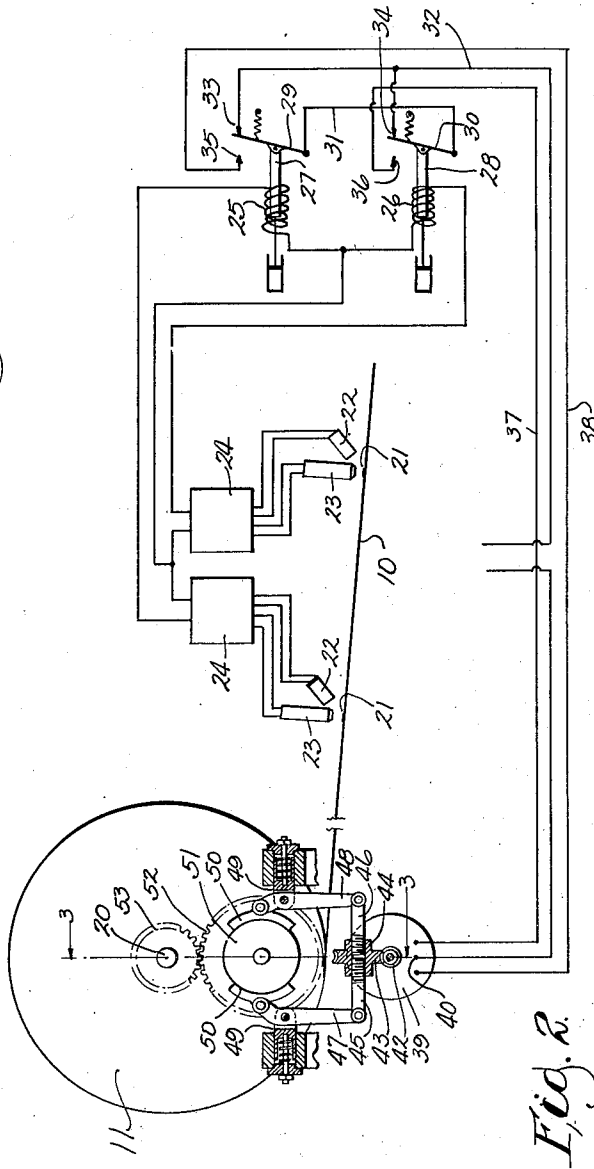
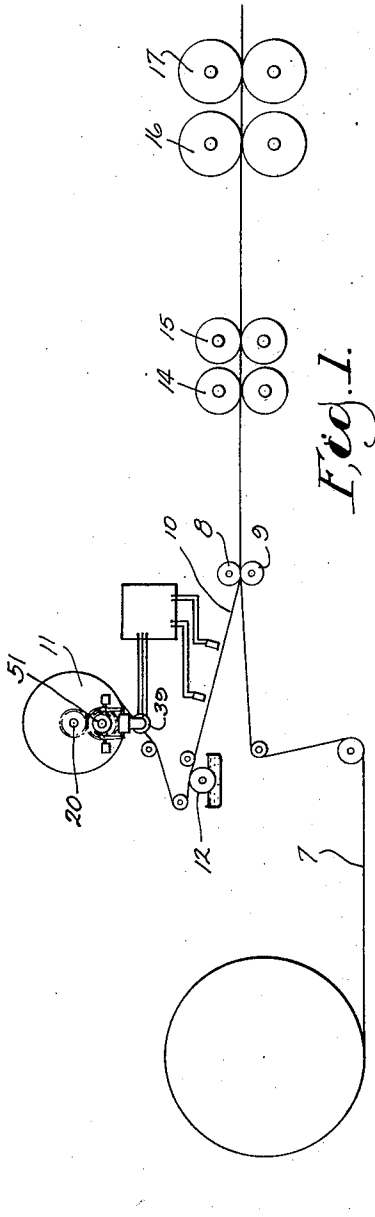
M. A. WATERS

2,375,451

WEB SYNCHRONIZING DEVICE

Filed Aug. 2, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

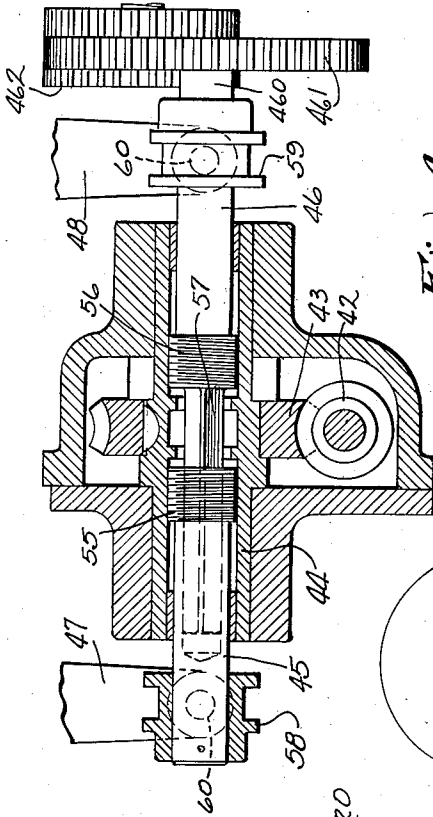


Fig. 4.

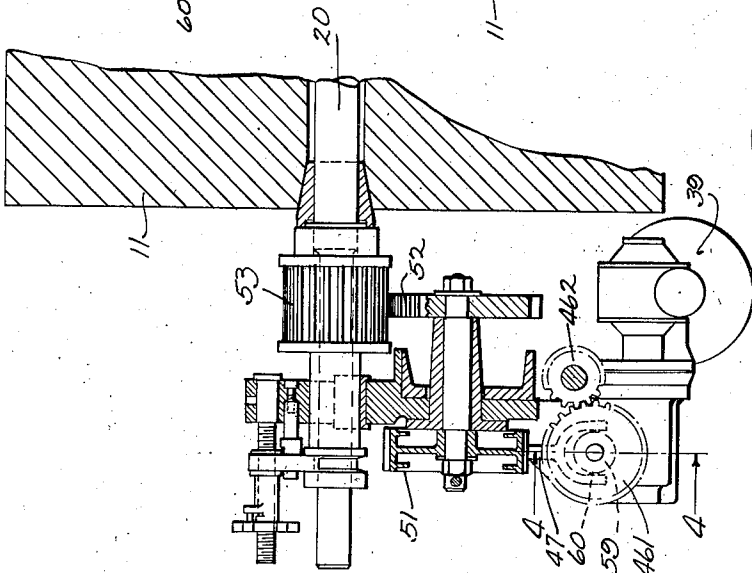


Fig. 3.

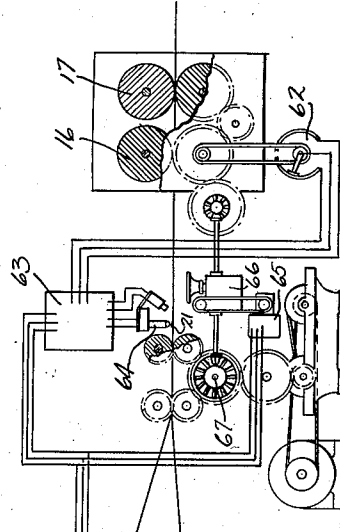


Fig. 5.

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UNITED STATES PATENT OFFICE

2,375,451

WEB SYNCHRONIZING DEVICE

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Application August 2, 1940, Serial No. 349,687

21 Claims. (Cl. 271—2.3)

This invention relates to improvements in web synchronizing devices. The apparatus has particular utility in connection with a machine such as disclosed in my Patent 2,164,436 of July 4, 1939, but it is also useful for a variety of other purposes.

Wherever there are any operations which must be formed in registry with a previously printed web, it is an object of the invention to facilitate such registry by varying automatically the tension on the web so that by stretching the web to a greater or less degree it is possible to compensate for variations in web length such as normally result from the least change in the humidity and temperature conditions to which the web may be subject. Instead of being previously printed, the web may have been embossed or cut and it may be desired to register some subsequent operation with the printing, embossing or cutting. In any such case, it is advantageous to control with minute accuracy by tensioning the web the exact spacing between repetitions of any pattern embossed, printed or cut therein.

A composite multi-ply web might be difficult, if not impossible, to stretch by braking tension due to the combined strength of the several plies, particularly when one ply is of cardboard. It is, therefore, an object of the invention to control registration of a multi-ply web by exerting that control only on the top patterned ply thereof before the plies are united and thereafter cementing the plies together.

It is my purpose either to facilitate registration by maintaining pattern repetitions at fixed spacings by tensioning the web or to maintain registration of the pattern with a die or the like which conducts a subsequent operation on the web irrespective of the spacing between successive patterns. In either case, the registration of the web pattern with means for performing a subsequent operation in registration therewith will be facilitated.

Other objects will appear from the following disclosure of the invention.

In the drawings:

Fig. 1 is a diagrammatic view in side elevation of box blanking apparatus to which the invention is applicable.

Fig. 2 is an enlarged diagrammatic detail view partially in section and partially in side elevation showing how the tensioning device may be operated and showing the electrical connections for its operation.

Fig. 3 is a further enlarged view in section taken on the line 3—3 of Fig. 2.

Fig. 4 is a further enlarged detail view in section on the line 4—4 of Fig. 3.

Fig. 5 is a diagrammatic view similar to Fig. 1 showing a modified embodiment of the invention applicable to the specific structure of my former Patent 2,164,436.

Like parts are identified by the same reference characters throughout the several views.

While the invention is equally applicable to a single ply web, I have shown it in use in a machine in which the web to be operated on comprises two plies in accordance with the disclosure of my former patent. A relatively heavy lower ply web 7, which may be regarded as not printed and hence not requiring registration is united between the rolls 8 and 9 with a printed and relatively lightweight upper paper ply 10 supplied by parent roll 11 and treated with adhesive by a conventional glue pot arrangement diagrammatically indicated at 12.

The pairs of rolls at 14 and 15 may be regarded as feed rolls and the rolls at 16 and 17 may be regarded as printing, embossing or cutting die rolls, the operation of which must be synchronized with a pattern previously printed on the top paper ply 10.

In accordance with the present invention, the registration is either entirely controlled or is facilitated by automatically varying the tension on the mandrel or support 20 for the parent roll 11 of web 10 in accordance with some factor which has to do with registration. In the device shown in Figs. 1 to 4 inclusive, the sheet is so varied in tension as to maintain a fixed spacing between successive registration marks on the web 10 and this, in turn, facilitates, while it does not directly control, the registration of the printed pattern on the sheet with the die rolls 16 and 17.

As explained in said Patent 2,164,436, the web 10 is provided at intervals with registration marks such as those indicated at 21 in Fig. 2. The web is highly illuminated by the light sources 22 and the light reflected from the surface of the web is picked up by "electric eyes" 23. It is not material to the invention what type of photo-electric cell is used. The impulse produced in the photo-electric cell by the passage of the registration mark 21 is amplified in each case by a conventional amplifier indicated at 24, the details of which are well known and require no illustration here. The first amplifier 24 operates a solenoid 25 and the other a solenoid 26. The armatures 27 and 28 of solenoids 25 and 26 are connected respectively to switch blades 29 and 30 which have their respective pivoted ends in elec-

trical connection through conductor 31. Their respective free ends are both seated against live contacts connected with the same conductor 32, the contacts being numbered 33 and 34, respectively. As indicated diagrammatically by the springs, the switch blades 29 and 30 are biased for setting normally against contacts 33 and 34. When either of the switch blades is closed by the operation of its associated solenoid, it will move from the live contact with which it is normally connected and will engage another contact. Switch blades 29 may be engaged by operation of solenoid 25 with contact 35. Switch blade 30 may be engaged by operation of solenoid 26 with contact 36. Contacts 35 and 36 respectively are connected by conductors 37 and 38 with the terminals of a reversible electric motor 39 which has a contact 40 connected with the other side of the line.

If the registration marks 21 on the web pass simultaneously beneath the electric eyes 23, the two solenoids 25 and 26 will be operated simultaneously and will simultaneously move the switches 29 and 30. The concurrent movement of both switches from the live terminals 33 and 34 will not produce any operation of the motor 39. However, if the second electric eye 23 at the right of Fig. 2 registers with the registration mark on the web before the first electric eye at the left of Fig. 2 registers with its mark 21, it will be an indication that the web is too greatly tensioned. Accordingly, the solenoid 26 will be operated before solenoid 25 with the result that while switch conductor 29 is still receiving current from line 32 through stationary contact 33, the switch blade 30 will be moved into engagement with contact 36 whereby such current, communicated through conductor 31, will be delivered to the motor 39 through line 37 and will operate the motor in a brake releasing direction.

Conversely, if the web tension is insufficient and the web has contracted so that there is insufficient spacing between the registration marks 21 of the web, then one of such marks will reach the first electric eye 23 at the left of Fig. 2 before the other mark reaches the second electric eye 23 at the right of Fig. 2. In this situation, solenoid 25 will be operated prior to solenoid 26 and while switch blade 30 is still receiving current from line conductor 32 through contact 34, switch blade 29 will be moved into engagement with contact 35 whereby to transmit such current through conductor 31 to operate the motor in a direction to apply the brake hereinafter described and thereby to increase the tension on the web.

As diagrammatically illustrated in Fig. 2, the motor 39 turns in one direction or the other to actuate through worm 42 a worm gear 43 on a nut 44 which acts like a turnbuckle on a pair of bolts 45 and 46 connected respectively to levers 47 and 48 and having right and left hand threaded connections respectively with the nut 44. As a precautionary measure, the levers 47 and 48 are pivoted to yieldable mountings 49 which relieve excessive braking pressure but, for the purposes of the present invention, the levers may be considered as if their respective fulcrums were fixed. The two levers have brake shoes at 50 engaging a brake drum 51 connected by means of gear 52 with arbor 20 upon which the armed roll 11 is mounted.

It will, of course, be understood that the entire arrangement as described is diagrammatic since there is an infinite number of possible mechanical and electrical connections by which too wide a

spacing between the registry marks 21 on the web may be made to decrease the braking pressure applied to the parent roll 11 while too narrow a spacing between the registry marks 21 may be made to relax the braking tension on the web. In the arrangement as disclosed, dash pots 54 exemplify means for so retarding the return of the switch blades 29 and 30 as to preclude the possibility of their getting a converse and undesired impulse on the return movement.

The details of the brake mechanism are shown in Figs. 3 and 4. Fig. 4 shows how the worm gear operated by the motor is keyed to the tubular nut 44 having right and left hand threads engaged respectively with the threaded portions 55 and 56 of the bolt elements 45 and 46. Since the bolt elements do not rotate with respect to each other, bolt element 46 is desirably provided with a squared extension 57 piloted in a squared socket in bolt element 45. Bolt element 46 has an extension at 460 from its outer end carrying a gear 461 meshing with an axially elongated pinion 462 which is subject to manual control. The pinion 462 and gear 461 may be used to rotate the bolt elements 46 and 45 concurrently whereby to secure an initial or datum setting of the brake as desired. During normal operation, the pinion will be stationary and gear 461 will slide axially on the pinion in response to movements of the bolt element 46 as induced by rotation of the nut 44 in one direction or the other by the motor. In order to permit of this datum adjustment whereby the bolt elements 45 and 46 rather than the nut receive rotative movements, the bolt elements may transmit their motion to the respective brake levers 47 and 48 by means of convention spools 58 and 59 engaged by forks shown in dotted lines at 60 on the respective levers 47 and 48.

It will be readily understood that by varying the tension on the printed ply of the composite web in such a way as to keep the pattern repetitions at fixed spacing, the problem of registering the patterns of the web with the dies 16 and 17 in the manner disclosed in my former Patent 2,164,636 is greatly simplified. It is possible, however, to directly correlate the tensioning of the web with the functioning of the die by using the identical electric eye arrangement shown in my former patent. This is illustrated in Fig. 5. One of the dies comprising the pair shown at 16 is connected to a rotary switch device 62 having electrical connections to the amplifier 63. The electric eye 64 likewise has suitable electrical connections to amplifier 63. This is the identical arrangement disclosed in my former patent for operating the reversible motor 65 to control a drive through differential 66 to the die pairs 16 and 17 from the main drive member 67.

The lower die of die pair 16 obviously rotates clockwise as viewed in Fig. 5 and the corresponding direction of rotation is imparted to the moving contact of the rotary switch 62.

The passage of the indicating symbol 21 on the web beneath the electric eye 64 will deliver an electrical impulse to the moving contact of switch 62. If such contact is, at the moment, centered between the stationary segments of the switch, the circuit to the motor 39 which adjusts the brake will remain open. However, if the pattern on the web has advanced even slightly with reference to the die, as is the case in the relative positions of the parts shown in Fig. 5, the engagement of the rotary switch contact with the stationary segment at the left in the switch will

cause the impulse generated by the electric eye to pass to the motor 39 to energize such motor in a direction to increase tension on the web, thereby stretching the web and retarding the progress of the pattern toward the die until registration is re-established. If, on the other hand, the indicia 21 is retarded with respect to its proper relation to the die, then it will not reach a position beneath the electric eye until after the rotary switch has contacted the segment at the right in Fig. 5, whereupon the impulse resulting from the scanning operation of the electric eye will be communicated from the rotary switch contact to the segment at the right, whereby the motor will be operated in a direction to decrease the braking action, thereby decreasing the stretching of the web and permitting successive patterns to accelerate slightly with reference to the die until registration is re-established.

Either with or without the differential drive control, this electric eye may also be used to control the tensioning of the web in the manner above disclosed, there being the same set of electrical connections from the amplifier 63 to the reversible motor 39 for operating the brake levers 47 and 48 to vary the tensioning on roll 11 in the manner already described. In this instance, it will be apparent that there is a direct correlation between the functioning of the switch 62 as controlled by die pair 16 and the passage of the indicating mark 21 on the web as registered through the electric eye 64 upon the amplifier 63. Since a surprising amount of stretch is possible even in a paper web, the control resulting from the variation in tension on the web may, if desired, be made to substitute entirely for the adjustment effected in the differential 66. Or, as herein disclosed, the tensioning of the web may merely supplement the action of the differential, the two devices working together to maintain registration.

I claim:

1. The method herein disclosed of controlling the feed of a pattern ply which method consists in the provision on the ply of indicating means repeated in synchronism with pattern repetitions thereon, detecting at spaced points the passage of said indicator means continuously feeding the ply past said points and so tensioning said ply and thereby varying the stretch thereof as to require said indicating means to pass said points at predeterminedly spaced intervals.

2. A device of the character described comprising a rotative support for a roll of web material having a synchronizing indicia repeated thereon, continuously operable means for feeding web from said roll, means for resisting the feeding of such web whereby to tension the web to the extent of stretching the web during its continued movement, means responsive to the passage of indicia marked on the web, and means controlled by said responsive means for adjusting said second means for varying the resistance to web movement whereby to increase and decrease the tension thereof in accordance with the frequency of response to the passage of said indicia.

3. The combination with continuously operable web feeding means and a shaft rotatable in accordance with web advance, of a brake operable upon said shaft with variable effect in a range such that the web will be tensioned to the point of stretching the web and means for varying the application of said brake to said shaft whereby to increase and decrease the tension of the web

to vary the length thereof during its continued advance, a photo-electric device positioned in operative proximity to the web and responsive to indicia printed thereon, and means operatively controlled by said photo-electric device for actuating the means for varying the application of said brake in a manner to correct registration by varying web tension and thereby varying web length between said shaft and feeding means.

4. In a device of the character described, the combination with means for continuously feeding a patterned web having indicia repeated at intervals thereon in synchronism with the pattern, of a shaft spaced from said means and rotatable in accordance with web advance toward said means, means operable upon said shaft for variably resisting the rotation thereof whereby to control the tension of said web, whereby variably to stretch the web during its continued movement, a die operable upon said web in synchronism with the pattern thereof, means actuated in accordance with die movement, means responsive to the passage of the indicia on said web, and coordinating means responsive to said last two means for varying the resistance to shaft rotation and thereby varying the tension on the web in a direction to correct lack of registration between the pattern of the web and the die acting in synchronism therewith.

5. In combination with continuously operable web feeding means a device for controlling the feed of a web having spaced indicia, said device comprising spaced detectors positioned in proximity to the path of said web and responsive to the passage of the indicia thereon, a variable web tensioning means independent of said feeding means and including mechanism for varying web tension, and connections from said detectors to said mechanism for the operation of said mechanism in accordance with variations in the interval between the indicia of said web.

6. A device of the character described comprising the combination with means for continuously feeding a web having spaced indicia, of a shaft spaced from said feeding means and rotatable in accordance with web advance toward said means, a brake for resisting shaft rotation whereby to tension the web between said shaft and feeding means and to stretch it in the course of its advance, means for varying braking action to vary such resistance and thereby to vary the stretch of the web, a detector adjacent the path of web advance including means responsive to the passage of such indicia thereon, means cooperative with said detector to determine whether such indicia passed the detector at proper intervals, and means operated by said detector for actuating said tension varying mechanism in a direction to increase web tension and stretch when the interval between said indicia is insufficient and to decrease web tension to permit of web contraction when the interval between such indicia is excessive.

7. In a device of the character described, the combination with means for continuously withdrawing a web from a supply roll, of a supply roll shaft, a brake drum connected therewith, brake means operable upon said drum, oppositely pivotal levers connected with said means, oppositely screw threaded bolt elements connected with the levers, a nut provided with opposite threads in operative engagement with said bolt elements, a reversible motor connected to said nut for the rotation thereof, electrical connections to said motor, and means including an electric eye in op-

erative controlling relation to said connections, said electric eye being positioned adjacent the path of advance of a web from said roll shaft.

8. The combination with a roll shaft and means for continuously feeding a web therefrom, of a brake drum connected with the roll shaft, brake means coacting with the drum and variable as to pressure, a reversible motor in operative connection with the brake means for increasing and decreasing the pressure thereof according to the direction of operation of the motor, and electrical connections to the motor provided with control means including an electric eye located in proximity to the path of web advance from said roll means.

9. In a device of the character described for controlling the registration of indicia printed on a web with a roll over which such web is fed, the combination with continuously operable web feeding means, of a shaft rotatable in accordance with web advance toward said feeding means, a brake applicable to said shaft, means for applying the brake with variable intensity whereby to vary the stretch of the web as it approaches said feeding means during its continued advance, and control mechanism for said brake applying means including a device positioned to respond to indicia on said web and provided with operative connection to said last means.

10. The combination with a die and means for continuously feeding a patterned web thereto, of means for maintaining registry between the web pattern and the die comprising a rotatable member acting on the web before it reaches the die and rotated by the web, brake means for resisting the rotation of said member to tension the web en route to said feeding means mechanism for varying the action of said brake means on said member during web movement toward the die whereby to vary the stretch of said web, a device for detecting the acceleration of the pattern of the web with respect to the die, and means operated by said detecting device for actuating said mechanism in a direction to increase the action of said brake means on said member and consequently the stretch of the web when the pattern is thus accelerated.

11. A device of the character described, comprising the combination with a die and means for continuously feeding thereto a web having a pattern to be registered with the die, said web having indicia repeated thereon in synchronism with the pattern, of a rotary device engaged by the web and from which a web moves toward the die at a rate determined by the rotation of said device, means for resisting the rotation of said device sufficiently to tension and stretch the web, and mechanism for varying the effect of said resisting means upon said device whereby to vary the stretch of the web during its continued movement toward the die, an electric eye positioned in operative proximity to the web, and means controlled by said electric eye and connected with said mechanism for decreasing the resistance to web movement and consequently decreasing the tension of the web when the advance thereof is decelerated with respect to the operation of the die, thus re-establishing synchronism between the web pattern and the die.

12. A method of registering with a die the repetitive pattern of a web in continuous movement toward the die, said method comprising applying to a web portion spaced from the die a force tending to retard web movement toward the die,

maintaining the web constantly subject to said retarding force whereby to tension and stretch the web intervening between the die and the point of application of said force, maintaining said force at a substantially constant value sufficient to hold said web stretched to a degree intermediate the minimum and maximum stretch of which it is capable until it becomes manifest that the interval of pattern recurrence is not such as to register the pattern properly with the die and thereupon increasing the retarding force on the web for increasing the stretch thereof to correct too short an interval between pattern repetitions and decreasing such force to an extent insufficient to relieve the web of stretching tension upon the occurrence of too long an interval between pattern repetitions, and maintaining said force at a substantially constant value following each such increase and decrease until readjustment of said force is made.

13. A method of controlling the feed of a patterned web to a die, which method consists in providing the web with a succession of indicating means, maintaining the web in substantially continuous movement at a substantially constant rate to the die, continually applying a braking force resisting web movement, thereby stretching the web, and varying the amount of such force, the resistance and stretch, without wholly releasing such stretch and in accordance with the frequency with which said indicating means passes a given point.

14. A method of controlling registration of the repetitive pattern of a patterned elastic web with a device acting on said web, which method consists in constantly drawing the web toward the device, providing the web with a predetermined repetitive pattern including indicator means having fixed reference to pattern repetitions on said web, constantly braking the movement of the web and resisting the response of said web to the drawing of the web toward said device, thereby stretching said web, and varying the braking resistance and tension on said web to increase and decrease such tension short of full relief thereof and to stretch said web and allow it partially to shrink according as the interval between said indicating means is too slight or too great for correct registration with said device.

15. A method of controlling the registration of a repetitive pattern on the patterned ply of a multi-ply web with a device subsequently acting thereon, another ply of said web not requiring such registration, such method consisting in continuously drawing the plies of said web toward said device, applying a resisting force continuously to the patterned ply sufficient in value to stretch the patterned ply exclusively of such other ply, and positively adjusting the resisting force on the patterned ply to increase and relax the tension upon said ply to control the stretch thereof short of complete relief of such stretch and thereby to control registration of the pattern of said patterned ply with said device.

16. The method recited in claim 15 in further combination with the step of maintaining the tension on the patterned ply substantially constant except as the resisting force acting thereon is positively adjusted.

17. The method recited in claim 15 in further combination with the step of uniting the respective plies.

18. The method recited in claim 15 in further combination with the step of adhesively treating one of said plies, uniting it with the other

of said plies, and passing the united plies as a single composite web to said device.

19. The method of claim 15 in further combination with the steps of maintaining the tension on the patterned plies substantially constant between the successive adjustments of the retarding force acting thereon, continuously bonding the patterned ply to said other ply to maintain the pattern spacing determined by the stretch to which the pattern ply is subject, and passing said plies bonded as a single composite web to said device.

20. The method of maintaining a predetermined spacing between repetitive patterns on the patterned ply of a multi-ply web, such method consisting in drawing from separate supply rolls a plurality of plies to compose said web, one of said plies having a repetitive pattern, continuously resisting the movement of the patterned ply sufficiently to tension and stretch the patterned

ply, varying the resistance to the movement of the patterned ply without wholly releasing such resistance, whereby to increase and decrease the tension thereon for maintaining a predetermined spacing between pattern repetitions and thereupon bonding the patterned ply while stretched to another ply of said web.

21. The method herein disclosed which comprises the patterning of a web, marking the web with regulating indicia, operating on the web with a die synchronized with said pattern, continuously feeding the web to the die, braking the movement of the web toward the die and thereby tensioning and stretching the web, and continuously maintaining the web stretched under tension while varying the braking tension on the web and the stretch thereof in accordance with the synchronization of the passage of successive indicia with the operation of said die.

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