Nov. 14, 1972

P. ZERNOV ET AL

3,702,673

WEB-HANDLING MECHANISM FOR CONTROLLING WEB SPEED

Filed Sept. 13, 1971

2 Sheets-Sheet 1

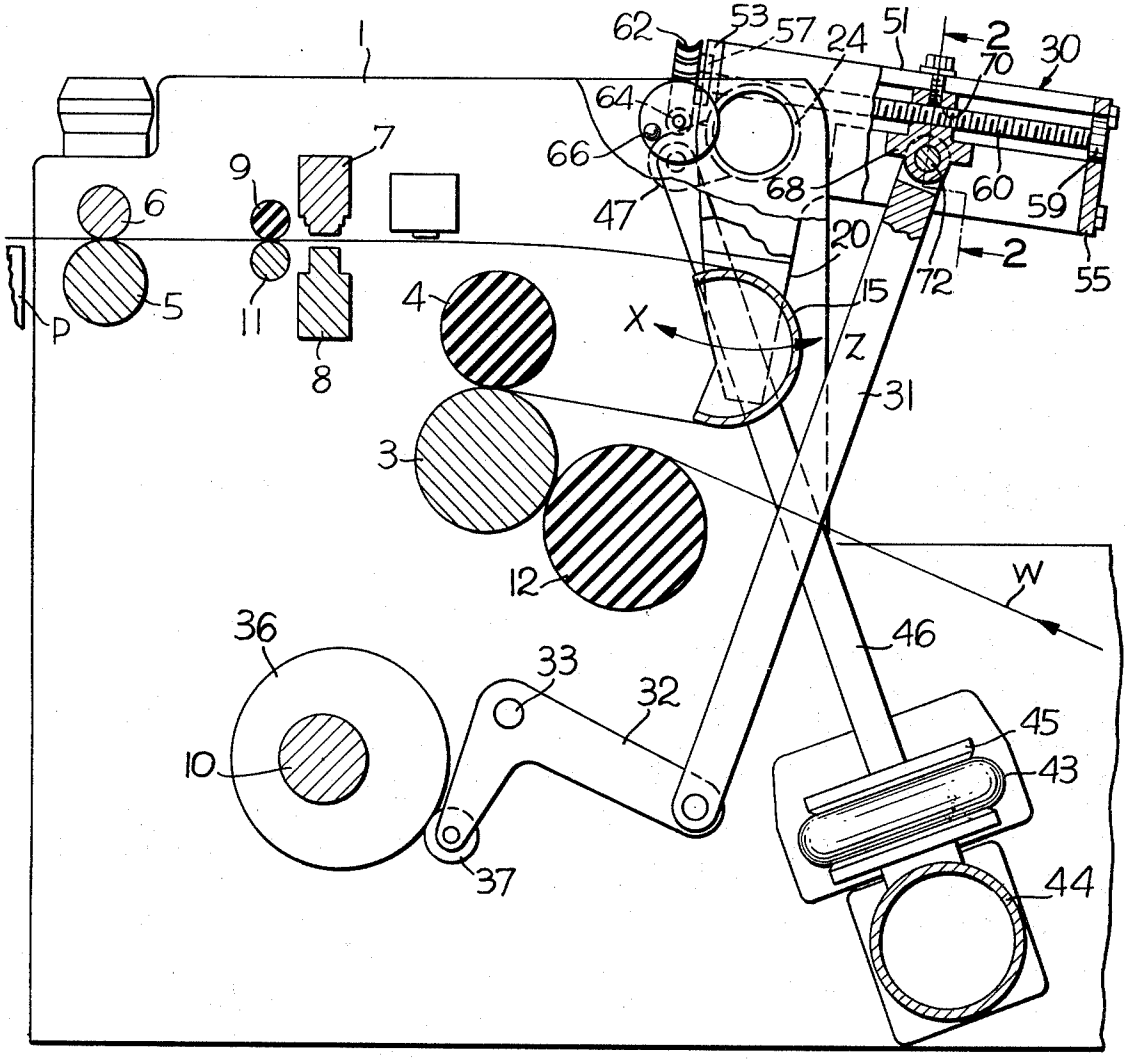


FIG. 1

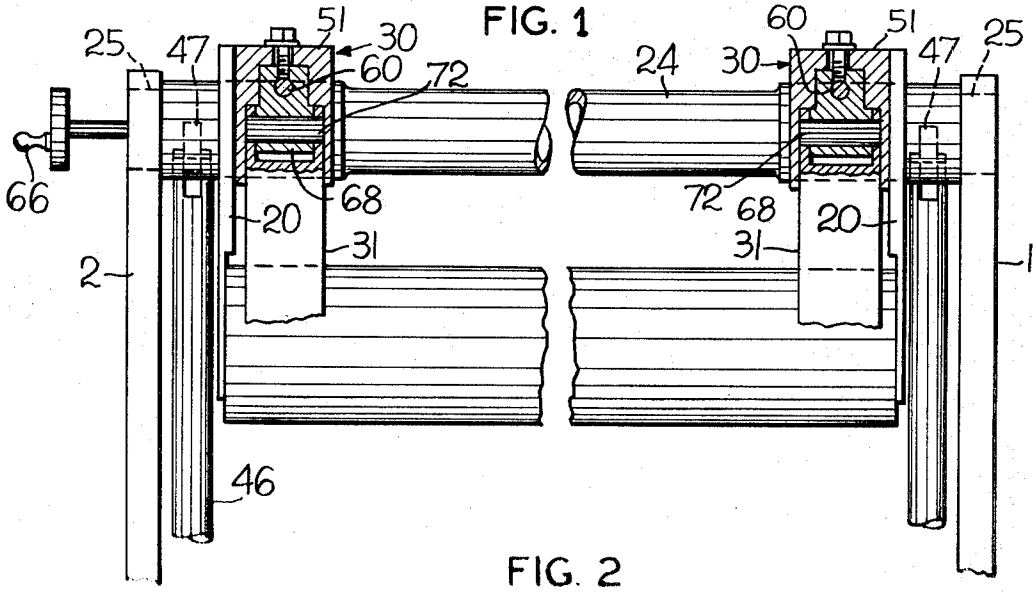


FIG. 2

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2 Sheets-Sheet 2

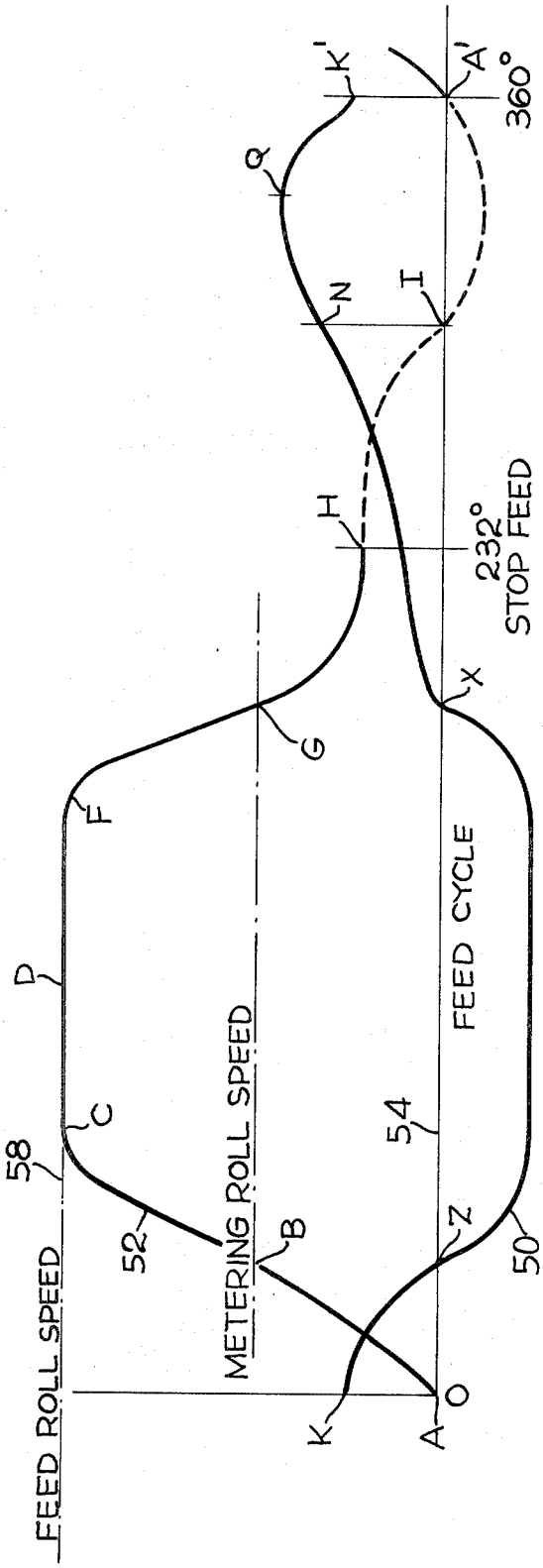


FIG. 4

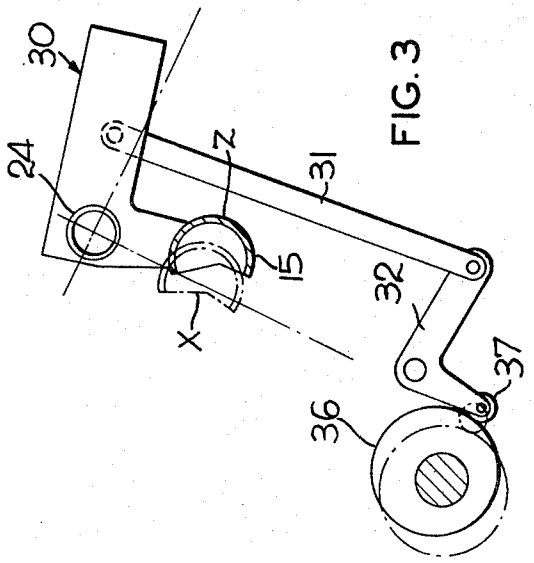


FIG. 3

United States Patent Office 3,702,673 Patented Nov. 14, 1972

3,702,673

WEB-HANDLING MECHANISM FOR CONTROLLING WEB SPEED

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Int. Cl. B65h 17/44
U.S. Cl. 226—4 19 Claims

ABSTRACT OF THE DISCLOSURE

Web-handling apparatus for feeding a web to a carton-forming press or the like and in which the web is continuously fed by metering rolls after passing through the metering rolls, the web is intermittently stopped prior to its entry into the press by disengagement of the feed rolls or by a brake bar. Means such as a curved plate are movable with the web to maintain constant contact therewith to prevent slapping action of the web as it is taken up by the feed rolls when the latter are engaged and control acceleration and deceleration of the web. Instead of stopping the web with a conventional brake bar, movement of the curved plate is programmed to take up the web as fast as the metering rolls meter the web to the feed rolls.

BACKGROUND OF THE INVENTION

Carton blank forming presses operate intermittently and a web is fed thereto for intermittent operation on the web. As a result, the web must be started and stopped at the entry side of the press so as to feed successive lengths of web to the press. The carton blank handling apparatus located at the entry side of the press usually consists of a set of metering rolls which act continuously on the web to precisely feed the web at a measured rate. After the web passes through the metering rolls, it then normally passes between a brake bar which can periodically clamp the web to stop its movement, and then passes through intermittently-acting feed rolls which periodically engage the web and feed a length into the press. Unless remedial action is taken by suitable means, the web periodically forms a loop when the brake bar is clamped down (or when the feed rolls periodically disengage the web) because the metering rolls continue to feed the web, and then when the brake bar is released and the feed rolls again act on the web, the loop is drawn out and the web is again under tension.

Such a prior art web-handling apparatus is shown in the U.S. Pat. No. 3,385,178, issued May 28, 1968 to P. Zernov and entitled "Drive Mechanism for Carton Blank Forming Press." That mechanism discloses a web-handling apparatus at the entry end of the press, and which apparatus permits the formation of a free loop at the discharge side of the metering rolls. When the loop of that device was pulled or snapped out by the action of the intermittently-acting feed rolls, the loop was pulled tightly or snapped against certain parts of the apparatus causing noise, slapping, or a violent thump, and because of little available settling time, misregistry or misfeeding of precise lengths of web resulted.

U.S. Pat. No. 3,608,804 of Sept. 28, 1971 to R. Swansen, Jr. (assigned to the same assignee as aforementioned Pat. No. 3,385,178) and entitled "Web Handling Mechanism for Carton Blank Forming Apparatus or the Like." discloses means in the form of a movable dancer or curved plate which follows the loop of the web as it is being formed to eliminate slapping action of the loop in the web as it is pulled taut. In the said patent, the dancer linkage was adjustable to accommodate different lengths

of web feed by means of an incrementally-adjustable ball and socket arrangement. While the invention disclosed in the aforesaid patent was satisfactory for its intended purpose, it is desirable to provide improved linkages of this character.

SUMMARY OF THE INVENTION

The present invention contemplates a web-handling apparatus including a set of metering rolls, a pair of intermittently-acting feed rolls and, preferably although not necessarily, a releasable brake bar located between the pairs of rolls for periodically stopping movement of the web. The apparatus furthermore has a movable dancer or curved plate which continually maintains contact with the web at a location between the metering rolls and the brake bar or feed rolls and is programmed to prevent formation of a web loop by controlling the acceleration and deceleration of the web during the entire feed cycle.

The linkage which controls movement of the dancer or curved plate is infinitely adjustable by screw means.

A cam controlling movement of the linkage for the curved plate permits the machine to operate without a conventional brake bar. Instead of stopping the web with a brake bar, the motion of the curved plate is programmed to take up web as fast as the metering rolls are metering the web.

Spring-loaded nip wheels with built-in overrunning clutches are mounted in the feed table between the feed rolls and the curved plate. These wheels nip the web and allow the feed rolls to pull web through them, but prevent the web from backing up due to the movement of the curved plate while the plate is taking up the slack during the stop feed cycle.

Web-handling apparatus in accordance with the invention permits extremely accurate cutoff and side register control at all speeds and during machine speed changes. Furthermore, controlled acceleration and deceleration of the web provides a soft start and stop with no abrupt changes in speed or shocks, allowing the machine to run at higher speeds with fewer nicks and thereby permits the cut form to hold together. This allows greater freedom in die layout. Improved stripper register results from the fact that the cut form stays together, is in a more precisely timed relationship to the stripper and does not break loose from the web.

These and other objectives and advantages of the present invention will appear hereinafter as this disclosure progresses, reference being made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical, cross-sectional view through the web-handling apparatus embodying the present invention;

FIG. 2 is a view taken generally along the line 2—2 in FIG. 1;

FIG. 3 is a view similar to FIG. 1, but showing the dancer in one extreme position; and

FIG. 4 is a graph showing web speed and the position of the dancer relative thereto.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus shown in FIG. 1 is similar in many respects to that shown in the said U.S. Pat. 3,385,178 and the said U.S. Pat. No. 3,608,804, and such apparatus includes two heavy side members 1 and 2 which are fabricated from heavy plate steel and which form the frame of the machine. A set of metering rolls 3, 4, and 12 are located in the frame and roll 3 can be driven in the manner of that shown in the said U.S. Pat. 3,385,178 so that it precisely feeds the web W. A pair of intermitting-acting feed rolls 5 and 6 are also located in the machine

and as shown in FIG. 1, are closed together to provide a nip for feeding the web into a press P. As press P is conventional and as the means for intermittently opening and closing the feed rolls is conventional, it is not believed necessary to describe such in detail, but if further detail is believed to be either necessary or desirable in respect to the press or means for driving the feed rolls, reference may be had to the said U.S. Pat. No. 3,385,178.

A conventional brake bar is also provided in the frame and this includes a stationary upper portion **7** and a reciprocable lower brake bar **8**. The brake bar has been shown in FIG. 1 as being open and, generally, when the brake bar is closed, the feed rolls **5** and **6** are open, and, conversely, when the feed rolls **5** and **6** are closed to feed the web, the brake bar is opened. This means for periodically opening the brake bar is also shown in the said U.S. Pat. 3,385,178 and it will be noted that the drives for both the feed rolls **5** and **6** and the brake bar **8** are from the cam shaft **10** mounted in the machine. In respect to the brake bars, it is believed sufficient to say that the lower bar is periodically moved in a vertical direction to open and close the brake bar in timed relation with the feed rolls **5** and **6**. It is to be understood, however, that in accordance with the present invention, the brake bar could be omitted if desirable. This is possible because movement of the dancer or curved plate **15** by cam **36** is such that the web is taken up as fast as the metering roll **3** feeds the web to feed rolls **5** and **6**. Furthermore, in accordance with the invention, hold-back means in the form of a pair of hold-back rollers **9** and **11** are provided between the feed rolls **5** and **6** and the location of the dancer **15**. Upper hold-back roller **9** is rubber-covered or otherwise treated to increased its friction and lower roll **11** is a steel idler roller mounted on bearings. The upper roller **9** is provided with a built-in one-directional clutch so that it can turn in a clockwise direction (with respect to FIG. 1) but not in a counterclockwise direction. The hold-back rollers **9** and **11**, when the brake bars **7** and **8** open but before the feed rolls **5** and **6** start to feed, serve to prevent the web from being pulled back from the press P by the movement of curved plate **15**.

It is to be understood that suitable means (not shown) are provided at the entry side of the metering rolls to guide the web into the metering rolls.

In operation, the metering rolls constantly feed the web, whereas the feed rolls **5** and **6** only intermittently feed the web. Consequently, a loop would tend to develop between the pairs of rolls whenever the feed rolls are open (not feeding) and the brake bar is closed to clamp the web unless corrective action is taken as in accordance with the invention.

In accordance with the present invention, a movable dancer **15** has been provided for moving in timed relationship to the formation and pulling out of the web. This dancer takes the form of a generally semi-circular in cross section tube which is mounted at either end on a pair of arms **20**, which arms, in turn, are rigidly fixed to the tubular shaft **24**. The shaft **24** is journalled on appropriate anti-friction bearings **25** (FIG. 2) in the side walls **1** and **2** and can be oscillated so as to swing the dancer **15** between the positions X and Z shown in FIG. 3 and in a timed manner in relationship to the web to prevent a loop being formed and pulled out. A pair of adjustable links **30** are rigidly secured to each end of shaft **24** and each link **30** is urged in a counterclockwise direction (as viewed in FIG. 1) by a cam-driven pivoted bell-crank **32** and push rod **31**. Crank **32** is pivoted at **33**. Each adjustable link **30** comprises a housing or supporting means **51** of inverted U-shaped cross-sectional configuration (as shown in FIG. 2) having end plates **53** and **55** on which bearings **57** and **59**, respectively, are mounted. Housing **51** is rigidly connected to tubular shaft **24**. The bearings **57** and **59** support the ends of a member or rotatable threaded screw **60** which is axially disposed on housing **51**. One end of screw **60** is provided with a pinion gear **62** which meshes with worm gear **64** which is mounted for rotation between side frames **1** and **2**. Worm gear **64** is provided with a handle **66** to enable it to be rotated manually in either direction to thereby rotate screw **60** in either direction. A movable block **68** having a threaded opening **70** therein is disposed on screw **60** and is adjustably movable along the screw axis with respect to housing **51** as screw **60** is rotated. Block **68** is provided with a pivot pin **72** which enables the block to be pivotally connected to push rod **31**. The adjustable links **30** (and thus the dancer **15**) are positioned by using handle **66** to turn worm gear **64**, the pinion gears **62** and, thus, screws **60** to move the blocks **68** along their respective screws. The position of the link determines the amount of "feed-up," that is to say, it determines the amount of swinging movement of the dancer in accordance with the length of "feed-up" of the web provided by the metering rolls **3** and **4**. The links **30** are infinitely adjustable along the length of the screws **60**. The crank **32** is oscillated about its pivot point **33** on the frame by the action of the cam **36** which is rotatable with the cam shaft **10**, and which cam causes the follower **37** and its associated crank **32** to swing the rod **31**.

The shaft **24** is urged to the clockwise position (FIG. 1) by means of the pair of air cylinders **43**, of which only one is shown but which are understood to be located adjacent each end of the shaft **24** (FIG. 2). A compressed air chamber **44** is provided for both the air cylinders **43** and acts on the diaphragm **45** of the cylinder **43** to shift the plungers **46**. Each plunger **46** is pivotally connected to an air cylinder link bracket **47** on shaft **24**. Thus, elongated chamber **44**, located transversely of the web, acts as an accumulator so that rapid and positive biasing of shaft **24** is provided by the cylinders **43** and this biasing is accomplished without any lost motion or delay because of the relatively large volume of pressure action in chamber **44** and acting on the diaphragm **45** of each of the cylinders **43**.

As mentioned, the cam **36** is driven from the same cam shaft **10** that drives similar cams (not shown) for actuating the feed rolls **5** and **6** and the brake bar **8** and these drive means are clearly shown in the said U.S. Pat. No. 3,385,178.

Thus, the feed roll, the brake bar and the dancer are all moved in precise timed relation with the formation and pulling out of the web, as will now be described.

As shown in FIG. 1, the position of the dancer **15** is shown almost at and moving toward the right position, the web has been tightly drawn around the dancer by such movement, the feed rolls have just closed and are slipping, and the brake bar **8** is open. This position of the dancer will be referred to as position K on curve **50**. In this condition, the movement of the dancer is equal in speed to that of the meter roll, i.e., both are handling the same amount of web.

In FIG. 3, dancer or curved plate **15** is shown to be movable between an extreme left-hand position (designated by the letter X) and an extreme right-hand position (designated by the letter Z), in a manner hereinafter explained.

Referring to FIG. 4, the graph shows the relationship between web speed at its entry into the feed rollers **5** and **6** (except as hereinafter noted) and the movement of dancer **15** during one complete cycle of operation. However, a previous cycle of operation is to be assumed for purposes of discussion hereinafter. Furthermore, it is to be assumed that the curves **50** and **52** on the graph are not drawn to scale but merely illustrate general relationships. Also, the general shape of the curves would remain similar to that shown in FIG. 4, although values would change if linkage **30** is readjusted from the position shown in FIGS. 1 and 3.

In the graph, curve **50** represents speed and direction of movement of curved plate **15**. In other words, portions of curve **50** above line **54** represent movement of curved plate **15** in one direction (i.e., toward position

Z in FIG. 3 and away from the feed rolls 5 and 6 and away from metering roll 3). Portions of curve 50 below line 54 represent movement of curved plate 15 in another direction (i.e., toward position X in FIG. 3 and toward the feed rolls 5 and 6 and toward metering roll 3). In curve 50, the points Z and X are the points (also shown in FIG. 3 as positions Z and X) at which curved plate 15 reverses its direction of movement.

In the graph, curve 52 represents web speed into the feed rollers 5 and 6 for those portions of curve 52 between points A and H. Between points H and *a'* on curve 52, no web is feeding into the feed rolls 5 and 6 but metering roll 3 is still providing web which must be taken up.

Referring to FIG. 4, one cycle of operation and the method of controlling the web during the cycle is described as follows.

At point A on curve 52, web speed is zero, the brake bars 7 and 8 are open and the feed rolls or feed means 5 and 6 are closed, and the feed cycle begins. At point A, the metering rolls or metering means 3, 4 and 12 are in operation at constant speed. Also at point A on curve 52, as curve 50 shows, curved plate or dancer 15 is at point K and is ready to decelerate as it moves toward extreme position or reversal point Z. Thus, dancer 15 is tight against the web and the web is taut. The effective speed of dancer 15 matches metering roll speed (line 56) and both are handling the same amount of web.

Proceeding from point K toward point Z on curve 50, dancer 15 is decelerated to zero speed prior to its reversal of direction and this allows the net speed of the web going into the feed rolls 5 and 6 (and thus into the cutter or press P) to increase because dancer 15 is now taking up less web than the metering roll 3 is providing.

At point B on curve 52, web feed speed equals and then exceeds web metering speed until web feed equals the speed of feed rolls 5 and 6. Simultaneously, proceeding from point Z on curve 50, dancer 15 accelerates toward point X thereby causing deceleration of web feed speed and giving it a velocity equal to that of the feed roller speed, as shown at point C and along portion D of curve 52. Along portion D of curve 52, it is to be understood than dancer 15 is moving at a constant effective velocity that matches the metering speed of metering roller 3 and the feed speed of feed rollers 5 and 6.

This constant velocity condition exists until point F on curve 52 is reached, whereupon dancer 15 begins to decelerate as it moves toward position X. As this occurs, the web feed speed decreases because dancer 15 is no longer providing as much web as it was just previously.

When dancer 15 reaches point X on curve 50, it reverses direction and, at this point, web feed speed is at point G on curve 52, i.e., it matches the speed of metering roll 3. However, as dancer 15 now begins to accelerate toward point Z again, it begins to subtract or take up the excess web being supplied by metering roll 3 and, consequently, web feed speed begins to fall below metering roll speed.

When web feed speed reaches point H on curve 52, which point represents approximately half of the speed of metering roll 3, web feed to feed rolls 5 and 6 is stopped entirely by opening the feed rolls 5 and 6. Closing brake bars 7 and 8, if such are provided or operative, prevents the web from continuing to enter cutter or press P.

At point H on curve 52, it is to be understood that dancer 15 is not moving fast enough toward position Z on curve 50 to take up as much as metering roll 3 is delivering. Consequently, a slight loop of web tends to form around dancer 15 and continues to form until the dancer reaches point N on curve 50, at which point the velocity of the dancer equals metering roll speed. A further increase in velocity of dancer 15 is necessary to take up the slack in the web. This increase in velocity continues until point Q on curve 50 is reached. At point Q, velocity starts to decrease until point K' is reached. At point K', the effective velocity of dancer 15 is equal to metering roll speed. The effect of this programmed velocity of dancer 15 is to tauten the web prior to the next cycle of operation. However, the acceleration is rapid and because, in accordance with one aspect of the invention, the brake bars 7 and 8 are either open (inoperative) or not provided, it is necessary to prevent the portion of the web in cutter or press P from being moved in a reverse direction and pulled out therefrom. Reverse movement of the web is prevented by the rollers 9 and 11 which tightly grip the web and only permit its movement forward into press P but not in a reverse direction.

At point A' on curve 52 and at point K' on curve 50, the apparatus is ready for the next successive cycle of operation which is carried out in the same manner as the cycle hereinbefore described.

We claim:

1. Web-handling apparatus comprising a set of continuously acting metering rolls for a web, a pair of intermittent feed rolls for said web, a shiftable dancer located on the discharge side of said metering rolls for engagement with said web, and means for shifting said dancer in timed relationship with said web, said means for shifting said dancer comprising a cam and an adjustable linkage, said cam actuating said linkage in timed relationship with the feeding of said web and said adjustable linkage varying the displacement of said dancer to accommodate different repeat lengths of the web, said adjustable linkage comprising: supporting means mounted for pivotal movement on said apparatus and rigidly connected to said dancer, a block adjustably movable with respect to said supporting means, and a link pivotably connected to said block and movable in response to rotation of said cam to effect shifting of said dancer.

2. A linkage according to claim 1 including locking means for locking said block in position with respect to said supporting means.

3. A linkage according to claim 2 including a member axially disposed on said supporting means and on which said block is mounted for axial movement with respect to said supporting means.

4. A linkage according to claim 3 wherein said member is a screw means which makes threaded engagement with said block whereby relative movement between said screw means and said block effects a change in position of said block with respect to said supporting means.

5. A linkage according to claim 4 wherein said screw means is mounted for selective axial rotation on said supporting means.

6. A linkage according to claim 5 including a first gear rigidly mounted on said screw means and a second gear mounted for manual rotation on said supporting means for rotating said first gear and said screw means to adjustably move said block in an axial direction with respect to said housing.

7. A linkage according to claim 2 wherein said locking means comprises a bolt engageable with said supporting means and said block.

8. Web-handling apparatus comprising a set of continuously-acting metering rolls for a web, a pair of intermittent feed rolls for said web, a shiftable dancer located on the discharge side of said metering rolls for engagement with said web, means for shifting said dancer in timed relationship with said web, and web-gripping means between said feed rolls and said shiftable dancer to prevent said web from being drawn in a direction opposite to normal web feed direction at said feed rolls by said dancer as said dancer shifts.

9. Web-handling apparatus according to claim 8 wherein said web-gripping means is an intermittently operable brake bar.

10. Web-handling apparatus according to claim 8 wherein said web-gripping means comprises hold-back means including a pair of rollers which grip said web and are rotatable only in web feed direction.

11. Web-handling apparatus according to claim 10 wherein at least one of said hold-back rollers is provided with a one-directional clutch.

12. Web-handling apparatus according to claim 11 wherein at least one of said holdback rollers is provided with a high-friction surface.

13. A method of controlling web feed speed of a web to web feed means in web-handling apparatus which comprises continuously operable web-metering means; intermittently operable web feed means; and a shiftable dancer in contact with said web between said metering means and said feed means, said dancer being shiftable between two extreme positions; said method comprising the steps of: providing a supply of web from said metering means; starting operation of said web feed means whereby the web is being moved through and by said web feed means; simultaneously shifting said dancer to control the amount of web supplied to said web feed means; stopping operation of said web feed means whereby the web is no longer moved by said web feed means; and continuing to shift said dancer whereby it takes up web as rapidly as the web is delivered by said metering means.

14. A method according to claim 13 including the step of gripping said web between said web feed means and said dancer at least after stopping operation of said web feed means to prevent said web from being drawn in a direction opposite to web feed direction at said feed rolls by said dancer as said dancer shifts.

15. A method according to claim 14 wherein the step of gripping is carried out by means of intermittently operable brake bars.

16. A method according to claim 14 wherein the step of gripping is carried out by means of continuously acting hold-back rollers.

17. A method of controlling web feed speed of a web to web feed means in web-handling apparatus which comprises continuously operable web metering means; intermittently operable web feed means; and a shiftable dancer in contact with said web between said metering means and said feed means, said dancer being shiftable between two extreme positions; said method comprising the steps of: starting operation of said web feed means whereby the web is being moved through and by said

web feed means; simultaneously with said starting operation decreasing the speed of said dancer as it moves in a direction toward one extreme position whereby web feed speed can increase toward metering means speed; reversing the direction of movement of said dancer and moving it at increasing speed toward another extreme position whereby web feed speed can increase from metering means speed to feed means speed; moving said dancer at constant speed whereby web feed speed is maintained at feed roll speed; moving said dancer at decreasing speed whereby web feed speed decreases to metering roll speed; reversing the direction of movement of said dancer and moving it at increasing speed toward said one extreme position whereby web feed speed decreases below metering roll speed; stopping operation of said web feed means whereby the web is no longer moved by said web feed means; and moving said dancer at speed whereby it takes up web as rapidly as the web is delivered by said metering means.

18. A method according to claim 17 wherein stopping operation of said web feed means occurs while web is still being supplied to said web feed means and including the step of thereafter accelerating the speed of movement of said dancer whereby the dancer takes up excess web as rapidly as the web is delivered by said metering means and makes said web taut.

19. A method according to claim 18 including the step of gripping said web between said web feed means and said dancer at least after stopping operation of said web feed means to prevent said web from being drawn in a direction opposite to web feed direction at said feed rolls by said dnacer as said dancer shifts.

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ALLEN N. KNOWLES, Primary Examiner

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U.S. Cl. X.R.

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