United States Patent [19]

Henry

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[54] **WEB ROLL CRADLE WITH POSITIVE DRIVE**

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[73] Assignee: **The Woodman Company, Inc.,** Decatur, Ga.

[*] Notice: The portion of the term of this patent subsequent to Jan. 22, 1991, has been disclaimed.

[22] Filed: **Jan. 21, 1974**

[21] Appl. No.: **435,246**

Related U.S. Application Data

[63] Continuation of Ser. No. 234,494, March 14, 1972, Pat. No. 3,787,001.

[52] **U.S. Cl.** **242/75.43;** 242/55; 242/66

[51] **Int. Cl.**..... **B65h 17/08;** B65h 75/02

[58] **Field of Search** 242/75.43, 55, 65, 66, 242/67.3, 75.3, 75.4, 75.44, 156.2

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Primary Examiner—Edward J. McCarthy

Attorney, Agent, or Firm—Lowe, King & Price

[57] **ABSTRACT**

Apparatus and method of cyclic or intermittent feeding and unwinding of sheet material includes a pneumatic motor that drives the rotary web roll support and a brake that serves to stall out the motor when the predetermined length of material has been unwound. Draw means is provided to draw the predetermined length of film in a manufacturing process, such as packaging, with a slack loop being formed between the draw means and the web roll. The pneumatic motor is preferably a cylinder and rack combination with a drive stroke producing a capability greater than said predetermined length with the brake stalling out the motor at the end of the stroke to assure proper feed during each cycle and to maintain the tension in the web at a minimum and substantially constant during the complete operation. The slack loop is formed by a dancer assembly with linkage means comprising a cam and leaf spring applying the brake in a progressive manner only during the final moments of unwinding of the material. The dancer assembly desirably has insufficient pulling or tensioning power to pull film from the web roll so that complete reliance for feeding is put on the positive drive. The drive means and the draw means are operated at mutually exclusive times and are coordinated by first and second valves that actuate the drive means as the draw means are withdrawn to complete the drawing step.

7 Claims, 5 Drawing Figures

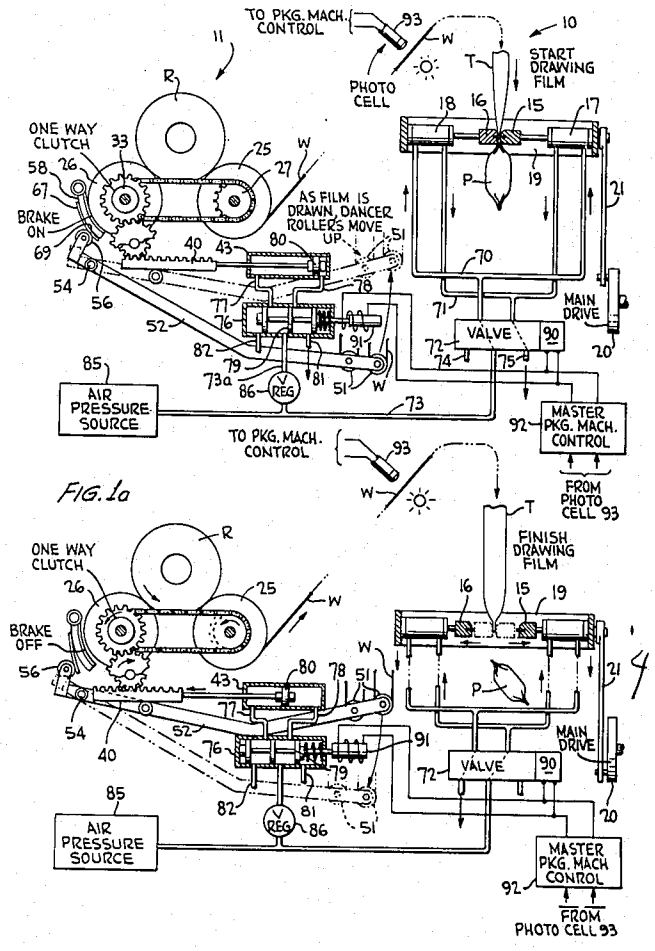


FIG. 1

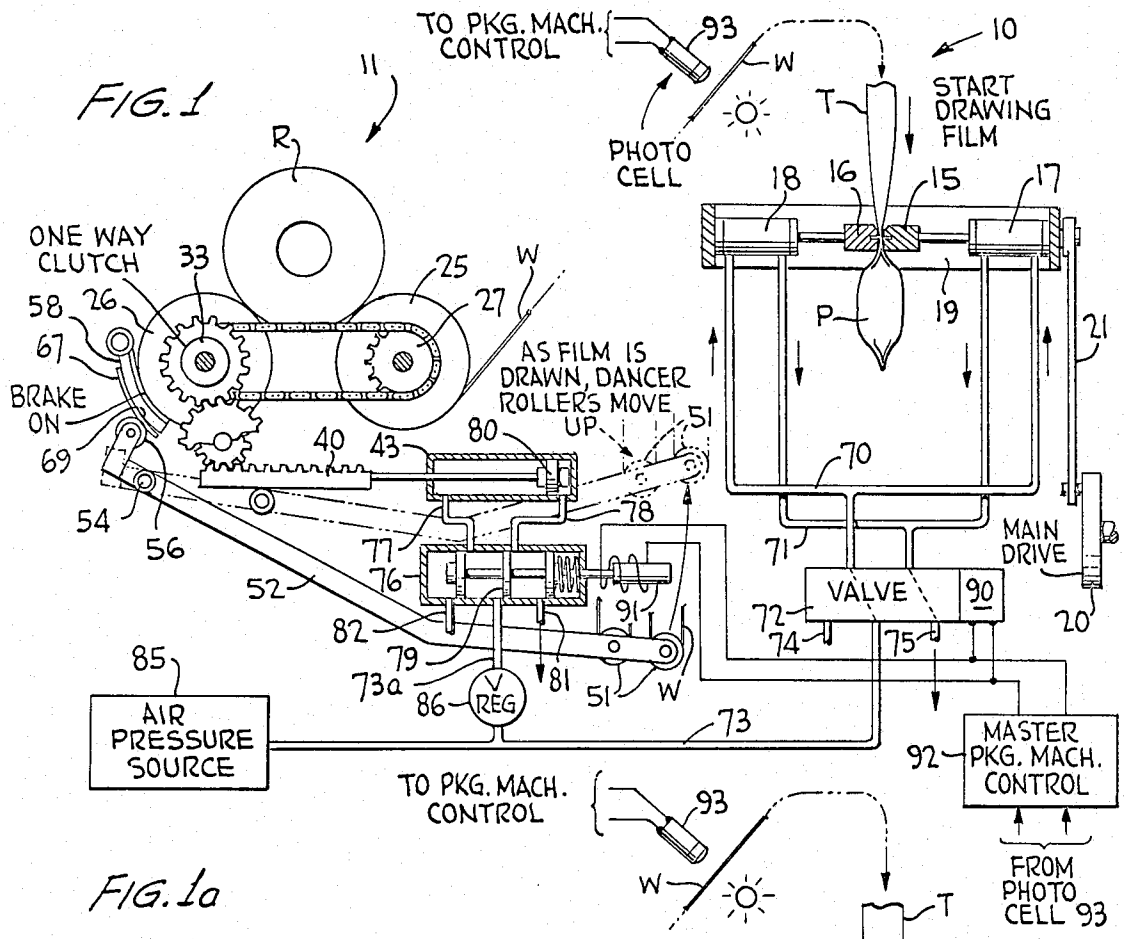

TO PKG. MACH. CONTROL
93
W
PHOTO CELL
11
10
START DRAWING FILM
T
R
18
16
15
17
ONE WAY CLUTCH
33
25
27
W
58
26
67
BRAKE ON
69
AS FILM IS DRAWN, DANCER ROLLERS MOVE UP
40
43
80
51
P
19
21
70
54
56
78
77
76
71
MAIN DRIVE
52
VALVE
90
91
72
74
75
20
82
79
73a
86
V REG
81
51
W
85
AIR PRESSURE SOURCE
73
MASTER PKG. MACH. CONTROL
92
FROM PHOTO CELL 93

FIG. 1a

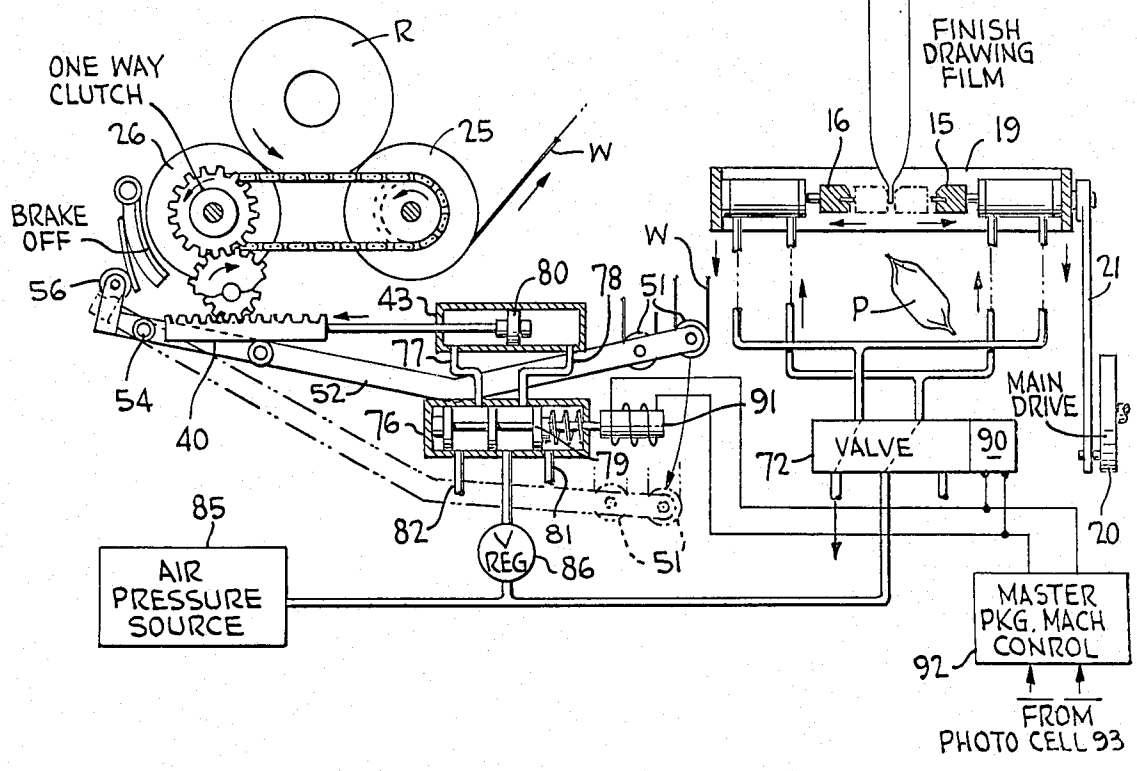

TO PKG. MACH. CONTROL
93
W
T
FINISH DRAWING FILM
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16
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19
ONE WAY CLUTCH
26
25
W
BRAKE OFF
56
80
78
51
43
P
21
77
54
52
40
76
91
MAIN DRIVE
VALVE
90
72
79
20
85
82
81
V REG
86
51
AIR PRESSURE SOURCE
MASTER PKG. MACH CONROL
92
FROM PHOTO CELL 93

FIG. 3

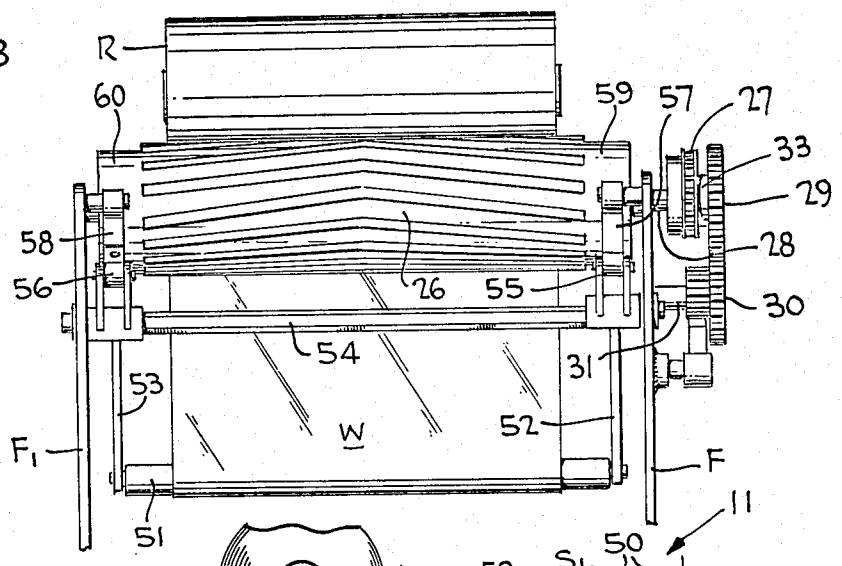


FIG. 2

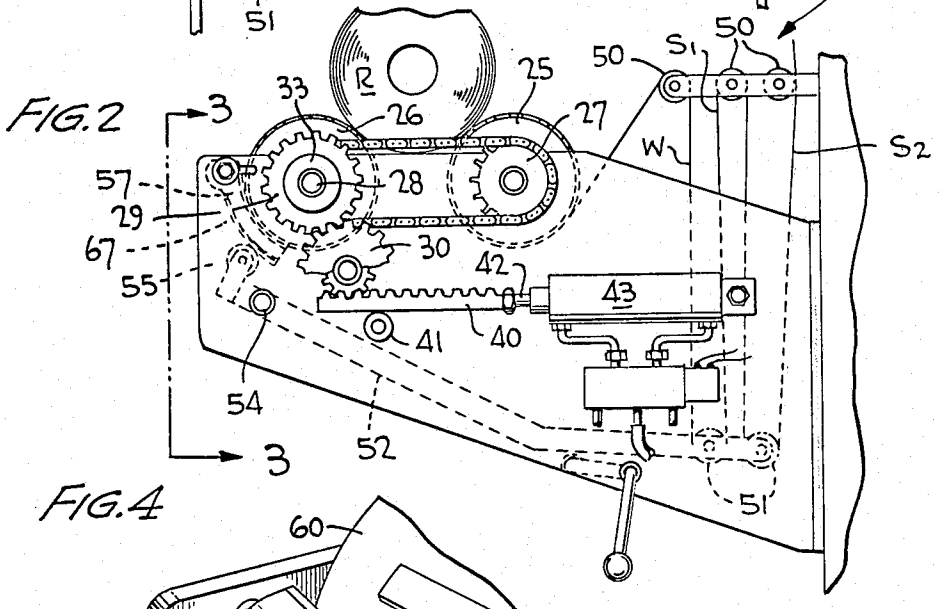
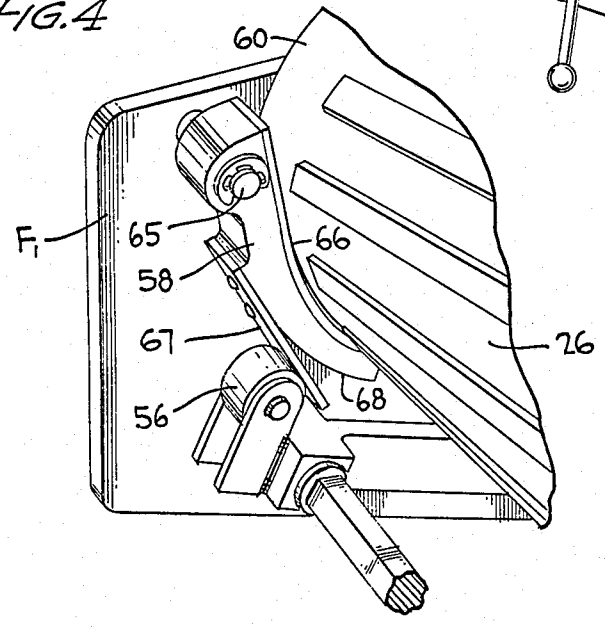


FIG. 4



WEB ROLL CRADLE WITH POSITIVE DRIVE

This is a continuation of application Ser. No. 234,494, filed Mar. 14, 1972, now U.S. Pat. No. 3,787,001.

The present invention relates to unwinding of sheet material, such as packaging film, and relates more particularly to a system for unwinding material by positive drive of the web roll and maintenance of a constant, minimum tension in the web.

BACKGROUND OF THE INVENTION

In form and fill packaging, as in many other environments where a web of sheet material is handled, it is necessary to withdraw predetermined lengths of material from a web roll. The length of film drawn from the roll is then used for forming a package for a commodity, or for some similar operation. It is necessary in such operations to maintain the lengths of sheet material or film of an exact dimension and to draw the film without unduly tensioning the sheet material. The first requirement of drawing exact lengths of material has been satisfactorily met for all grades, thicknesses and types of sheet material, such as by use of photoelectric control responsive to a preprinted mark on the film at each package length. This photocell control is integrated into the overall packaging machine control and exact lengths of material or packaging film may be drawn in a continuous fashion without difficulty.

However, with regard to the latter problem related to the actual feeding and unwinding of the sheet material, some difficulty today still exists. First, there are many types of film that are used in packaging machines so that in order for a machine to be versatile it must be capable of operating on different films that vary greatly in terms of resistance to unwinding, stretchability, fracturability and general strength. In the past, unwinding systems have almost exclusively relied upon the use of the tension in the web generated by the drawing means to pull the material from the roll which is supported on a rotary support means, either on an arbor or a web roll cradle. The rotary support means is braked at the end of the drawing stroke by means of a dancer arm that is responsive to the decrease in tension of the web in a slack loop. In other words, the sheet material is pulled from the web rool by an increase in tension in the web; this increase in tension decreasing the size of the slack loop by raising a dancer arm. The connected brake means is taken out of operative engagement with the rotary support means and the spring bias of the dancer arm increases the tension in the film to, in turn, start the web roll turning for unwinding. Upon completion of the feeding, the roll will continue to turn until the dancer arm once again applies the brakes by another decrease in tension; that is, an increase in the size of the slack loop. Such a prior art system that is successful with most kinds of packaging material are shown in my previous patents Henry et al., entitled Web Roll Cradle, issued Sept. 9, 1969, U.S. Pat. No. 3,465,979 and Henry, entitled Web Roll Cradle for Loosely Wound Material, issued Feb. 9, 1971, U.S. Pat. No. 3,561,692.

One particular type of packaging film that is becoming more and more popular in the form and fill environment, is polyethylene film. This film is preferred in many packaging situations, such as for frozen foods and other commodities, such as nuts and candies, because of its softness and highly pliable nature. These qualities however, make it extremely difficult to use the tension

in the film itself to pull the material from a web roll in a successful manner. The successive turns of the film on the web roll tend to stick to each other under certain ambient conditions, such as in a hot and humid environment, and the web is subject to stretching when placed under tension.

Furthermore, with all kinds of packaging film in roll form, there is the problem of inadvertently dropping and/or resting a roll on its side. This forms a deleterious flat spot on the periphery of the roll. If a cradle is used, the support rollers tend to stall due to wedge-like action when the spot engages either roller. Also, the adjacent turns of the web are pressed together at the spot and thus tend to stick more than usual during unwinding. These conditions thus prevent efficient unwinding, either on a cradle or arbor, by the previous web pull or tensioning method. Finally, the size of the web roll previously has been limited since the considerable inertia that must be overcome to start an oversized roll is greater than can be supplied by pulling on the web without damage thereto.

OBJECTIVES OF THE INVENTION

And, accordingly, it is the main object of the present invention to provide a universal feeding and unwinding system for sheet material from a web roll wherein positive drive is provided directly to the web roll and the tension in the web is maintained at a minimum and substantially constant.

It is still another object of the present invention to provide an unwinding system wherein a predetermined length of material may be fed from a web roll without reliance on the tension in the material for control.

It is still another object of the present invention to provide an unwinding method and apparatus in conjunction with a drawing of a predetermined length of material for packaging film that operates on the concept of providing overdriving capacity directly to the web roll and a brake system responsive to a slack loop that overrides or stalls out the drive after a predetermined length of material has been unwound.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

My present invention is preferably embodied in a web roll cradle wherein the roll support rollers are positively driven directly in response to a function other than the tension in the web being drawn from the roll. By tieing the control of the positive drive on another function, such as the completion of the drawing stroke of the sealing jaws of a form and fill packaging machine, the web is not subject to deleterious stretching, fracturing or tearing that has been a problem in the past especially when certain packaging films are used. The system is highly versatile because of this feature, is smoother in operation and highly reliable. This system can be used not only for any type of packaging material, but also in virtually any application other than packaging machines where intermittent unwinding is a necessity.

The positive drive is preferably provided by a pneumatic cylinder having a drive rack connected to the piston and operating through a gear train and one-way clutch to drive the support rollers of the cradle. The actuation of the cylinder is controlled to feed a new length of film from the web roll by the packaging machine control including the photocell detector that interrupts the drawing of the film by the sealing jaws. In

this manner, the initiation of the drive cycle is independent of the tension, and yet is invariably in step with the needs of the machine. On each cycle of the machine, the pneumatic cylinder has sufficient capacity to unwind more than a single, predetermined length of material in order to assure that a shortage does not exist. The exact length of film is obtained in a novel manner by employing a dancer assembly control brake that serves to stall out or override the pneumatic motor when the proper length has been unwound. A slack loop formed between the web roll and the draw means controls the dancer with the maximum slack loop being provided at the start of the drawing step and the minimum slack loop being provided at the start of the driving step.

Further in accordance with the present invention, a linkage means in the form of a cam and leaf spring is provided between the dancer assembly and the brake in order to progressively apply the braking pressure in the last moments of each unwinding step and to assure a rapid and positive stop without virtually any increase in tension in the web. Although a conventional arbor can be used in accordance with the broader aspects of the present invention, a roll cradle is preferred so that the drive stroke is the same regardless of the diameter of the web roll. The system automatically adapts to drawing different lengths of film over a limited range through the extra driving capacity since the brake means or disabling means would merely override the driving motor at an earlier or later point, as required.

Still other objects and advantages of the present invention will become readily apparent to those skilled in this art from the following detailed description, wherein I have shown and described only the preferred embodiment of the invention, simply by way of illustration of the best mode contemplated by me of carrying out my invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modification in various obvious respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view of the feeding and unwinding system of the present invention showing the web roll cradle in a standby position and the draw means ready to draw a new predetermined length of packaging film;

FIG. **1***a* is a schematic view of the feeding and unwinding system of FIG. **1** showing the web roll cradle being driven after the completion of the drawing step;

FIG. **2** is a side view of the system of FIG. **1** but showing the components in the sequence at the end of the cradle driving stroke and prior to the next cycle;

FIG. **3** is a rear view of the web roll cradle taken in the direction shown by the line **3-3** of FIG. **2**; and

FIG. **4** is a perspective view, enlarged to show detail, of the brake shoe and the operating linkage means on the dancer arm assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to FIG. **1** of the drawings, a more detailed description of what I consider at present to be a preferred embodiment of the invention is shown in schematic form and the salient features may be more fully described. The figure essentially shows the feeding system for the packaging film of a form, fill and packaging machine, which comprises generally a package forming device **10** and a web roll cradle **11** with a web W being in readiness for unwinding and feeding from a web roll R. As mentioned above, it will be readily understood by those skilled in the art that the broadest aspects of the invention are concerned with the novel manner of handling the web W and unwinding the same in an intermittent fashion from the roll R and that therefore the concepts could be used in environments other than packaging where intermittent draw-out of film or other sheet material is necessary.

The packaging forming device **10** may be of any conventional structure suitable to draw a predetermined length of material in an intermittent or cyclic fashion. In the embodiment shown, the predetermined length of film or web W to be drawn during each cycle is represented by the length of package P formed by successive heat seals transversely positioned across a tube T formed of the web W. These heat seals are formed by cooperating sealing jaws **15, 16** that are operated toward and away from the tube T by a pair of air cylinders **17, 18.** The cylinders **17, 18** are carried on a reciprocating carriage **19** that is moved through any suitable power means, such as a crank **20** and arm **21** driven from the main drive of the packaging machine. Of course, if desired, the relative movement between the tube T and the carriage **19** alternatively may be obtained by reciprocating a component in engagement with the tube T while holding the carriage **19** in a fixed position, as is well known.

With reference to FIGS. **1–3,** the main components of the web roll cradle **11** may be more fully understood. The web roll R is supported between a pair of support rollers **25, 26** which are coupled for mutual rotation by a suitable chain and sprocket coupling **27.** Positioned outboard of the chain sprocket on support shaft **28** of the rear roller **26** is a power gear **29** (see FIG. **3**), which gear forms a part of a gear train also including a driving step-up gear **30** mounted on a stub shaft **31** supported on the side frame F of the cradle **11.** Formed as an integral part of the power gear **29** is a one-way clutch **33** that permits rotation of the driving gear in a direction to unwind the web W from the roll R but slips when the gear is driven in the reverse direction.

The step-up gear **30** is driven from a drive rack **40** that is urged into engagement with the smaller of the two gears by a guide roller **41,** as shown in FIG. **2.** The rack is attached to piston rod **42** of the pneumatic cylinder **43.** Thus, as is apparent and as will be further explained, the actuation of the cylinder **43** operates to drive the web roll support rollers **25, 26** in a forward direction to feed the web W with the one-way clutch **33** permitting the return stroke in readiness for the next feeding cycle.

The web W passes around suitable stationary guide rollers **50** where multiple slack loops S_1 and S_2 are formed in the web W by cooperating movable guide rollers **51** (see FIG. **2**). The movable rollers **51** are mounted on a dancer arm assembly including spaced arms **52, 53** (see FIG. **3**), which are mounted on pivot cross bar **54** supported by the side frames F, F_1 at the rear of the cradle assembly **11.**

The rear end of the arms **52, 53** carry cam rollers **55, 56** that serve as a part of an operating linkage means to brake shoes **57, 58** operating against circumferential friction surfaces **59, 60** at the ends of the rear roller **26.**

As best shown in FIG. 4, the brake shoe 58 is mounted on a shaft 65 extending outwardly from the side frame F_1 and includes a suitable frictional padding 66 that engages the brake surface 60 to bring about the braking effect. A leaf spring 67 is fixed to the back of the brake shoe 58 at the upper portion of a curved base 68. The spring 67 provides resiliency in the operation of the brake shoe 58 toward the braking surface 60 since the operating cam roller 56 engages the shoe 58 only through the spring 67.

When the dancer arm assembly is in the raised position (see FIG. 1a), the brake shoe 58 is spaced from the cooperating surface 60 and thus there is no braking force applied to the support roller 26. However, when the dancer arm assembly is in the lowered position of FIG. 1 (see also FIG. 2) the brake shoe 58 is applied with maximum force due to the camming action of the roller 56 against the spring 67. With the dancer arm assembly in its lowermost position, the leaf spring 67 is bent under maximum conditions and the inside face thereof has been brought into engagement with the curved surface 68 (see FIG. 2) to a point 69 (FIG. 1) below the initial or attachment point (FIG. 2). This means that the leverage against the brake shoe 57 is progressively increased and thus the braking force is progressively increased to a maximum during, and only during, the final moments of downward movement of the dancer arm assembly. This gives a positive braking action that assures positive stalling out of the motor or cylinder 43 with a desirably rapid and progressive but smooth deceleration motion. It will be understood that the operation of the brake shoe 57 at the far side of the cradle 11 is identical and complementary to that just described.

The interconnected control between the package forming device 10 and the web roll cradle 11 forms an important aspect of the present invention and will now be discussed. The pneumatic cylinders 17, 18 that operate the sealing jaws 15, 16 are provided with pressurized fluid and exhausted through feed lines 70, 71, respectively. A first valve 72 distributes the pressurized air from a feed conduit 73 to the line 70 when the sealing jaws 15, 16 are to be moved toward the tube T that is being sealed to form the package P. Simultaneously, the first valve 72 exhausts through the line 71, the opposite side of the cylinders 17, 18 through the exhaust ports 74 or 75.

The pneumatic cylinder 43 is connected to a second control valve 76 (preferably, identical to the first valve 72) that is operative to feed and exhaust said cylinder 43 through the transfer lines 77, 78. In other words, in the position shown in FIG. 1, spool element 79 connects feed conduit 73a to the transfer line 77 to cause piston 80 of the cylinder 43 to be shifted to the right for the return stroke. At the same time, the spool element 79 exhausts the line 78 through exhaust port 81. When the spool 79 of the second valve 76 is in the opposite position, as shown in FIG. 1a, the piston 80 is moved toward the fully extended position with the line 78 supplying the pressurized fluid and the line 77 exhausting the fluid from the soft side by releasing the same through exhaust port 82. The feed conduits 73a and 73 are provided with pressurized air from pressure source 85, and a separate air pressure regulator 86 is or may be provided along the conduit 73a in order to adjust the air pressure acting against the piston 80 to control force and speed of the driving of the rollers 25, 26.

The valves 76 may include suitable electrical actuators, such as solenoids 90, 91, and in accordance with this invention, the solenoids are controlled in synchronization by the central or master packaging machine control 92. Feeding information to this control is a conventional photocell 93 that is operative to sense control marks on the web W to designate the length of film to form the package P by opening of the sealing jaws 15, 16 at the proper instant. The signal from the photocell 93 is fed to the packaging machine control 92, and this signal in turn, operates solenoid 90 to open the sealing jaws 15, 16, as shown in FIG. 2, which is the end of the drawing stroke in the operation.

The cutting loose of the package P and the opening of the sealing jaws 15, 16 preferably occurs before bottom dead center of the crank 20 for built-in overtravel to assure full length drawing on each cycle (FIG. 2). Similarly, the start of drawing film of FIG. 1 may be below top dead center to permit stripping (settling) of product into the package P, if desired.

OPERATION

The basic overall operation of the above-described apparatus and the related method for unwinding the web roll R should now be evident to one skilled in the art, but it will be now reviewed to further bring out and emphasize the novel aspects of the invention. The carriage 19 of the device 10, which is in the preferred embodiment the package forming mechanism, is shown in FIG. 1 at the start of the drawing stroke where the sealing jaws 15, 16 have finally closed and have formed a transverse seal across the tube T. The crank 20 operating from the main drive of the machine on a definite recurring cycle, starts the downward motion of the carriage 19 to carry out this drawing step.

At this time, the rollers 51 of the dancer arm assembly are in their lowermost position shown by the full lines of FIG. 1 with the brake shoe 58 (and the brake shoe 57) in the fully applied condition. The piston 80 of the cylinder 43 has moved the rack 40 into the fully retracted position in standby for the forward drive of the rolls 25, 26. In this position, the web W is tensioned; however, since a portion of the weight of the dancer arm assembly is supported by the camming engagement at the cam roller 56 (and roller 55), the tension is reduced even below the operating minimum so that the web is not deleteriously stretched or deformed even during shut-down periods that can be experienced with a machine between work shifts, for example.

As soon as the carriage 19 has moved a finite or predetermined distance downwardly from the position shown in FIG. 1, the guide rollers 51 are raised, as shown by the arrows in FIG. 1. During this time, the brake is released so that the rolls 25, 26 are ready to be freely driven; however, the cylinder 43 is still retained in the standby or retracted position.

As the guide rollers 51 are lifted from their lowermost position, the tension in the web is now determined solely by the weight of the dancer arm assembly pivoted about the pivot shaft 54. It is a desiratum of the invention that this operating tension be maintained at a minimum and not vary by a significant amount. This is accomplished by marking the components of a light material and/or providing counterbalancing weight at the rear of the dancer arm assembly; the tension thus being only that necessary to promote a wrinkle-free and non-sag condition. Also, there is no spring urging

the assembly to the lowermost position, as is common on prior art devices.

With the drawing step reaching conclusion, the sealing jaws **15, 16** approach their lowermost position and the photocell **93** senses the package length mark. At this moment, the sealing jaws **15, 16** are withdrawn from their dotted line position to the full line position (FIG. 1*a*) to release the tube T and to cause the package P that has been previously cut to drop away in finished form. The photocell **93** has caused this action through the master packaging machine control **92,** the valve **72** and its actuator **90.** Concurrently, because of the direct interconnection of the actuator **91** with the actuator **90,** the spool element **79** of the valve **76** is switched to the position shown in FIG. **1a** and the piston **80** thus begins the drive motion. This is continued until at the moment that the step of driving the roll R is finished, the dancer guide rollers **51** are at their lowermost position.

To further explain and to note the important braking operation, as the rack **40** continues to drive the rollers **25, 26,** the dancer guide rollers **51** continue their downward movement toward the dotted line position of FIG. **1a.** Just before the rollers reach the rest position, the cam roller **56** is brought into engagement with the leaf spring **67** (see FIG. **4**) and the application of braking force is begun. At this point, the rack **40** has almost, but not completely, reached the end of its stroke. The braking force is rapidly, but smoothly applied until the point of maximum leverage engagement **69** (FIG. **1**) is obtained between the leaf spring **67** and the curved base **68.** At this point, the support rollers **25, 26** have been locked in position by the braking action and the pneumatic motor or cylinder **43** has had its piston **80** stalled out. The pressure provided through the regulator **86** is such that the compressible fluid on the right of the piston **80** is not sufficient to overdrive the application of the brake **58** (and the brake **57** on the other side). Accordingly the feed of the web W stops at just the desired point, or in other words, when the guide rollers **51** are in their dotted line position (FIG. **1a**) at the lowermost point of travel.

When the carriage **19** has returned to its uppermost position by moving relative to the tube T (see FIG. **1**), the master packaging machine control **92** through a suitable timing device, such as a cam, trips the actuator solenoids **90, 91** to bring the sealing jaws **15, 16** together for the start of the next drawing stroke, and concurrently, quick returns the piston **80** and the drive rack **40** to the standby position in readiness for the next cycle.

In summary, it can be seen that one of the salient features of the intermittent unwind method and apparatus of the present invention is that the tension in the web is held at an operating minimum throughout the cycle. This is accomplished by initiating and performing the driving operation in response to an independent machine function, such as the completion of the drawing stoke, rather than in response to a design increase in the tension, and stalling out the driving motor or cylinder **43** of the web cradle **11** by a braking operation when the proper length has been unwound from the roll R. For simplicity of control, the actuating means for the sealing jaws **15, 16** of the packaging device **10** are directly interconnected with the actuating cylinder **43** of the roll cradle **11** causing the operations to be at mutually exclusive times; or in other words, each is operative during the rest period of the other. Exact feeding of the web W is performed with ease since the drive rack **40** has a built-in overrun that allows for at least some stalling period by the brakes during each cycle.

In this disclosure, there is shown and described only the preferred embodiment of the invention, but, as aforementioned, it is to be understood that the invention is capable of use in various other combinations and environment and is capable of changes or modifications within the scope of the inventive concept as expressed herein.

I claim:

1. The method of cyclic or intermittent feeding and unwinding of sheet material from a web roll comprising the steps of intermittently drawing a predetermined length of sheet material of said web roll supported on spaced support rollers, intermittently directly driving said web roll through said support rollers to the final turn of said roll to unwind a predetermined length of material substantially equal to that drawn and concurrently forming a slack loop between said web roll and said draw means varying from a minimum to a maximum slack loop, said direct driving step being initiated and performed substantially independently of the tension in said web, whereby the tension in said web remains at a minimum and substantially constant as determined by the formation of said slack loop and the duration of the driving step is substantially the same during each cycle regardless of the diameter of the web roll.

2. The method of feeding and unwinding of claim **1** wherein the drawing step and the driving step are at different times and the driving step is terminated prior to said drawing step.

3. The method of feeding and unwinding of claim **2** wherein the driving step is commenced concurrently with the completion of the drawing step.

4. The method of feeding and unwinding of claim **1** wherein said driving step lasts longer than necessary to produce the predetermined length of material and braking is applied with respect to said roll to override said driving to produce said predetermined length.

5. The method of feeding and unwinding of claim **1** wherein tension is placed on said web in said slack loop that is limited to a value insufficient to unwind said material by itself.

6. The method of claim **1** wherein said maximum slack loop is provided at the start of the drawing step and the minimum slack loop is provided at the start of said driving step.

7. The method of claim **1** wherein is provided a progressive braking of said web roll only during the final moments of unwinding, whereby free rotation at other times allows minimum tension, and progressively reducing said tension further during braking to avoid stretching of said material during down time.

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