(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 514 697 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.10.2012 Bulletin 2012/43

(51) Int Cl.:
B65H 23/182 *(2006.01)*

(21) Application number: **12002506.9**

(22) Date of filing: **05.04.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **18.04.2011 US 201161476644 P**
21.02.2012 US 201213401583

(71) Applicant: **Alkar-RapidPak-MP Equipment, Inc.**
Lodi, WI 53555 (US)

(72) Inventors:
- **Bonneville, Craig R.**
Black Earth, WI 53515 (US)
- **Eisele, Ian Thornley**
Cross Plains, WI 53528 (US)

(74) Representative: **Gesthuysen, von Rohr & Eggert**
Patentanwälte
Huyssenallee 100
45128 Essen (DE)

(54) Systems and methods for supplying a web of packaging material to an indexing-motion packaging machine

(57) The invention relates to a system for supplying a web of packaging material to a packaging machine, the system comprising: a motor (14) rotating a roll (16) of a web of packaging material (12), a conveyor conveying the web (12) from upstream to downstream. The system is characterized in that it further comprises the system further comprises a dancer (36) located downstream of the roll (16) and upstream of the conveyor, the dancer (36) being movable between first and second positions based upon a change in tension of the web (12), and a control circuit (154) controlling the motor (14) and being in communication with at least one sensor (56) sensing the position of the dancer (36), wherein the control circuit (54) controls the motor (14) to rotate the roll (16) to thereby cause the dancer (36) to move from the first position to the second position, wherein the control circuit (54) calculates a starting speed of the motor (14) based upon the movement of the dancer (36) from the first position to the second position, and further wherein the control circuit (54) controls the motor (14) at the calculated starting speed to begin supplying the web (12) to the conveyor.

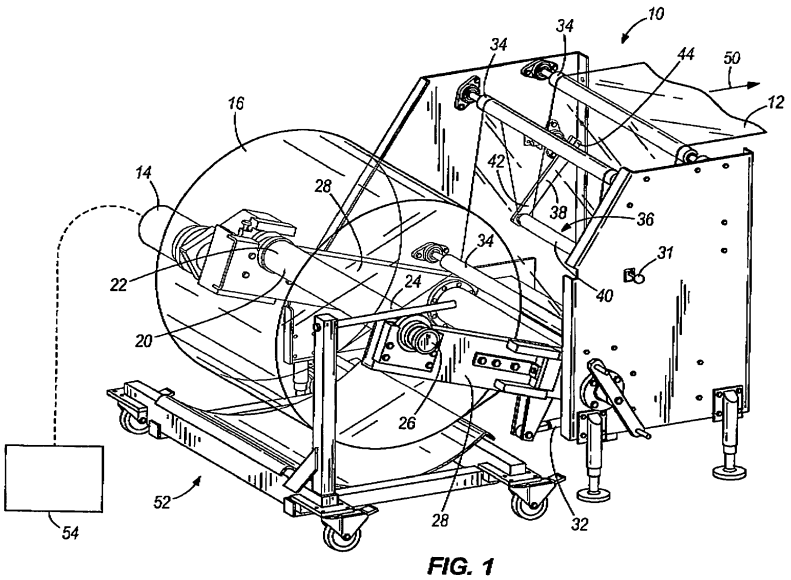

FIG. 1

EP 2 514 697 A2

Description

[0001] The present disclosure relates to packaging machines, and more particularly to methods and systems for supplying a web of packaging material to indexing-motion packaging machines.

[0002] The present invention is directed to a system for supplying a web of packaging material to a packaging machine with the features of the introductory part of claim 1 or claim 11 and to a method for the same purpose with the features of the introductory part of claim 6 or claim 7 or claim 14.

[0003] US-A-5,170,611 and US-A-5,205,110, the disclosures of which are incorporated herein by reference, disclose indexing motion apparatuses and methods for vacuum packaging of articles such as hot dogs, sliced luncheon meat, cheese or pharmaceuticals. In one example, an apparatus and method for supplying web material to an indexing advancement mechanism, such as may be associated with a packaging machine which forms the web into a component of a package is disclosed. The web is supplied from a supply roll to an unwind mechanism, which continuously unwinds the web during indexing advancement of the web by the advancement mechanism of the packaging machine. The unwind mechanism includes an unwind motor which is operable to vary the rate at which the web is unwound from the supply roll. Tension is maintained in the web upstream of the advancement mechanism by a take-up mechanism interposed between the unwind mechanism and the advancement mechanism. The unwind motor speed is controlled by the position of a movable arm associated with the take-up mechanism.

[0004] EP-A-2 253 543 and EP-A-2 253 544, the disclosures of which are incorporated herein by reference, disclose packaging machines including a web transport conveyor transporting a web of flexible packaging material from upstream to downstream locations through a series of stations, and packaging apparatuses including a forming station and a closing station, each having movable die members that are counterbalanced. This prior art forms the started point of the invention. Stretching and/or wrinkling of the web packaging material at start up of the conveyor of a packaging machine has been found problematic in the prior art structures. So the object of the invention is to provide a system and a method for supplying a web of packaging material to a packaging machine that prevents or at least reduces stretching and/or wrinkling of the web packaging material.

[0005] The above mentioned problem is solved in a first attempt by a system with the features of the introductory part of claim 1 and the features of the characterizing part of claim 1 in combination therewith. An alternative solution of the same problem is provided by a system according to claim 11.

[0006] As far as the method is concerned, above mentioned problem is solved by a method with the features of the introductory part of claim 6 together with the features of the characterizing part of claim 6.

[0007] In a different approach the problem is solved by a method according to claim 7 also.

[0008] Finally, claim 14 addresses a further method that solves above mentioned problem.

[0009] In the first alternative of the invention a system is provided where a motor rotates a roll of a web of packaging material. A conveyor conveys the web from upstream to downstream. A dancer is located downstream of the roll and upstream of the conveyor. The dancer is movable between first and second positions based upon a change in tension of the web. A control circuit controls the motor and is in communication with at least one sensor sensing the position of the dancer. The control circuit controls the motor to rotate the roll to thereby cause the dancer to move from the first position to the second position. The control circuit calculates a starting speed of the motor based upon the movement of the dancer from the first position to the second position. The control circuit further controls the motor at the calculated starting speed to begin supplying the web to the conveyor.

[0010] Preferred modifications and further improvements of this system are the subject matter of the dependent claims 2 to 5.

[0011] According to claim 6 a method according to the invention includes the steps of supplying a web of packaging material from a roll to a conveyor for conveying the web from upstream to downstream, rotating the roll to change tension of the web and cause a dancer to move from a first position to a second position, sensing the movement of the dancer, calculating a starting rotational speed of the roll based upon the movement of the dancer from the first position to the second position, and rotating the roll at the calculated starting rotational speed to supply the web to the conveyor.

[0012] In a slightly different approach a method for supplying a web of packaging material according to claim 7 includes (1) supplying a web of packaging material from a roll to a conveyor that conveys the web from upstream to downstream; (2) providing a dancer located downstream of the roll and upstream of the conveyor, the dancer being movable between first and second positions based upon a change in tension of the web; (3) controlling the motor to rotate the roll and thereby cause the dancer to move from the first position to the second position; (4) sensing the movement of the dancer; (5) calculating the starting speed of the motor based upon the movement of the dancer from the first position to the second position; and (6) controlling the motor at the calculated starting speed to supply the web to the conveyor.

[0013] Preferred and optional modifications of above mentioned method according to the invention are the subject matter of the dependent method-claims 8 to 10.

[0014] A further system according to the invention is the subject matter of claim 11 with dependent claims 12 and 13.

[0015] A further method according to the invention is the subject matter of claim 14 with a dependent claim 15.

[0016] Hereafter, embodiments of systems and methods for supplying a web of packaging material to an indexing motion packaging machine are described with reference to the following Figures. The same numbers are used throughout the Figures to reference like features and components.

Fig. 1 is a perspective view of a system for supplying a web of packaging material to a packaging machine,

Fig. 2 is like Fig. 1, excluding a cart for transporting a roll of a web of packaging material,

Fig. 3 is a side view of the roll and a dancer located downstream of the roll and upstream of the conveyor,

Fi g. 4 is a view like Fig. 3 showing the dancer in a different position,

Fig. 5 is a flow chart illustrating one example of a method of supplying a web of packaging material to a packaging machine,

Fig. 6 is a flow chart illustrating another example of a method of supplying a web of packaging material to a packaging machine,

Fig. 7 is a flow chart illustrating another example of a method of supplying a web of packaging material to a packaging machine.

[0017] In the present description, certain terms have been used for brevity, clearness and understanding. No unnecessary limitations are to be inferred therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes only and are intended to be broadly construed. The different assemblies described herein may be used alone or in combination with other assemblies. Various equivalents, alternatives, and modifications are possible within the scope of the appended claims.

[0018] Figs. 1 and 2 depict a system 10 for supplying a web of packaging material 12 to a packaging machine such as one of the machines described in incorporated US-A-5,170,611 and US-A-5,205,110 or incorporated EP-A-2 253 543 and EP-A-2 253 544.

[0019] In other examples, the system 10 is operable with other types of packaging machines having a conveyor for indexing the web of packaging material 12. The system 10 includes, among other things, a motor 14 that rotates a roll 16 of the web of packaging material 12. The motor 14 rotates the roll 16 from its core 18. The motor 14 can include a servo motor or other type of means for causing rotation of the roll 16. The motor 14 is operably connected to a rotary spindle or shaft 20 that extends through the core 18 of the roll 16 and engages with the core 18 to cause the noted rotation of the roll 16. In this example, the rotary shaft 20 has one end 22 operably connected to the motor 14 and another end 24 connected to a locking knob or cap 26. Thus, the roll 16 can be connected to or removed from the motor 14 and rotary shaft 20 by removing and replacing the cap 26. The rotary shaft 20 is supported at its ends 22, 24 by support arms 28, which extend from a support frame 30. The support arms 28 can be raised and lowered by one or more hydraulic lifting cylinders 32. Cylinders 32 can be actuated by a user via manual valve 31.

[0020] The support frame 30 is located downstream of the roll 16 and upstream of the noted conveyor. The support frame 30 supports one or more idler rollers 34 for guiding the path of travel of the web 12 from the roll 16 to the noted conveyor. The support frame 30 also supports a dancer 36, which in this example includes a pair of arms 38 and a cross shaft 40. The dancer 36 is movable between a first, raised position shown in Fig1. 4 and a second, lowered position shown in Fig. 3. The arms 38 have a first end 42 connected to the cross shaft 40 and a second, opposite end 44 that is pivotally connected to opposite sides of the support frame 30. The dancer 36, including in this example the noted arms 38 and cross shaft 40 is freely pivotable about the second end 44 such that changes in tension of the web 12 will cause said movement between the noted first and second positions. For example, increasing the tension in the web 12 causes the web 12 to act on the cross shaft 40 and pull the first end 42 of the arms 38 upwardly in the direction of arrow 46, Fig. 4, and thus move the dancer 36 upwardly in the direction of arrow 46. Conversely, releasing tension in the web 12 releases the dancer 36 such that gravity causes the web 12 and the first end 42 of the arms 38 to move downwardly in a direction opposite arrow 46. It will thus be understood that rotation of the roll 16 in a forward direction, shown at arrow 48, Fig. 3, releases tension in the web 12 and allows the dancer 36 to move from the first, raised position shown in Fig. 4 to the second, lower position shown in Fig. 3. Conversely, rotation of the roll 16 in a direction opposite arrow 48 creates tension in the web 12 and causes the dancer 36 to move from the second, lower position shown in Fig. 3 to the first, raised position shown in Fig. 4. Further, when the noted conveyor draws the web 12 forwardly with respect to the roll 16, as shown at arrow 50, the tension in the web 12 is increased, thus causing the dancer 36 to move from the second, lower position shown in Fig. 3 to the first, raised position shown in Fig. 4, as shown at arrow 46. This occurs while the roll 16 remains stationary or rotates at a speed that is less than the speed at which the web 12 is drawn onto the conveyor.

[0021] Referring to Fig. 1, a delivery cart 52 is shown for transporting the roll 16 for manually loading onto the support frame 30 by inserting the rotary shaft 20 into the core 18. Fig. 2 shows the system 10 having the cart 52 removed therefrom.

[0022] The system 10 also includes a control circuit 54

for controlling the motor 14. The type of control circuit 54 can vary and includes a microprocessor having memory and programmable logic for carrying out one or more software routines. The control circuit 54 also has inputs and outputs for receiving and sending information to components of the system 10, such as for example the motor 14 and/or sensors associated with the motor 14 and/or rotary shaft 20 for identifying an angle of rotation made by the motor 14. Further, the control circuit 54 is in communication with one or more position sensors 56, Figs. 3 and 4, which in the example shown are conventional proximity sensors placed at the second ends 44 of the arms 38 of dancer 36. The position sensors 56 are conventional items that sense or detect the position of the arms 38 as the dancer 36 moves between the noted first and second positions shown in Figs. 3 and 4.

[0023] The present inventors have found it desirable to prevent stretching and/or wrinkling of the web packaging material 12 at startup of the noted conveyor. Previously, especially in situations where jumbo film rolls are used, only heavy or thick webs, such as semi-rigid or rigid webs, could be used. This is due to the fact that if the heavy roll 16 must be unwound by pulling on the web 12 in the direction of arrow 50, lighter web materials would be stretched by the tension required to make the roll 16 turn. Stretching of the web results in the web becoming narrower and creates wrinkles in the web, which are not desirable for packaging. The smaller the diameter of roll 16, the faster the initial speed of rotation that is required to avoid damaging the web 12. The larger the diameter of the roll 16, the slower the initial speed of rotation that is required.

[0024] To solve this problem, the present inventors developed a system that includes the control circuit 54, which is programmed to control the motor 14 at start-up to rotate the roll 16 backwards to increase the tension in the web 12 and thereby cause the dancer 36 to move from the second, lowered position shown in Fig. 3 to the first, raised position shown in Fig, 4.

[0025] Thereafter, the control circuit 54 is programmed to control the motor 14 to rotate the roll 16 forwards, thereby allowing the dancer 36 to move by gravity from the first, raised position shown in Fig. 4 to the second, lowered position shown in Fig. 3. The one or more position sensors 56 sense the noted movement of the dancer 36 from the first position to the second position and communicate this information to the control circuit 54.

[0026] The control circuit 54 is further configured to calculate a starting speed of the motor 14 based upon the movement of the dancer 36 from the first, raised position to the second, lowered position. For example, the control circuit 54 can be configured to calculate the diameter of the roll 16 based upon the movement of the dancer 36 from the first position to the second position. More specifically, the control circuit 54 can calculate the diameter of the roll 16 based upon the degree of rotation of the motor 14 required to move the dancer 36 from the first position to the second position. Based upon this diameter of the roll 16, the control circuit 54 can be programmed to calculate the degree of rotation of the motor 14 required to move the dancer 36 from the first position to the second position. Based upon this diameter of the roll, the control circuit 54 can calculate the starting speed of the motor 14. This can be particularly helpful at start-up of the machine when the initial diameter of the roll 16 is unknown (at least unknown to the control circuit 54).

[0027] The following equations can be used by the control circuit 54:

First determine how fast to feed film in inches per seconds
S=index length / (60/cycles per minute)

Second calculate roll diameter
D=R2
R= 12inches/ (2πA/360)
12 inches= the amount of film to achieve the initial movement of the dancer arm 34 from the second position to the first position
π =3.141592
A= degree of rotation of the motor 14 that was required to achieve the initial movement of the dancer arm 34 from the second position to the first position

Third Calculate circumference of roll
C= D π
D= diameter
π =3.141592

Fourth calculate motor 14 speed in degree per sec
M=S/ (C/360)

[0028] After startup, the control circuit 54 can be configured to control the speed of the motor 14 to maintain a substantially constant tension in the web 12 during indexing motion of the noted conveyor. Upon an indexing motion of the conveyor, the control circuit 54 can monitor a time of movement of the dancer 36 from the first position to the second position based upon inputs from the position sensors 56. Thereafter, the control circuit 54 can be programmed to control the speed of the motor 14 to maintain a substantially constant time of movement of the dancer 36 at each subsequent index. Generally, this will require the control circuit 54 to slowly increase the speed of rotation of the motor 14 to accommodate for decreasing diameter of the roll 16 as the web 12 is discharged to the conveyor.

[0029] Fig. 5 depicts one example of a method of supplying a web of packaging material 12 to a packaging machine, such as those described in the incorporated U.S. patents and patent applications. Such a method includes supplying the web of packaging material 12 from a roll 16 to a conveyor for conveying the web 12 from upstream to downstream, see e.g. arrow 50, Fig. 1. At step 100, the control circuit 54 is operated to control the motor 14 to rotate the roll 16 to change the tension in the

web 12 and cause the dance 36 to move from a first position, such as shown in Fig. 4, to a second position, such as shown in Fig. 3. At step 102, one or more position sensors 56 sense movement of the dancer 36. Based upon this sensed change in position, the control circuit 54 can calculate a starting rotational speed of the roll 16, as explained above. At step 104, the control circuit 54 controls the motor 14 to rotate the roll 16 at the calculated starting rotational speed to thereby supply the web 12 to the noted conveyor in a manner that does not cause stretching or other damage to the web 12.

[0030] Fig. 6 depicts another example of a method for supplying a web of packaging material 12 to a conveyor, such as those described in the incorporated U.S. patents and U.S. patent applications. At step 110, the system 10 is at startup. At step 112, the control circuit 54 is operated to control the motor 14 to rotate the roll 16 in one direction, such as opposite the direction shown at arrow 50. At step 114, one or more position sensors 56 sense movement of the dancer 36 into a first position, see e.g. Fig. 4. At step 116, the control circuit 54 operates the motor 14 to rotate the roll 16 in a second, opposite direction, see e.g. arrow 50, Fig. 1. At step 118, the one or more position sensors 56 sense movement of dancer 36 into a second position, see e.g., Fig. 3. At step 120, the control circuit 54 calculates the degree of rotation of the motor 14 that occurred during movement of the dancer 36 from the noted first position to the noted second position. At step 122, the control circuit is configured to calculate a preferred initial speed of the motor 14 at startup of the system 10.

[0031] Fig. 7 depicts another example of a method for supplying a web of packaging material 12 to a packaging machine, such as those described in the incorporated U.S. patents and patent applications. At step 130, the system is at startup. At step 132, a roll 16 of a web of packaging material 12 is rotated to change tension in the web 12. At step 134, movement of a dancer 36 caused by the change in tension is sensed. At step 136, a control circuit calculates a starting rotational speed of the roll 16 based upon the sensed movement of the dancer 36. At step 138, the roll 16 is rotated at the calculated starting rotational speed. At step 140, the time of movement of the dancer 36 from a first position to a second position is monitored over a period of an indexing motion of the noted conveyor. At step 142, the speed of the motor 14 is controlled by a control circuit 54 to maintain substantially constant tension in the web of packaging material 12.

[0032] Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from this invention. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures.

Claims

1. A system for supplying a web of packaging material to a packaging machine, the system comprising:

   a motor (14) rotating a roll (16) of a web of packaging material (12),
   a conveyor conveying the web (12) from upstream to downstream;
   characterized in that
   the system further comprises a dancer (36) located downstream of the roll (16) and upstream of the conveyor, the dancer (36) being movable between first and second positions based upon a change in tension of the web (12),
   and a control circuit (154) controlling the motor (14) and being in communication with at least one sensor (56) sensing the position of the dancer (36),
   wherein the control circuit (54) controls the motor (14) to rotate the roll (16) to thereby cause the dancer (36) to move from the first position to the second position,
   wherein the control circuit (54) calculates a starting speed of the motor (14) based upon the movement of the dancer (36) from the first position to the second position, and
   further wherein the control circuit (54) controls the motor (14) at the calculated starting speed to begin supplying the web (12) to the conveyor.

2. The system according to claim 1, **characterized in that**
   the control circuit (54) calculates the diameter of the roll (16) based upon the movement of the dancer (36) from the first position to the second position,
   preferably, wherein the control circuit (54) calculates the diameter of the roll (16) based upon the degree of rotation of the motor (14) required to move the dancer (36) from the first position to the second position, and/or the control circuit (54) calculates the starting speed of the motor (14) based upon the diameter of the roll (16).

3. The system according to claim 1 or 2, **characterized in that**,
   the control circuit (54) controls the motor (14) to rotate the roll (16) in a first direction so that the dancer (36) moves from the second position to the first position and then controls the motor (14) to rotate the roll (16) in a second, opposite direction so that the dancer (36) moves from the first position to the second position,
   wherein, preferably, the first position is higher than

the second position with respect to the conveyor, and/or
wherein, preferably, the sensor (56) comprises a first sensor portion sensing when the dancer (36) is in the first position and a second sensor portion sensing when the dancer (36) is in the second position.

4. The system according to any one of the preceding claims, **characterized in that**
the roll (16) has a core (18) and the motor (14) rotates the roll (16) from the core (18).

5. The system according to any one of the preceding claims, **characterized in that**
the conveyor conveys the web (12) in an indexing motion,
wherein, preferably, upon an indexing motion of the conveyor the control circuit (54) controls the speed of the motor (14) to maintain a substantially constant tension in the web (12) during indexing motion of the conveyor, wherein, further preferably, upon an indexing motion of the conveyor, the control circuit (54) monitors a time of movement of the dancer (36) from the first position to the second position and then controls the speed of the motor (14) to maintain a substantially constant time of movement of the dancer (36).

6. A method of supplying a web of packaging material to a packaging machine, the method comprising: supplying a web of packaging material from a roll to a conveyor for conveying the web from upstream to downstream, **characterized by** the following steps:

rotating the roll to change tension of the web and cause a dancer to move from a first position to a second position,
sensing the movement of the dancer,
calculating a starting rotational speed of the roll based upon the movement of the dancer from the first position to the second position, and
rotating the roll at the calculated starting rotational speed to supply the web to the conveyor.

7. A method for supplying a web of packaging material to a packaging machine, the method comprising: supplying a web of packaging material from a roll to a conveyor that conveys the web from upstream to downstream, **characterized by** the following steps:

providing a dancer located downstream of the roll and upstream of the conveyor, the dancer being movable between first and second positions based upon a change in tension of the web,
controlling the motor to rotate the roll and thereby cause the dancer to move from the first position to the second position,
sensing the movement of the dancer,
calculating a starting speed of the motor based upon the movement of the dancer from the first position to the second position, and
controlling the motor at the calculated starting speed to supply the web to the conveyor.

8. The method according to claim 7, **characterized by** the following feature:

calculating the diameter of the roll at start-up based upon the movement of the dancer from the first position to the second position, wherein, preferably, calculating the diameter of the roll is done based upon the degree of rotation of the motor required to move the dancer from the first position to the second position, and, preferably, calculating the starting speed of the motor is done based upon the diameter of the roll.

9. The method according to claim 7 or 8, **characterized by** the following feature:

controlling the motor to rotate the roll in a first direction so that the dancer moves from the second position to the first position and then controlling the motor to rotate the roll in a second, opposite direction so that the dancer moves from the first position to the second position, and/or
wherein the roll has a core and the method comprises rotating the roll from the core, and/or
wherein the method comprises conveying the web in an indexing motion.

10. The method according to any one of the preceding method claims, **characterized in that**
it comprises controlling the speed of the motor to maintain a substantially constant tension in the web during indexing motion of the conveyor, wherein, preferably, upon an indexing motion of the conveyor, a time of movement of the dancer from the first position to the second position is monitored and then the speed of the motor is controlled to maintain a substantially constant time of movement of the dancer.

11. A system for supplying a web of packaging material to a packaging machine, the system comprising:

a motor (14) rotating of a roll (16) of a web (12) of packaging material, and
a control circuit (54) controlling the motor (14), **characterized by**
a sensor (56) sensing changes in the position of a dancer (36) caused by rotation of the roll (16),
wherein the sensed changes are input to the control circuit (54),
wherein the control circuit (54) controls the mo-

tor (14) to rotate the roll (16) at a starting speed of rotation that is based upon sensed changes in position of the dancer (36) and then further controls the speed of the motor (14) to maintain substantially constant tension in the web (12) of flexible packaging material during indexing motion of the packaging machine.

12. The system according to claim 11, **characterized in that** the control circuit (54) calculates the starting speed of rotation for the motor (14) based upon a degree of rotation of the motor (14) required to move the dancer (36) a certain amount.

13. The system according to claim 11 or 12, **characterized in that** upon an indexing movement of the machine, the control circuit (54) monitors a time of movement of the dancer (36) and further controls the speed of the motor (14) to maintain a substantially constant time of movement of the dancer (36) based upon the time of movement.

14. A method for supplying a web of packaging material to an indexing-motion packaging machine, the method comprising: rotating of a roll of a web of packaging material; sensing changes in position of a dancer caused by rotation of the roll; rotating the roll at a starting speed of rotation that is based upon sensed changes in position of the dancer and then maintaining substantially constant tension in the web of flexible packaging material during indexing motion of the packaging machine.

15. The method according to claim 14, **characterized in that** it comprises rotating the roll so as to decrease tension in the web and thereby allow the dancer to move, and calculating the starting speed of rotation of the motor based upon the movement of the dancer.

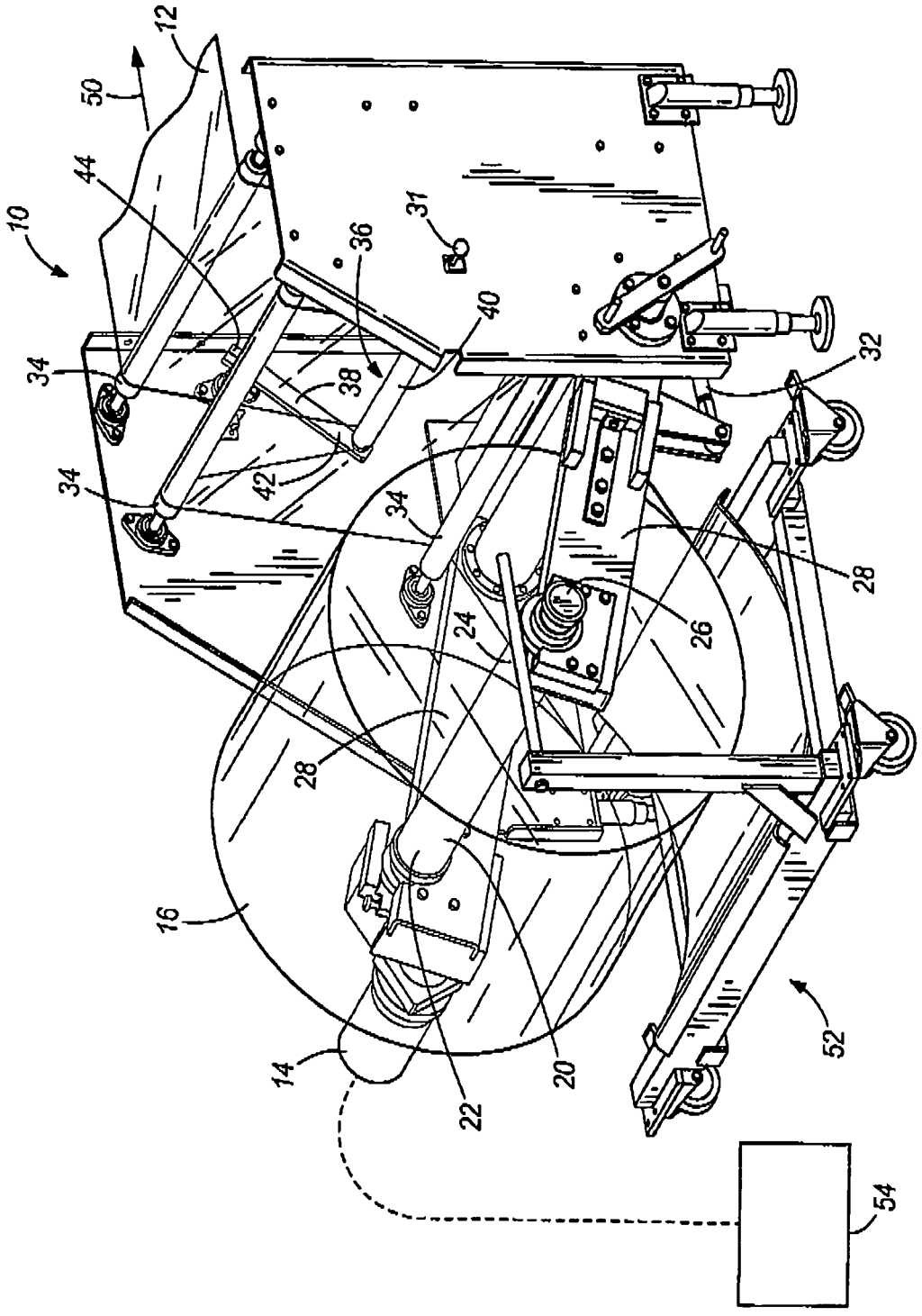

FIG. 1

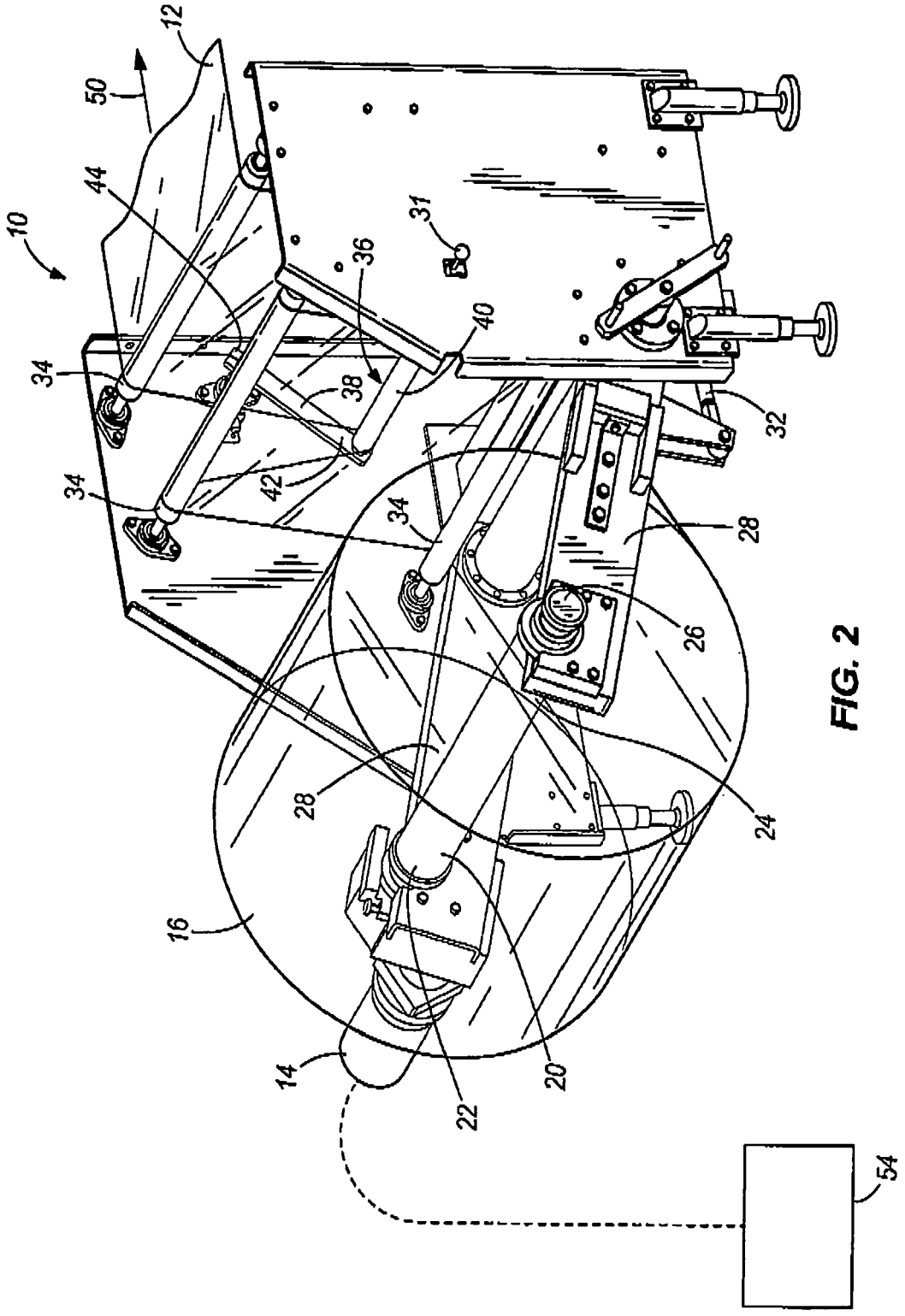

FIG. 2

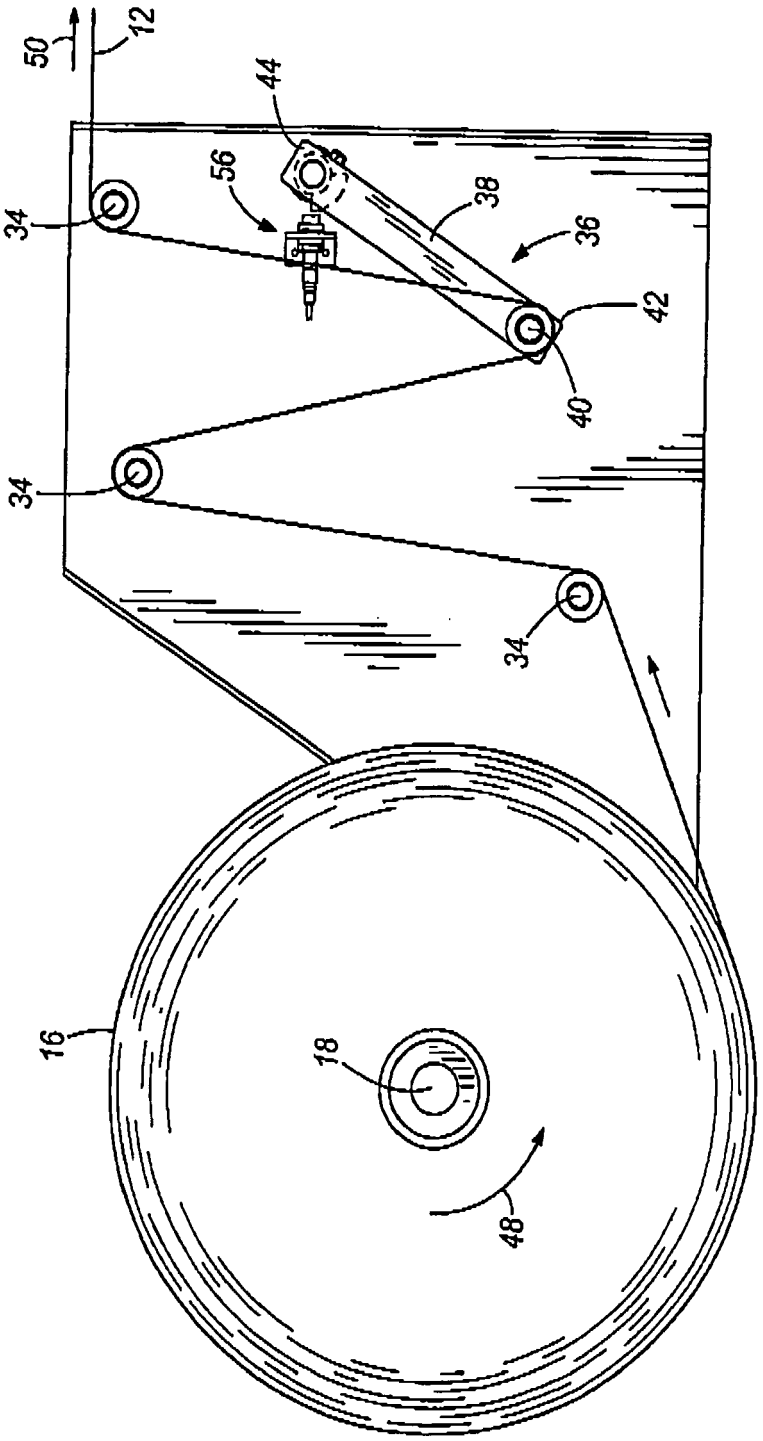

FIG. 3

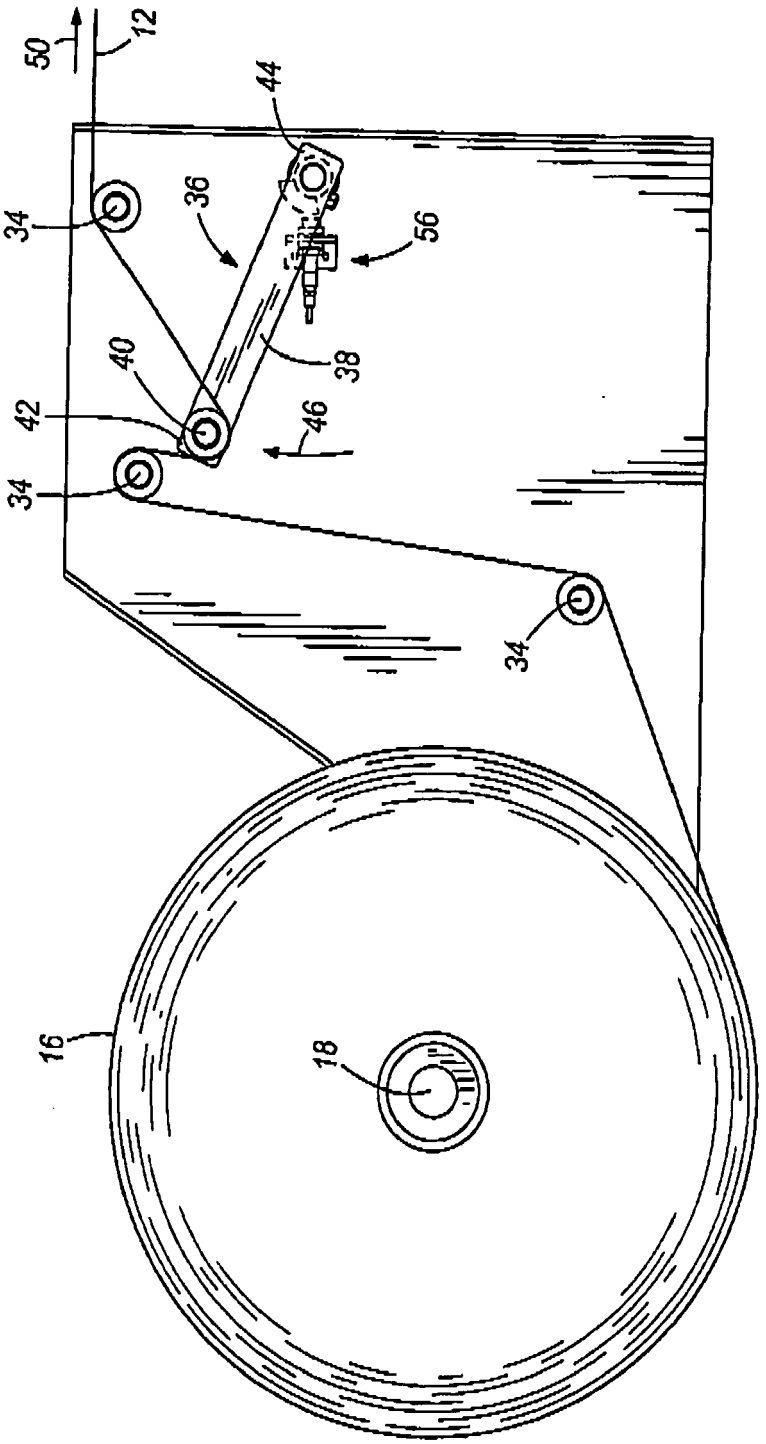

FIG. 4

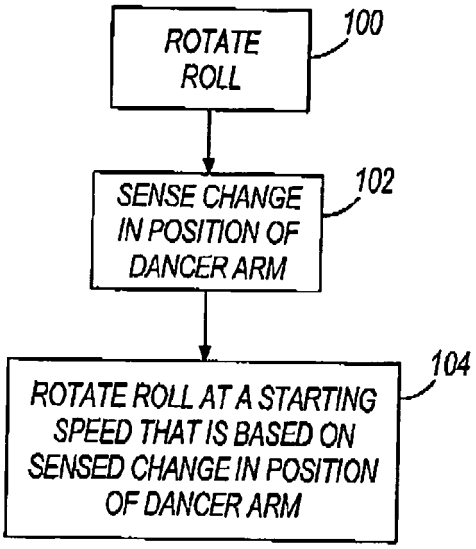
ROTATE ROLL
100
SENSE CHANGE IN POSITION OF DANCER ARM
102
ROTATE ROLL AT A STARTING SPEED THAT IS BASED ON SENSED CHANGE IN POSITION OF DANCER ARM
104

FIG. 5

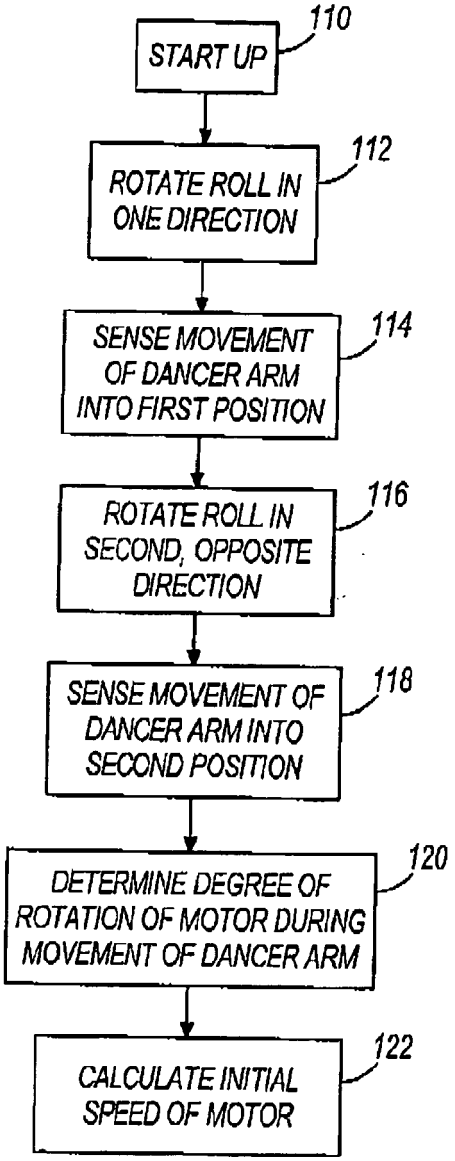
START UP
110
ROTATE ROLL IN ONE DIRECTION
112
SENSE MOVEMENT OF DANCER ARM INTO FIRST POSITION
114
ROTATE ROLL IN SECOND, OPPOSITE DIRECTION
116
SENSE MOVEMENT OF DANCER ARM INTO SECOND POSITION
118
DETERMINE DEGREE OF ROTATION OF MOTOR DURING MOVEMENT OF DANCER ARM
120
CALCULATE INITIAL SPEED OF MOTOR
122

FIG. 6

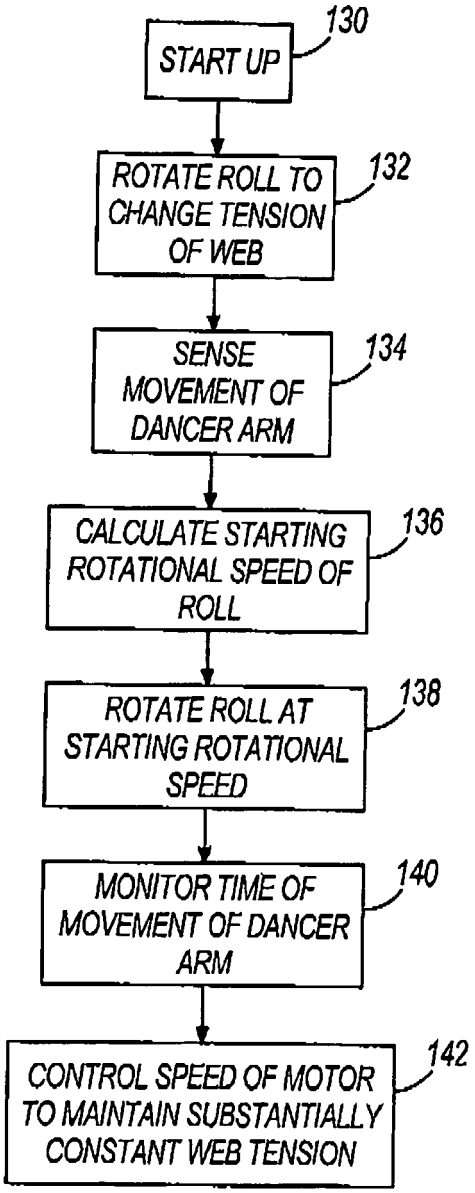
START UP
130
ROTATE ROLL TO CHANGE TENSION OF WEB
132
SENSE MOVEMENT OF DANCER ARM
134
CALCULATE STARTING ROTATIONAL SPEED OF ROLL
136
ROTATE ROLL AT STARTING ROTATIONAL SPEED
138
MONITOR TIME OF MOVEMENT OF DANCER ARM
140
CONTROL SPEED OF MOTOR TO MAINTAIN SUBSTANTIALLY CONSTANT WEB TENSION
142

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5170611 A **[0003] [0018]**
- US 5205110 A **[0003] [0018]**
- EP 2253543 A **[0004] [0018]**
- EP 2253544 A **[0004] [0018]**