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

(11) EP 1 203 717 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.05.2002 Bulletin 2002/19

(51) Int Cl.[7]: **B65B 9/08**, B65B 59/02, B65B 57/04, B65H 23/038

(21) Application number: **01309332.3**

(22) Date of filing: **02.11.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **03.11.2000 US 245611 P**

(71) Applicant: **Klockner Bartelt, Inc.**
Sarasota, Florida 34243 (US)

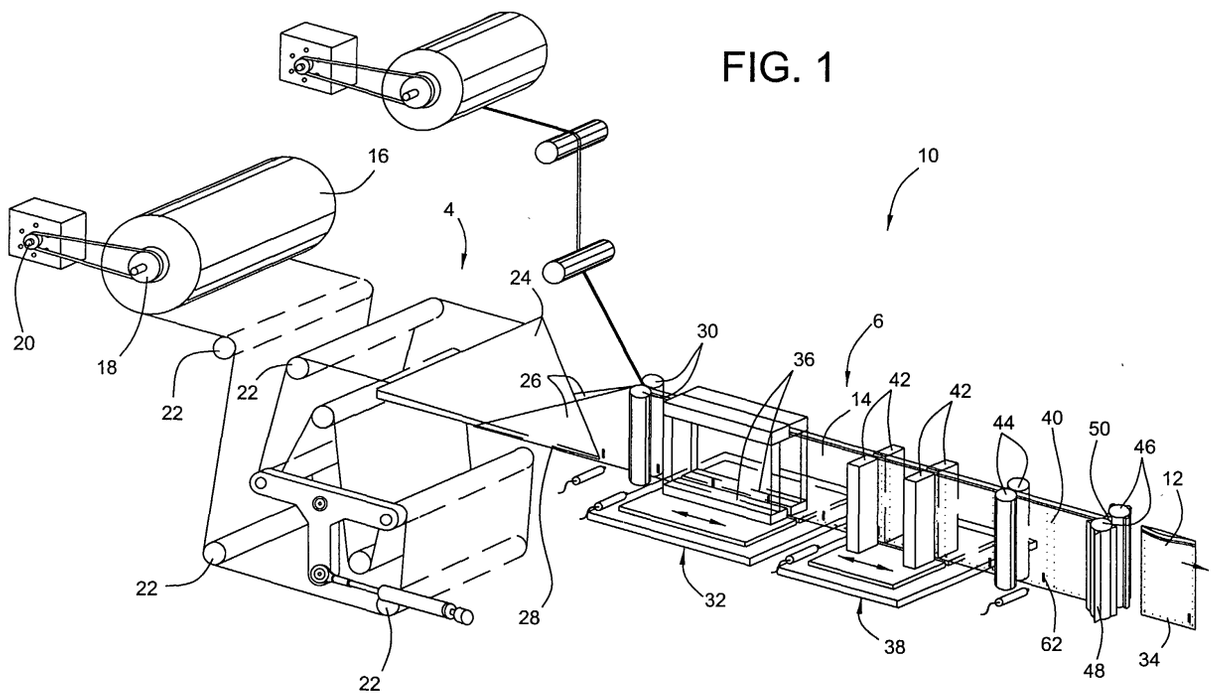
(72) Inventor: **Hook, Kevin L.**
Sarasota, Florida 34232 (US)

(74) Representative: **Knott, Stephen Gilbert et al**
MATHISEN, MACARA & CO.
The Coach House
6-8 Swakeleys Road
Ickenham Uxbridge UB10 8BZ (GB)

(54) Method and device for controlling the height of a web in a packaging machine

(57) A packaging machine (10) that uses cylinders to automatically adjust the pressure gradient on a web feed roller system is presented. The cylinders (106,108) are controlled by an air operated or an electrical sensing device that senses the edge of the web (14). When the sensor (104) detects the web (14) rising it will increase the pressure on bottom of the feed rollers (44) and lower the pressure at the top. This action drives the web down. When the web falls below the proper height the reverse happens and the web is driven back up. This system creates a seeking process that is always driving the web to the correct height. The system can also be used on a pivoting feed roller system. The sensor feedback turns an eccentric that changes the pressure gradient, moving the web to the proper height.

FIG. 1



EP 1 203 717 A1

Description

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This patent application claims the benefit of U. S. provisional patent application 60/245,611, filed November 3, 2000.

FIELD OF THE INVENTION

[0002] The present invention relates to packaging machines, and more particularly relates to horizontal form, fill, and seal packaging machines.

BACKGROUND OF THE INVENTION

[0003] Packaging machines are generally known in which a continuous web of material is converted into a plurality of individual pouches. The continuous web of material is folded in half over a plow to form two continuous side panels joined by a bottom fold. The folded web is passed through a series of seal bars which form transverse seals between the side panels, thereby forming a strip of pouches interconnected by transverse seals. A cutter cuts through each transverse seal to form individual pouches with unsealed top edges. The individual pouches are transferred to a pouch filler, filled with product, and sealed. The sealed pouches are then collected for transport. Machines of this type may be categorized as either horizontal or vertical machines, depending on the general direction of web travel. The present invention relates to horizontal packaging machines in which the web travels horizontally.

[0004] The type and volume of product being packaged often determines whether the packaging process should use a continuously or intermittently advancing web. Certain products, such as hard candy, require a fill based on weight instead of volume. Scale fillers require relatively long periods to fill a pouch. As a result, slower cycle continuous motion or intermittent motion is required to provide additional fill time. In addition, larger volume fills require more time, and therefore intermittent motion through the filler may be necessary. More free flowing products, such as sugar, may be dispensed using a diving funnel suitable for filling continuously advancing pouches.

[0005] In light of the above, packaging machines have been developed specifically for either intermittent or continuous operation. Continuous motion machines typically require web-engaging components which are moveable and can be phased with the advancing web. For example, U.S. Patent No. 5,722,217 to Cloud discloses a packaging machine for use with a continuously advancing web. The '217 device uses a sealing drum to form the vertical seals of the pouches. Sealing wires are circumferentially spaced about the sealing drum to provide sealing points. The web is entrained about the drum and the drum is rotated so that seals are formed as the web continuously advances. The '217 device further fills the pouches while they are still connected and therefore the web must be continuously advanced through the pouch filler section as well. It is not seen, however, that the '217 device is operable with an intermittently advancing web since it would be difficult to control the sealing drum so that it starts and stops at the appropriate times.

[0006] Most conventional intermittent motion machines, on the other hand, have web-engaging components which are stationary and perform operations during dwell periods between incremental advances. For example, U.S. Patent No. 5,181,365 to Garvey, et al. discloses a packaging machine for use with an intermittently advancing web. The '365 device has sealers and a cutter spaced longitudinally along the web path at fixed locations. These components perform their associated operations during web dwells. Accordingly, machines such as that disclosed in the '365 patent are not suitable for use with a continuously advancing web since the stationary components would stretch or tear the web during operation.

[0007] During operation, the web can slowly shift up and down. The shifting can create problems in the pouch manufacturing such as misalignment of seals, pouches cut incorrectly, etc. Additionally, the web may drop when the packaging machine is started. One of the causes of the shifting is the tension on the web as it pulls through the feed rollers of the machine. The feed rollers are balanced using a set of springs located at the top and bottom of the feed rollers. The web gets "unbalanced" in several ways. First, when the machine is stopped the web can sag due to heat from the seal bars and be much looser than the running tension. This can cause the web to shift a large distance very quickly. After the first bag or two are through the machine after the machine is started, the tension returns to running state and the bag slowly returns to the required level. Second, as the tension in the web changes due to how tight it was rolled, static buildup, changes in slip, and other variables can cause the system to become unbalanced. This causes a slow movement of the web either up or down and the web will remain at that location until the pressure is readjusted on the feed rollers. Third, changing the speed can change the running tension requiring the feed rollers to be rebalanced.

[0008] Machine operators have attempted to overcome this problem by manually adjusting the tension on the feed rollers to adjust web height using a line of sight approach. However, this approach only provides a coarse adjustment of the web height. What is needed is a method to automatically adjust web height that provides precision adjustment of the web height.

SUMMARY OF THE INVENTION

[0009] A general aim of the present invention is to pro-

vide a packaging machine that automatically adjusts the height of the web that is operable with both intermittently and continuously advancing webs.

[0010] A related object of the present invention is to provide an adjustment mechanism that can be fit on existing machines.

[0011] In light of the above, present invention provides a packaging machine in which the tension of a feed roller is automatically controlled based upon the position of the web.

[0012] The present invention provides a pneumatic control for adjusting the tension of the feed roller. The position of the web is determined and the web is shifted up or down by adjusting the tension of the feed roller assembly of the packaging machine.

[0013] These and other aims, objectives, and features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIG. 1 is a schematic view in perspective of a packaging machine in accordance with the present invention;

FIG. 2 is a block diagram of the feed roller control system in accordance with the present invention for use with the packaging machine of FIG. 1;

FIG. 3 illustrates a flow chart of a method of automatically adjusting web height in a packaging machine in accordance with the teachings of the present invention;

FIG. 4 is a front view of the feed roller incorporating the feed roller control system of FIG. 2;

FIG. 5 is a side view of the feed roller incorporating the feed roller control system of FIG. 2;

FIG. 6 is a top view of the feed roller incorporating the feed roller control system of FIG. 2; and

FIG. 7 is a bottom view of the feed roller incorporating the feed roller control system of FIG. 2.

[0015] While the invention is susceptible of various modifications and alternative constructions, certain illustrative embodiments thereof have been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Referring now to the drawings, a packaging machine 10 is illustrated in FIG. 1. The packaging machine 10 produces pouches 12 from a continuous web 14 of material. The web 14 has pre-printed registration marks 62 at spaced intervals corresponding to the desired pouch width. The position of the registration marks is known with respect to the printed artwork. The web is made of sealable material, which includes heat-sealable material (such as polyethylene or polypropylene) and pressure-sensitive cold seal film. The embodiments described below are directed mainly to a machine 10 running heat-sealable web material.

[0017] According to the embodiment illustrated in FIG. 1, the packaging machine has an infeed section 4 which supplies the folded web 14 to a sealing section 6. The planar web material is typically provided as a wound roll 16. The infeed section 4 has a reel 18 for supporting the roll 16. The reel 18 rotates to unwind the roll 16, thereby dispensing the web 14. The reel 18 may be conventionally controlled or may have a dedicated unwind motor 20 for varying an unwind speed. The web 14 is threaded over tension rollers 22 and a plow assembly 24 for folding the web to form side panels 26 joined at a common bottom edge 28. As illustrated in FIG. 1, the bottom edge 28 is formed with a V-shape. The plow assembly 24 may also include a gusset blade (not shown) for forming a W-shaped bottom edge. The folded web 10 is passed through a pair of infeed rolls 30 to cleanly define the fold lines in the web. In accordance with certain aspects of the present invention, the infeed rolls 30 may also pull the web through the first portion of the packaging machine, as described in greater detail below.

[0018] The web 14 next travels through a sealing portion of the machine 10 in which any of a number of pouch forming operations take place. In accordance with the embodiment illustrated in FIG. 1, the web 14 first passes through a bottom or first seal station 32 for forming a bottom seal 34, such as a delta seal, in the web 14. The web 14 next passes through a side seal station 38 which forms vertical side seals 40 in the web. Upon leaving the side seal station 38, the web 14 is formed as a strip of pouches interconnected at the side seals 40. The seal stations 32, 38 may use heated seal bars to form seals in heat-sealable web material, or may use unheated seal bars when the web material is a cold seal film. If heated, the seal bars have a heating element such as a heat tube extending therethrough. The heat tube is preferably electrically operated and controlled to provide a desired sealing temperature at the surface of the seal bar.

[0019] In accordance with certain aspects of the present invention, the seal stations 32, 38 are operable to form seals in the web 14 as the web advances. Further details of seal stations may be found in U.S. Patent Application No. 09/185,355, filed November 3, 1998, which is hereby incorporated by reference.

[0020] In the above embodiment, the sealing stations 32, 38 operate in a duplex mode, in which the web 14 advances two web widths between each actuation of the

seal bars. Accordingly, the bottom seal bars 36 are two pouch widths wide to simultaneously form two bottom seals 34. Similarly, the side seal station 38 carries two pairs of side seal bars 42. The machine 10 may also be operated in a simplex mode, whereby the web 14 is advanced a single pouch width between each actuation. In simplex mode, the bottom seal bars 36 are only one pouch width wide, and the side seal station 38 has a single pair of side seal bars 42.

[0021] The seal bars are operated to engage the web as the web advances for both continuous and intermittent web motion. It will be appreciated that for intermittent web motion, the machine 10 of the present invention could be operated so that the seal bars engage the web during dwells, as is conventional. Alternatively, the seal bars contact the web as the web advances, regardless of whether the web is advancing continuously or intermittently. By operating the seal stations in this manner, the seal bars will always be in contact with the web for a sufficient period of time to form the seals regardless of the dwell time between each intermittent advance of the web. Furthermore, the machine operates in a similar fashion for both continuous and intermittent web motion, thereby simplifying the controls and providing a machine which operates in a consistent manner.

[0022] A pair of feed rollers 44 are located downstream of the seal stations to pull the web through the sealing section of the machine 10. The feeder rollers 44 are positioned to pinch the web 14, thereby frictionally advancing the web. In accordance with certain aspects of the present invention, the feeder rolls are operable both continuously and intermittently. In one embodiment, a variable speed motor, such as drive roll servomotor 80 (see FIG. 7), is connected to and operates the feeder rollers.

[0023] A cutter is positioned immediately downstream of the feeder rollers 44. The cutter is adapted to cut the web at the formed side seals as the web advances. The cutter comprises a pair of cutter rolls 46 having a plurality of circumferentially spaced blades 48 on one of the rolls and a a plurality of similarly spaced cutting surfaces 50 on the other roll. The cutter rolls 46 are mounted for rotation so that a blade 48 contacts the web 14 at the same time as an associated cutting surface 50 to thereby sever a leading pouch 12 from the web. Each pouch severed by the cutter rolls 46 is then transferred to a pouch filling section by a transfer mechanism.

[0024] For purposes of explanation, a pneumatic cylinder shall be used to describe certain aspects of the invention. While pneumatic cylinders are shown, it should be noted that other types of cylinders such as hydraulic cylinders and the like can be used. Turning now to figure 2, a feed roller control system 100 is shown. Feed roller controller 102 senses the edge of the web using web sensor 104. Web sensor 104 may be an air operated or an electrical sensing device. In one embodiment, the web sensor 104 senses the edge of the web by forcing air through both sides of the sensor and detecting air back pressure. A change in back pressure indicates the position of the web. Feed roller controller 102 increases the pressure on the bottom of the feed rollers 44 and lowers the pressure at the top of the feed rollers 44 when it determines the web is rising. This action forces the web down. When the feed roller controller 102 detects that the web falls below the proper height, the web is driven back up by decreasing the pressure on the bottom of the feed rollers 44 and increasing the pressure at the top of the feed rollers 44. The feed roller controller 102 adjusts the pressure using pneumatic cylinders 106, 108. Pneumatic cylinder 106 is mounted at the top of the feed roller 44. Pneumatic cylinder 108 is located at the bottom of the feed roller 44. The feed roller controller 102 increases pressure on the feed roller 44 by increasing air in the pneumatic cylinders 106, 108. Feed roller controller 102 decreases pressure by reducing air pressure in the pneumatic cylinder. A spring (not shown) located in the feed roller forces the pneumatic cylinder rod 107, 109 back.

[0025] Turning now to figure 3, the steps the feed roller controller 102 performs is shown. The web height is determined based upon web sensor 104 (step 200). The web height is then compared to one or more thresholds (step 202). In one embodiment, the web height is compared to a single threshold. In an alternate embodiment, the web height is compared to an upper threshold and a lower threshold. If the web height is greater than the single threshold (or alternatively, the upper threshold), the feed roller controller 102 drives the web down by increasing the pressure on the bottom of the feed rollers 44 via cylinder 108 and lowers the pressure at the top of the feed rollers 44 via cylinder 106 (step 206). If the web height is lower than the single threshold (or alternatively, the lower threshold) (step 208), the feed roller controller 102 drives the web up by decreasing the pressure on the bottom of the feed rollers 44 via the cylinder 108 and increasing the pressure at the top of the feed rollers 44 via the cylinder 106 (step 210). Steps 200-210 are repeated after driving the web down, driving the web up, or if the web is at the desired position (or alternatively, within the upper and lower threshold) for as long as the the packaging machine is operating.

[0026] Turning now to Figures 4-7, the feed rollers 44 and feed roller control system components are shown. Figure 4 shows one of the feed rollers 44 and the web sensor 104. Figure 5 shows the feed rollers 44, the web sensor 104, and the pneumatic cylinders 106, 108.

[0027] Turning now to Figure 6, one of the shafts 45 of the feed rollers 44 is attached to mounting plate 110. When the feed roller control system 100 increases the air pressure in pneumatic cylinder 106, the rod 107 pushes on roller assembly plate edge 120, which results in an increase in pressure at that end of the feed roller as previously described. When air pressure is reduced, the spring (not shown) of the feed roller 44 pushes the rod 107 back. The feed roller controller 100 operates pneumatic cylinder 108 the same way it operates pneu-

matic cylinder 106.

[0028] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The term "cylinder" includes pneumatic and hydraulic cylinders and other devices that perform the function of increasing or decreasing the pressure at the top or bottom of the feed rollers. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

[0029] The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obvious modifications are possible in light of the above teachings. For example, the feed roller control system can also be used on a pivoting feed roller system where only pressure at the top of the feed roller is increased or decreased. The embodiments discussed were chosen and describe to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention.

Claims

1. A method to control web height of a web in a packaging machine having feed rollers comprising the steps of:

   sensing the web height of the web;
   comparing the web height to at least one threshold; and
   increasing the pressure in a first cylinder located near a bottom of the feed rollers to increase a first magnitude of pressure at the bottom of the feed rollers and decreasing the pressure in a second cylinder located near a top of the feed rollers to decrease a second magnitude of pressure at the top of the feed rollers if the web height is above the threshold.

2. The method according to claim 1 further comprising the step of:

   decreasing the pressure in the first cylinder to decrease the first magnitude of pressure and increasing the pressure in the second cylinder to increase the second magnitude of pressure if the web height is below the threshold.

3. The method according to claim 1 or 2 wherein the threshold comprises an upper threshold and a lower threshold and wherein the step of increasing the pressure in a first cylinder and decreasing the pressure in the second cylinder if the web height is above the threshold comprises the step of increasing the pressure in a first cylinder and decreasing the pressure in the second cylinder if the web height is above the upper threshold.

4. The method according to any of claims 1 to 3 wherein the step of decreasing the pressure in the first cylinder and increasing the pressure in the second cylinder if the web height is below the threshold comprises the step of decreasing the pressure in the first cylinder and increasing the pressure in the second cylinder if the web height is below the lower threshold.

5. The method according to claim 1 wherein the step of sensing the web height includes the steps of sensing an edge of the web by forcing air through both sides of an air operated sensor and detecting a change in air back pressure.

6. The method according to claim 1 wherein the first cylinder and second cylinder are hydraulic cylinders and wherein the step of increasing the pressure in the first cylinder and decreasing the pressure in the second cylinder comprises the steps of increasing a first amount of hydraulic fluid in the first cylinder and decreasing a second amount of fluid in the second cylinder.

7. The method according to claim 1 wherein the first cylinder and second cylinder are pneumatic cylinders and wherein the step of increasing the pressure in the first cylinder and decreasing the pressure in the second cylinder comprises the steps of increasing a first amount of air in the first cylinder and decreasing a second amount of air in the second cylinder.

8. A device for maintaining a height of a web to a desired position in a packaging machine having feed rollers comprising:

   a first cylinder in moveable contact with a top of one of the feed rollers;
   a second cylinder in moveable contact with a bottom of one of the feed rollers;
   a controller in communication with the first cyl-

inder and the second cylinder; and
a sensor in communication with the controller, the sensor detecting the height of the web, the controller commanding at least one of the first cylinder and the second cylinder to contact one of the top and the bottom to move the web to the desired position.

9. The device according to claim 8 wherein the first cylinder and the second cylinder are hydraulic cylinders.

10. The device according to claim 8 herein the first cylinder and the second cylinder are pneumatic cylinders.

11. The device according to claim 8 wherein the sensor is an air sensor and wherein the air sensor detects the height of the web by sensing back air pressure.

12. The device according to any of claims 8 to 10 wherein the controller commands the first cylinder to contact the top of the one of the feed rollers if the height of the web is above the desired position.

13. The device according to claim 9 or 12 wherein the controller commands the second cylinder to contact the bottom of the one of the feed rollers if the height of the web is below the desired position.

14. A packaging machine having a web height control module to automatically control the height of a web, the packaging machine for converting a web into a plurality of pouches comprising:

an infeed section to supply the web to a sealing section;
the sealing section sealing and cutting the web, the sealing section receiving the web from the infeed section and comprising:

a first seal station for forming a bottom seal;
a second seal station for forming vertical seals;
a pair of feed rollers frictionally engaging the web to pull the web through the first seal station and the second seal station;
a cutter receiving the web from the pair of feed rollers and adapted to cut the web proximate to the vertical seals; and

characterized by the web height control comprising:

a first cylinder in moveable contact with a top of at least one of the pair of feed rollers;
a second cylinder in moveable contact with a bottom of at least one of the pair of feed rollers;
a controller in communication with the first cylinder and the second cylinder; and
a web position sensor to detect the height of the web.

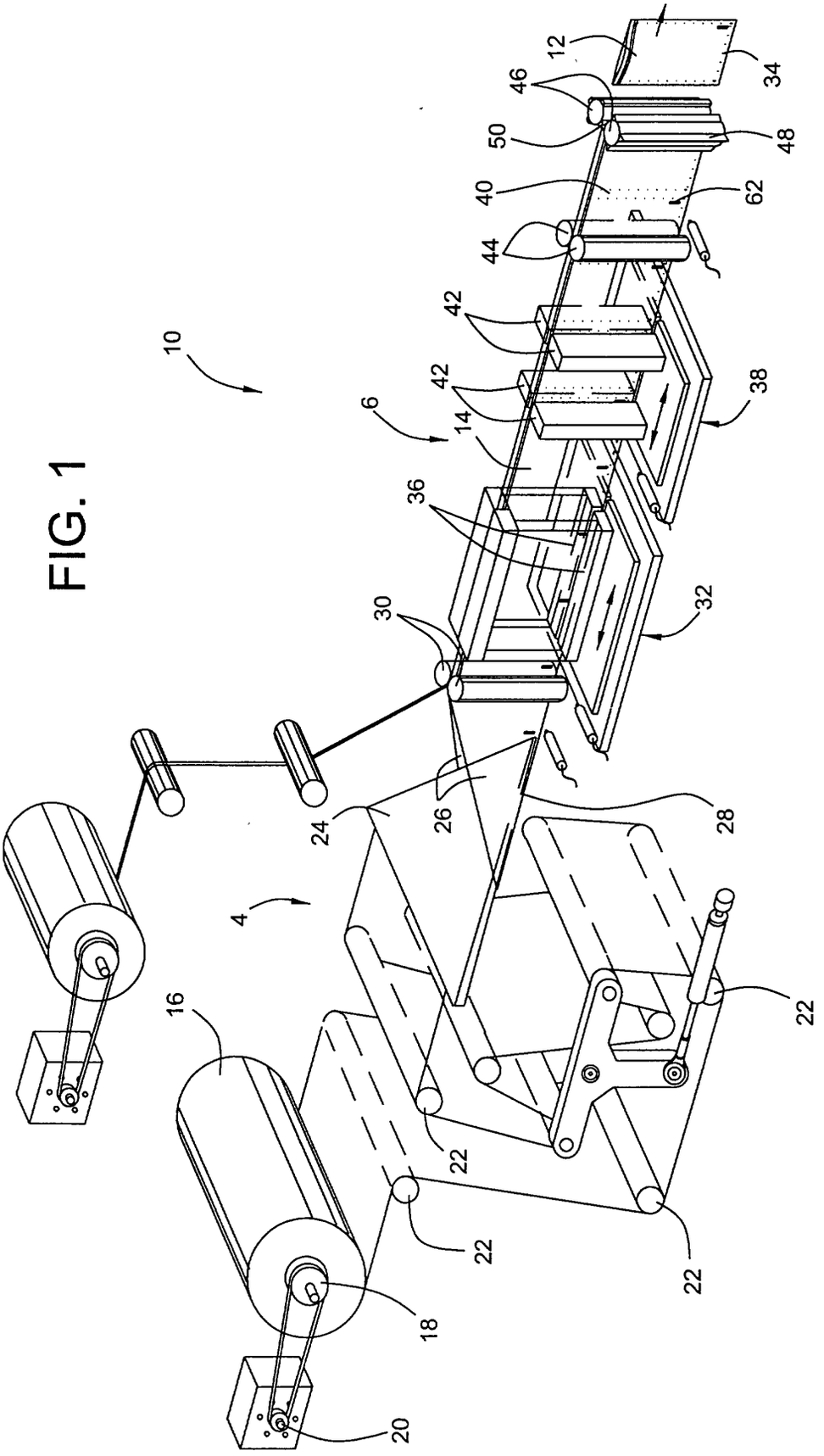
15. The packaging machine according to claim 14 wherein the first cylinder and the second cylinder are pneumatic cylinders.

16. The packaging machine according to claim 14 wherein the first cylinder and the second cylinder are hydraulic cylinders.

17. The packaging machine according to any of claims 14 to 16 wherein the controller commands the first cylinder to contact the top of the at least one of the feed rollers to increase the pressure at the top of the at least one of the feed rollers if the height of the web is above a desired position.

18. The packaging machine according to any of claims 14 to 17 wherein the controller commands the second cylinder to contact the bottom of the at least one of the feed rollers to increase the pressure at the bottom of the at least one of the feed rollers if the height of the web is below a predetermined position.

FIG. 1


10
12
34
46
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48
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62
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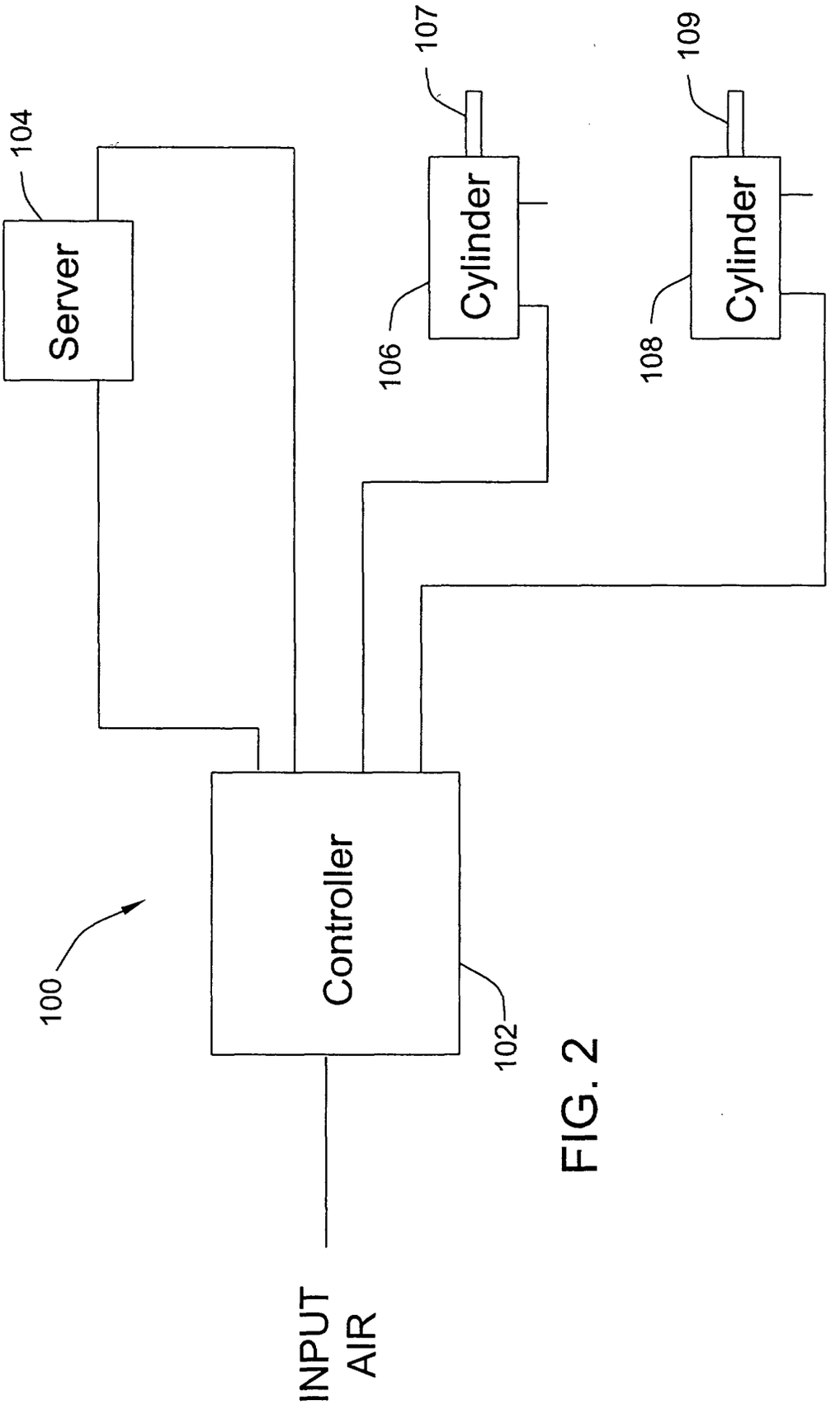

104
Server
107
Cylinder
106
109
Cylinder
108
100
Controller
102
INPUT
AIR

FIG. 2

FIG. 3

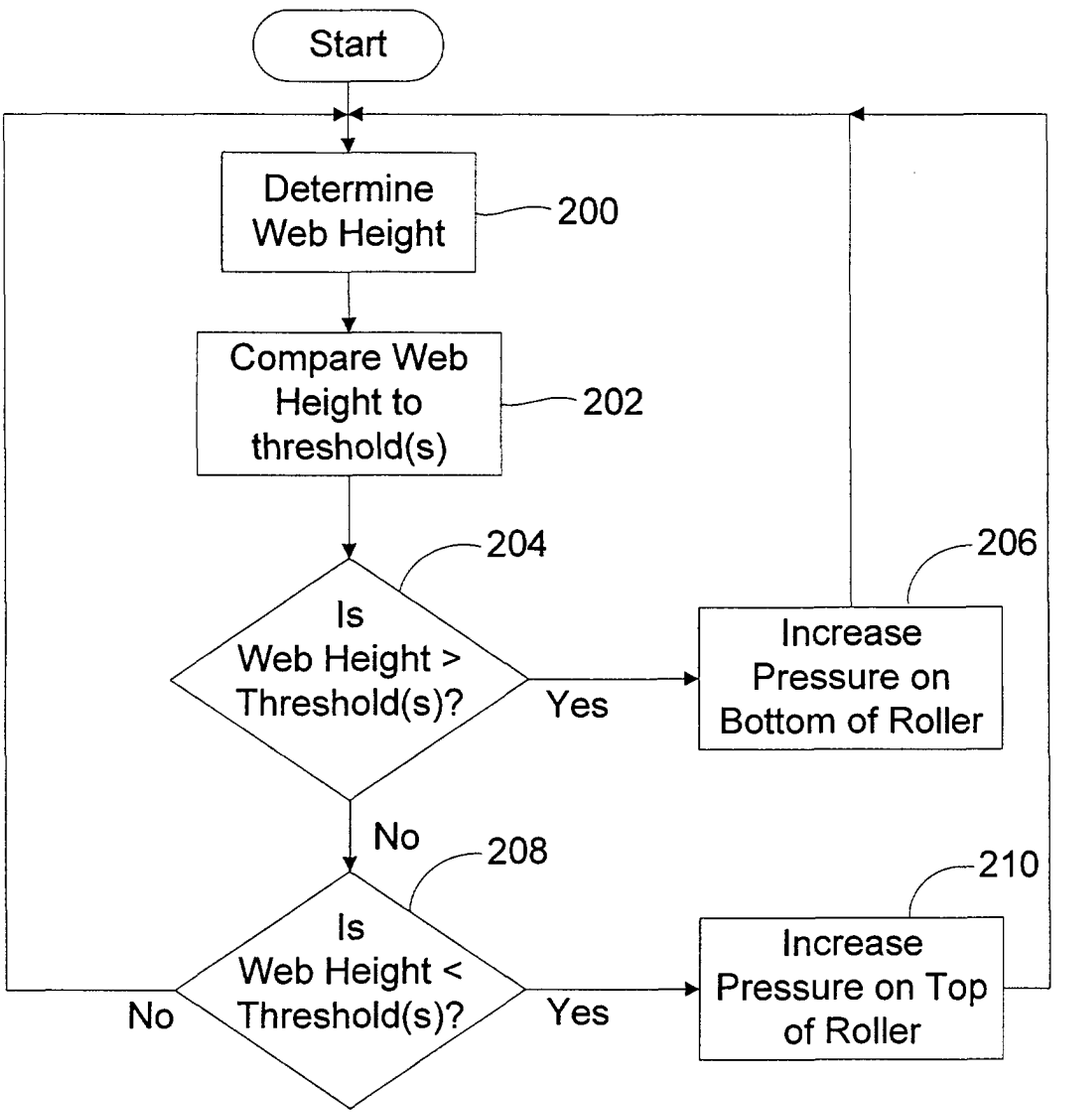

Start
Determine Web Height
200
Compare Web Height to threshold(s)
202
204
Is Web Height > Threshold(s)?
Yes
206
Increase Pressure on Bottom of Roller
No
208
Is Web Height < Threshold(s)?
No
Yes
210
Increase Pressure on Top of Roller

FIG. 4

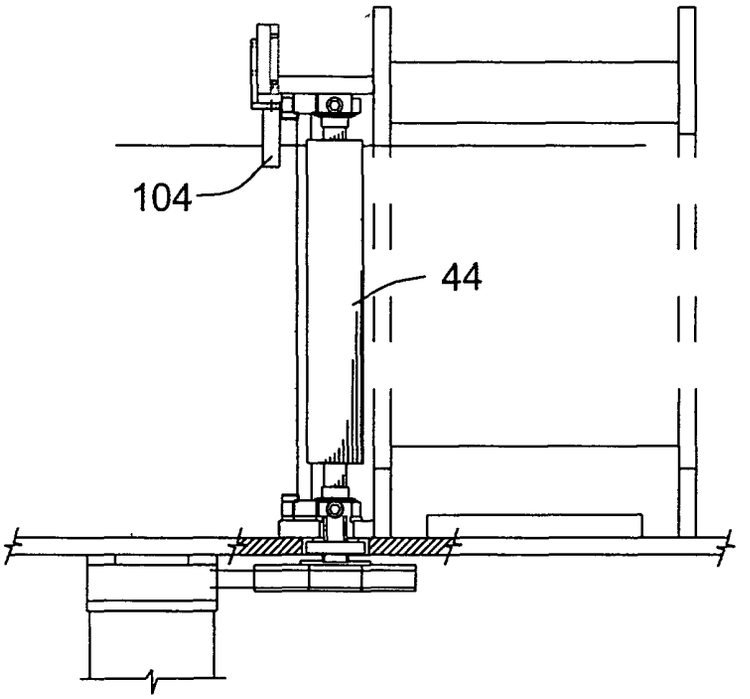


FIG. 5

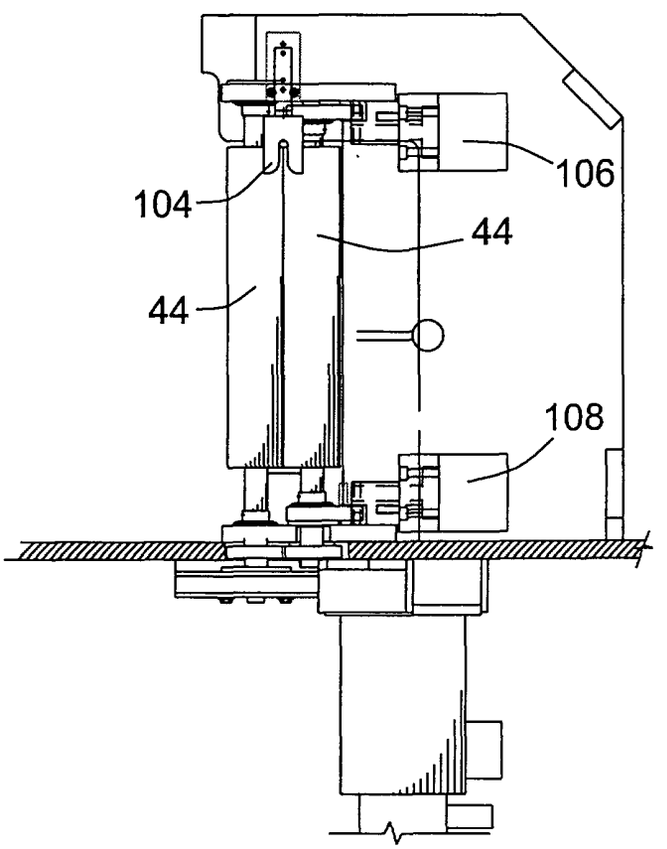


FIG. 6

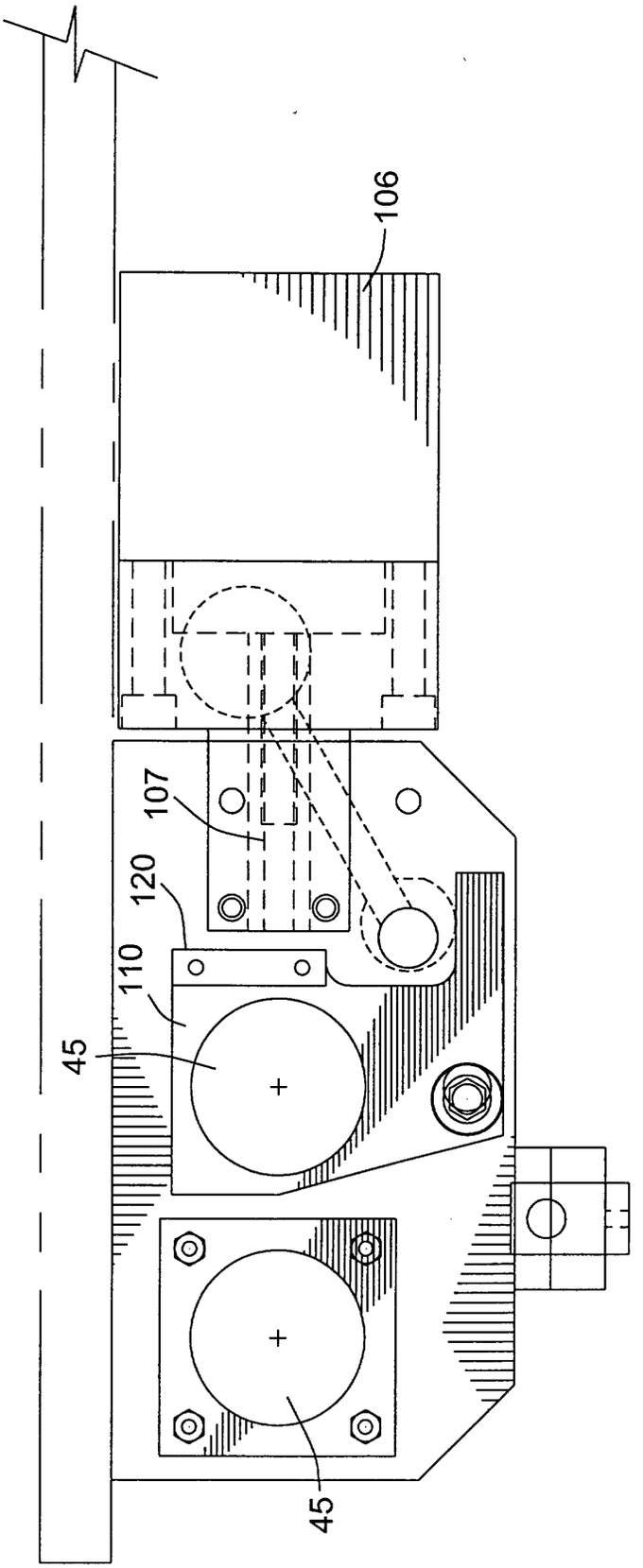
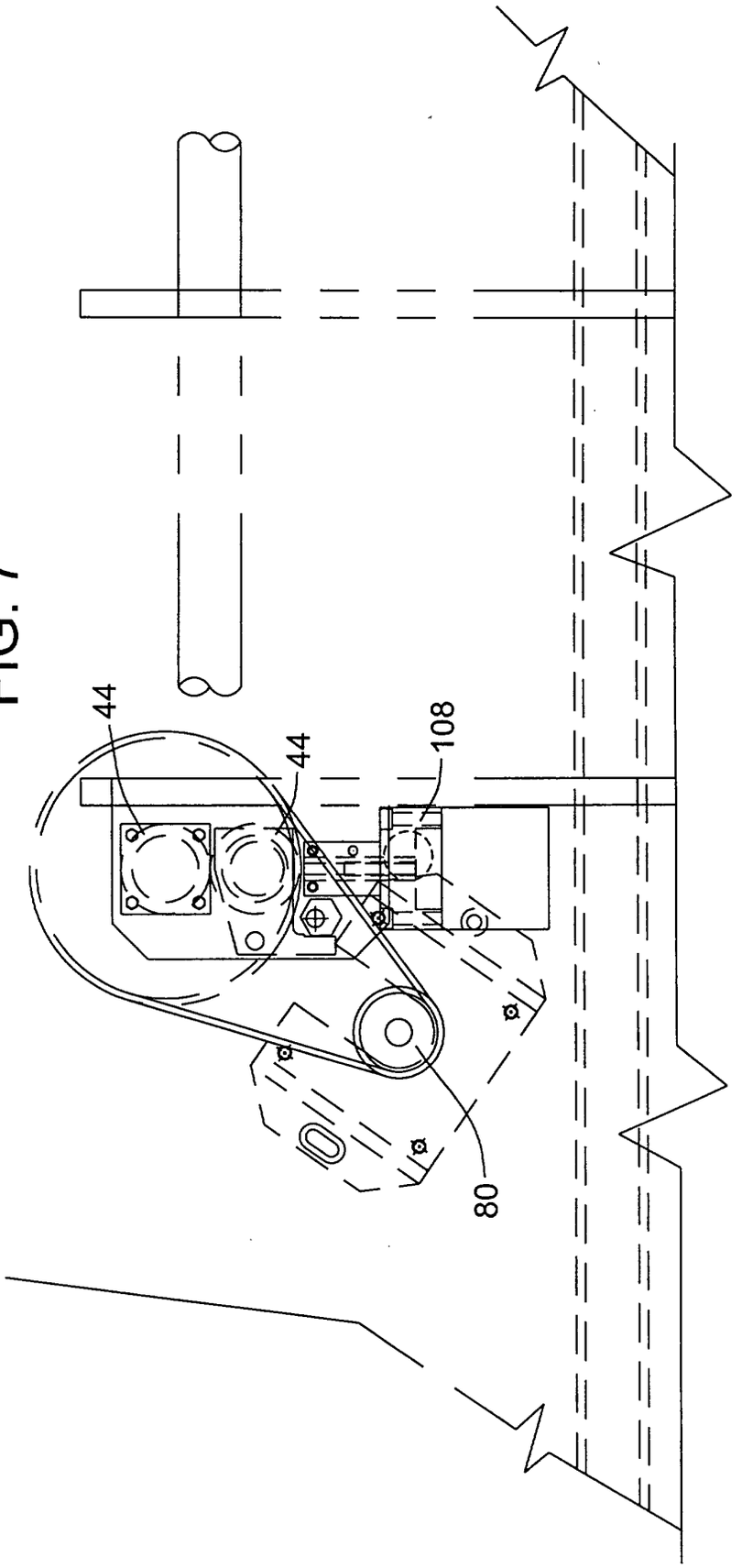


FIG. 7



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 30 9332

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 771 730 A (CLOUD CORP) 7 May 1997 (1997-05-07) * column 8, line 13 - column 12, line 40; figures 6-8 *	1,8,14	B65B9/08 B65B59/02 B65B57/04 B65H23/038
A	US 4 212 422 A (BARTON HARVEY R JR ET AL) 15 July 1980 (1980-07-15) * column 4, line 57 - column 6, line 16; figures *	1,8	
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B65B
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 February 2002	Jagusiak, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 9332

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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18-02-2002

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