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(54) Title: APPARATUS AND METHOD FOR THE CONTROLLED LUBRICATION AND CLEANING OF CONVEYORS
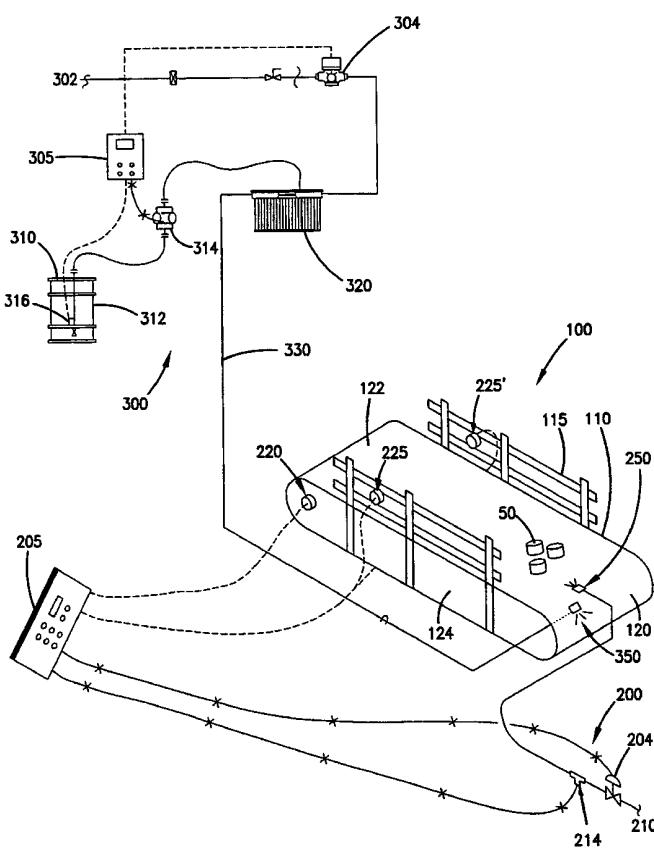
(57) Abstract: A method for automatically cleaning and lubricating conveyor belt systems is disclosed. A microprocessor controlled control unit (205) senses the movement of the conveyor belt (120) and the presence of items, for example bottles (50), on the conveyor. The control units initiates the application of lubricant, detergent and rinse water onto the conveyor according to the speed of the conveyor, the presence of items and the time passed since the previous application. If the conveyor is stationary, that is, is not in motion, no lubricant or cleaning solution is applied. If the conveyor is moving but no items are on the belt, a reduced amount of lubricant is despensed onto the conveyor system. The conveyor cleaning and lubricating process may be carried out during normal production operations.

WO 01/27005 A1

APPARATUS AND METHOD FOR THE
CONTROLLED LUBRICATION AND CLEANING OF CONVEYORS

Field of the Invention

5   The invention relates to a new and improved apparatus and method for

cleaning and lubricating conveyors using a microprocessor controlled control

system. The control system senses the activity of the conveyor and the presence of

items on the conveyor, and in return lubricates and washes the conveyor as needed.

This automated system also reduces the amount of cleaning labor needed, as well as

10   reduces the amount of wasted cleaning and lubricating supplies.

Background of the Invention

Conveyors commonly used in the food and packaging industries (in

particular soft drink manufacturing facilities, breweries, fruit juice manufacturing

facilities, dairies, etc.) generally require periodic cleaning in order to maintain the

15   conveyor in a sanitary condition. This cleanliness requirement in turn requires the

application of various cleaning ingredients such as detergents, sanitizers,

bactericides, slimicides, etc. A simple, yet very time and labor intensive practice is

to apply these cleaning ingredients to the conveyor system manually, either by high

pressure hot water, steam, or other methods. Additionally, there is a tendency in

20   manual cleaning to over-apply and waste the cleaning products. This manual

practice is both expensive, cumbersome and dangerous and may not provide an

adequately clean conveyor belt. The art recognizes a need for improved methods

and apparatus. U.S. Patent No. 5,372,243 provides an alternative to the above

described cleaning method. King teaches a pneumatically controlled cleaning and

25   rinsing system for conveyors. The valves for providing cleaning and rinsing

ingredients are pneumatically actuated, as are the timers and sequencer valves.

Pneumatically controlled and actuated equipment is stressed because of the desire to

eliminate corrosion of electrical equipment and components in wet environments.

Others have provided alternate conveyor cleaning and/or lubricating systems

30   to replace systems that include electrical equipment. U.S. Patent No. 5,129,481

describes an apparatus and method for lubricating conveyors and belts used in the

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food industry comprising a device including valves which are alternately opened and closed by an actuating device driven from the conveyor movement. The valves supply a lubricant which is fed to output nozzles for spraying onto the conveyors for lubricating purposes, and the valves will only feed lubricant when the conveyor is

5   moving. Alternately, U.S. Patent No. 5,289,899 teaches an air-driven delay valve or relay, which is driven from the conveyor system, and which connects to a counter which controls the valve that passes lubricant in a pulsating or intermittent fashion.

However, pneumatically controlled systems, such as those described above, can be inaccurate, for example, in their time measurement and fluid dispensing,

10   leading to ineffective cleaning and/or lubricating of the conveyor and wasted supplies. A substantial need exists for a cleaning and lubricating system for conveyors that is simple, accurate, versatile, reliable, and is easy to maintain.

Summary of the Invention

15   The present invention relates to a new and improved apparatus and method for cleaning and lubricating conveyor systems using a microprocessor controlled control system. The control system senses movement of the conveyor belt and the presence of any items, such as cans, bottles, or food products, on the conveyor belt, and in return either cleans or lubricates the conveyor as needed. This automated

20   system reduces the amount of labor needed to perform these critical tasks, as well as reduces the amount of wasted cleaning and lubricating supplies.

In particular, the present invention relates to a conveyor system that includes the combination of a conveyor system, a washing system, and a lubrication system. The conveyor system is for transporting an object, with the conveyor system

25   including a conveyor belt having a front side and a back side, and a drive mechanism for providing movement to the belt. The washing system is for rinsing and washing the conveyor belt and includes a water source, a detergent source, a mixing chamber to mix the water and the detergent to form a cleaning solution, and an applicator for application of the cleaning solution onto the belt. In some embodiments, the

30   applicator is a spray nozzle. The application of the cleaning solution onto the belt is controlled by a control system, which comprises a microprocessor adapted to

provide a signal to open the applicator to provide rinse or cleaning solution onto the belt. The lubrication system is for lubricating the conveyor belt to improve belt tracking and to extend the useable life of the belt. The lubrication system includes a lubricant source and an applicator for application of the lubricant onto the belt. In some embodiments, the applicator is a spray nozzle. The application of the lubricant onto the belt is controlled by a lubricant control system that includes a first sensing system to sense movement of the belt, a second sensing system to sense presence of items on the belt, and a control system comprising a microprocessor that receives signals from the sensing systems and sends signals to open the applicator to provide lubricant onto the belt on a predetermined, timed basis.

The amount of lubricant applied to the belt is dependent on the signals from the first and second sensing systems. In particular, if the first sensing system confirms movement of the belt and the second sensing system confirms an object, the microprocessor provides a signal to provide lubricant so that a first amount of lubricant is fed from the lubricant source and is applied onto the conveyor. If the first sensing system confirms movement of the belt but the second sensing system does not confirm the presence of an object, the microprocessor provides a signal to provide lubricant so that a second amount of lubricant is fed from the lubricant source and is applied to the conveyor, the second amount of lubricant being less than the first amount. If the first sensing system does not confirm movement, whether or not items are present on the belt, the microprocessor does not provide a signal to apply lubricant.

In a further aspect of the invention, the washing system comprises a microprocessor to provide a signal to apply a rinse or cleaning solution to the conveyor belt for a predetermined time interval. Typically, this washing process occurs after any production run on the conveyor system is complete. The washing process generally includes a first rinse step, a cleaning step, and a second rinse step.

The invention will be further described in relation to the included drawings.

Brief Description of the Drawings

Figure 1 is a schematic perspective view showing an apparatus of this invention, including a conveyor system;

Figure 2 is a simplified schematic diagram in top view of a conveyor system having multiple zones; and

Figure 3 is a block diagram illustrating the logic used by the apparatus of this invention to provide the method for the lubrication and cleaning of the conveyor system.

Detailed Description

The invention relates to a new and improved apparatus and method for cleaning and lubricating conveyors using a microprocessor controlled control system. The control system senses the activity of the conveyor and the presence of items on the conveyor, and in return either cleans or lubricates the conveyor as needed. If the control system only senses movement of the conveyor but no item on the conveyor, only a small amount of lubricant is applied to the conveyor sufficient to keep the conveyor belt properly lubricated.

Referring now to the Figures, wherein like elements are represented by like numerals throughout the various views, Figure 1 shows a general arrangement of a conveyor maintenance system 100 that has a lubrication system 200 and a washing system 300. The apparatus 100 is used for lubricating and washing a conveyor system 110, although not necessarily simultaneously.

Conveyor system 110 includes a conveyor belt 120 having a front side 122 and a back side 124, and a structure 115 to support belt 120. Front side 122 of belt 120 is the side on which items, such as bottles or cans 50, are carried. Back side 124 is the inner side when belt 120 is formed as a loop (as shown in Figure 1), and back side 124 typically contacts a drive mechanism (not shown). Conveyor systems, such as those designated as conveyor system 110, are well known.

Washing system 300 has a water source 302, a detergent source 310, and a device in which the water and the detergent are mixed. In Figure 1, such a mixing device is shown as mixing chamber 320. Water source 302 is typically a potable

water source and is generally supplied at about 5 to 20 gallons per minute at a

pressure of about 60 to 125 psi, although other volumetric rates and pressures could

be used. Detergent source 310 can be a drum 312, such as a 55 gallon drum, or a

larger storage tank. The detergent may be any solution, mixture, component or the

5   like used for cleaning, disinfecting, degreasing, etc. A low level alarm 316 may be

used within detergent source 310 to warn of low detergent supply. A controller 305

is used to control valves 304, 314 which allow feed from water source 302 and

detergent source 310, respectively, to flow to mixing chamber 320. Once the water

and detergent are mixed in a mixing device, for example, mixing chamber 320, the

10   cleaning mixture or solution is applied to the conveyor belt. In Figure 1, the solution

is supplied via delivery pipe 330 to a detergent applicator, shown as spray nozzle

350 (shown in phantom in Figure 1). Spray nozzle 350 applies cleaning solution to

back side 124 of conveyor belt 120. Optionally, the cleaning solution could be

applied to front side 122 of conveyor belt 120 or other areas of conveyor system 110,

15   such as structure 115.

     In some steps during the washing procedure, it may be desired to provide a

water-only rinse of the conveyor system 110; that is, no detergent is used. The

process of washing is considered to comprise rinsing. Rinsing is performed in the

same manner as washing, except that typically no detergent is added to provide the

20   solution. There may, however, be additives provide to the water source to produce a

rinse solution. Often, a three-step process is used: a first rinse step, a washing or

cleaning step, and a second rinse step.

     The washing process, which includes the steps of applying rinse and/or

cleaning solution, may be applied to conveyor belt 120 at predetermined intervals,

25   for example, a one to three minute rinse after every hour of operation. Rinse and/or

cleaning solution may also, or alternately, be applied at the end of the production run

that uses conveyor system 110, for example, at the end of the work day or shift. The

conveyor belt 120 may continue to run (i.e., move) during the cleaning operation or

may be stopped.

Generally, no sensors are needed in washing system 300 if it is desired to rinse and/or washing conveyor belt 120 after its use. The washing may be activated by, for example, a manual switch after the production run has been completed.

Lubrication system 200 has a lubricant source 210 and a lubricant applicator,
5   such as spray nozzle 250, to apply lubricant to front side 122 of conveyor belt 120. Optionally, the lubricant could be applied to back side 124 of conveyor belt 120. In accordance with the present invention, the amount of lubricant applied to belt 120 is dependent on both the movement of conveyor belt 120 and the presence of items, such as cans 50, on belt 120. If belt 120 is in motion and items are present on the
10 belt, a first amount of lubricant is applied to front side 122 of belt 120. If belt 120 is in motion and no items are present, a second amount of lubricant is applied, with the second amount of lubricant being less that the first amount. If no movement of belt 120 is sensed, whether or not any items are present on belt 120, no lubricant is applied. This series of inquiries and resulting actions is illustrated in Figure 3,
15 which is a block diagram of the logic used to determine the application of the lubricant.

Movement of belt 120 is sensed by a sensor 220, which in Figure 1 is positioned to monitor back side 124 of belt 120. Presence of items, such as cans 50, is sensed by sensor 225. Figure 1 shows two sensors 225, 225' on opposites sides of
20 belt 120 and mounted on structure 115. Although only one sensor 225 for monitoring the belt and two sensors 225, 225' for monitoring presence of items are shown, any number of sensors can be used. Sensors 220, 225, 225' may be any sensors capable of sensing movement and/or presence of items; usable sensors include well known devices such as motion or vibration detectors, or laser, IR or
25 other sensors. In another embodiment, the sensor may be directly wired or otherwise connected to the conveyor system's motor.

Sensors 220, 225, 225' are connected to a control system 205 which includes a microprocessor (not shown) therein. Signals from sensors 220, 225, 225' are processed by the microprocessor, which then sends a signal to valve 204 which
30 controls supply of lubricant from source 210 to nozzle 250.

The microprocessor usable in the control system 205 of the present invention may be a programmable general purpose microprocessor, also known as a "PLC" or a programmable logic controller. 'Ladder logic' is typically the format used when programming this microprocessor. The microprocessor is incorporated into the

5   control system 205 and may be attached to equipment such as a monitor, touch screen, keyboard, or a mouse. The microprocessor is then also connected to the sensors and valves.

If sensor 220 provides a negative signal to control system 205 indicating that belt 120 is not moving, control system 205 provides a signal to close valve 204 so

10   that no lubricant is applied to belt 120. If sensor 220 provides a positive signal indicating that belt 120 is in motion, and sensor 225 provides a positive signal indicating that items such as cans 50 are present on belt 120, control system 205 provides a signal to open valve 204 so that a first amount of lubricant flows to nozzle 250 and is applied to belt 120. If sensor 220 provides a positive signal

15   indicating that belt 120 is moving, but sensor 225 provides a negative signal indicating that no items are present on belt 120, control system 205 provides a signal to open valve 204 partially so that a second amount of lubricant flows to nozzle 250 and is applied to belt 120. The second amount of lubricant allowed through valve 204 and applied by nozzle 250 is less that the first amount, because no lubrication is

20   need between items and the belt if no items are present. The lubrication desired, when no items are present, is a minimal amount, simply to reduce friction and maintain flexibility of the belt.

Lubricant source 210 can be any container such as a drum, a large storage tank, or can be supplied by a delivery pipe from a remote location. Valve 204 is

25   preferably a pneumatic (air actuated) valve and is controlled by signals from control system 205. An air injection tee 214 may be included in lubricant system 200 to provide a stream of air to be mixed with the lubricant before it is applied to belt 120.

Referring now to Figure 2, a conveyor system 500 is typically divided into

30   multiple zones, generally at least two zones, often more than two zones. Figure 2 shows conveyor system 500 with four zones. A "zone" is a region or length of

conveyor and each zone typically has its own conveyor belt, support framework, conveyor track, and drive mechanism for the conveyor belt. Often, a zone may have multiple conveyor belts that may or may not have their own drive mechanism.

5   Figure 2 is a top simplified schematic diagram of conveyor system 500 divided into four zones. Conveyor system 500 includes a filler station 520 where a container, such as a can or bottle, is filled. Conveyor belt 510 moves the container from one station, such as filler station 520, to the next station. From filler 520, the container progresses along conveyor belt 510 to seamer station 530 where the container is sealed, e.g., capped. From seamer 530, the container progresses through

10   a warmer station 540. After warmer 540, the container progresses to accumulation area 550, where multiple containers are stored until they are ready to be sent to caser station 560. At caser 560, the containers are packaged for delivery and distribution, for example, cans may be packaged in plastic 6-pack rings, or in paperboard boxes for 12 and 24 packs.

15   Conveyor system 500 is divided into four zones I, II, III, and IV, which extend from seamer 530 to caser 560. Zone I extends from after seamer 530 to warmer 540, but could optionally start at filler 520. Zone II extends from after warmer 540 to accumulation area 550. After accumulation area 550, conveyor system 500 is divided into two zones, III and IV, which extend to caser station 560.

20   In accordance with the present invention, each zone may include a system for controlling the lubricant and a system for controlling the rinse and cleaning solutions, the systems may, however, be shared with one or multiple additional zones. In a preferred embodiment, a single control system is capable of controlling all lubricant systems, without the need for an individual control system for each

25   lubrication system.

It should be noted that although Figure 2 is schematically drawn showing a single conveyor belt 510 extending the length of conveyor system 500, conveyor belt 510 actually may include multiple belts. Typically, each bend or turn in the system requires a new belt. For example, conveyor belt 510a extends from filler station 520

30   to seamer station 530. From seamer 530, two belts 510b, 510c extend to warmer 540. Both belts 510b, 510c are within zone I. From warmer 540, belts 510d, 510e,

510f and 510g in zone II extend to accumulation area 550. Belt 510h in zone III and belt 510I in zone IV extend to caser station 560. Each belt 510a, 510b, etc., may have its own drive mechanism (not shown), or multiple belts may share a drive mechanism.

5   A single control system with a microprocessor can be used to control all lubricant systems that apply lubricant to belts 510a, 510b, etc. Similarly, a single control system with a microprocessor can be used to control all washing systems.

        The above-captioned drawings, explanation and specification describe the elements of the conveyor system lubrication and washing system and its method of

10   use. While a variety of embodiments can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

WE CLAIM:

1.   A combination lubricating and cleaning system for an operating conveyor system, the system comprising:

(a)   a conveyor for transporting an object, the conveyor comprising a belt having a front side and a back side, driven by a drive mechanism;

(b)   a washing system comprising a water source, a detergent source, a mixer to mix the non-aqueous cleaning and the detergent to form a cleaning solution, a detergent applicator to apply the cleaning solution onto the belt, and a control system, the control system comprising a microprocessor adapted to apply the cleaning solution onto the belt; and

(c)   a lubrication system comprising a lubricant source, a lubricant applicator to apply lubricant onto the belt, and a lubricant control system, the lubricant control system comprising:

(i)   a first sensing system to sense movement of the belt;

(ii)   a second sensing system to sense presence of items on the belt; and

(iii)   a control system comprising a microprocessor adapted to open a microprocessor controlled application system onto the belt, wherein if the first sensing system confirms movement of the belt and the second sensing system confirms an object, the microprocessor provides a signal to open the lubricant applicator so that a first amount of lubricant is fed from the lubricant source and is applied onto the conveyor; and

if the first sensing system confirms movement of the belt but the second sensing system does not confirm an object, the microprocessor provides a signal to open the lubricant applicator so that a second amount of lubricant is fed from the lubricant source and is applied to the conveyor, the second amount of lubricant being less than the first amount; and

if the first sensing system does not confirm movement, the microprocessor does not provide a signal to open the lubricant applicator.

2.   The combination system according to claim 1, wherein the lubricant applicator comprises a spray nozzle.

3.   The combination system according to claim 1, wherein the detergent applicator comprises a spray nozzle and the mixer comprises a mixing chamber.

4.   The combination system according to claim 1, wherein the system comprises two zones, wherein each zone comprises a conveyor; a solenoid, a valve and a controller configured and arranged to control the lubricant; and a solenoid, a valve and a controller configured and arranged to control the cleaning solution.

5.   The combination system according to claim 1, wherein the system comprises two or more zones, wherein each zone comprises a conveyor; a solenoid, a valve and a controller configured and arranged to control the lubricant; and a solenoid, a valve and a controller configured and arranged to control the cleaning solution.

6.   The combination system according to claim 5, wherein the two or more zones are arranged between a filler station and a caser station.

7.   The combination system of claim 1 wherein the microprocessor for the cleaning system is the same as the microprocessor for the lubricating system.

8.   A conveyor lubricating system for application of lubricant onto a conveyor system, the conveyor system used for moving items on a belt and having a track, the lubrication system comprising:
       a lubricant source,
       a lubricant applicator for application of the lubricant onto the tracks, and
       a control system, the control system comprising:
              (i)   a first sensing system to sense movement of the belt;

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(ii)   a second sensing system to sense presence of items on the

belt;

(iii)   a microprocessor to open the nozzle to spray lubricant onto

the belt;

5   wherein if the first sensing system confirms movement of the belt and the second

sensing system confirms an object, the microprocessor provides a signal to open the

lubricant applicator so that a first amount of lubricant is fed from the lubricant

source and is applied onto the tracks; and

if the first sensing system confirms movement but the second sensing system does

10   not confirm an object, the microprocessor provides a signal to open the lubricant

applicator so that a second amount of lubricant is fed from the lubricant source and

is applied to the tracks, the second amount of lubricant being less than the first

amount; and

if the first sensing system does not confirm movement, the microprocessor does not

15   provide a signal to open the lubricant applicator.

         9.   The conveyor lubricant system according to claim 8, wherein the

lubricant applicator is a spray nozzle.

20   10.   A conveyor cleaning system for cleaning a conveyor system used for

moving items on a belt, the cleaning system comprising:

         a liquid source for providing a liquid;

         an applicator for application of the liquid onto the belt;

         a microprocessor to provide a signal to open the nozzle to spray the liquid.

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         11.   The cleaning system according to claim 10 wherein the liquid source

is a water source and the liquid is water.

         12.   The cleaning system according to claim 10, wherein the applicator is

30   a spray nozzle.

13.   The cleaning system according to claim 11 further comprising:

a detergent source for providing a detergent; and

a mixing chamber for mixing the water and the detergent to form a solution.

5   14.   The cleaning system according to claim 13, wherein the system comprises two or more zones, wherein each zone comprises a solenoid, a valve and a controller configured and arranged to control the mixing of the water and the detergent to form the solution.

10   15.   The cleaning system according to claim 11, wherein the microprocessor provides a signal to apply the liquid for a period every hour the conveyor system is in use, the period being from one to three minutes.

16.   The cleaning system according to claim 11, wherein the
15   microprocessor provides a signal to apply the liquid after the conveyor system has been used.

FIG. 1
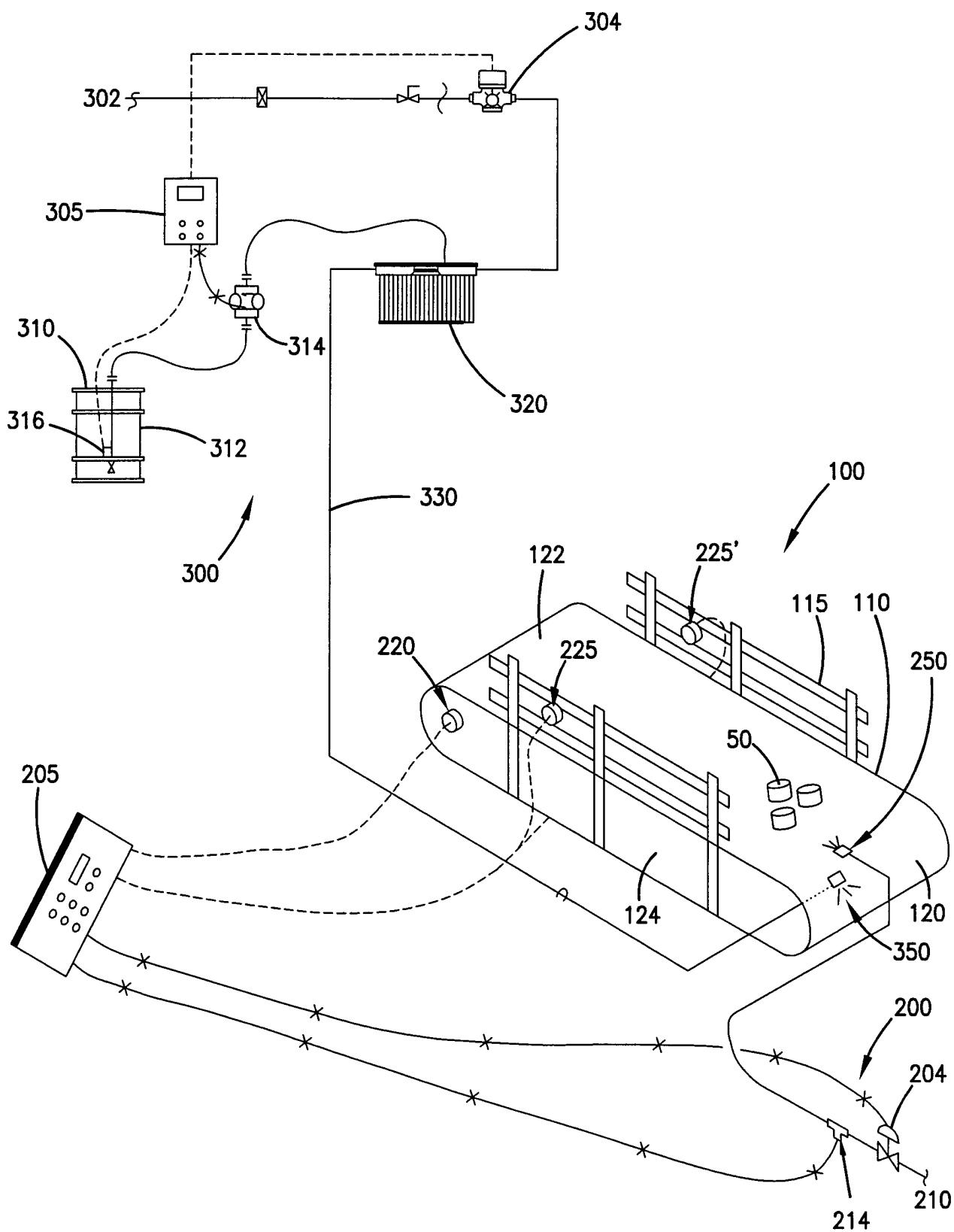
FIG. 2
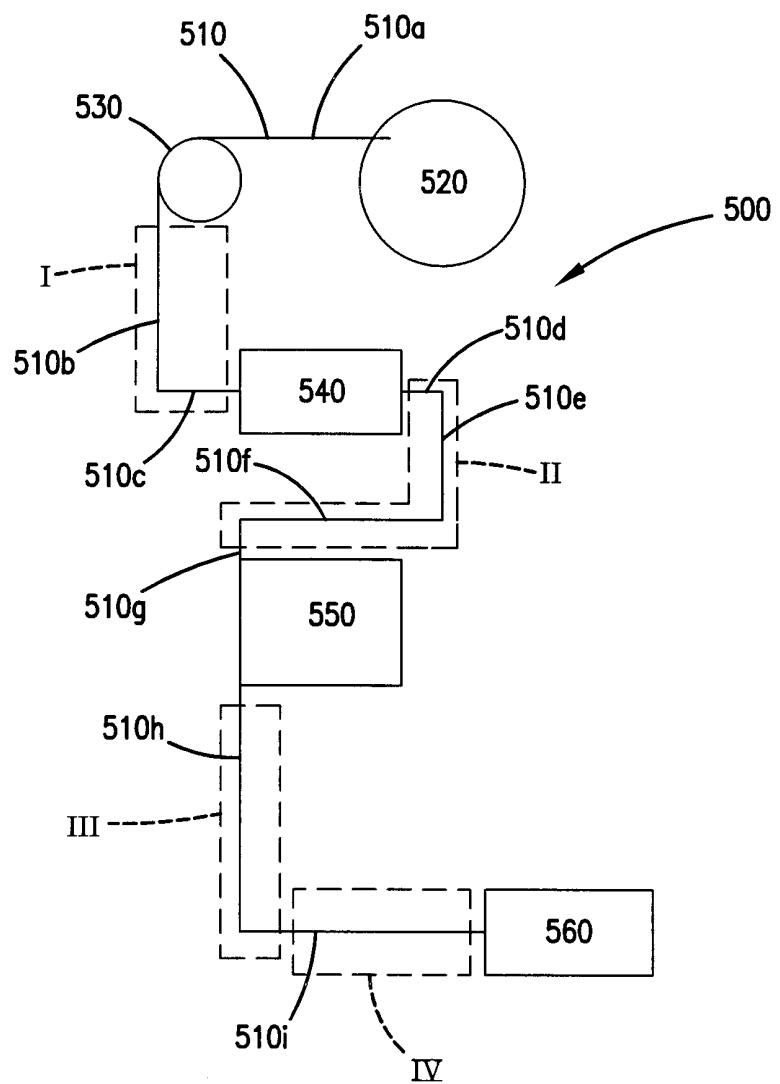
FIG. 3
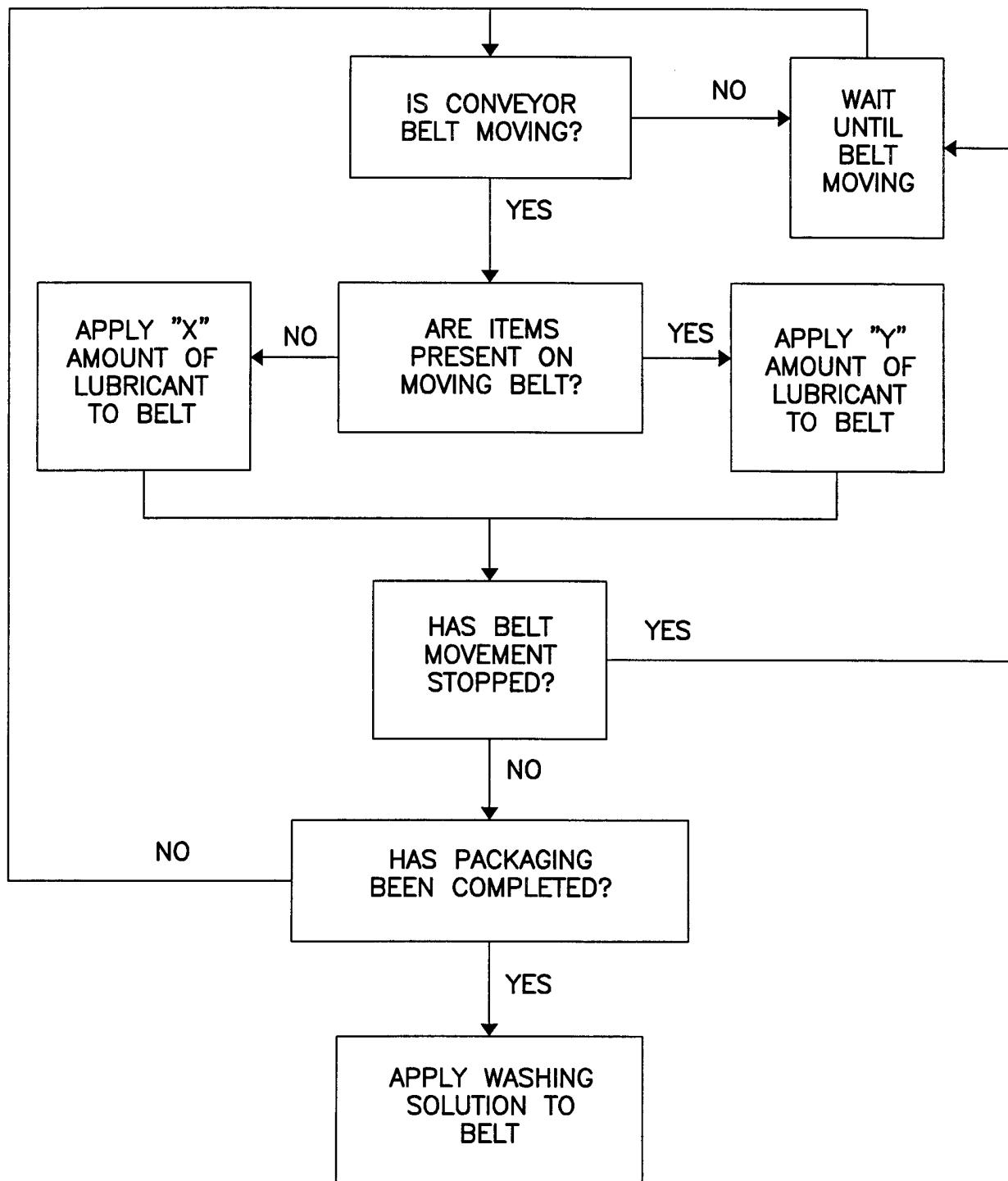
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   B65G45/02   B65G45/22   B08B3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   B65G   B08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	column 4, line 47 -column 5, line 30 column 7, line 15 - line 58 figures 3-9	11-16
Y	US 4 226 325 A (VANDAS EDWARD B) 7 October 1980 (1980-10-07) column 3, line 64 -column 4, line 42 column 4, line 57 -column 5, line 12 figures 1-3	11-16
A	GB 2 174 018 A (E V D ENGINEERING CO LTD) 29 October 1986 (1986-10-29) page 1, line 87 - line 97 page 2, line 75 - line 93 page 3, line 33 - line 42 figures 1,3	8,9

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|X| Further documents are listed in the continuation of box C. |X| Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 January 2001	24/01/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Papatheofrastou, M

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 067 590 A (KING SR JAMES L ET AL) 26 November 1991 (1991-11-26) column 1, line 60 -column 2, line 6 column 2, line 29 - line 49 figures 1-4	1-4
A	WO 95 08499 A (HANTMANN BERNHARD ;HENKEL ECOLAB & CO OGH (DE)) 30 March 1995 (1995-03-30) page 5, line 12 -page 6, line 7 figure 1	6

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