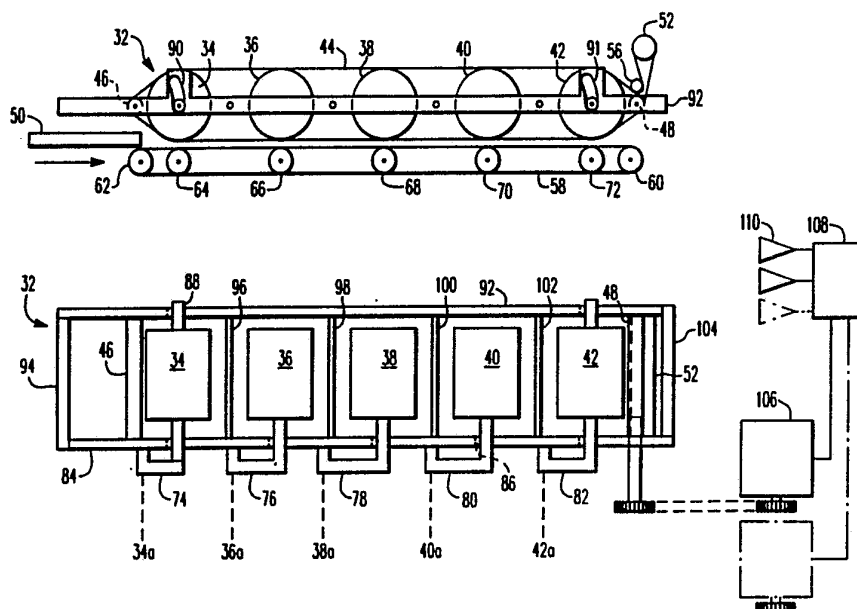




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(21) International Application Number: PCT/US92/06753 (22) International Filing Date: 7 August 1992 (07.08.92) (30) Priority data: 742,752 9 August 1991 (09.08.91) US (71) Applicant: WESTINGHOUSE ELECTRIC CORPORATION [US/US]; Westinghouse Building, Gateway Center, Pittsburgh, PA 15222 (US). (72) Inventors: WAKAMIYA, Stanley, Katsuyoshi ; 10225 Little Brick House Court, Ellicott City, MD 21043 (US). DEEMER, Diane, Lemon ; 8739 Hayshed Lane, Columbia, MD 21045 (US). KOUROUPIS, John ; 307 Stonewall Road, Baltimore, MD 21228 (US). McCONNELL, William, Patrick ; 6913 Rockfields Road, Baltimore, MD 21207 (US). BUCKLEY, John, Joseph, Jr. ; 6182 Fairbourne Court, Hanover, MD 21076 (US). TILLES, David, Jerome ; 1009 Riverside Avenue, Baltimore, MD 21230 (US).		(74) Agents: SUTCLIFF, Walter, G. et al.; Westinghouse Electric Corporation, Law Department, 1310 Beulah Road, Pittsburgh, PA 15235 (US). (81) Designated States: AU, CA, DE, GB, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE). Published <i>With international search report.</i>

(54) Title: INDUCTION SUBSYSTEM FOR MAIL SORTING SYSTEM



(57) Abstract

An induction line segment of a mail induction system including a plurality of dancer pulleys arranged in a row to include an upstream-most dancer pulley and a downstream-most dancer pulley, a first end pulley located upstream of the upstream most dancer pulley, a second end pulley located downstream of the downstream-most dancer pulley, a drive pulley located radially outwardly of the second end pulley, a first belt fitted over the plurality of dancer pulleys and running between the two end pulleys and around the drive pulley, the first and second end pulleys have a diameter smaller than the diameter of the dancer pulleys, and a second belt running between third and fourth end pulleys and running over a plurality of idler pulleys, a mail piece passageway being defined between an inner run of the second belt and an inner run of the first belt, wherein the dancer pulleys are forced radially outwardly by passage of a mail piece having a thickness greater than a distance between the inner runs of the first and second belts, wherein a spring restoring force is developed by said radial outward movement of the dancer pulleys.

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INDUCTION SUBSYSTEM FOR MAIL SORTING SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates generally to mail sorting machinery and, more specifically, to an improved mail induction subsystem for delivering mail to a transport/stacker.

Description of the Related Art

10 It is known to an induction subsystem in which pieces of mail are fed into the induction subsystem automatically or manually, and subsequently, the mail pieces are delivered to carriers of a transport system and subsequently
15 the individual mail pieces are dropped into designated bins according to zip code, mail stop, name, geographical location, etc.

20 Flats mail is generally defined to include a wide variety of mail pieces in terms of size, shape and weight. These include, for example,

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newspapers, periodicals, magazines, envelopes, postcards, etc.

Since much of flats mail is relatively thin, presently designed induction subsystems are
5 limited in terms of the thickness of individual mail pieces capable of being run through the induction subsystem.

Another drawback to conventional mail induction subsystems is that, when operated under
10 control of a system control, the timing of when a piece of mail is introduced into the induction subsystem it must be very accurate for the mail piece to arrive at its designated carrier in the transport system. Presently available induction
15 subsystems do not count for real time variations attributable to belt slippage and other factors.

Thus, a need exists for a more accurate and reliable induction subsystem capable of more accurately delivering mail pieces to a transport
20 system.

SUMMARY OF THE INVENTION

An object of the present invention is therefore to provide a mail induction subsystem
25 which is capable of monitoring the position of an individual mail piece and providing mid-course correction in speed to ensure accurate delivery to a transport system.

Another object of the present invention is to
30 provide a mail induction subsystem which is constructed in a modular fashion to facilitate customization of the subsystem to fit individual

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needs of the customer.

Another object of the present invention is to provide an induction subsystem which is capable of delivering mail pieces of greater thickness with
5 reliability and accuracy.

These and other objects of the invention are met by providing an induction line section of a mail induction system, including a plurality of dancer pulleys arranged in a row to include an
10 upstream-most dancer pulley and a downstream-most dancer pulley, a first end pulley located upstream of the upstream most dancer pulley, a second end pulley located downstream of the downstream-most dancer pulley, a drive pulley located radially
15 outwardly of the second end pulley, a first belt fitted over the plurality of dancer pulleys and running between the two end pulleys and around the drive pulley, the first and second end pulleys have a diameter smaller than the diameter of the
20 dancer pulleys, a second belt running between third and fourth end pulleys and running over a plurality of idler pulleys, a mail piece passageway being defined between an inner run of the second belt and an inner run of the first
25 belt, wherein the dancer pulleys are forced radially outwardly by passage of a mail piece having a thickness greater than a distance between the inner runs of the first and second belts, wherein a spring restoring force is developed by
30 said radial outward movement of the dancer pulleys.

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These and other objects will become more apparent with reference to the following detailed description and drawings.

5

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective, schematic view of an induction subsystem according to the present invention;

10 Fig. 2 is a top view of an induction line section according to the present invention;

Fig. 3 is a side elevational view, partly schematic, of the induction line section of Fig. 2; and

15 Fig. 4 is an enlarged, sectional view of a typical dancer roller according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 Referring to Fig. 1, a mail induction subsystem according to the present invention is generally referred to by the numeral 10 and includes an auto feeder 12 and two manual feeders 14 and 16. Various other modules can be inserted between the feeders 12, 14 and 16, and the

25 transport/stacker module 18. The transport/stacker module 18 is described in U.S. Patent Application Serial No. _____, entitled TRANSPORT/STACKER MODULE FOR MAIL PROCESSING SYSTEM, by Grapes et al., filed

30 concomitantly with the present application, and is hereby incorporated by reference. By way of example, the various modules between the

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transport/stacker module 18 and the feeders 12, 14, and 16 include an inserter module 20, a printer/verifier module 22, a label applicator 24, a multi-line intelligent character reader module (MLIC) 26 and a flats bar code reader 28.

The various modules defines an induction line 30 which delivers individual mail pieces to the transport/stacker module 18. The induction line 30 includes a plurality of roller sections which transport the mail pieces by counter-rotating belts frictionally engaging the mail pieces.

One aspect of the present invention is that the induction line 30 comprises a plurality of induction roller segments, one of which is illustrated in Figs. 2 and 3.

The induction line section 32 includes a plurality of dancer pulleys 34, 36, 38, 40, 42 which swing about respective axes 34a, 36a, 38a, 40, and 42a through a range of about 20°. A belt 44 runs over the surface of the dancer pulleys and is looped around two end pulleys 46 and 48 which have rotation axes coplanar with the rotation axes of the dancer pulleys. The belt 44 is driven by a drive pulley 52, and an idler pulley 54 ensures at least 180° wrap of the belt 44 on the drive pulley. Also, the location of the idler pulley 54 is such that the belt geometry at the end pulley 48 is substantially the same as the end pulley 46.

A counter-rotating belt 58 runs between end pulleys 60 and 62, of which pulley 60 is driven, with idler pulleys 64, 66, 68, 70 and 72 therebetween. Preferably drive pulleys 52 and 60

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are driven by the same motor and timed to rotate both belts 44 and 58 at the same speed.

Each dancer pulley is supported on a corresponding swing arm 74, 76, 78, 80 and 82, respectively, each of which is pivotally mounted to a horizontal plate 84. The plate 84 may be counter-top of a modular cabinet, for example, and has arcuate channels 86 formed therein to permit the dancer pulleys to swing arcuately away from the mail carrying gap between the two belts 44 and 58.

The end dancer pulleys 34 and 42 are also supported at the opposite ends by having a cam follower 88 ride in an arcuate cam track 90 formed in an upper support bar 92. The support bar is mounted on fixed pillar supports 94, 96, 98, 100 and 102.

The rollers 62, 64, 66, 68, 70, 72 and 60 have fixed rotational axes, while the rotational axes of the dancer pulleys 34, 36, 38, 40 and 42 swing outwardly to expand the distance between the inner run of belt 44 and the inner run of belt 58 to accommodate mail pieces of variable thickness. When the mail piece 50 pushes the dancer pulleys outwardly, a spring bias is generated by the belt 44, which is preferably elastic. This spring bias forces the dancer pulleys back to their original, inner most positions with the need for a separate spring.

A typical dancer pulley 36 is illustrated in Fig. 4. A support shaft 36a may be fixedly connected to the arm 76 so that the pulley 36 is

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journalled for rotation at the end of the shaft 36a. The profile 36b of the pulley 36 is crowned slightly to ensure that the belt stays on the pulley. Pulleys 34 and 42 can be provided with shaft extensions with cam followers thereon which extend in a direction opposite the shaft 36a for engagement with the cam track 90 and 91.

While the drive pulley 52 can be driven with a conventional D.C. motor, another aspect of the present invention entails driving the drive pulley 52 with a servo motor 106 under the control of a system controller 108. Position sensors 110, such as through beam infrared sensor positioned to aim a beam through the space between the plate 84 and the bottom of the dancer pulleys, feed signals to the controller 108 to determine the location of a mail piece at various points along the induction line. If the controller 108 determines that the mail piece is ahead or behind scheduled arrival at the transport/stacker module, the servo motor 106 is driven at a speed sufficient to correct the actual travel time of the mail piece to coincide with the scheduled travel time. Thus, pulley segment 32 of the induction line can function as a catch-up mechanism, and is particularly useful downstream of a leveler device, or immediately before the transport/stacker module. Multiple catch-up mechanism could be provided with additional servo motors, as shown in broken lines in Fig. 3.

Regardless of whether the drive pulleys are driven by servo motors or conventional A.C. or

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D.C. motors, one aspect of the present invention is that the induction line can be broken into a plurality of segments so that the induction line can be increased or decreased in length, or
5 modified to include or remove modules as needed.

Preferably, the end pulleys 46 and 48 have a diameter of 1/2 inch and the dancer pulleys 34, 36, 38, 40, and 42 have a diameter of about 3 inches, thus defining a ratio in diameter for the
10 dancer pulleys to the end pulleys to be about 6:1. It has been determined that this ratio will allow the induction line section 32 to accommodate mail pieces having a thickness up to 1/4 inch, with sufficient spring return force being generated by
15 the belt 44, which in a preferred embodiment is about four inches wide.

The system controller is programmed to predict when a mail piece will arrive at a particular carrier after the mail piece has been
20 introduce, either by a manual feeder or an automatic feeder. Thus, the system controller essentially times the delivery of the mail piece, based on the expected speed of the induction line, and the speed of the containers of the transport
25 system as they are positioned at the discharged end of the induction line. Due to belt slippage, or other factors, the expected time of arrival may not always coincide with the actual time of arrival. Thus, the present invention provides a
30 catch-up mechanism, which provides a mid-course, or end-course correction for the time of delivery of the mail piece either by accelerating the speed

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or decelerating the speed of the mail piece by controlling the servo motor.

5 Numerous modifications and adaptations of the present invention will be apparent to those so skilled in the art and thus it is intended by the following claims to cover all such modifications and adaptations which fall within the true spirit and scope of the invention.

10 What is Claimed Is:

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Claims

1. An induction line section of a mail induction system comprising:

5 a plurality of dancer pulleys arranged in a row to include an upstream-most dancer pulley and a downstream-most dancer pulley;

a first end pulley located upstream of the upstream most dancer pulley;

10 a second end pulley located downstream of the downstream-most dancer pulley;

a drive pulley located radially outwardly of the second end pulley;

15 a first belt fitted over the plurality of dancer pulleys and running between the two end pulleys and around the drive pulley, the first and second end pulleys have a diameter smaller than the diameter of the dancer pulleys;

20 a second belt running between third and fourth end pulleys and running over a plurality of idler pulleys, a mail piece passageway being defined between an inner run of the second belt and an inner run of the first belt, wherein the dancer pulleys are forced radially outwardly by passage of a mail piece having a thickness greater
25 than a distance between the inner runs of the first and second belts, wherein a spring restoring force is developed by said radial outward movement of the dancer pulleys.

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2. An induction line section according to claim 1, wherein a ratio of the diameter of the idler pulleys to the first and second end pulleys is about 6:1.

3. An induction line section according to claim 1, further comprising a drive motor operatively coupled to the drive pulley and to one of the third and fourth end pulleys for
5 simultaneously rotating the two belts in opposite directions at the same speed.

4. An induction line section according to claim 1, further comprising a servo motor drive operatively coupled to the drive pulley and to one of the third and fourth end pulleys, at least one
5 position sensor for determining a point in time at which a piece of mail passes, and a system controller, receiving an output signal from the position sensor and sending a control signal to the servo motor to operate the servo motor at a
10 speed sufficient to correct deviations from scheduled time of arrival of a mail piece at a stacker module.

5. A catch-up mechanism for a mail induction system comprising:

a mail induction section including first and second counter-rotating belts between which a mail
5 piece is delivered to a stacker module;

a position sensor located upstream of the induction line section;

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a system controller for receiving an output signal of the position sensor and comparing scheduled location of a mail piece to actual location of the same mail piece; and

5 a servo motor, operatively coupled to the system controller, and drivingly coupled to the first and second belts, for driving the two belts at a speed sufficient to cause the mail piece to arrive at the stacker module on schedule.

6. An induction line section of a mail induction system comprising:

a first belt running between first and second end pulleys with a plurality of idler pulleys of
5 equal diameter therebetween;

a second belt running between third and fourth end pulleys and a plurality of dancer pulleys of equal diameter disposed therebetween;

10 means for imparting rotation in at least one of the first and second end pulleys and at least one of the third and fourth end pulleys;

wherein the rotation axes of the third and fourth end pulleys and the dancer pulleys are mutually coplanar.

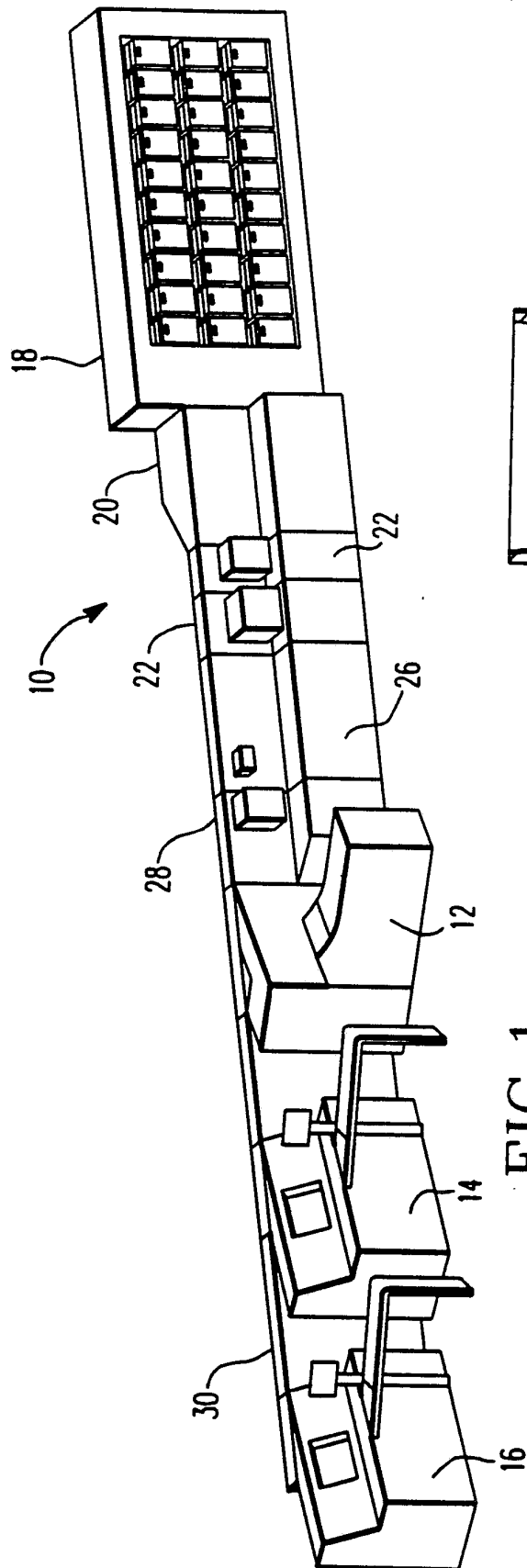
$\frac{1}{2}$ 

FIG. 1

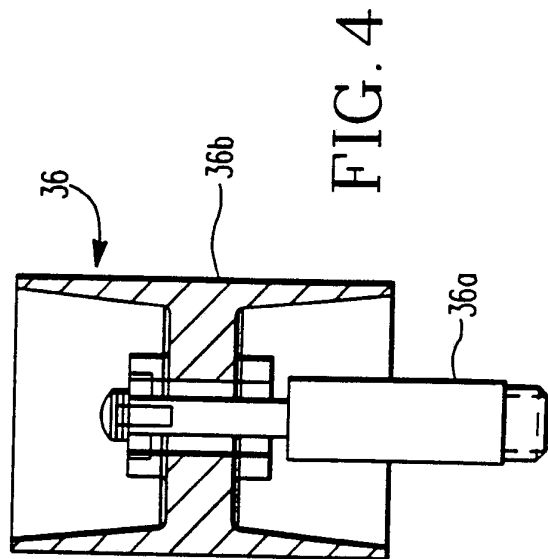


FIG. 4

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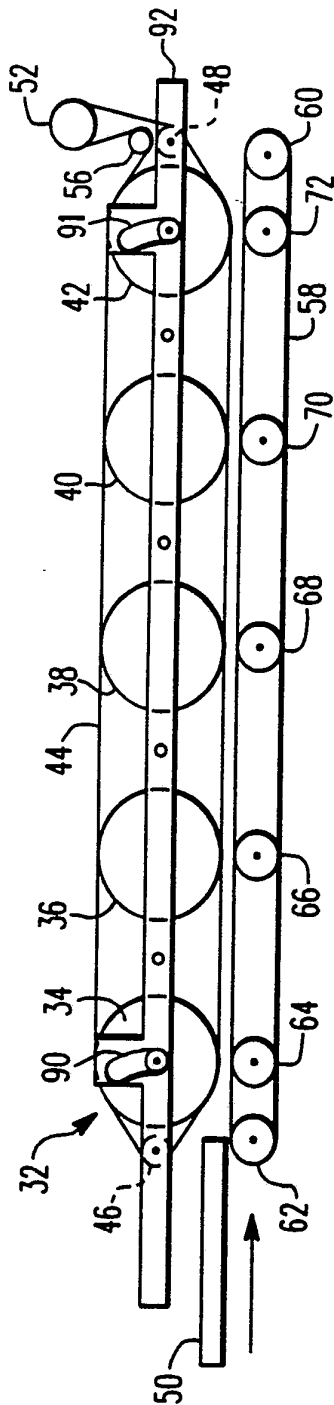


FIG. 2

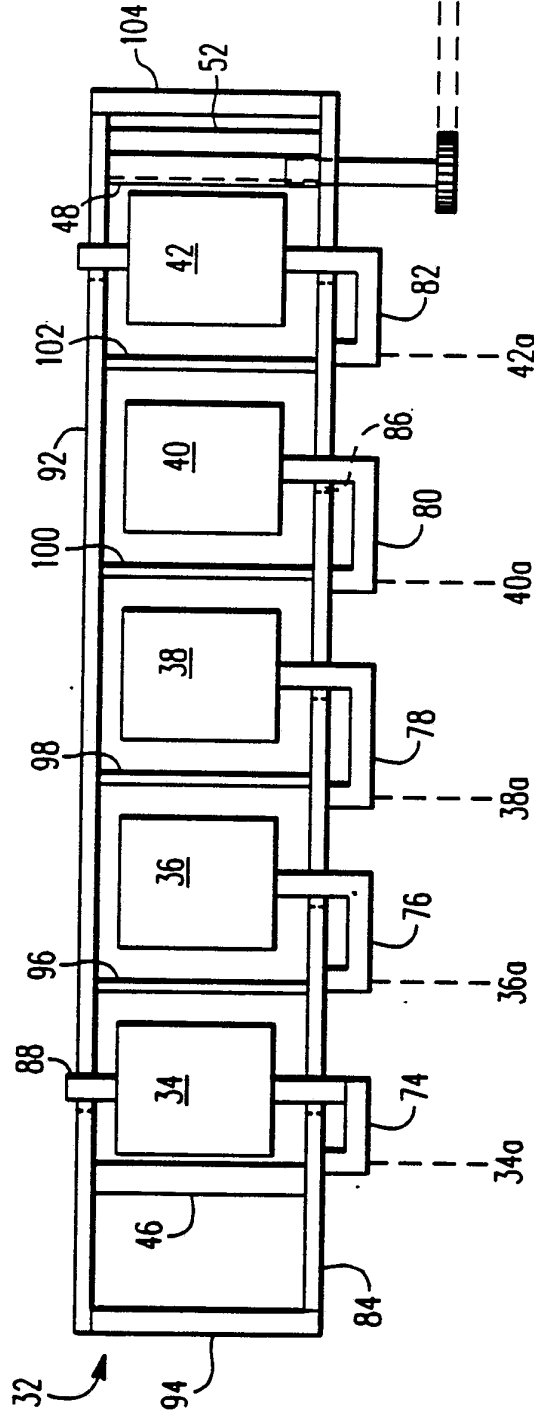
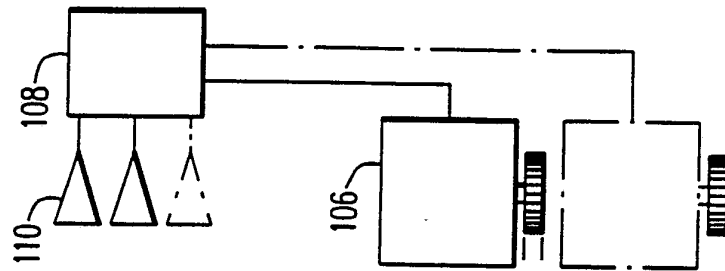


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 92/06753

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B07C3/02; B65G15/14

II. FIELDS SEARCHED**Minimum Documentation Searched⁷**

Classification System

Classification Symbols

Int.Cl. 5

B65G ; B07C ; G06K

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸**III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹**

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US,A,3 951 257 (STORACE ET AL) 20 April 1976 see figures see column 2, line 32 - column 4, line 27 ---	1,3,6
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 197 (M-324)11 September 1984 & JP,A,59 086 545 (TAIYOU SHIYOKAI KK) 18 May 1984 see abstract ---	3-6
P,X	EP,A,0 491 631 (MERLIN GERIN) 24 June 1992 see column 2, line 14 - column 3, line 51 see figure 2 --- -/--	1,3

¹⁰ Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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IV. CERTIFICATION

Date of the Actual Completion of the International Search

05 NOVEMBER 1992

Date of Mailing of this International Search Report

24. 11. 92

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

LAPEYRONNIE P.F.J.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US,A,4 382 471 (C.L.PETERSON) 10 May 1983 see figure 2 see column 3, line 55 - column 4, line 36 -----	1,2

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. US 9206753
SA 63711**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3951257	20-04-76	None	
EP-A-0491631	24-06-92	FR-A- 2670473	19-06-92
US-A-4382471	10-05-83	None	