

REPUBLICA I



No. 13-170703- -00000-0000

SUPERINTENDENCIA DE

Fecha: 2013-07-18 15:48:49 Dep. 2020 DIR.NUEVASCR  
Tra. 11 PATENTEIYII Eve: 378 FASENACIONALI  
Act. 411 PRESENTACION Folios: 58

DIVISION DE NUEVAS CREACIONES

SOLICITUD DE PATENTE

INVENCION

EXPEDIENTE :  
  
TITULO : SISTEMA CON MÚLTIPLES CABINAS  
EN UN POZO DE ASCENSOR  
  
SOLICITANTE : SMART LIFTS LLC  
  
DOMICILIO : CA - E.E.U.U.  
  
APODERADO : JUAN CARLOS CUESTA Q.  
  
FECHA :

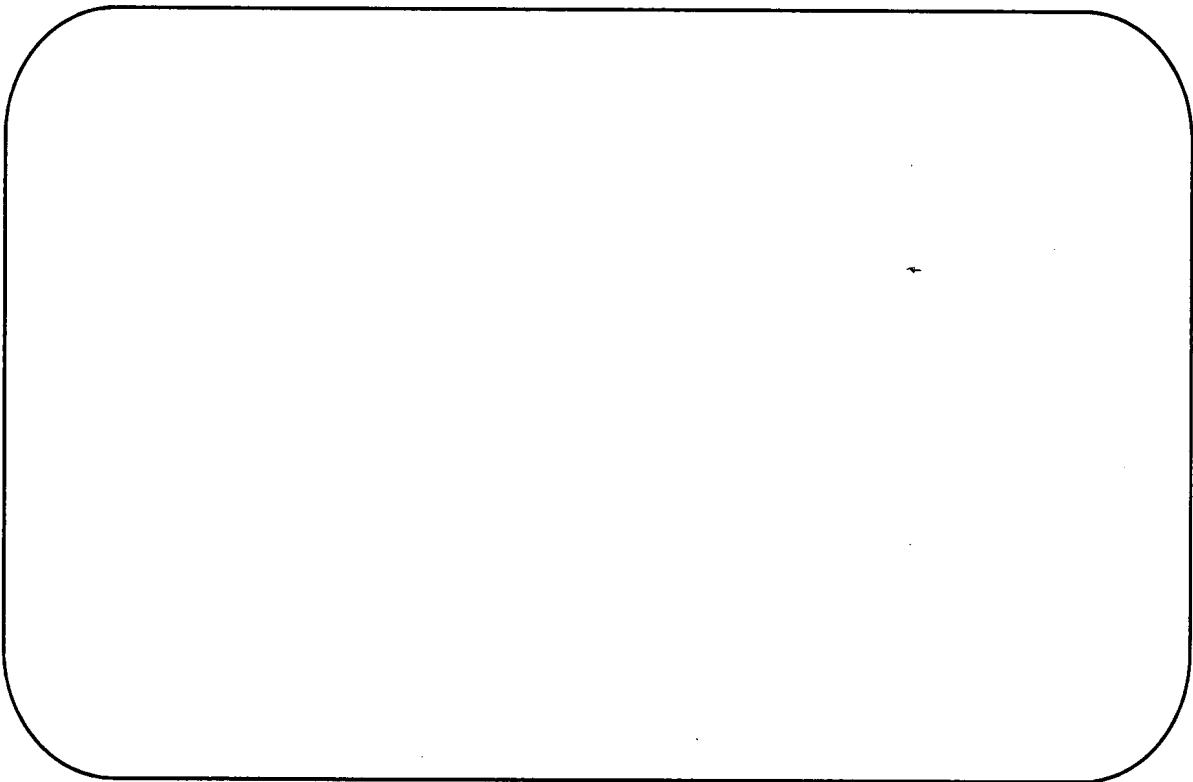
| PETITORIO                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------|--------------------------|----------|------------|------------|--|--|--|--|--|--|--|--|--|
| <br><b>Industria y Comercio</b><br>SUPERINTENDENCIA                                                                    | SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO<br><br><b>No. 13-170703- -00000-0000</b><br>Fecha: 2013-07-18 15:48:49 Dep. 2020 DIR.NUEVASCR<br>Tra. 11 PATENTEIYII Eve: 378 FASENACIONALI<br>Act. 411 PRESENTACION Folios: 58                                                                                                                                                                                                                                                                                                                               |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <b>FORMULARIO ÚNICO DE SOLICITUD DE PATENTES</b><br><b>PCT</b><br><b>ENTRADA EN FASE NACIONAL</b><br><b>SOLICITUD DE:</b>                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>1</div> <div><input checked="" type="checkbox"/> Patente de Invención<input type="checkbox"/> Patente de Modelo de Utilidad</div>                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div><input type="checkbox"/> Capítulo I<input type="checkbox"/> Capítulo II</div>                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>2</div> <div><b>SOLICITANTE</b></div>                                                                                                                                                              | <div>Nombre: SMART LIFTS LLC<br/>Dirección: 1164 CHESTNUT STREET<br/>MENLO PARK CA 94025, EEUU<br/>Nacionalidad o Domicilio: E.E.U.U. - CA<br/>Lugar de Constitución:<br/>Teléfono: Fax:<br/>E- mail:</div> <div><b>IDENTIFICACION</b><br/><input type="checkbox"/> C.C.<input type="checkbox"/> NIT<br/><input type="checkbox"/> C.E.<input type="checkbox"/> Otro<br/>Cual<br/>Número</div>                                                                                                                                                                                                                                            |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>3</div> <div><b>REPRESENTANTE APODERADO</b></div>                                                                                                                                                  | <div>Nombre: JUAN CARLOS CUESTA QUINTERO<br/>Dirección: CALLE 72 No 10-07 of 603<br/>Teléfono: 2113097 Fax:<br/>E- mail: juancuesta@cuestalawyers.com<br/>abogadocuesta@cuestalawyers.com</div> <div><b>IDENTIFICACIÓN</b><br/><input checked="" type="checkbox"/> C.C.<input type="checkbox"/> NIT<br/><input type="checkbox"/> C.E.<input type="checkbox"/> Otro<br/>Cual <u>CÉDULA DE CIUDADANÍA</u><br/>Número <u>79.339.809</u> TP <u>43.273</u><br/>En caso de haber presentado poder general para asuntos que se adelanten ante la Delegatura de Propiedad Industrial, sírvase indicar el numero de radicación (del poder).</div> |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>4</div> <div><b>INVENTOR (ES)</b><br/>(72)</div>                                                                                                                                                   | <div>Nombre: JACOBS JUSTIN<br/>Dirección: 1164 CHESTNUT STREET MENLO PARK CA 94025, EEUU<br/>Nacionalidad o Domicilio: E.E.U.U. - CA</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>5</div> <div><b>PCT (86)</b><br/>Solicitud Internacional No. <u>PCT/US2011/063210</u> Fecha <u>04.12.2011</u><br/>Publicación internacional No. <u>WO2012/099645</u> Fecha <u>26.07.2012</u></div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>6</div> <div><b>Título (54)</b> <u>SISTEMA CON MÚLTIPLES CABINAS EN UN POZO DE ASCENSOR</u></div>                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>7</div> <div><b>Clasificación internacional (51)</b> <u>B66B 9/00 (2006.01)</u></div>                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| <div>8</div> <div><b>Prioridad</b><br/><input checked="" type="checkbox"/> SI <input type="checkbox"/> NO</div>                                                                                         | <table border="1"><thead><tr><th>(33) País de Origen</th><th>(32) Fecha</th><th>(31) Número de Solicitud</th></tr></thead><tbody><tr><td>E.E.U.U.</td><td>19.01.2011</td><td>13/009/701</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></tbody></table>                                                                                                                                                                                                                                                                                                            | (33) País de Origen      | (32) Fecha | (31) Número de Solicitud | E.E.U.U. | 19.01.2011 | 13/009/701 |  |  |  |  |  |  |  |  |  |
| (33) País de Origen                                                                                                                                                                                     | (32) Fecha                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (31) Número de Solicitud |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
| E.E.U.U.                                                                                                                                                                                                | 19.01.2011                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 13/009/701               |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |
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| <div>9</div> <div><b>Comprobante de pago No.</b> <u></u> <b>Fecha</b> <u></u></div>                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |            |                          |          |            |            |  |  |  |  |  |  |  |  |  |

**10 Anexos**

- ☐ Comprobante de pago de la tasa de presentación de la solicitud.
- ☐ Documento que acredita la existencia y representación legal de la persona jurídica peticionaria, en cuanto no estén inscritas en alguna Cámara de Comercio Colombiana.
- ☐ Poderes, si fuere el caso.
- ☐ Documento de cesión del inventor al solicitante o a su causante.
- ☐ Traducción de la solicitud internacional al castellano (Resumen, descripción, reivindicaciones, dibujos)
- ☐ Copia del examen preliminar internacional efectuado por la Autoridad Internacional de Examen preliminar (IPEA)
- ☐ Traducción de examen preliminar internacional efectuado por la IPEA
- ☐ De ser el caso, copia del contrato de acceso.
- ☐ De ser el caso, documento que acredite la licencia o autorización de uso de conocimientos tradicionales de las comunidades indígenas.
- ☐ De ser el caso, certificado de depósito del material biológico
- ☐ Arte final 12x12.
- ☐ De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionadas parcial o totalmente con la invención de esta solicitud.
- ☐ De ser el caso, modificaciones efectuadas a la solicitud internacional.
- ☐ Otros

**11**

**FIGURA CARACTERISTICA:**



**12**

**Solicito la concesión de la patente**

**NOMBRE** JUAN CARLOS CUESTA QUINTERO

**FIRMA**

  
C.C. 79.339.809 TP 43.273

**POWER OF ATTORNEY**

I, the undersigned Justin Jacobs by the rights that I represent and acting as President and Legal Representative(s) of SMART LIFTS, LLC an organization existing under the laws of the State of California, United States of America and in present execution of its (social) objective, domiciled at 1164 Chestnut Street, Menlo Park, CA 94025, USA do hereby grant POWER OF ATTORNEY to Mr. Juan Carlos Cuesta Quintero and/or Mrs. Diana Romero Calvo, members of Cuesta & Asociados Ltda., residing in Bogotá, Colombia, and identified with CC 79.339.809 and CC 52.250.482 and with professional card 43.273 CSJ and 121.002 CSJ, respectively, to act on behalf of grantor before any entity, authority and/or person, specially before those Administrative, Contentious-Administrative, Judicial and/or any other, in all matters concerning the following:

1.- To file, obtain and/or register any of the type of Intellectual and Industrial Property right, such as: Patents of Inventions and Model Utility Patents; Industrial Designs, Trademarks, Slogans, Trade Names and emblems or ensigns, and Appellations of Origin; copyrights in any of their presentations (display); sanitary registrations, operating authorizations and/or licenses; as well as their renewals or extensions, assignments, changes of name and/or domicile, agreements and licenses, domain names applications. Especially those related to: international application no. PCT/US2011/063210.

2.- To bring actions of opposition, observances, infringement or refutation, reconsideration, complaints, appeals or legal recourses, cancellation, nullity and other actions related with rights derived from the above-mentioned matters and against the unfair competition, engage facilitation hearings, as well as to intervene or participate in Civil, Commercial, Criminal, or Contentious-Administrative Trials; in actions or lawsuits or litigation's that grantor initiates or are initiated against him.

3.- In order that this mandate is sufficient enough for all the matters referenced above, I (we) do hereby expressly grant full and ample POWER OF ATTORNEY to exercise the special rights established under Art. 70 of the Civil Procedure Code, this is: to conciliate, settle, submit to arbitration, waive legal proceedings, defer the harmonious testimony or decisive oath, absolve or acquit positions; and to receive the object related to the litigation or to take possession of the said object. Attorneys may execute any other act that requires a special clause; for any and/or all the provisions mentioned in these instruments.

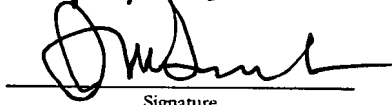
4.- To exercise Judicial Proxy and to ratify or not the officious agency. Attorneys may also grant power of attorney over the same to act in and out of the Colombian territory.

5.- To substitute or delegate this Power of Attorney to act in Colombia and abroad in favor of other or others and to revoke such substitutions or delegations.

6.- It is expressly stated that attributions listed under this Power of Attorney are merely exemplifying and not limitative of other implicit attributions, therefore, the attorneys -in fact- are authorized to exercise without any restriction whatsoever, all the rights granted by the law in force and/or with the legislation to be enacted in the future, related and/or resulting and/or are the consequence of the subject of this Power and regarding all hereby stated.

Granted and signed at Menlo Park, CA, USA

on July 8, 2013



Signature

**PODER ESPECIAL**

Yo (nosotros), \_\_\_\_\_, abajo firmante(s), por los derechos que represento(amos) en mi(nuestra) calidad de **REPRESENTANTE LEGAL** de la sociedad \_\_\_\_\_

\_\_\_\_\_ constituida bajo las leyes de \_\_\_\_\_ y en actual cumplimiento de su objeto social, con domicilio en \_\_\_\_\_, por el presente

instrumento confiero PODER ESPECIAL a favor de Juan Carlos Cuesta Quintero y/o Diana Romero Calvo, miembros de la firma Cuesta & Asociados Ltda., domiciliados en Bogotá, Colombia, identificados con C.C. 79.339.809 y CC 52.250.482 y Tarjetas Profesionales 43.273 CSJ y 121.002 CSJ, respectivamente, para que actuando a nombre del (de la) otorgante lo (la) represente(n) ante cualquier entidad, autoridad, y/o persona, especialmente ante las del orden Administrativo, Contencioso-Administrativo, Judicial y/o de cualquier otra que fuere, en todo lo referente a los siguientes asuntos:

1.- Solicitar, tramitar, inscribir y/o registrar cualquiera de las modalidades de Propiedad Industrial, esto es, las Patentes de Invención y Modelos de Utilidad; los Diseños Industriales; los Signos Distintivos, como: Marcas, Lemas, Nombres y Enseñas Comerciales y Denominaciones de Origen; Derechos de Autor; Registros Sanitarios y de Variedades Vegetales; así como sus renovaciones o prórrogas, transferencias, cambios de nombre y/o domicilio, contratos y licencias, solicitud de nombres de dominio. Caso específico, para \_\_\_\_\_

2.- Ejercer acciones de oposición, observación, impugnación, reposición, apelación, cancelación, nulidad y demás que se relacionen con derechos derivados de los asuntos indicados y en contra de la competencia desleal, así como participar en audiencias de facilitación intervenir en Juicios Cíviles, Comerciales, Penales, Contencioso-Administrativos, en acciones o juicios que promueva o se promuevan en contra del (la) mandante.

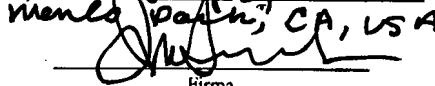
3.- Para que en todos los asuntos arriba mencionados este mandato sea suficiente, confiero expresamente este Poder amplio y suficiente, para ejercer las facultades especiales establecidas en el artículo 70 del Código de Procedimiento Civil, esto es: conciliar, transigir, comprometer el pleito en árbitros, desistir del pleito, deferir al juramento decisorio, absolver posiciones, y recibir la cosa sobre la cual verse el litigio o tomar posesión de ella. Los mandatarios podrán ejecutar cualquier otro acto que requiera de cláusula especial para cualquiera o todas las disposiciones que se mencionan en este instrumento.

4.- Ejercer Procuración Judicial, y ratificar o no la agencia oficiosa. Los mandatarios quedan facultados para conferir poder en los asuntos aquí mencionados, para actuar bien dentro o fuera del territorio colombiano.

5.- Sustituir o delegar el presente Poder y revocar tales sustituciones o delegaciones.

6.- Se deja expresa constancia que las facultades enumeradas en este mandato son meramente ejemplificativas y no limitativas de otras facultades implícitas, por cuyo motivo, los mandatarios están autorizados a ejercer, sin restricción alguna, todos los derechos de acuerdo con la ley vigente y/o con la legislación que se promulgue en el futuro, se relacionen y/o emerjan y/o sean consecuencia del objeto del presente Poder y en razón de lo aquí expresado.

Dado y firmado en Menlo Park, CA, USA el July 8, 2013 at



Firma

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| <p>Acuerdos en litigios vs. Genéricos</p> <ul style="list-style-type: none"> <li>* Redadas / Investigaciones sobre el terreno</li> <li>* Cuestionarios / Citación</li> <li>* Investigaciones sectoriales: <ul style="list-style-type: none"> <li>- Comisión Europea (2008)</li> <li>- Corea del Sur (2010)</li> <li>- Ucrania (2011)</li> <li>- Turquía (2012)</li> <li>- Rumanía (2013)</li> <li>- Francia (2013)</li> </ul> </li> <li>* Obligaciones de información (por ejemplo, acuerdos de liquidación de patente en los EE.UU. / UE)</li> </ul> | <p>El NOVAVATIS</p> |
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| <p>Acuerdos en litigios vs. Genéricos</p> <ul style="list-style-type: none"> <li>* <i>FTC vs Actavis</i> (Corte Suprema de USA)</li> <li>- Pago por retraso/pago compensatorio</li> <li>* EU-Investigaciones sectoriales</li> <li>- Acuerdos</li> <li>- Retraso en la entrada de genéricos</li> <li>- Transferencia de valor – pago compensatorio, acuerdos secundarios</li> <li>* EC DG Comp-investigations initiated vs Servier, Lundbeck, Johnson &amp; Johnson/Sandoz</li> </ul> | <p>El NOVAVATIS</p> |
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| <p>Preocupaciones del Derecho a la Competencia</p> <ul style="list-style-type: none"> <li>* Monopolio de la patente vs. Derecho a la Competencia</li> <li>* Abuso de la posición dominante en el mercado</li> <li>* EC: multas de hasta el 10% de ventas globales</li> <li>* <i>Commission v AstraZeneca</i> (CJEU, C-457/10, 2012)</li> <li>- SFCs para omeprazol</li> <li>- Comportamiento inconsistente con Oficinas de Patentes</li> <li>- Multa € 52.5m</li> </ul> | <p>El NOVAVATIS</p> |
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ASSIGNMENT

I, the undersigned, (Inventor's name), Justin Jacobs, which here and after is referred as the ASSIGNOR,

Citizen/s of United States of America,  
Residing at 1164 Chestnut Street, Menlo Park, CA 94025, USA  
By these presents declare under oath to be the solo and true inventor/s of the invention entitled:  
"SYSTEM HAVING MULTIPLE CABS IN AN ELEVATOR SHAFT"

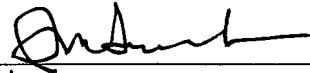
And,

SMART LIFTS, LLC a corporation organized and existing under the law of [country] the United States of America having its domicile in 1164 Chestnut Street Menlo Park, California 94025, United States of America (Country, city & address) and represented by (individual's name) Justin Jacobs, acting as its (job title) President, which here and after is named as ASSIGNEE,

Both, ASSIGNOR and ASSIGNEE have agreed to the following:

To ASSIGN from the ASSIGNOR to the ASSIGNEE the Industrial Property Rights related to the Patent PCT/US2011/063210, from December 4, 2011 (date).

Given on July 8, 2013  
in Menlo Park, CA, USA.

  
Justin Jacobs  
ASSIGNOR

  
Smart Lifts, LLC  
ASSIGNEE

CESION

Yo / Nosotros, abajo firmando/s (Nombre del inventor) \_\_\_\_\_, quien en adelante será el CEDENTE,

Ciudadano/s de \_\_\_\_\_  
domiciliado/s en \_\_\_\_\_  
Por el presente documento declaramos bajo juramento ser el/los único/s y verdadero/s inventor/es de la invención titulada:  
"\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_"

Y,

\_\_\_\_\_ una sociedad debidamente constituida y existente bajo las leyes de (país) \_\_\_\_\_, con domicilio en [país, ciudad y dirección] \_\_\_\_\_ y representada por (nombre) \_\_\_\_\_ quien actúa como (título) \_\_\_\_\_, quien en adelante será el CESIONARIO,

Ambos, CEDENTE y CESIONARIO han acordado lo siguiente:  
CEDER del CEDENTE al CESIONARIO los derechos de propiedad Industrial relativos a la Patente PCT /-/---/----, del \_\_\_\_\_ (fecha)

Dado en \_\_\_\_\_ el \_\_\_\_\_

\_\_\_\_\_  
CEDENTE

\_\_\_\_\_  
CESIONARIO

## ASSIGNMENT

WHEREAS, I, Justin Jacobs, (hereinafter referred to as "ASSIGNOR"), am the inventor of application for United States Letters Patent for the invention entitled "System Having Multiple Cabs in an Elevator Shaft", Application Serial No. 13/009,701, filed on January 19, 2011;

WHEREAS, SMART LIFTS, LLC a corporation existing under the laws of the State of California having its principal place of business at 1164 Chestnut Street, Menlo Park, California 94025 (hereinafter referred to as "ASSIGNEE"), is desirous of acquiring the entire right, title and interest in and to the invention, improvements and said application for Letters Patent;

NOW THEREFORE, for and in consideration of One Dollar (\$1.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, said ASSIGNOR, has sold, assigned and set over, and by these presents does hereby sell, assign and set over unto the said ASSIGNEE, its legal representatives, successors and assigns, its entire rights, title and interest in and to said application to United States Letters Patent, and the invention disclosed, described or claimed in said application to Letters Patent, together with all divisions, reissues, continuations and extensions thereof, and any and all rights of recovery for past infringement of said application to Letters Patent.

ASSIGNOR also hereby sells and assigns to said ASSIGNEE, its successors, assigns and legal representatives the full and exclusive rights, title and interest to the invention disclosed in said application for patent and any applications throughout the world, including the right to file applications and obtain patents, utility models, industrial models and designs for said invention in its own name throughout the world including all rights of priority, all rights to publish cautionary notices reserving ownership of said invention and all rights to register said invention in appropriate registries;

ASSIGNOR further agrees to execute any and all powers of attorney, applications, assignments, declarations, affidavits, and any other papers in connection therewith necessary to perfect such rights, title and interest in ASSIGNEE, its successors, assigns and legal representatives;

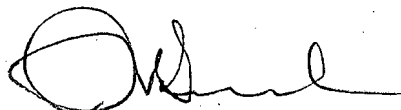
ASSIGNOR hereby further agrees that ASSIGNOR will communicate to said ASSIGNEE, or its successors, assigns and legal representatives, any facts known to me respecting any improvements; and, at the expense of said ASSIGNEE, to testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, continuation-in-part, reissue and substitute applications, make all lawful oaths, and generally do everything possible to vest title in said ASSIGNEE and to aid said ASSIGNEE, its successors, assigns and legal representatives to obtain and enforce proper protection for said invention in all countries; and

ASSIGNOR authorizes ASSIGNEE or the appointed agent of the ASSIGNEE, to enter the Application serial number and filing date of the patent application in spaces provided herein.

IN WITNESS WHEREOF, ASSIGNOR has cause this agreement to be executed on the date below.

1-17-2013

Date



Signature: Justin Jacobs

# **SYSTEM HAVING MULTIPLE CABS IN AN ELEVATOR SHAFT**

**INVENTOR  
JUSTIN JACOBS**

## **FIELD OF INVENTION**

[0001] The invention relates generally to a multi-cab elevator system having cabs which move independently of each other in an elevator shaft.

## **BACKGROUND**

[0002] Reducing the number of elevator shafts used in a building has been attempted for years in order to increase the space available for profitable purposes. It is expected that the number of hoistways in some large buildings could be reduced by over 80%. For years, double deck cabs have been used in order to increase the passenger capacity of a hoistway, with each deck serving even or odd floors. However, double deck cabs can limit the freedom of travel provided to passengers. Some systems have used multiple one-way shafts with several cabs being transferred from one shaft to another in order to create a loop of travel. This has proven to be too costly due to complexity and increased energy usage.

[0003] Another way to accomplish this is by having multiple cabs in a single shaft. The number of cabs in an individual shaft has been limited to two or three cabs due to the auxiliary equipment used for operation of one cab interfering with another cab's operation. Placing counterweights for the various cabs that do not interfere with each other can be a significant problem as the number of cabs increases. Using one central counterweight or two counterweights on opposing corners of a cab can result in less than ideal balance of the cabs. In some instances, the space needed for the travel of counterweights can be reduced, but this may require cable storage outside of the existing footprint of the elevator shaft. This is a drawback, since a significant advantage of a multiple cab elevator system is reducing the footprint used.

[0004] Elevator systems capable of using multiple cabs are also usually incapable of operating in an existing elevator shaft without substantial modification. This can significantly increase the installation cost of such a system.

## **SUMMARY**

[0005] The present invention is an elevator system which allows four or more cabs to operate independently in a single elevator shaft. The cables used for various systems are generally restricted to areas outside the pathway of the cabs to eliminate interference. In an embodiment, the top cab is connected to two counterweights, while the rest of the cabs are connected to four counterweights each. The connection points between the top cab and its counterweights are at the center of the top surface of the cab. The connection points between the lower cabs and the counterweights are located on either side (wall) of the cabs and horizontally shifted relative to one another in order to avoid interference between cables and provide unencumbered access to each of the counterweight channels and pulleys. As long as interference preventing the

movement of any of the cabs is avoided, various numbers of cabs may be used, and various numbers of counterweights may be used for the top and lower cabs. The present invention does not require any storage of cables due to each counterweight having its own counterweight channel and traveling the length of the hoistway.

[0006] In an embodiment, the cabs use two tracks which are located on opposite sides of the elevator shaft for guidance and breaking functions. The use of center side tracks provides more even weight distribution than other arrangements, such as one track near each of the four corners of the cab. The use of two tracks also creates less friction between the tracks and cabs, which results in energy savings. Each cab connects to a specific lift cable on the rear or one side of the cab. Each lift cable can be connected to, for example, a motor pulley and floor pulley to allow controlled movement of each cab independently.

[0007] The features and advantages described in the specification are not all inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0008] Figure 1 is an illustration of the front providing an overview of an elevator system in accordance with one embodiment of the present invention.

[0009] Figure 2 is an illustration of the cabs in the hoistway from another perspective highlighting the connections of the counterweights, motors and track elements to the cabs, in accordance with one embodiment of the present invention.

[0010] Figures 3A to 3D are illustrations of the top view of cabs 1, 2, 3 and 4 that show how each cab is connected to, among other things, the counterweights, vertical tracks, and motors, in accordance with one embodiment of the present invention.

[0011] Figure 4 is an illustration of a front view of cab 2 that shows how the counterweights and vertical tracks are attached to the cab in accordance with one embodiment of the present invention.

[0012] Figure 5 is an illustration of the top of the elevator shaft that shows the placement of the counterweights in their channels in accordance with one embodiment of the present invention.

[0013] Figure 6 is an illustration of the placement of the track and how the motor system is attached to each of the cabs in accordance with one embodiment of the present invention.

[0014] Figure 7 is an illustration the operation of an elevator shaft having multiple cabs in accordance with an embodiment of the present invention.

#### **DETAILED DESCRIPTION OF THE INVENTION**

[0015] A preferred embodiment of the present invention is now described with reference to the figures where like reference numbers indicate identical or functionally similar elements. Also in the figures, the left most digit of each reference number corresponds to the figure in which the reference number is first used.

[0016] Reference in the specification to “one embodiment” or to “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least one embodiment of the invention. The appearances of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment.

[0017] In addition, the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the claims.

[0018] A view from the front of a preferred embodiment of the multi-cab elevator system is illustrated in Figure 1. A hoistway 100 is shown having four cabs 110. It should be recognized that the arrangement of the counterweight and motor systems allow for the operation of more than four cabs in other embodiments. Six, or more cabs can be operated in a single hoistway/shaft. This is made possible by the offset of counterweights and motors, as discussed below. The cabs 110 in the hoistway 100 are all aligned vertically. From top to bottom, the cabs are referred to as cab 1 (110A), cab 2 (110B), cab 3 (110C) and cab 4 (110D). Each of the cabs 110 is capable of moving throughout the hoistway 100 independently of one another, without passing another cab, due to each cab having an associated motor 130 and horizontally separated cables, pulleys 140 and counterweights 120.

[0019] The movement of the cabs 110 is driven by motors 130 positioned at the top of the hoistway 100, in the preferred embodiment. In alternate embodiments the motors 130 can be placed in different locations, such as the bottom of the hoistway or each motor can be placed at different locations. Each cab is connected to a motor 130 by a lift cable 136. Each lift cable 136 is attached to a cab 110 at two vertically aligned motor connection points 150 on the cab, e.g., on the rear face of the cab. Each cab can also have a single motor connection point 150 rather than the two illustrated. In this case, each end of a lift cable would attach to the same motor connection point. The motor connection points 150 of each cab are horizontally shifted to prevent interference (interaction) with another cables 136 from another cab 110. For example, in Figure 1, the motor connections points 150 shift from right to left as the cabs 110 become lower in the hoistway 100. This allows a plurality of cabs beyond the four in this embodiment to each be controlled by a dedicated motor without any obstruction caused by the lift cables 136. One end of each of the lift cables 136 connects to the upper motor connection point 150 on a cab. The lift cables 136 are then routed through the motors 130 near the ceiling of the hoistway. The lift

cables 136 are then routed through floor pulleys 170 which are attached to the bottom of the hoistway. Finally, the other end of each of the lift cables 136 is attached to the lower of the two motor connection points 150.

**[0020]** In an embodiment, counterweights 120 are located on the sides and rear of the cabs 110 and travel along the length of the hoistway 100. Each of the counterweights 120 is connected to a cab by a counterweight cable running through one of the counterweight pulleys 140 located at the top of the hoistway 100. The counterweight pulleys 140 along the sides of the hoistway are aligned, in an embodiment, coaxially. Different sized pulleys account for different spacing between the cabs 110 and counterweights 120. Alternatively, multiple pulleys can be used to vary the spacing between the cabs 110 and counterweights 120. The counterweights 120 are all kept in individual counterweight channels in order to control the movement of the counterweights 120 and to avoid interaction/interference between counterweights 120. For example, the counterweights 120 and pulleys 140 can be horizontally shifted in order to provide unencumbered access to each of these systems and avoid interference with other equipment.

**[0021]** The bottom cab, cab 4 (110D), has a spring 180 or another collision dampening device on the bottom of the cab as a safety precaution. In the event of a collision between the bottom of the hoistway 100 and cab 4 110D, the spring mitigates the damage from impact. With the possible exception of the top cab, cab 1 100A, all cabs 110 have a bumper 160 or another collision dampening safety device on the top of the cab. The bumpers 160 are similarly used as a safety precaution to lessen the impact of a collision between two of the cabs 110.

**[0022]** Figure 2 is another perspective of the elevator system in accordance with one embodiment of the present invention. The cabs 110 move along two tracks 230 on each side of the hoistway that run the length of the hoistway 100. The cabs 100 are attached to the tracks 230 using guides 220. While illustrated as wheels, the guides 220 may also be double pronged guides which can serve as brakes. A mix of different types of guides can also be used, with some providing guidance and others providing brakes and guidance. Each of the depicted cabs 110 has four guides 220, two on opposite sides of the cab. In a preferred embodiment, each of the cabs has two guides 220, one on opposite sides of the cab. Various numbers of guides can be used. Having two tracks, rather than one at each corner as in some conventional systems, provides better weight distribution, e.g., more balanced weight distribution, and lower maintenance costs in certain situations. The use of two tracks also causes less friction between the guides and tracks which results in more efficient operation of the elevator system. In an embodiment two of the guides are positioned substantially along a center axis or plane of a first wall of the cab 110A and two guides are positioned substantially along a center axis or plane of a second wall of the cab 110A, wherein in one embodiment the first and second walls of the cab 110 are substantially parallel. The uppermost cab, cab 1 (110A), is connected to two counterweights 120 at the rear of the hoistway 100. In an embodiment, only one counterweight 120 is connected to cab 1 (110A). These counterweights are attached to cab 1 (110A) at

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counterweight connection point 240A, which is located at the center of roof of cab 1 (110A). In alternate embodiments cab 1 (110A) is connected to a different number of counterweights, e.g., one, four etc. In alternate embodiments cab 1 (110A) has multiple connection points, for example, similar to those described below.

**[0023]** In one embodiment, the remaining cabs, e.g., cab 2 (110B), cab 3 (110C) and cab 4 (110D), are connected to four counterweights each, with two located on either side of the cab. It is shown that the counterweight connection points 240 on the cabs 110 are horizontally shifted in order to avoid interference with one another. For instance, the cab 3 connections points 240C are shifted toward the front and rear of the hoistway 100 relative to the cab 2 connection points 240B.

**[0024]** Figures 3A, 3B, 3C, and 3D illustrate a top view of each of the cabs in one embodiment of the invention. As illustrated in Figure 3A and as described above, the location of the cab 1 counterweights 120A is different than that of the other three cabs. The counterweight connection point 240A for cab 1 (110A) is located at the middle of the top of the cab rather than on the sides. The counterweight connection point is not implemented in this fashion on the other cabs since there is a cab above which would interfere with the counterweight connection cable. The counterweight connection point 240A is attached to the counterweights 120A at the rear of the hoistway. As illustrated, counterweights 120 can be attached to dividing walls 360. Dividing walls 360 allow counterweights and other equipment to be attached to both sides of the dividing wall 360. This increases the amount of counterweights and cabs that can fit in a single hoistway. The rear dividing wall can be extended to span the width of the rear of the hoistway.

Counterweights can also be attached to the outer hoistway wall rather than a dividing wall, if dividing walls are not included. However, dividing walls allow significant flexibility in the selection and placement of counterweights. By using a dividing wall, a large number of counterweights can be included which allows many cabs to fit into a single hoistway. In some instances, these counterweights can be long and narrow in order to reduce the horizontal space occupied. Wells might be included at the bottom of the hoistway to provide long counterweights, and therefore cabs, full range of motion. The counterweights used by the cabs do not need to be of the same size or shape as long as the counterweights are kept evenly balanced for each of the cabs. In addition, a large number of counterweights, e.g., 16, can be used for a single cab as long as the counterweights for each cab are kept balanced.

**[0025]** Figures 3B, 3C and 3D illustrate a top view of cabs 2, 3 and 4 respectively in accordance with one embodiment of the present invention. All of these cabs feature similar counterweight locations. Four counterweights 120 are placed horizontally near the sides of the cab, one in each quadrant of the cab. This arrangement, with four connection points to the counterweights, provides balance superior to conventional arrangements such as two counterweights in opposing corners. In one embodiment, in order to improve balance, the two counterweights 120 on each side of the cab are placed equidistant from the guides 220. As discussed above, the distance

between the counterweights and the guides can be altered for each cab to prevent interference between counterweights, cables and pulleys. For example, the counterweight connection points 240B for cab 2 can be positioned so that an axis or plane formed between opposite connection points passes through or near the two-dimensional center of the cab 110B. That is, an imaginary axis or plane between counterweight connection point 240B in the upper left of Figure 3B and counterweight connection point 240B in the lower right of Figure 3B passes at or near the two-dimensional center of cab 110B (for example, near the center of bumper 160B in the two-dimensional perspective of Figure 3B). Similarly an imaginary axis between counterweight connection point 240B in the upper right of Figure 3B and counterweight connection point 240B in the lower left of Figure 3B passes at or near the center of cab 110B. This assists in balancing the cabs and reducing the torque on the guides 220.

[0026] Similarly, the motor connection points 150 on the rear of each of the cabs are shifted on each cab in the hoistway to prevent interference between the motor systems and cables of each cab.

[0027] In one embodiment, as illustrated in Figure 3B, the counterweights 120B of cab 2 110B are located nearest the tracks 230 on either side of the elevator shaft. Four counterweight connection points 240B are aligned with the counterweights and connected to the counterweights by a cable. A motor connection point 150B connects to a motor 130B towards the rear of the of elevator shaft to enable movement of the cab. The motor connection point 150B is horizontally shifted from motor connection points from other cabs to avoid interference with other cables. Two guides 220B are in line with the tracks 230 and direct the cab as it moves along the length of the elevator shaft.

[0028] In accordance with one embodiment and as illustrated in Figure 3C, the counterweights 120C of cab 3 110C are located adjacent to the cab 2 counterweights 120B towards the outside of the hoistway. Four counterweight connection points 240C are aligned with the counterweights and connected to the counterweights by a cable. As discussed above, the distance between the counterweights and the guides can be altered for each cab to prevent interference between counterweights, cables and pulleys. For example, the counterweight connection points 240C for cab 3 can be positioned so that an axis or plane formed between opposite connection points passes through or near the two-dimensional center of the cab 110C. That is, an imaginary axis or plane between counterweight connection point 240C in the upper left of Figure 3C and counterweight connection point 240C in the lower right of Figure 3C passes at or near the two-dimensional center of cab 110C (for example, near the center of bumper 160C in the two-dimensional perspective of Figure 3C). Similarly an imaginary axis between counterweight connection point 240C in the upper right of Figure 3C and counterweight connection point 240C in the lower left of Figure 3C passes at or near the center of cab 110C. As described above, this assists in balancing the cabs and reducing the torque on the guides 220.

**[0029]** A motor connection point 150C connects to a motor 130C towards the rear of the of elevator shaft to enable movement of the cab. The motor connection point 150C is horizontally shifted from motor connection points of other cabs to avoid interference with other motors and cables. Two guides 220C are in line with the tracks 230 and direct the cab as it moves along the length of the elevator shaft.

**[0030]** As illustrated in Figure 3D, the counterweights 120D of cab 4 110D are located adjacent to the cab 3 counterweights 120C towards the outside of the hoistway. Four counterweight connection points 240D are aligned with the counterweights and connected to the counterweights by a cable. As discussed above, the distance between the counterweights and the guides can be altered for each cab to prevent interference between counterweights, cables and pulleys. For example, the counterweight connection points 240D for cab 4 are positioned so that an axis or plane formed between opposite connection points passes through or near the two-dimensional center of the cab 110D. That is, an imaginary axis or plane between counterweight connection point 240D in the upper left of Figure 3D and counterweight connection point 240D in the lower right of Figure 3D passes at or near the two-dimensional center of cab 110D (for example, near the center of bumper 160D in the two-dimensional perspective of Figure 3D). Similarly an imaginary axis between counterweight connection point 240D in the upper right of Figure 3D and counterweight connection point 240D in the lower left of Figure 3D passes at or near the center of cab 110D. As describe above, this assists in balancing the cabs and reducing the torque on the guides 220.

**[0031]** A motor connection point 150D connects to a motor 130D near the rear of the of elevator shaft to enable movement of the cab. The motor connection point 150D is horizontally shifted from motor connection points of other cabs in order to avoid interference with other motors and cables. In addition, it should be noted that in another embodiment any of the cabs may be connected to multiple motors at multiple motor connection points. Two guides 220D are in line with the tracks 230 and direct the cab as it moves along the length of the elevator shaft.

**[0032]** Bumpers 160 on cabs 2, 3, and 4 are also illustrated in Figures 3B, 3C and 3D respectively. As described above, these bumpers mitigate the impact in a collision between two cabs. Electric sensors 310 and chain landings 320 are also depicted on the top of all of the cabs 110. The electric sensors provide information regarding cab location and can also provide information about the status of the cab, e.g., movement, direction, power status etc. The chain landings 320 can be used as an additional safety device, for example. While not illustrated, in an embodiment, horizontally shifted electric power and data cables originate at the vertical midpoint of each hoistway in order to minimize the distance to the cabs at any given time, and to prevent interference or storage of such cables. The data cables can also provide information to a central location and receiving information from a central location to assist in cab control, environmental control, etc.

[0033] Figure 4 illustrates a perspective from the front of cab 2 (110B). The tracks 230 are shown on either side of the cab. The two front counterweights 120B are also on either side of the cab. Two additional counterweights connected to cab 2 110B are behind the tracks 230B, but are not illustrated in Figure 4. Each of the counterweights 120 in the system is guided by a channel which runs the length of the hoistway. As shown, the two counterweights 120B in Figure 4 are contained in the channels 410B. The counterweights 120B are connected to the cab 110B by cab 2 counterweight cables 420B. The counterweight cables 420B are attached at the counterweight connection points 240B as discussed above. The lift cable 136B is shown to be attached to the cab 110B at two vertically aligned motor connection points 150B. In some embodiments, the control equipment 460 is located in the bottom portion of the cab. The control equipment 460 can also be located in the top or side portions of the cab. Among other things, the control equipment governs breaking, opening and closing of doors, leveling of a cab with building floors, and the movement of a cab, ensuring passengers reach their destination without incident. Sensor chains 440 are attached to the bottom of the cab in order to help detect the location of other cabs in the system. Similarly, electric and optical sensors 310B keep track of obstructions that may be located above the cab 110B and can assist in identifying the location of the cab 110B in the elevator shaft. A previously mentioned bumper 160B is located on top of the cab should a collision occur between cab 2 110B and another cab from above.

[0034] Figure 5 illustrates the layout of the counterweights and counterweight channels, as well as the pulleys in accordance with one embodiment of the invention. The counterweight channels 410 and the cab 1 counterweights 120A are placed along the rear of the hoistway, in contrast to the placement of the other cabs' counterweights, in this embodiment. The cab 1 counterweights 120A are attached to cab 1 by counterweight cables 420A. Each of the counterweight cables runs through a pulley above the counterweight channel and a pulley above the center of cab 1 110A. The cab 1 counterweight channels are horizontally shifted from the motor assembly to prevent interference and allow unencumbered access to each i.e., the motor assembly 130 is between the cabs 110 and the cab 1 counterweights 120A. In the present embodiment, motor 130A is connected to cab 1 110A. This also preserves space and allows additional motors to be mounted for additional cabs. The placement of cab 1's counterweights at the rear of the hoistway is due to preference only. Other embodiments are possible which do not restrict counterweights to the disclosed locations. In alternate embodiments the position of counterweights 120A and counterweight channels 410A for cab 1 (110A) can vary, for example, they can be similar to the orientation set forth below with reference to cabs 2-4. This might be useful to allow doors on both the front and rear of the cabs.

[0035] In one embodiment, as shown in Figure 5, the counterweight channels 410B of cab 2 110B are located near the tracks 230 on either side of the elevator shaft. In alternate embodiment the counterweight channels can be positioned elsewhere provided the channels, counterweights and related cables associated with the cabs do not interfere with each other. Pulleys 140B are

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located above the counterweight channels 410B and route the counterweight cables 420B from the counterweights 120B to the counterweight connection points 240B. Motor 130B, horizontally shifted from the other motors, is connected to the rear of cab 2 110B to enable movement of the cab.

**[0036]** The counterweight channels 410C of cab 3 110C are located adjacent to the counterweight channels 410B for cab 2 110B. Pulleys 140C are located above the counterweight channels 410C and route the counterweight cables 420C from the counterweights 120C to the counterweight connection points 240C. Motor 130C, horizontally shifted from the other motors, is connected to the rear of cab 3 110C to enable movement of the cab.

**[0037]** The counterweight channels 410D of cab 4 110D are located adjacent to the counterweight channels 410C for cab 3 110C and nearest the front and back of the elevator shaft. Pulleys 140D are located above the counterweight channels 410D and route the counterweight cables 420D from the counterweights 120D to the counterweight connection points 240D. Motor 130D, horizontally shifted from the other motors, is connected to the rear of cab 4 110D to enable movement of the cab.

**[0038]** The counterweight channels and counterweights for cabs 2, 3 and 4 can be stacked back-to-back on the sides of the hoistway. If preferred, the counterweights and their channels can be confined to the inside of the hoistway as well. While not shown in Figure 5, adjacent counterweight channels placed back-to-back can overlap as long as the counterweights are offset so that pulley systems do not interfere with one another. This can increase the number of cabs that the system is able to operate when counterweight space is a limitation. The counterweight pulleys along either side of the hoistway can be coaxial and horizontally shifted in the same manner as the counterweights in order to allow the addition of more cabs. In an alternate embodiment, the counterweights and counterweight channels 410 are positioned external to the hoistway/shaft.

**[0039]** Figure 6 illustrates a side view of the motor system used for each cab in accordance with one embodiment. In an embodiment, the motor illustrated here for cab 2 110B is similar for all cabs 110 although the particular positioning of the cables will vary. A vertical track 230 runs along each side of the hoistway and each track 230 connects to a cab at one or two guides 220B. The two guides 220B are attached to the track 230 and vertically aligned along the side of the cab 110B. Two motor connection points 150B are located on the back of the cab and vertically aligned. One end of a lift cable 136B is attached to the top motor connection point 150B. The lift cable 136B is then routed through the motor 150B, which is located near the top of the hoistway 100. The lift cable 136B then runs the length of the hoistway and is routed through the floor pulley 170B. Between the motor connection points 150B, the lift cable 136B is circular and continuous. Finally, the other end of the lift cable 136B is attached to the bottom motor connection point 150B. Like the counterweight system, this motor system eliminates the need for any cable storage.

**[0040]** While it is feasible in some embodiments for one hoistway to be used, e.g., in a deep mine shaft or a tall tower, two or more hoistways are used in the preferred embodiment for increased passenger convenience. With multiple hoistways, hoistways can alternate and coordinate the direction their cabs are traveling in effect creating a circular traffic pattern. Proper coordination of the directions cabs are traveling in can minimize the delay that passengers experience. The control system would ensure that enough cabs for service were traveling in each direction. Two hoistways with multiple cabs are expected to be sufficient for many buildings with 20 or more floors. In one embodiment, it is estimated that an additional hoistway is added for each additional 20 stories..

**[0041]** Figure 7 illustrates the general operation of a hoistway with four cabs 110A-D. A hoistway is shown at 7 different points in time, 9:05 through 9:11, in order to demonstrate operation of the system. At 9:05, Cab 1 (110A) is located at floor 1 and the rest of the cabs are located at basement slots 710. The basement slots 710 may be on floors used for car parking. At 9:06, cab 1 (110A) moves up to transport passengers and the other cabs move up 1 level in order to prepare to transport passengers. At 9:07, cab 2 (110B) begins transporting passengers and cab 3 (110C) moves to floor 1 in preparation. At 9:08 cabs 2 and 3 are still transporting passengers and cab 4 has moved to floor 1 in preparation for transporting passengers. Cab 1 (110A) has moved to the attic or mechanical equipment slots 720 in order to allow the other cabs to service any of the floors in the hoistway. People transferring from parked cars on basement floors use cabs 2, 3 and 4 to arrive at their desired floors.

**[0042]** Attic 720 and basement 710 hoistway slots may be included to enable each cab to service all of the floors in the building, in this case, floors 1-10. For example, if attic hoistway slots A1-A3 were not present, only cab 1 (110A) would be able to service floor 10. Cab 1 (110A) would not be able to move out of the way and allow the other cabs to reach floor 10. The hoistway can still operate if the attic and basement slots are not included, but certain cabs would not be able to provide service to certain floors.

**[0043]** At 9:09, Cab 1 (110A) has moved to floor A3 in order to make room for cab 2 (110B) and cab 3(110C) in the attic slots. The cabs continue to travel upwards while transporting passengers and eventually moving to the highest floor possible. At this point, a similar process is begun in the opposite direction. In some situations, the cabs can reverse their direction of travel before all of the cabs have reached their highest or lowest point.

**[0044]** An advantage of this invention is that in addition to future buildings, many existing buildings can effectively and inexpensively be retrofitted for compatibility with the present invention. In an embodiment, the components can be contained within the existing hoistway and counterweights areas. In addition, the system may not need to store cables due to the arrangement of pulleys, counterweights and motors. In addition, some or most of the cables, pulleys, motors and other equipment can be located outside of the common hoistway, including above or below the hoistway. In an embodiment, by utilizing multiple cabs in a single shaft, a

building can achieve additional elevator capacity while eliminating one or more shafts and converting those shafts to revenue producing space on each floor. The space used for elevator lobbies throughout a building can also be reduced by eliminating one or more shafts.

[0045] Modifications can be made to the system in order to allow opposing doors to be used on each of the cabs 110. For example, while not illustrated, all of the counterweights, motors and related equipment which would impede access to a rear door can be moved to the edges of the rear of the hoistway or cab or to the sides of the hoistway or cab alongside the lower cab counterweights. Similarly, counterweights, motors and related equipment can be placed on the front of the cab as long as they are towards the sides and do not affect use of the door. While useful for future buildings, the present invention is also compatible with existing buildings and elevator systems.

[0046] Each of the cabs moves independently due to each cab using separate counterweights and motors. In order to enable each cab to serve every floor of a building, cab storage levels may be included above and/or below the floors that are serviced. For example, in order for cab 1 (110A) to service the lowest serviced floor, there must be enough room under the lowest serviced floor for cabs 2 through 4 to be stored. Attic and basement hoistway slots could also be used to store cabs and suspend operation of certain cabs. This can help reduce operating costs during low usage periods such as nights, weekends and holidays in an office building. The system can also select a cab to serve only a certain subset of floors, which can help with high traffic sections of some large buildings, or with a certain number of floors dedicated to one company.

[0047] The above describes various embodiments relative to a building. It is envisioned that in alternate embodiments the invention can be utilized with a mine (underground), a tower, or integrated with horizontal movement systems.

[0048] While particular embodiments and applications of the present invention have been illustrated and described herein, it is to be understood that the invention is not limited to the precise construction and components disclosed herein and that various modifications, changes, and variations may be made in the arrangement, operation, and details of the methods and apparatuses of the present invention without departing from the spirit and scope of the invention as it is defined in the appended claims.

[0049] What is claimed is:

1. An elevator system comprising:

a first elevator shaft;

at least four elevator cabs positioned within said first elevator shaft, said four elevator cabs including a first elevator cab positioned above a second elevator cab, said second elevator cab positioned above a third elevator cab and said third elevator cab positioned above said fourth elevator cab, each of said four cabs having a first and second wall that are substantially parallel;

a first set of four cables coupled to said second elevator cab, two cables of said first set of four cables positioned on said first wall of said second elevator cab and the remaining two cables of said first set of four cables positioned on said second wall of said second elevator cab, wherein each of said four cables is connected to one counterweight in a first set of counterweights;

a second set of four cables coupled to said third elevator cab, two cables of said second set of four cables positioned on said first wall of said third elevator cab and the remaining two cables of said second set of four cables positioned on said second wall of said third elevator cab, wherein each of said four cables is connected to one counterweight in a second set of counterweights, each of said second set of four cables positioned such that the cables do not interfere with said first set of four cables connected to said second elevator cab; and

a third set of four cables coupled to said fourth elevator cab, two cables of said third set of four cables positioned on said first wall of said fourth elevator cab and the remaining two cables of said third set of four cables positioned on said second wall of said fourth elevator cab, wherein each of said four cables is connected to one counterweight in a third set of counterweights, each of said third set of four cables positioned such that the cables do not interfere with either said first set of four cables connected to said second elevator cab or said second set of four cables connected to said third elevator cab.

2. The elevator system of claim 1, wherein said elevator cabs further comprise:

a first guide, positioned on said first wall, for engaging a first vertical path in the elevator shaft; and

a second guide, positioned on said second wall, for engaging a second vertical path in the elevator shaft.

3. The elevator system of claim 2, where said first guide is positioned substantially along a center axis of said first wall and said second guide is position substantially along a center axis of said second wall.

4. The elevator system of claim 1, wherein a first axis is formed between one cable of said two cables of said first set of four cables positioned on said first wall and one cable of said two

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cables of said first set of four cables positioned on said second wall, and wherein said first axis passes substantially through the two-dimensional center of the second elevator cab.

5. The elevator system of claim 1, further comprising:

a first set of four pulleys, each pulley disposed to receive one cable of the first set of four cables;

a second set of four pulleys, each pulley disposed to receive one cable of the second set of four cables; and

a third set of four pulleys each pulley disposed to receive one cable of the third set of four cables.

6. The elevator system of claim 1, wherein said first set of counterweights are positioned external to the elevator shaft.

7. The elevator system of claim 1, wherein said first set of counterweights comprises four counterweights, each of said four counterweights in said first set of counterweights coupled to one of said cables in said first set of four cables.

8. The elevator system of claim 7, wherein said second set of counterweights comprises four counterweights, each of said four counterweights in said second set of counterweights coupled to one of said cables in said second set of four cables.

9. The elevator system of claim 8, wherein said third set of counterweights comprises four counterweights, each of said four counterweights in said third set of counterweights coupled to one of said cables in said third set of four cables.

10. The elevator system of claim 7, further comprising a set of four counterweight channels, each of said four counterweight channels for housing one of said first set of counterweights.

11. The elevator system of claim 1, further comprising a first set of counterweight channels, each counterweight channel in said first set of counterweight channels encloses one counterweight in said first set of counterweights.

12. The elevator system of claim 11, further comprising a second set of counterweight channels, each counterweight channel in said second set of counterweight channels encloses one counterweight in said second set of counterweights.

13. The elevator system of claim 12, further comprising a third set of counterweight channels, each counterweight channel in said third set of counterweight channels encloses one counterweight in said third set of counterweights,

14. The elevator system of claim 13, wherein said first, second and third counterweight channels are positioned such that the first set of counterweights do not interfere with the second or third set of counterweights during elevator operation.
15. The elevator system of claim 1 further comprising:  
a first lift cable coupled to a first location of said second cab and a first motor, said first lift cable capable of moving said second cab in response to activation of said first motor.
16. The elevator system of claim 15, wherein said first lift cable is also coupled to a second location of said second cab, wherein during movement of the second cab, said first lift cable moves and no portion of said first lift cable is stored.
17. The elevator system of claim 15 further comprising:  
a second lift cable coupled to a first location of said third cab and a second motor, said second lift cable capable of moving said third cab in response to activation of said second motor, wherein said second lift cables do not interfere with said first lift cables during operation.
18. The elevator system of claim 17, wherein said second lift cable is also coupled to a second location of said third cab, wherein during movement of the third cab, said second lift cable moves and no portion of said second lift cable is stored.
19. The elevator system of claim 17 further comprising:  
a third lift cable coupled to a first location of said fourth cab and a third motor, said third lift cable capable of moving said fourth cab in response to activation of said third motor, wherein said third lift cables do not interfere with said first lift cables or said second lift cables during operation.
20. The elevator system of claim 19, wherein said third lift cable is also coupled to a second location of said fourth cab, wherein during movement of the fourth cab, said third lift cable moves and no portion of said third lift cable is stored.

## **Abstract of the Disclosure**

An elevator system which utilizes four or more independently moving cabs in each elevator shaft. The lower cabs are connected to four spatially separated counterweights at four different counterweight connection points. The connection points are horizontally shifted on different cabs in order to prevent interference between cables, pulleys and counterweights. The top cab may be connected to one or two counterweights by connection points on the roof of the cab. The cabs are mounted on two tracks, each track on one side of the elevator shaft. The system includes a motor attached to each of the cabs by lift cables to facilitate the independent movement of all cabs. Existing buildings can be retrofit for compatibility with the present invention.

**SISTEMA CON MÚLTIPLES CABINAS EN UN POZO DE ASCENSOR****CAMPO DE LA INVENCION**

5        La invención se refiere en general a un sistema de ascensor de múltiples cabinas que tiene cabinas que se mueven independientemente una de la otra en un pozo de ascensor.

**ANTECEDENTES**

10        La reducción del número de pozos de ascensores utilizados en un edificio se ha intentado durante años con el fin de aumentar el espacio disponible para fines de rentabilidad. Se espera que el número de huecos del ascensor en algunos edificios grandes pudiera reducirse en más del  
15        80%. Durante años, se han utilizado cabinas de doble piso con el fin de aumentar la capacidad de pasajeros de un hueco del ascensor, sirviendo cada piso plantas pares o impares. Sin embargo, las cabinas de doble piso pueden limitar la libertad de recorrido facilitada a los pasajeros. Algunos sistemas han  
20        utilizado múltiples pozos de un solo sentido con diversas cabinas siendo transferidas de un pozo a otro con el fin de crear un bucle de recorridos. Esto ha demostrado ser demasiado costoso debido a la complejidad y al mayor consumo energético.

25        Otra forma de lograr esto es teniendo múltiples cabinas en un solo pozo. El número de cabinas en un pozo individual se ha limitado a dos o tres cabinas debido a que el equipo auxiliar utilizado para la operación de una cabina interfiere con la operación de otra cabina. La colocación de contrapesos  
30        para que las diversas cabinas no interfieran entre sí puede ser un problema significativo ya que el número de cabinas aumenta. Utilizar un contrapeso central o dos contrapesos en esquinas opuestas de una cabina puede dar como resultado en menos del balance ideal de las cabinas. En algunos casos, el  
35        espacio necesario para el recorrido de los contrapesos se puede reducir, pero esto puede requerir almacenamiento de cables fuera del espacio ocupado existente del pozo del

ascensor. Esto es un inconveniente, ya que una ventaja significativa de un sistema de ascensor de múltiples cabinas está reduciendo el espacio ocupado utilizado.

Los sistemas de ascensor capaces de utilizar múltiples cabinas también son generalmente incapaces de operar en el pozo de ascensor existente, sin una modificación sustancial. Esto puede aumentar significativamente el coste de la instalación de un sistema de este tipo.

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### SUMARIO

La presente invención es un sistema de ascensor que permite que cuatro o más cabinas operen de forma independiente en un único pozo de ascensor. Los cables utilizados para los diversos sistemas están generalmente restringidos a áreas fuera de la trayectoria de las cabinas para eliminar las interferencias. En una realización, la cabina superior se conecta a dos contrapesos, mientras que el resto de las cabinas se conectan a cuatro contrapesos cada una. Los puntos de conexión entre la cabina superior y sus contrapesos están en el centro de la superficie superior de la cabina. Los puntos de conexión entre las cabinas inferiores y los contrapesos están situados a cada lado (pared) de las cabinas y se desplazan horizontalmente uno respecto al otro con el fin de evitar la interferencia entre los cables y proporcionar un acceso sin trabas a cada uno de los canales y poleas de los contrapesos. Siempre que se evite la interferencia que evita el movimiento de cualquiera de las cabinas, diversos números de cabinas se pueden utilizar, y diversos números de contrapesos se pueden utilizar para las cabinas superior e inferior. La presente invención no requiere ningún almacenamiento de los cables debido a que cada contrapeso tiene su propio canal de contrapeso y recorre la longitud del hueco del ascensor.

En una realización, las cabinas utilizan dos pistas que se encuentran en lados opuestos del pozo del ascensor para las funciones de orientación y ruptura. El uso de pistas laterales centrales proporciona una distribución de peso más

uniforme que otras disposiciones, tal como una pista cerca de cada una de las cuatro esquinas de la cabina. El uso de dos pistas crea también menos fricción entre las pistas y las cabinas, que se traduce en ahorro de energía. Cada cabina se conecta a un cable de elevación específico en la parte posterior o en un lado de la cabina. Cada cable de elevación se puede conectar a, por ejemplo, una polea de motor y polea baja para permitir el movimiento controlado de cada cabina de forma independiente.

Las características y ventajas descritas en la memoria descriptiva no son todo incluido y, en particular, muchas características y ventajas adicionales serán evidentes para un experto en la materia a la vista de los dibujos, memoria descriptiva y reivindicaciones. Por otra parte, cabe señalar que el lenguaje utilizado en la memoria descriptiva se ha seleccionado principalmente para facilitar la lectura y con fines educativos, y no ha sido seleccionado para definir o delimitar el objeto de la invención.

#### BREVE DESCRIPCIÓN DE LOS DIBUJOS

La Figura 1 es una ilustración de la parte frontal que proporciona una visión general de un sistema de ascensor de acuerdo con una realización de la presente invención.

La Figura 2 es una ilustración de las cabinas en el hueco del ascensor desde otra perspectiva destacando las conexiones de los contrapesos, los motores y elementos de pista para las cabinas, de acuerdo con una realización de la presente invención.

Las Figuras 3A a 3D son ilustraciones de la vista superior de las cabinas 1, 2, 3 y 4 que muestran cómo cada cabina se conecta, entre otras cosas, a los contrapesos, pistas verticales, y motores, de acuerdo con una realización de la presente invención.

La Figura 4 es una ilustración de una vista frontal de la cabina 2 que muestra cómo los contrapesos y las pistas verticales se unen a la cabina de acuerdo con una realización de la presente invención.

La Figura 5 es una ilustración de la parte superior del pozo de ascensor que muestra la colocación de los contrapesos en sus canales de acuerdo con una realización de la presente invención.

5 La Figura 6 es una ilustración de la colocación de la pista y de cómo el sistema de motor se une a cada una de las cabinas de acuerdo con una realización de la presente invención.

La Figura 7 es una ilustración de la operación de un pozo de ascensor que tiene múltiples cabinas de acuerdo con una realización de la presente invención.

#### DESCRIPCIÓN DETALLADA DE LA INVENCION

Una realización preferida de la presente invención se describe a continuación con referencia a las figuras, en las que los números de referencia similares indican elementos idénticos o funcionalmente similares. También en las figuras, el dígito más a la izquierda de cada número de referencia corresponde a la figura en la que se utilizó por primera vez el número de referencia.

La referencia en la memoria descriptiva a "una realización" o "una sola realización" significa que un determinado elemento, estructura o característica descrita en relación con las realizaciones se incluye en al menos una realización de la invención. Las apariciones de la frase "en una realización" en diversos lugares de la memoria descriptiva no se están refiriendo todas necesariamente a la misma realización.

Además, el lenguaje utilizado en la memoria descriptiva se ha seleccionado principalmente para facilitar la lectura y con fines educativos, y no pueden haber sido seleccionado para definir o delimitar el objeto de la invención. En consecuencia, la divulgación de la presente invención está destinada a ser ilustrativa, pero no limitante, del alcance de la invención, que se expone en las reivindicaciones.

Una vista desde la parte frontal de una realización preferida del sistema de ascensor de múltiples cabinas se

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ilustra en la Figura 1. Un hueco del ascensor 100 se muestra teniendo cuatro cabinas 110. Se debe reconocer que la disposición de los sistemas de contrapesos y de motor permite la operación de más de cuatro cabinas en otras realizaciones.

5 Seis o más cabinas se pueden operar en un solo hueco/pozo. Esto se hace posible por el desplazamiento de los contrapesos y motores, como se describe a continuación. Las cabinas 110 en el hueco del ascensor 100 se alinean verticalmente. De arriba a abajo, las cabinas se refieren como cabina 1 (110A),  
10 cabina 2 (110B), cabina 3 (110C) y cabina 4 (110D). Cada una de las cabinas 110 es capaz de moverse a lo largo del hueco del ascensor 100 independientemente una de otra, sin pasar a otra cabina, debido a que cada cabina tiene un motor asociado 130 y los cables, poleas 140 separados horizontalmente y los  
15 contrapesos 120.

El movimiento de las cabinas 110 es impulsado por motores 130 situados en la parte superior del hueco del ascensor 100, en la realización preferida. En realizaciones alternativas, los motores 130 se pueden colocar en diferentes  
20 lugares, tales como la parte inferior del hueco del ascensor o cada motor se puede colocar en diferentes lugares. Cada cabina se conecta a un motor 130 por un cable de elevación 136. Cada cable de elevación 136 se une a una cabina 110 en dos puntos de conexión del motor 150 verticalmente alineados  
25 en la cabina, por ejemplo, en la cara posterior de la cabina. Cada cabina puede tener también un solo punto de conexión del motor 150 en lugar de los dos ilustrados. En este caso, cada extremo de un cable de elevación se debe fijar al mismo punto de conexión del motor. Los puntos de conexión del motor 150  
30 de cada cabina se desplazan horizontalmente para evitar interferencias (interacción) con otros cables 136 de otra cabina 110. Por ejemplo, en la Figura 1, los puntos de conexión del motor 150 se desplazan de derecha a izquierda a medida que las cabinas 110 bajan en el hueco del ascensor  
35 100. Esto permite que una pluralidad de cabinas, más allá de las cuatro de esta realización, se controle cada una por un motor dedicado sin ninguna obstrucción causada por los cables

de elevación 136. Un extremo de cada uno de los cables de elevación 136 se conecta con el punto de conexión superior del motor 150 en una cabina. Los cables de elevación 136 se dirigen después a través de los motores 130 cerca del techo del pozo de ascensor. Los cables de elevación 136 se dirigen después a través de poleas de piso 170 que se unen a la parte inferior del hueco del ascensor. Por último, el otro extremo de cada uno de los cables de elevación 136 se une a la parte inferior de los dos puntos de conexión del motor 150.

En una realización, los contrapesos 120 se sitúan a los lados y la parte posterior de las cabinas 110 y se desplazan a lo largo de la longitud del hueco del ascensor 100. Cada uno de los contrapesos 120 se conecta a una cabina por un cable de contrapeso que discurre a través de una de las poleas de contrapeso 140 situadas en la parte superior del hueco del ascensor 100. Las poleas de contrapeso 140 a lo largo de los lados del hueco del ascensor se alinean coaxialmente, en una realización. Poleas de diferentes tamaños representan diferentes separaciones entre las cabinas 110 y los contrapesos 120. Como alternativa, múltiples poleas se pueden utilizar para variar la separación entre las cabinas 110 y los contrapesos 120. Los contrapesos 120 se mantienen todos en canales de contrapeso individuales con el fin de controlar el movimiento de los contrapesos 120 y para evitar la interacción/interferencia entre los contrapesos 120. Por ejemplo, los contrapesos 120 y las poleas 140 se pueden desplazar horizontalmente con el fin de proporcionar un acceso sin trabas a cada uno de estos sistemas y de evitar la interferencia con otros equipos.

La cabina inferior, cabina 4 (110D), tiene un muelle 180 u otro dispositivo de amortiguación de colisión en la parte inferior de la cabina como una precaución de seguridad. En el caso de una colisión entre la parte inferior del hueco del ascensor 100 y la cabina 4 110D, el muelle mitiga los daños causados por el impacto. Con la posible excepción de la cabina superior, cabina 1 100A, todas las cabinas 110 tienen una defensa 160 u otro dispositivo de seguridad de

160 amortiguación de colisión en la cabina superior. Las defensas 160 se utilizan de manera similar como medida de precaución para reducir el impacto de una colisión entre dos de las cabinas 110.

5 La Figura 2 es otra perspectiva del sistema de ascensor de acuerdo con una realización de la presente invención. Las cabinas 110 se mueven a lo largo de dos pistas 230 a cada lado del hueco del ascensor que discurren la longitud del hueco del ascensor 100. Las cabinas 100 se unen a las pistas 10 230 utilizando guías 220. Si bien se ilustran como ruedas, las guías 220 pueden ser también guías de puntas dobles que pueden servir como frenos. Una mezcla de diferentes tipos de guías se puede utilizar también, algunas proporcionando orientación y otras proporcionando frenos y orientación. Cada 15 una de las cabinas 110 representadas tiene cuatro guías 220, dos en lados opuestos de la cabina. En una realización preferida, cada una de las cabinas tiene dos guías 220, una en lados opuestos de la cabina. Se pueden utilizar diversos números de guías. Tener dos pistas, en lugar de una en cada 20 esquina como en algunos sistemas convencionales, proporciona una mejor distribución del peso, por ejemplo, una distribución de peso más equilibrada, y menores costes de mantenimiento en ciertas situaciones. El uso de dos pistas provoca también menos fricción entre las guías y las pistas, 25 lo que da como resultado una operación más eficaz del sistema de ascensor. En una realización, dos de las guías se sitúan sustancialmente a lo largo de un eje o plano central de una primera pared de la cabina 110A y dos guías se sitúan sustancialmente a lo largo de un eje o plano central de una 30 segunda pared de la cabina 110A, en el que en una realización, la primera y segunda paredes de la cabina 110 son sustancialmente paralelas. La cabina superior, cabina 1 (110A), se conecta a dos contrapesos 120 en la parte posterior del hueco del ascensor 100. En una realización, 35 solamente un contrapeso 120 se conecta a la cabina 1 (110A). Estos contrapesos se unen a la cabina 1 (110A) en el punto de conexión del contrapeso 240A, que se encuentra en el centro

del techo de la cabina 1 (110A). En realizaciones alternativas, la cabina 1 (110A) se conecta a un número diferente de contrapesos, por ejemplo, uno, cuatro, etc. En realizaciones alternativas, la cabina 1 (110A) tiene  
5 múltiples puntos de conexión, por ejemplo, similar a los descritos a continuación.

En una realización, las cabinas restantes, por ejemplo, la cabina 2 (110B), la cabina 3 (110C) y la cabina 4 (110D), se conectan a cuatro contrapesos cada una, con dos situados a  
10 cada lado de la cabina. Se muestra que los puntos de conexión de contrapeso 240 en las cabinas 110 se desplazan horizontalmente con el fin de evitar la interferencia de unos con otros. Por ejemplo, los puntos de conexión 240C de la cabina 3 se desplazan hacia la parte frontal y posterior del  
15 hueco del ascensor 100 en relación con los puntos de conexión 240B de la cabina 2.

Las Figuras 3A, 3B, 3C, y 3D ilustran una vista superior de cada una de las cabinas en una realización de la invención. Como se ilustra en la Figura 3A y como se ha  
20 descrito anteriormente, la ubicación de los contrapesos 120A de la cabina 1 es diferente que la de la de las otras tres cabinas. El punto de conexión del contrapeso 240A de la cabina 1 (110A) se sitúa en la parte intermedia de la parte superior de la cabina en lugar de en los lados. El punto de  
25 conexión del contrapeso no se implementa de esta manera en las otras cabinas, ya que hay una cabina encima de la que podría interferir con el cable de conexión del contrapeso. El punto de conexión del contrapeso 240A se une a los contrapesos 120A en la parte posterior del hueco del  
30 ascensor. Como se ilustra, los contrapesos 120 se pueden unir a las paredes divisorias 360. Las paredes divisorias 360 permiten que los contrapesos y otros equipos se unan a ambos lados de la pared divisoria 360. Esto aumenta la cantidad de contrapesos y cabinas que pueden caber en un solo hueco del  
35 ascensor. La pared divisoria posterior se puede extender para abarcar la anchura de la parte posterior del hueco del ascensor. Los contrapesos se pueden unir también a la pared

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exterior del hueco del ascensor en lugar de a una pared divisoria, si no se incluyen paredes divisorias. Sin embargo, las paredes divisorias permiten una gran flexibilidad en la selección y colocación de contrapesos. Mediante el uso de una pared divisoria, se puede incluir un gran número de contrapesos, lo que permite que muchas cabinas se ajusten en un solo hueco del ascensor. En algunos casos, estos contrapesos pueden ser largos y estrechos con el fin de reducir el espacio horizontal ocupado. Pozos podrían incluirse en la parte inferior del hueco del ascensor para proporcionar a los largos contrapesos, y por tanto a las cabinas, un intervalo total de movimiento. Los contrapesos utilizados por las cabinas no tienen que ser del mismo tamaño o forma, siempre y cuando los contrapesos se mantengan uniformemente en equilibrio para cada una de las cabinas. Además, un gran número de contrapesos, por ejemplo, 16, se puede utilizar para una sola cabina, siempre y cuando los contrapesos para cada cabina se mantengan en equilibrio.

Las Figuras 3B, 3C y 3D ilustran una vista superior de las cabinas 2, 3 y 4, respectivamente, de acuerdo con una realización de la presente invención. Todas estas cabinas cuentan con lugares de contrapeso similares. Cuatro contrapesos 120 se colocan horizontalmente cerca de los lados de la cabina, uno en cada cuadrante de la cabina. Esta disposición, con cuatro puntos de conexión a los contrapesos, proporciona un equilibrio superior con respecto a las disposiciones convencionales tal como dos contrapesos en esquinas opuestas. En una realización, con el fin de mejorar el equilibrio, los dos contrapesos 120 a cada lado de la cabina se colocan equidistantes entre las guías 220. Como se ha descrito anteriormente, la distancia entre los contrapesos y las guías se puede alterar para que cada cabina evite la interferencia entre los contrapesos, los cables y las poleas. Por ejemplo, los puntos de conexión del contrapeso 240B para la cabina 2 se pueden situar de manera que un eje o plano formado entre los puntos de conexión opuestos pase a través o cerca del centro bidimensional de la cabina 110B. Es decir,

un eje o plano imaginario entre el punto de conexión del contrapeso 240B en la parte superior izquierda de la Figura 3B y el punto de conexión del contrapeso 240B en la parte inferior derecha de la Figura 3B pasa en o cerca del centro bidimensional de la cabina 110B (por ejemplo, cerca del centro de la defensa 160B en la perspectiva bidimensional de la Figura 3B). Del mismo modo, un eje imaginario entre el punto de conexión del contrapeso 240B en la parte superior derecha de la Figura 3B y el punto de conexión del contrapeso 240B en la parte inferior izquierda de la figura 3B pasa en o cerca del centro de la cabina 110B. Esto ayuda al equilibrio de las cabinas y a reducir el par en las guías 220.

Del mismo modo, los puntos de conexión del motor 150 en la parte posterior de cada una de las cabinas se desplazan en cada cabina en el hueco del ascensor para evitar la interferencia entre los sistemas de motor y los cables de cada cabina.

En una realización, como se ilustra en la Figura 3B, los contrapesos 120B de la cabina 2 110B se encuentran más cerca de las pistas 230 a cada lado del pozo de ascensor. Cuatro puntos de conexión del contrapeso 240B se alinean con los contrapesos y se conectan a los contrapesos mediante un cable. Un punto de conexión del motor 150B se conecta a un motor 130B hacia la parte posterior del pozo de ascensor para permitir el movimiento de la cabina. El punto de conexión del motor 150B se desplaza horizontalmente desde los puntos de conexión del motor de las otras cabinas para evitar la interferencia con otros cables. Dos guías 220B están en línea con las pistas 230 y dirigen la cabina a medida que se mueve a lo largo de la longitud del pozo de ascensor.

De acuerdo con una realización y como se ilustra en la Figura 3C, los contrapesos 120C de la cabina 3 110C se encuentran adyacente a los contrapesos 120B de la cabina 2 hacia el exterior del hueco del ascensor. Cuatro puntos de conexión del contrapeso 240C se alinean con los contrapesos y se conectan a los contrapesos mediante un cable. Como se ha descrito anteriormente, la distancia entre los contrapesos y

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las guías se puede alterar para cada cabina, para evitar la interferencia entre los contrapesos, los cables y las poleas. Por ejemplo, los puntos de conexión del contrapeso 240C para la cabina 3 se pueden situar de manera que un eje o plano formado entre los puntos de conexión opuestos pase a través o cerca del centro bidimensional de la cabina 110C. Es decir, de un eje o plano imaginario entre el punto de conexión del contrapeso 240C en la parte superior izquierda de la Figura 3C y el punto de conexión del contrapeso 240C en la parte inferior derecha de la Figura 3C pasa en o cerca del centro bidimensional de la cabina 100C (por ejemplo, cerca del centro de la defensa 160C en la perspectiva bidimensional de la Figura 3C). Del mismo modo un eje imaginario entre el punto de conexión del contrapeso 240C en la parte superior derecha de la Figura 3C y el punto de conexión del contrapeso 240C en la parte inferior izquierda de la Figura 3C pasa en o cerca del centro de la cabina 110C. Como se ha descrito anteriormente, esto ayuda al equilibrio de las cabinas y a reducir el par en las guías 220.

Un punto de conexión del motor 150C se conecta a un motor 130C hacia la parte posterior del pozo de ascensor para permitir el movimiento de la cabina. El punto de conexión del motor 150C se desplaza horizontalmente de los puntos de conexión del motor de otras cabinas para evitar interferencias con otros motores y cables. Dos guías 220C están en línea con las pistas 230 y dirigen la cabina a medida que se mueve a lo largo de la longitud del pozo de ascensor.

Como se ilustra en la Figura 3D, los contrapesos 120D de la cabina 4 110D se encuentran adyacentes a los contrapesos 120C de la cabina 3 hacia el exterior del hueco del ascensor. Cuatro puntos de conexión del contrapeso 240D se alinean con los contrapesos y se conectan a los contrapesos mediante un cable. Como se ha descrito anteriormente, la distancia entre los contrapesos y las guías se puede alterar para cada cabina, para evitar la interferencia entre los contrapesos, los cables y las poleas. Por ejemplo, los puntos de conexión

del contrapeso 240D para la cabina 4 se sitúan de manera que un eje o plano formado entre los puntos de conexión opuestos pase a través o cerca del centro bidimensional de la cabina 110D. Es decir, un eje o plano imaginario entre el punto de  
5 conexión del contrapeso 240D en la parte superior izquierda de la Figura 3D y el punto de conexión del contrapeso 240D en la parte inferior derecha de la Figura 3D pasa en o cerca del centro bidimensional de la cabina 110D (por ejemplo, cerca del centro de la defensa 160D en la perspectiva bidimensional  
10 de la Figura 3D). Del mismo modo, un eje imaginario entre el punto de conexión del contrapeso 240D en la parte superior derecha de la Figura 3D y el punto de conexión del contrapeso 240D en la parte inferior izquierda de la Figura 3D pasa en o cerca del centro de la cabina 110D. Como se ha descrito  
15 anteriormente, esto ayuda al equilibrio de las cabinas y a reducir el par en las guías 220.

Un punto de conexión del motor 150D se conecta a un motor 130D cerca de la parte posterior del pozo de ascensor para permitir el movimiento de la cabina. El punto de  
20 conexión del motor 150D se desplaza horizontalmente de los puntos de conexión del motor de otras cabinas con el fin de evitar interferencias con otros motores y cables. Además, cabe señalar que, en otra realización, cualquiera de las cabinas se puede conectar a múltiples motores en múltiples  
25 puntos de conexión del motor. Dos guías 220D están en línea con las pistas 230 y dirigen la cabina a medida que se mueve a lo largo de la longitud del pozo de ascensor.

Las defensas 160 en las cabinas, 2, 3 y 4 se ilustran también en las Figuras 3B, 3C y 3D respectivamente. Como se  
30 ha descrito anteriormente, estas defensas mitigan el impacto en una colisión entre dos cabinas. Sensores eléctricos 310 y aterrizajes por cadena 320 se representan también en la parte superior de todas las cabinas de 110. Los sensores eléctricos proporcionan información sobre la ubicación de la cabina y  
35 también pueden proporcionar información sobre el estado de la cabina, por ejemplo, movimiento, dirección, estado de potencia, etc. Los aterrizajes por cadena 320 se pueden

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utilizar, por ejemplo, como un dispositivo de seguridad adicional. Aunque no se ilustran, en una realización, cables de datos y de potencia eléctrica horizontalmente desplazados se originan en el punto medio vertical de cada hueco del ascensor con el fin de reducir al mínimo la distancia a las cabinas en un momento dado, y para evitar la interferencia o el almacenamiento de dichos cables. Los cables de datos pueden también proporcionar información en una ubicación central y recibir información desde una ubicación central para ayudar en el control de la cabina, control ambiental, etc.

La Figura 4 ilustra una perspectiva desde la parte frontal de la cabina 2 (110B). Las pistas 230 se muestran a cada lado de la cabina. Los dos contrapesos frontales 120B están también a ambos lados de la cabina. Dos contrapesos adicionales conectados a la cabina 2 110B están detrás de las pistas 230B, pero no se ilustran en la Figura 4. Cada uno de los contrapesos 120 en el sistema es guiado por un canal que discurre a lo largo del hueco del ascensor. Como se muestra, los dos contrapesos 120B en la Figura 4 están contenidos en los canales 410B. Los contrapesos 120B se conectan a la cabina 110B mediante los cables de contrapeso 420B de la cabina 2. Los cables de contrapeso 420B se unen en los puntos de conexión de contrapeso 240B como se ha descrito anteriormente. Se muestra que el cable de elevación 136B debe unirse a la cabina 110B en dos puntos de conexión del motor 150B alineados verticalmente. En algunas realizaciones, el equipo de control 460 se sitúa en la porción inferior de la cabina. El equipo de control 460 se puede situar también en las porciones superior o lateral de la cabina. Entre otras cosas, el equipo de control controla el frenado, abertura y cierre de puertas, la nivelación de una cabina con las plantas del edificio, y el movimiento de la cabina, lo que garantiza que los pasajeros lleguen a su destino sin incidentes. Cadenas de detección 440 se unen a la parte inferior de la cabina con el fin de ayudar a detectar la ubicación de otras cabinas en el sistema. Del mismo modo,

sensores eléctricos y ópticos 310B hacen un seguimiento de las obstrucciones que puedan localizarse por encima de la cabina 110B y pueden ayudar a identificar la ubicación de la cabina 110B en el pozo de ascensor. Una defensa 160B  
5 anteriormente mencionada se sitúa en la cabina superior de la cabina por si ocurre una colisión entre la cabina 2 110B y otra cabina desde arriba.

La Figura 5 ilustra la disposición de los contrapesos y de los canales de contrapeso, así como las poleas de acuerdo  
10 con una realización de la invención. Los canales de contrapeso 410 y los contrapesos 120A de la cabina 1 se colocan a lo largo de la parte posterior del hueco del ascensor, en contraste con la colocación de los contrapesos de las otras cabinas, en esta realización. Los contrapesos  
15 120A de la cabina 1 se unen a la cabina 1 mediante los cables de contrapeso 420A. Cada uno de los cables de contrapeso discurre a través de una polea por encima del canal de contrapeso y a través de una polea por encima del centro de la cabina 1 110A. Los canales de contrapeso de la cabina 1 se  
20 desplazan horizontalmente del conjunto de motor para evitar interferencias y permitir el acceso sin trabas a cada uno, es decir, el conjunto de motor 130 está entre las cabinas 110 y los contrapesos 120A de la cabina 1. En la presente realización, el motor 130A se conecta a la cabina 1 110A.  
25 Esto conserva también el espacio y permite que se monten motores adicionales en cabinas adicionales. La colocación de los contrapesos de la cabina 1 en la parte posterior del hueco del ascensor solamente obedece a preferencias. Otras realizaciones que no restringen los contrapesos a los lugares  
30 descritos también son posibles. En realizaciones alternativas, la posición de los contrapesos 120A y de los canales de contrapeso 410A en la cabina 1 (110A) puede variar, por ejemplo, pueden ser similares a la orientación que se establece a continuación con referencia a las cabinas  
35 2-4. Esto podría ser útil para permitir puertas tanto en la parte frontal como posterior de las cabinas.

En una realización, como se muestra en la Figura 5, los

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canales de contrapeso 410B de la cabina 2 110B se sitúan cerca de las pistas 230 a cada lado del pozo de ascensor. En la realización alternativa, los canales de contrapeso se pueden situar en otro lugar dentro de los canales, 5 contrapesos y cables relacionados asociados con las cabinas para no interferir entre sí. Las poleas 140B se sitúan por encima de los canales de contrapeso 410B y dirigen los cables de contrapeso 420B desde los contrapesos 120B hasta puntos de conexión de contrapeso 240B. El motor 130B, desplazado 10 horizontalmente desde los otros motores, se conecta a la parte posterior de la cabina 2 110B para permitir el movimiento de la cabina.

Los canales de contrapeso 410C de la cabina 3 110C se sitúan junto a los canales de contrapeso 410B de la cabina 2 15 110B. Las Poleas 140C se sitúan por encima de los canales de contrapeso 410C y dirigen los cables de contrapeso 420C desde los contrapesos 120C hasta los puntos de conexión del contrapeso 240C. El motor 130C, horizontalmente desplazado de los otros motores, se conecta a la parte posterior de la 20 cabina 3 110C para permitir el movimiento de la cabina.

Los canales de contrapeso 410D de la cabina 4 110D se sitúan junto a los canales de contrapeso 410C para la cabina 2 110C y más cerca de la parte frontal y posterior del pozo de ascensor. Las poleas 140D se sitúan por encima de los 25 canales de contrapeso 410D y dirigen a los cables de contrapeso 420D desde los contrapesos 120D hasta los puntos de conexión del contrapeso 240D. El motor 130D, desplazado horizontalmente desde los otros motores, se conecta a la parte posterior de la cabina 4 110D para permitir el 30 movimiento de la cabina.

Los canales de contrapeso y los contrapesos para las cabinas 2, 3 y 4 se pueden apilar espalda con espalda a los lados del hueco del ascensor. Si se prefiere, los contrapesos y sus canales pueden confinarse también en el interior del 35 hueco del ascensor. Aunque no se muestra en la Figura 5, los canales de contrapeso adyacentes colocados espalda con espalda se pueden superponer siempre que los contrapesos se

compensen de modo que los sistemas de polea no interfieran entre sí. Esto puede aumentar el número de cabinas que el sistema es capaz de operar cuando el espacio del contrapeso es una limitación. Las poleas de contrapeso a lo largo de cada lado del hueco del ascensor pueden ser coaxiales y estar horizontalmente desplazadas de la misma manera que los contrapesos con el fin de permitir la adición de más cabinas. En una realización alternativa, los contrapesos y los canales de contrapeso 410 se sitúan fuera del hueco/pozo.

La Figura 6 ilustra una vista lateral del sistema de motor usado para cada cabina de acuerdo con una realización. En una realización, el motor ilustrado aquí para la cabina 2 110B es similar para todas las cabinas 110 aunque el posicionamiento particular de los cables variará. Una pista vertical 230 discurre a lo largo de cada lado del hueco del ascensor y cada pista 230 se conecta a una cabina en una o dos guías 220B. Las dos guías 220B se unen a la pista 230 y se alinean verticalmente a lo largo del lado de la cabina 110B. Dos puntos de conexión del motor 150B se sitúan en la parte posterior de la cabina y se alinean verticalmente. Un extremo de un cable de elevación 136B se une al punto de conexión superior del motor 150B. El cable de elevación 136B se dirige después a través del motor 150B, que se sitúa cerca de la parte superior del hueco del ascensor 100. El cable de elevación 136B discurre después a lo largo del hueco del ascensor y se dirige a través de la polea baja 170B. Entre los puntos de conexión del motor 150B, el cable de elevación 136B es circular y continuo. Por último, el otro extremo del cable de elevación 136B se une al punto de conexión inferior del motor 150B. Al igual que el sistema de contrapesos, este sistema de motor elimina la necesidad de cualquier almacenamiento de cables.

Si bien es factible, en algunas realizaciones, que un hueco del ascensor se utilice, por ejemplo, en un pozo de mina profundo o en una torre alta, dos o más huecos del ascensor se utilizan en la realización preferida para aumentar la comodidad de los pasajeros. Con múltiples huecos

del ascensor, los huecos del ascensor pueden alternar y coordinar la dirección en que se desplazan sus cabinas creando el efecto de un patrón de tráfico circular. Una adecuada coordinación de las direcciones en que se desplazan las cabinas puede minimizar el retraso que experimentan los pasajeros. El sistema de control garantizará que suficientes cabinas para el servicio se desplazarán en cada dirección. Se espera que dos huecos del ascensor con diversas cabinas sean suficientes para muchos edificios con 20 o más plantas. En una realización, se estima que un hueco del ascensor adicional se añada por cada 20 plantas adicionales.

La Figura 7 ilustra la operación general de un hueco del ascensor con cuatro cabinas 110A-D. Un hueco del ascensor se muestra en 7 puntos diferentes en el tiempo, 9:05 a 9:11, con el fin de demostrar la operación del sistema. A las 9:05, la Cabina 1 (110A) se sitúa en la planta 1 y el resto de las cabinas se sitúan en las ranuras del sótano 710. Las ranuras del sótano 710 pueden estar en las plantas utilizadas para aparcar los coches. A las 09:06, la cabina 1 (110A) se mueve hacia arriba para el transporte de pasajeros y el resto de las cabinas suben 1 nivel para prepararse para el transporte de pasajeros. A las 9:07, la cabina 2 (110B) comienza el transporte de pasajeros y la cabina 3 (110C) se mueve a la planta 1 en preparación. A las 09:08, las cabinas 2 y 3 siguen transportando pasajeros y la cabina 4 se ha movido a la planta 1 en preparación para el transporte de pasajeros. La cabina 1 (110A) se ha movido a las ranuras del ático o de equipos mecánicos 720 con el fin de permitir que las otras cabinas presten servicio a cualquiera de las plantas en el hueco del ascensor. Las personas que se trasladan desde los coches aparcados en las plantas de sótanos utilizan las cabinas 2, 3 y 4 para llegar a las plantas deseadas.

Las ranuras del hueco del ascensor de ático 720 y del sótano 710 se pueden incluir para permitir que cada cabina preste servicio a todas las plantas del edificio, en este caso, las plantas 1-10. Por ejemplo, si las ranuras del hueco del ascensor del ático A1-A3 no estuviesen presentes,

solamente la cabina 1 (110A) sería capaz de prestar servicio a la planta 10. La cabina 1 (110A) no sería capaz de moverse fuera del camino y de permitir que las otras cabinas lleguen a la planta 10. El hueco del ascensor puede seguir operando  
5 si las ranuras del ático y del sótano no se incluyesen, pero ciertas cabinas no serían capaces de prestar servicio a ciertas plantas.

A las 09:09, la cabina 1 (110A) se ha movido a la planta A3 con el fin de dejar espacio para la cabina 2 (110B) y para  
10 la cabina 3 (110C) en las ranuras del ático. Las cabinas siguen desplazándose hacia arriba, mientras transportan pasajeros y, eventualmente, se mueven a la planta más alta posible. En este punto, un proceso similar se inicia en la dirección opuesta. En algunas situaciones, las cabinas pueden  
15 invertir su dirección de desplazamiento antes que todas las cabinas hayan alcanzado su punto más alto o más bajo.

Una ventaja de la presente invención es que, además de futuras construcciones, muchos edificios existentes pueden acondicionarse efectiva y económicamente para su  
20 compatibilidad con la presente invención. En una realización, los componentes pueden estar contenidos dentro del hueco del ascensor existente y en las áreas de contrapesos. Además, el sistema puede no necesitar almacenar los cables debido a la disposición de las poleas, contrapesos y motores. Además,  
25 algunos o la mayoría de los cables, poleas, motores y otros equipos pueden ubicarse fuera del hueco del ascensor común, incluso por encima o por debajo del hueco del ascensor. En una realización, mediante la utilización de múltiples cabinas en un solo pozo, un edificio puede lograr una capacidad de  
30 ascensor adicional, mientras elimina uno o más pozos y convierte dichos pozos en espacios de producción de ingresos en cada planta. El espacio utilizado para vestíbulos de ascensores en todo el edificio puede reducirse también al eliminar uno o más pozos.

35 Se pueden hacer modificaciones al sistema con el fin de permitir que se utilicen puertas opuestas en cada una de las cabinas 110. Por ejemplo, aunque no se ilustra, todos los

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contrapesos, motores y equipos relacionados que pudieran impedir el acceso a una puerta posterior se pueden mover a los bordes de la parte posterior del hueco del ascensor o cabina o a los lados del hueco del ascensor o cabina a lo largo del lado de los contrapesos inferiores de la cabina. Del mismo modo, los contrapesos, motores y equipos relacionados se pueden colocar en la parte delantera de la cabina, siempre y cuando estén hacia los lados y no afecten el uso de la puerta. Si bien es útil para futuras construcciones, la presente invención también es compatible con edificios y sistemas de ascensor existentes.

Cada una de las cabinas se mueve de forma independiente debido a que cada cabina utiliza contrapesos y motores separados. Con el fin de permitir que cada cabina preste servicio a cada planta de un edificio, los niveles de almacenamiento de cabina se pueden incluir por encima y/o debajo de las plantas que están servidas. Por ejemplo, con el fin de que la cabina 1 (110A) preste servicio a la planta servida más baja, debe haber suficiente espacio debajo de la planta servida más baja para que se almacenen las cabinas 2 a 4. Las ranuras del hueco del ascensor del ático y del sótano se podrían utilizar también para almacenar las cabinas y suspender la operación de ciertas cabinas. Esto puede ayudar a reducir los costos de operación durante los períodos de baja utilización, tales como durante la noche, fines de semana y vacaciones en un edificio de oficinas. El sistema puede también seleccionar una cabina para prestar servicio solamente a un determinado subconjunto de plantas, lo que puede ayudar con las secciones de tráfico elevado de algunos edificios de gran tamaño, o con un cierto número de plantas dedicadas a una sola empresa.

Lo anterior describe diversas realizaciones en relación con un edificio. Se prevé que realizaciones alternativas de la invención se puedan utilizar con una mina (bajo suelo), una torre, o integrarse con sistemas de movimiento horizontales.

Aunque las realizaciones y aplicaciones particulares de

la presente invención se han ilustrado y descrito en el presente documento, se debe entender que la invención no se limita a la construcción y componentes precisos divulgados en el presente documento y que diversas modificaciones, cambios  
5 y variaciones se pueden hacer en la disposición, operación y detalles de los métodos y aparatos de la presente invención sin alejarse del espíritu y alcance de la invención tal como se define en las reivindicaciones adjuntas.

Se hace constar que con relación a esta fecha, el mejor  
10 método conocido por la solicitante para llevar a la práctica la citada invención, es el que resulta claro de la presente descripción de la invención.

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**Lo que se reivindica es:**

Habiéndose descrito la invención como antecede, se  
5 reclama como propiedad lo contenido en las siguientes  
reivindicaciones:

1. Un sistema de ascensor que comprende:

un primer pozo de ascensor;

al menos cuatro cabinas de ascensor situadas dentro de  
10 dicho primer pozo de ascensor, incluyendo dichas cuatro  
cabinas de ascensor una primera cabina de ascensor situada  
por encima de una segunda cabina de ascensor, dicha segunda  
cabina de ascensor situada por encima de una tercera cabina  
de ascensor y dicha tercera cabina de ascensor situada por  
15 encima de dicha cuarta cabina de ascensor, teniendo cada una  
de dichas cuatro cabinas una primera y segunda paredes que  
son sustancialmente paralelas;

un primer conjunto de cuatro cables acoplado a dicha  
segunda cabina de ascensor, dos cables de dicho primer  
20 conjunto de cuatro cables situados en dicha primera pared de  
dicha segunda cabina de ascensor y los dos cables restantes  
de dicho primer conjunto de cuatro cables situados en dicha  
segunda pared de dicha segunda cabina de ascensor, en el que  
cada uno de dichos cuatro cables está conectado a un  
25 contrapeso en un primer conjunto de contrapesos;

un segundo conjunto de cuatro cables acoplado a dicha  
tercera cabina de ascensor, dos cables de dicho segundo  
conjunto de cuatro cables situados sobre dicha primera pared  
de dicha tercera cabina de ascensor y los dos cables  
30 restantes de dicho segundo conjunto de cuatro cables situados  
en dicha segunda pared de dicha tercera cabina de ascensor,  
en el que cada uno de dichos cuatro cables está conectado a  
un contrapeso en un segundo conjunto de contrapesos, cada uno  
de dicho segundo conjunto de cuatro cables situado de tal  
35 manera que los cables no interfieran con dicho primer  
conjunto de cuatro cables conectado a dicha segunda cabina de  
ascensor; y

un tercer conjunto de cuatro cables acoplados a dicha cuarta cabina de ascensor, dos cables de dicho tercer conjunto de cuatro cables situados sobre dicha primera pared de dicha cuarta cabina de ascensor y los dos cables restantes de dicho tercer conjunto de cuatro cables situados en dicha segunda pared de dicha cuarta cabina de ascensor, en el que cada uno de dichos cuatro cables está conectado a un contrapeso en un tercer conjunto de contrapesos, cada uno de dicho tercer conjunto de cuatro cables situado de tal manera que los cables no interfieran con ninguno de dicho primer conjunto de cuatro cables conectado a dicha segunda cabina de ascensor ni con dicho segundo conjunto de cuatro cables conectado a dicha tercera cabina de ascensor.

2. El sistema de ascensor de la reivindicación 1, en el que dichas cabinas de ascensores comprenden además:

una primera guía, situada en dicha primera pared, para acoplar una primera trayectoria vertical en el pozo de ascensor; y

una segunda guía, situada en dicha segunda pared, para acoplar una segunda trayectoria vertical en el pozo de ascensor.

3. El sistema de ascensor de la reivindicación 2, en el que dicha primera guía está situada sustancialmente a lo largo de un eje central de dicha primera pared y dicha segunda guía está situada sustancialmente a lo largo de un eje central de dicha segunda pared.

4. El sistema de ascensor de la reivindicación 1, en el que un primer eje es formado entre un cable de dichos dos cables de dicho primer conjunto de cuatro cables situado en dicha primera pared y un cable de dichos dos cables de dicho primer conjunto de cuatro cables situado en dicha segunda pared, y en el que dicho primer eje pasa sustancialmente a través del centro bidimensional de la segunda cabina de ascensor.

5. El sistema de ascensor de la reivindicación 1, que comprende además:

un primer conjunto de cuatro poleas, cada polea

dispuesta para recibir un cable del primer conjunto de cuatro cables;

un segundo conjunto de cuatro poleas, cada polea dispuesta para recibir un cable del segundo conjunto de cuatro cables; y

un tercer conjunto de cuatro poleas, cada polea dispuesta para recibir un cable del tercer conjunto de cuatro cables.

6. El sistema de ascensor de la reivindicación 1, en el que dicho primer conjunto de contrapesos está situado fuera del pozo de ascensor.

7. El sistema de ascensor de la reivindicación 1, en el que dicho primer conjunto de contrapesos comprende cuatro contrapesos, cada uno de dichos cuatro contrapesos en dicho primer conjunto de contrapesos acoplado a uno de dichos cables en dicho primer conjunto de cuatro cables.

8. El sistema de ascensor de la reivindicación 7, en el que dicho segundo conjunto de contrapesos comprende cuatro contrapesos, cada uno de dichos cuatro contrapesos en dicho segundo conjunto de contrapesos acoplado a uno de dichos cables en dicho segundo conjunto de cuatro cables.

9. El sistema de ascensor de la reivindicación 8, en el que dicho tercer conjunto de contrapesos comprende cuatro contrapesos, cada uno de dichos cuatro contrapesos en dicho tercer conjunto de contrapesos acoplado a uno de dichos cables en dicho tercer conjunto de cuatro cables.

10. El sistema de ascensor de la reivindicación 7, que comprende además un conjunto de cuatro canales de contrapeso, cada uno de dichos cuatro canales de contrapeso para alojar uno de dicho primer conjunto de contrapesos.

11. El sistema de ascensor de la reivindicación 1, que comprende además un primer conjunto de canales de contrapeso, cada canal de contrapeso en dicho primer conjunto de canales de contrapeso confina un contrapeso en dicho primer conjunto de contrapesos.

12. El sistema de ascensor de la reivindicación 11, que comprende además un segundo conjunto de canales de

contrapeso, cada canal de contrapeso en dicho segundo conjunto de canales de contrapeso confina un contrapeso en dicho segundo conjunto de contrapesos.

13. El sistema de ascensor de la reivindicación 12, que  
5 comprende además un tercer conjunto de canales de contrapeso, cada canal de contrapeso en dicho tercer conjunto de canales de contrapeso confina un contrapeso en dicho tercer conjunto de contrapesos,

14. El sistema de ascensor de la reivindicación 13, en  
10 el que dicho primer, segundo y tercer canales de contrapeso están situados de tal manera que el primer conjunto de contrapesos no interfiera con el segundo o tercer conjuntos de contrapesos durante la operación del ascensor.

15. El sistema de ascensor de la reivindicación 1 que  
15 comprende además:

un primer cable de elevación acoplado a una primera ubicación de dicha segunda cabina y a un primer motor, siendo dicho primer cable de elevación capaz de mover dicha segunda cabina en respuesta a la activación de dicho primer motor.

20 16. El sistema de ascensor de la reivindicación 15, en el que dicho primer cable de elevación está también acoplado a una segunda ubicación de dicha segunda cabina, en el que durante el movimiento de la segunda cabina, dicho primer cable de elevación es movido y ninguna porción de dicho  
25 primer cable de elevación es almacenada.

17. El sistema de ascensor de la reivindicación 15 que comprende además:

un segundo cable de elevación acoplado a una primera ubicación de dicha tercera cabina y a un segundo motor,  
30 siendo dicho segundo cable de elevación capaz de mover dicha tercera cabina en respuesta a la activación de dicho segundo motor, en el que dichos segundos cables de elevación no interfieren con dichos primeros cables de elevación durante la operación.

35 18. El sistema de ascensor de la reivindicación 17, en el que dicho segundo cable de elevación está también acoplado a una segunda ubicación de dicha tercera cabina, en el que

durante el movimiento de la tercera cabina, dicho segundo cable de elevación es movido y ninguna porción de dicho segundo cable de elevación es almacenada.

19. El sistema de ascensor de la reivindicación 17 que  
5 comprende además:

un tercer cable de elevación acoplado a una primera  
ubicación de dicha cuarta cabina y a un tercer motor, siendo  
dicho tercer cable de elevación capaz de mover dicha cuarta  
cabina en respuesta a la activación de dicho tercer motor, en  
10 el que dichos terceros cables de elevación no interfieren con  
dichos primeros cables de elevación o dichos segundos cables  
de elevación durante la operación.

20. El sistema de ascensor de la reivindicación 19, en  
el que dicho tercer cable de elevación está también acoplado  
15 a una segunda ubicación de dicha cuarta cabina, en el que  
durante el movimiento de la cuarta cabina, dicho tercer cable  
de elevación es movido y ninguna porción de dicho tercer  
cable de elevación es almacenada.

**RESUMEN**

Un sistema de ascensor que utiliza cuatro o más cabinas móviles de forma independiente en cada pozo de ascensor. Las cabinas inferiores se conectan a cuatro contrapesos espacialmente separados en cuatro puntos de conexión de contrapeso diferentes. Los puntos de conexión se desplazan horizontalmente en diferentes cabinas, con el fin de evitar la interferencia entre los cables, poleas y contrapesos. La cabina superior se puede conectar a uno o dos contrapesos por puntos de conexión en el techo de la cabina. Las cabinas se montan en dos pistas, cada pista en un lado del pozo de ascensor. El sistema incluye un motor unido a cada una de las cabinas mediante cables de elevación para facilitar el movimiento independiente de todas las cabinas. Los edificios existentes se pueden reacondicionar para su compatibilidad con la presente invención.

**REIVINDICACIONES**

1. Un sistema de ascensor que comprende:

un primer pozo de ascensor;

al menos cuatro cabinas de ascensor situadas dentro de  
5 dicho primer pozo de ascensor, incluyendo dichas cuatro  
cabinas de ascensor una primera cabina de ascensor situada  
por encima de una segunda cabina de ascensor, dicha segunda  
cabina de ascensor situada por encima de una tercera cabina  
de ascensor y dicha tercera cabina de ascensor situada por  
10 encima de dicha cuarta cabina de ascensor, teniendo cada una  
de dichas cuatro cabinas una primera y segunda paredes que  
son sustancialmente paralelas;

un primer conjunto de cuatro cables acoplado a dicha  
segunda cabina de ascensor, dos cables de dicho primer  
15 conjunto de cuatro cables situados en dicha primera pared de  
dicha segunda cabina de ascensor y los dos cables restantes  
de dicho primer conjunto de cuatro cables situados en dicha  
segunda pared de dicha segunda cabina de ascensor, en el que  
cada uno de dichos cuatro cables está conectado a su propio  
20 contrapeso en un primer conjunto de contrapesos, ninguno de  
los dos o más de dicho primer conjunto de cuatro cables  
conectado al mismo contrapeso;

un segundo conjunto de cuatro cables acoplado a dicha  
tercera cabina de ascensor, dos cables de dicho segundo  
25 conjunto de cuatro cables situados sobre dicha primera pared  
de dicha tercera cabina de ascensor y los dos cables  
restantes de dicho segundo conjunto de cuatro cables situados  
en dicha segunda pared de dicha tercera cabina de ascensor,  
en el que cada uno de dichos cuatro cables está conectado a  
30 su propio contrapeso en un segundo conjunto de contrapesos,  
ninguno de los dos o más de dicho segundo conjunto de cuatro  
cables conectado al mismo contrapeso, cada uno de dicho  
segundo conjunto de cuatro cables situado de tal manera que  
los cables no interfieran con dicho primer conjunto de cuatro  
35 cables conectado a dicha segunda cabina de ascensor; y

un tercer conjunto de cuatro cables acoplados a dicha  
cuarta cabina de ascensor, dos cables de dicho tercer

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conjunto de cuatro cables situados sobre dicha primera pared de dicha cuarta cabina de ascensor y los dos cables restantes de dicho tercer conjunto de cuatro cables situados en dicha segunda pared de dicha cuarta cabina de ascensor, en el que  
5 cada uno de dichos cuatro cables está conectado a su propio contrapeso en un tercer conjunto de contrapesos, ninguno de los dos o más de dicho tercer conjunto de cuatro cables conectado al mismo contrapeso, cada uno de dicho tercer conjunto de cuatro cables situado de tal manera que los  
10 cables no interfieran con ninguno de dicho primer conjunto de cuatro cables conectado a dicha segunda cabina de ascensor ni con dicho segundo conjunto de cuatro cables conectado a dicha tercera cabina de ascensor.

2. El sistema de ascensor de la reivindicación 1, en  
15 el que dichas cabinas de ascensores comprenden además:

una primera guía, situada en dicha primera pared, para acoplar una primera trayectoria vertical en el pozo de ascensor; y

una segunda guía, situada en dicha segunda pared, para  
20 acoplar una segunda trayectoria vertical en el pozo de ascensor.

3. El sistema de ascensor de la reivindicación 2, en el que dicha primera guía está situada sustancialmente a lo largo de un eje central de dicha primera pared y dicha  
25 segunda guía está situada sustancialmente a lo largo de un eje central de dicha segunda pared.

4. El sistema de ascensor de la reivindicación 1, en el que un primer eje es formado entre un cable de dichos dos cables de dicho primer conjunto de cuatro cables situado en  
30 dicha primera pared y un cable de dichos dos cables de dicho primer conjunto de cuatro cables situado en dicha segunda pared, y en el que dicho primer eje pasa sustancialmente a través del centro bidimensional de la segunda cabina de ascensor.

5. El sistema de ascensor de la reivindicación 1, que  
35 comprende además:

un primer conjunto de cuatro poleas, cada polea

dispuesta para recibir un cable del primer conjunto de cuatro cables;

un segundo conjunto de cuatro poleas, cada polea dispuesta para recibir un cable del segundo conjunto de  
5 cuatro cables; y

un tercer conjunto de cuatro poleas, cada polea dispuesta para recibir un cable del tercer conjunto de cuatro cables.

6. El sistema de ascensor de la reivindicación 1, en  
10 el que dicho primer conjunto de contrapesos está situado fuera del pozo de ascensor.

7. El sistema de ascensor de la reivindicación 1, en el que dicho primer conjunto de contrapesos comprende cuatro contrapesos, cada uno de dichos cuatro contrapesos de dicho  
15 primer conjunto de contrapesos acoplado a uno de dichos cables en dicho primer conjunto de cuatro cables.

8. El sistema de ascensor de la reivindicación 7, en el que dicho segundo conjunto de contrapesos comprende cuatro contrapesos, cada uno de dichos cuatro contrapesos de dicho  
20 segundo conjunto de contrapesos acoplado a uno de dichos cables en dicho segundo conjunto de cuatro cables.

9. El sistema de ascensor de la reivindicación 8, en el que dicho tercer conjunto de contrapesos comprende cuatro contrapesos, cada uno de dichos cuatro contrapesos de dicho  
25 tercer conjunto de contrapesos acoplado a uno de dichos cables en dicho tercer conjunto de cuatro cables.

10. El sistema de ascensor de la reivindicación 7, que comprende además un conjunto de cuatro canales de contrapeso, cada uno de dichos cuatro canales de contrapeso para alojar  
30 uno de dicho primer conjunto de contrapesos.

11. El sistema de ascensor de la reivindicación 1, que comprende además un primer conjunto de canales de contrapeso, cada canal de contrapeso de dicho primer conjunto de canales de contrapeso confina un contrapeso en dicho primer conjunto  
35 de contrapesos.

12. El sistema de ascensor de la reivindicación 11, que comprende además un segundo conjunto de canales de

contrapeso, cada canal de contrapeso de dicho segundo conjunto de canales de contrapeso confina un contrapeso en dicho segundo conjunto de contrapesos.

13. El sistema de ascensor de la reivindicación 12, que  
5 comprende además un tercer conjunto de canales de contrapeso, cada canal de contrapeso de dicho tercer conjunto de canales de contrapeso confina un contrapeso en dicho tercer conjunto de contrapesos,

14. El sistema de ascensor de la reivindicación 13, en  
10 el que dicho primer, segundo y tercer canales de contrapeso están situados de tal manera que el primer conjunto de contrapesos no interfiera con el segundo o tercer conjuntos de contrapesos durante la operación del ascensor.

15. El sistema de ascensor de la reivindicación 1 que  
15 comprende además:

un primer cable de elevación acoplado a una primera ubicación de dicha segunda cabina y a un primer motor, siendo dicho primer cable de elevación capaz de mover dicha segunda cabina en respuesta a la activación de dicho primer motor.

20 16. El sistema de ascensor de la reivindicación 15, en el que dicho primer cable de elevación está también acoplado a una segunda ubicación de dicha segunda cabina, en el que durante el movimiento de la segunda cabina, dicho primer cable de elevación es movido y ninguna porción de dicho  
25 primer cable de elevación es almacenada.

17. El sistema de ascensor de la reivindicación 15 que comprende además:

un segundo cable de elevación acoplado a una primera ubicación de dicha tercera cabina y a un segundo motor,  
30 siendo dicho segundo cable de elevación capaz de mover dicha tercera cabina en respuesta a la activación de dicho segundo motor, en el que dichos segundos cables de elevación no interfieren con dichos primeros cables de elevación durante la operación.

35 18. El sistema de ascensor de la reivindicación 17, en el que dicho segundo cable de elevación está también acoplado a una segunda ubicación de dicha tercera cabina, en el que

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durante el movimiento de la tercera cabina, dicho segundo cable de elevación es movido y ninguna porción de dicho segundo cable de elevación es almacenada.

19. El sistema de ascensor de la reivindicación 17 que  
5 comprende además:

un tercer cable de elevación acoplado a una primera  
ubicación de dicha cuarta cabina y a un tercer motor, siendo  
dicho tercer cable de elevación capaz de mover dicha cuarta  
cabina en respuesta a la activación de dicho tercer motor, en  
10 el que dichos terceros cables de elevación no interfieren con  
dichos primeros cables de elevación o dichos segundos cables  
de elevación durante la operación.

20. El sistema de ascensor de la reivindicación 19, en  
el que dicho tercer cable de elevación está también acoplado  
15 a una segunda ubicación de dicha cuarta cabina, en el que  
durante el movimiento de la cuarta cabina, dicho tercer cable  
de elevación es movido y ninguna porción de dicho tercer  
cable de elevación es almacenada.

21. El sistema de ascensor de la reivindicación 10, en  
20 el que dicho conjunto de cuatro canales de contrapeso están  
unidos a una pared divisoria, un primer subconjunto del  
conjunto de los cuatro canales de contrapeso unido a un  
primer lado de la pared divisoria y un segundo subconjunto  
del conjunto de cuatro canales de contrapeso unido a un  
25 segundo lado de la pared divisoria.

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## CLAIMS

What is claimed is:

1. An elevator system comprising:

a first elevator shaft;

at least four elevator cabs positioned within said first elevator shaft, said four elevator cabs including a first elevator cab positioned above a second elevator cab, said second elevator cab positioned above a third elevator cab and said third elevator cab positioned above said fourth elevator cab, each of said four cabs having a first and second wall that are substantially parallel;

a first set of four cables coupled to said second elevator cab, two cables of said first set of four cables positioned on said first wall of said second elevator cab and the remaining two cables of said first set of four cables positioned on said second wall of said second elevator cab, wherein each of said four cables is connected to ~~one~~ its own counterweight in a first set of counterweights, no two or more of said first set of four cables connected to the same counterweight;

a second set of four cables coupled to said third elevator cab, two cables of said second set of four cables positioned on said first wall of said third elevator cab and the remaining two cables of said second set of four cables positioned on said second wall of said third elevator cab, wherein each of said four cables is connected to ~~one~~ its own counterweight in a second set of counterweights, no two or more of said second set of four cables connected to the same counterweight, each of said second set of four cables positioned such that the cables do not interfere with said first set of four cables connected to said second elevator cab; and

a third set of four cables coupled to said fourth elevator cab, two cables of said third set of four cables positioned on said first wall of said fourth elevator cab and the remaining two cables of said third set of four cables positioned on said second wall of said fourth elevator cab, wherein each of said four cables is connected to ~~one~~ its own counterweight in a third set of counterweights, no two or more of said third set of four cables connected to the same counterweight, each of said third set of four cables positioned such that the cables do not interfere with either said first set of four cables connected to said second elevator cab or said second set of four cables connected to said third elevator cab.

2. The elevator system of claim 1, wherein said elevator cabs further comprise:

a first guide, positioned on said first wall, for engaging a first vertical path in the elevator shaft; and

a second guide, positioned on said second wall, for engaging a second vertical path in the elevator shaft.

3. The elevator system of claim 2, where said first guide is positioned substantially along a center axis of said first wall and said second guide is position substantially along a center axis of said second wall.
4. The elevator system of claim 1, wherein a first axis is formed between one cable of said two cables of said first set of four cables positioned on said first wall and one cable of said two cables of said first set of four cables positioned on said second wall, and wherein said first axis passes substantially through the two-dimensional center of the second elevator cab.
5. The elevator system of claim 1, further comprising:
  - a first set of four pulleys, each pulley disposed to receive one cable of the first set of four cables;
  - a second set of four pulleys, each pulley disposed to receive one cable of the second set of four cables; and
  - a third set of four pulleys, each pulley disposed to receive one cable of the third set of four cables.
6. The elevator system of claim 1, wherein said first set of counterweights are positioned external to the elevator shaft.
7. The elevator system of claim 1, wherein said first set of counterweights comprises four counterweights, each of said four counterweights ~~in~~ of said first set of counterweights coupled to one of said cables in said first set of four cables.
8. The elevator system of claim 7, wherein said second set of counterweights comprises four counterweights, each of said four counterweights ~~in~~ of said second set of counterweights coupled to one of said cables in said second set of four cables.
9. The elevator system of claim 8, wherein said third set of counterweights comprises four counterweights, each of said four counterweights ~~in~~ of said third set of counterweights coupled to one of said cables in said third set of four cables.
10. The elevator system of claim 7, further comprising a set of four counterweight channels, each of said four counterweight channels for housing one of said first set of counterweights.
11. The elevator system of claim 1, further comprising a first set of counterweight channels, each counterweight channel ~~in~~ of said first set of counterweight channels encloses one counterweight in said first set of counterweights.
12. The elevator system of claim 11, further comprising a second set of counterweight channels, each counterweight channel ~~in~~ of said second set of counterweight channels encloses one counterweight in said second set of counterweights.

13. The elevator system of claim 12, further comprising a third set of counterweight channels, each counterweight channel ~~in~~ of said third set of counterweight channels encloses one counterweight in said third set of counterweights,

14. The elevator system of claim 13, wherein said first, second and third counterweight channels are positioned such that the first set of counterweights do not interfere with the second or third set of counterweights during elevator operation.

15. The elevator system of claim 1 further comprising:  
a first lift cable coupled to a first location of said second cab and a first motor, said first lift cable capable of moving said second cab in response to activation of said first motor.

16. The elevator system of claim 15, wherein said first lift cable is also coupled to a second location of said second cab, wherein during movement of the second cab, said first lift cable moves and no portion of said first lift cable is stored.

17. The elevator system of claim 15 further comprising:  
a second lift cable coupled to a first location of said third cab and a second motor, said second lift cable capable of moving said third cab in response to activation of said second motor, wherein said second lift cables do not interfere with said first lift cables during operation.

18. The elevator system of claim 17, wherein said second lift cable is also coupled to a second location of said third cab, wherein during movement of the third cab, said second lift cable moves and no portion of said second lift cable is stored.

19. The elevator system of claim 17 further comprising:  
a third lift cable coupled to a first location of said fourth cab and a third motor, said third lift cable capable of moving said fourth cab in response to activation of said third motor, wherein said third lift cables do not interfere with said first lift cables or said second lift cables during operation.

20. The elevator system of claim 19, wherein said third lift cable is also coupled to a second location of said fourth cab, wherein during movement of the fourth cab, said third lift cable moves and no portion of said third lift cable is stored.

21. (Added) The elevator system of claim 10, wherein said set of four counterweight channels are attached to a dividing wall, a first subset of the set of four counterweight channels attached to a first side of the dividing wall and a second subset of the set of four counterweight channels attached to a second side of the dividing wall.

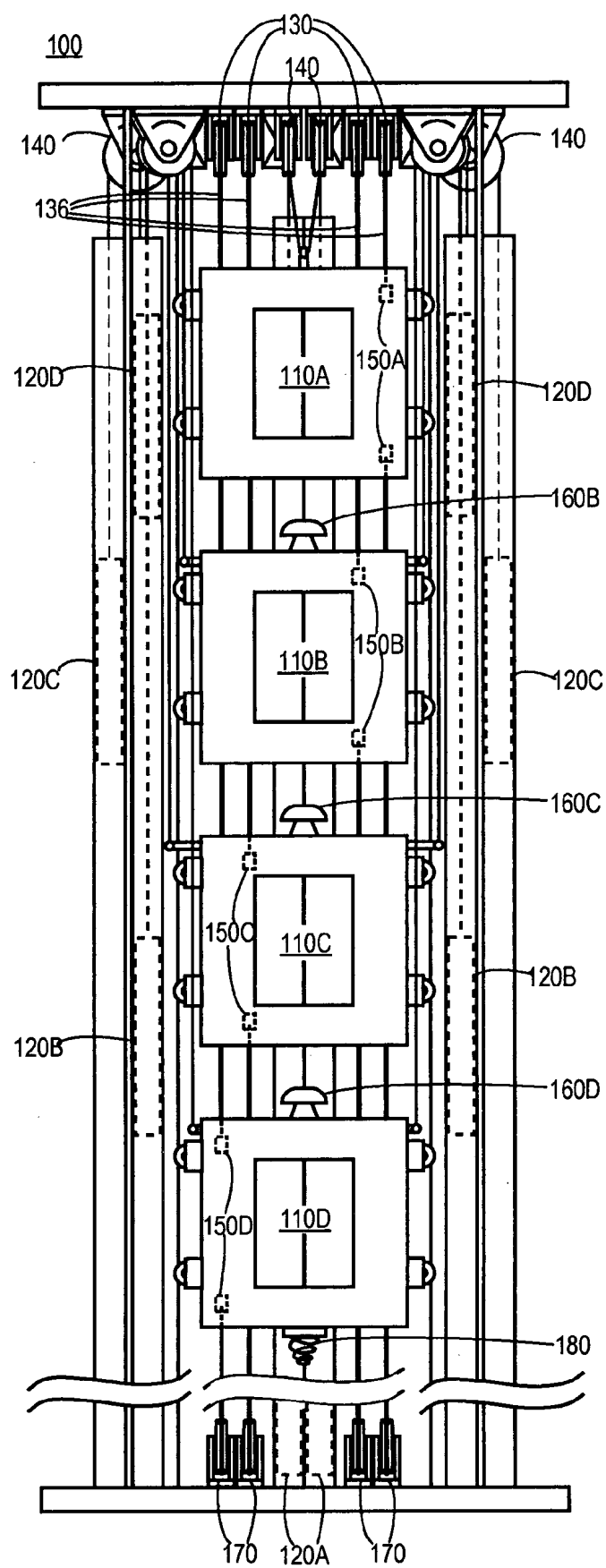


FIG. 1

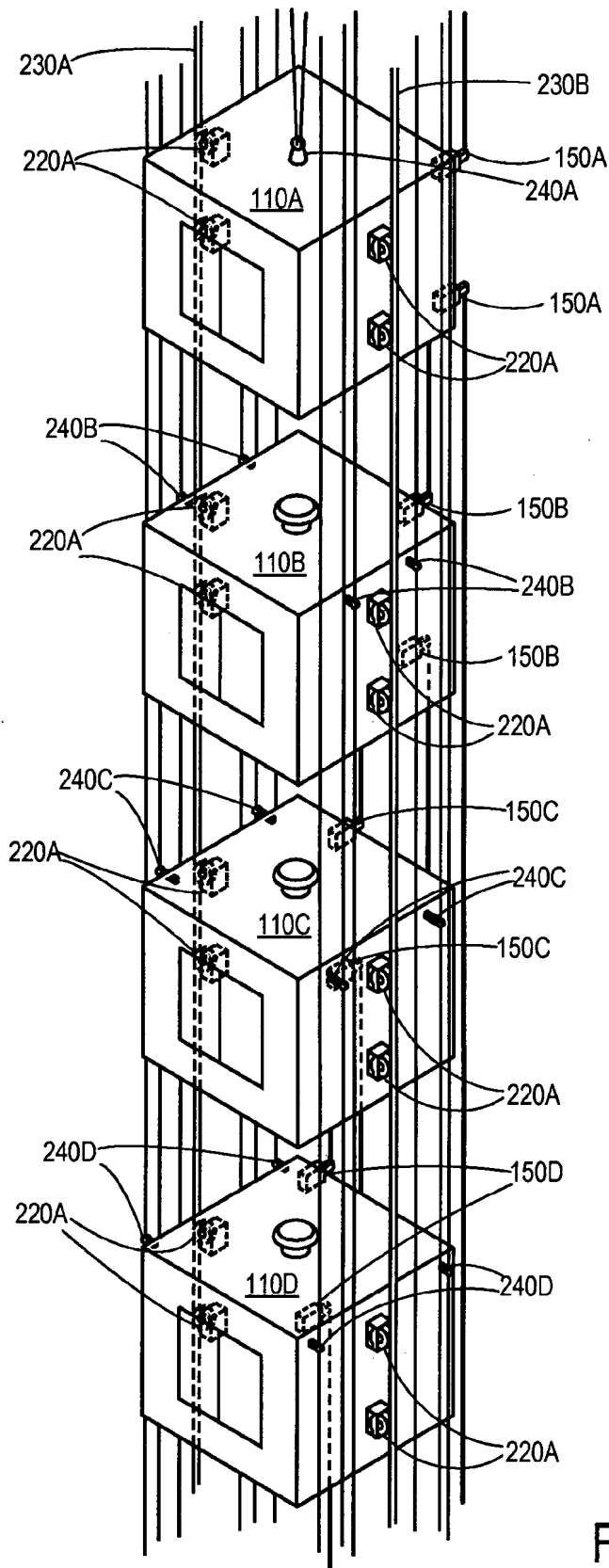


FIG. 2

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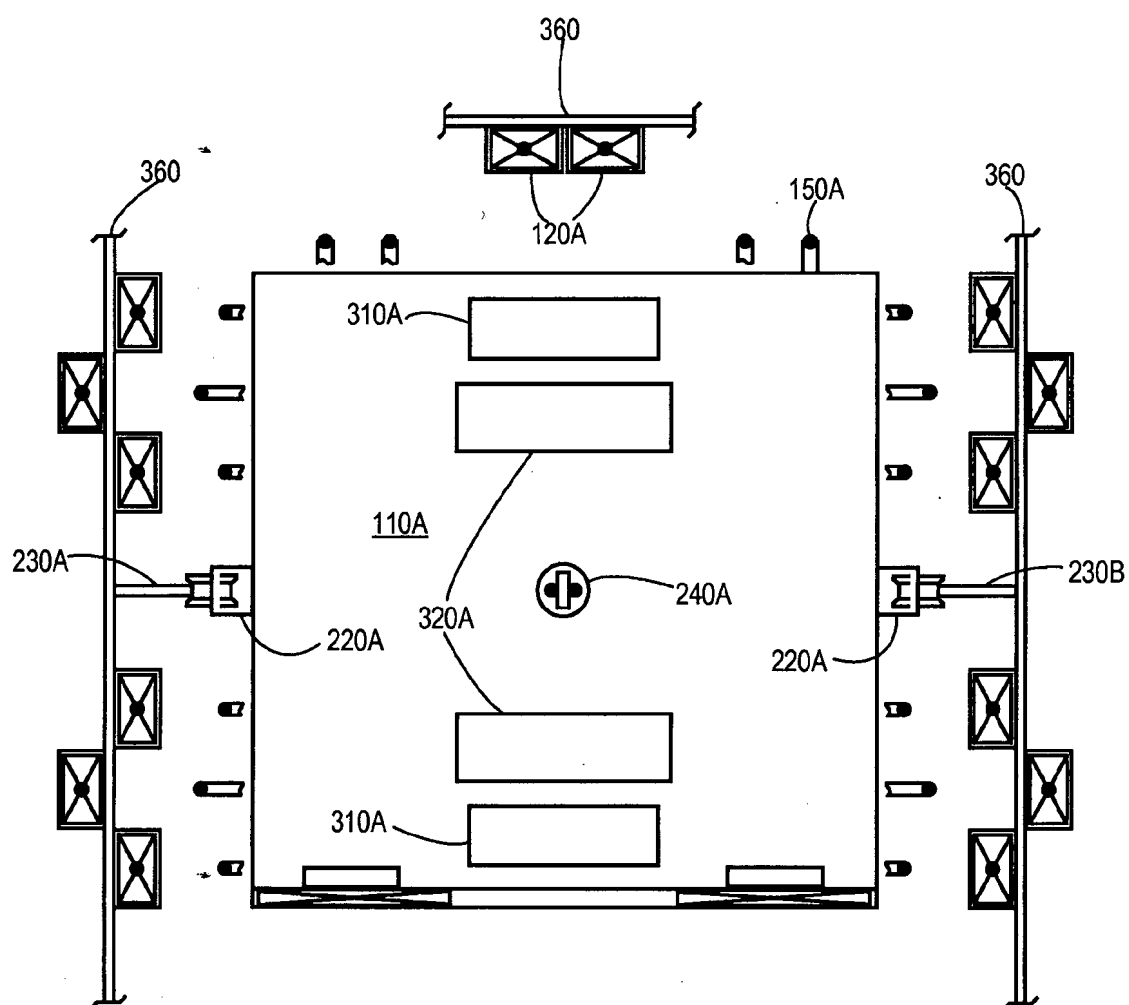


FIG. 3A

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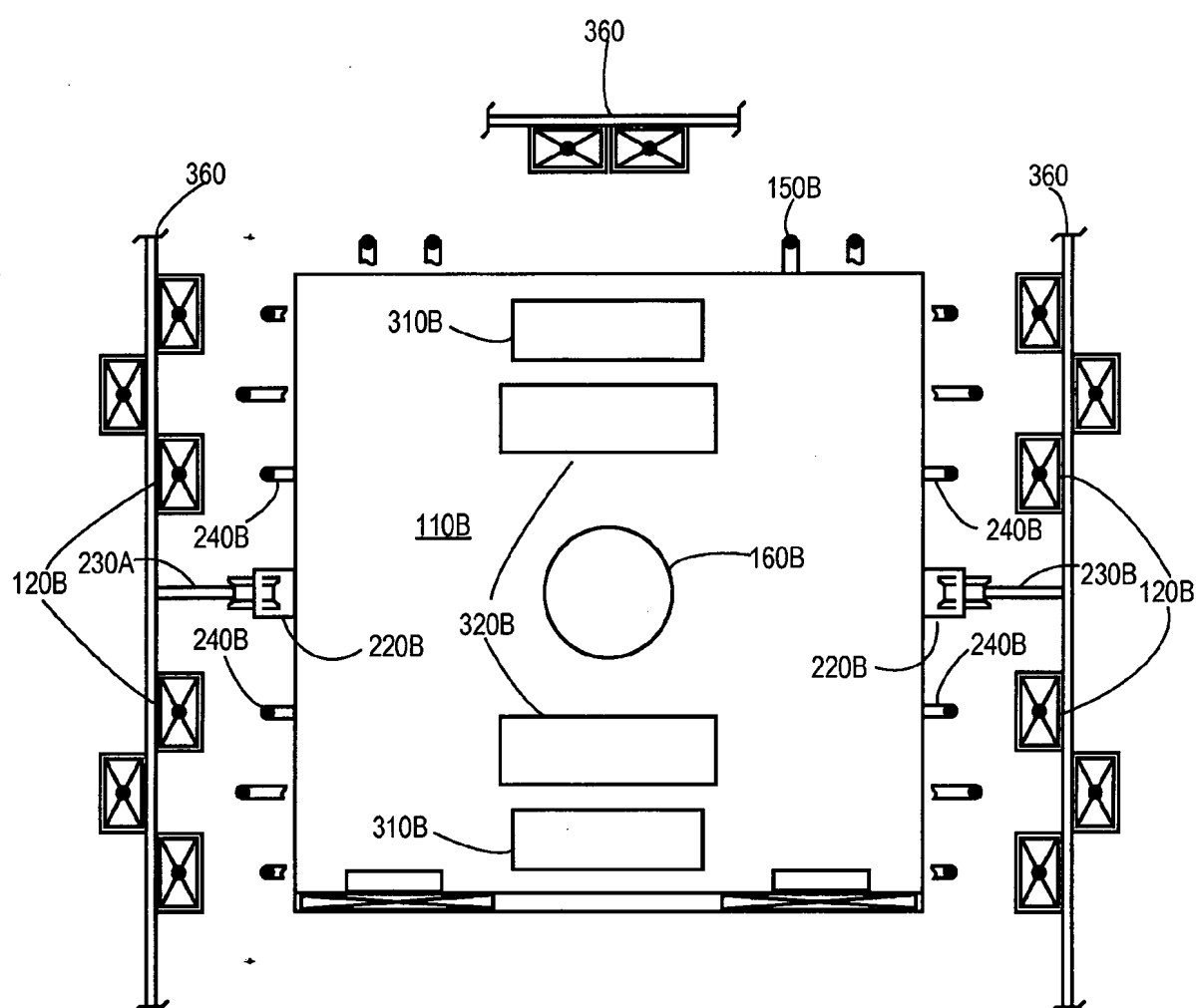


FIG. 3B

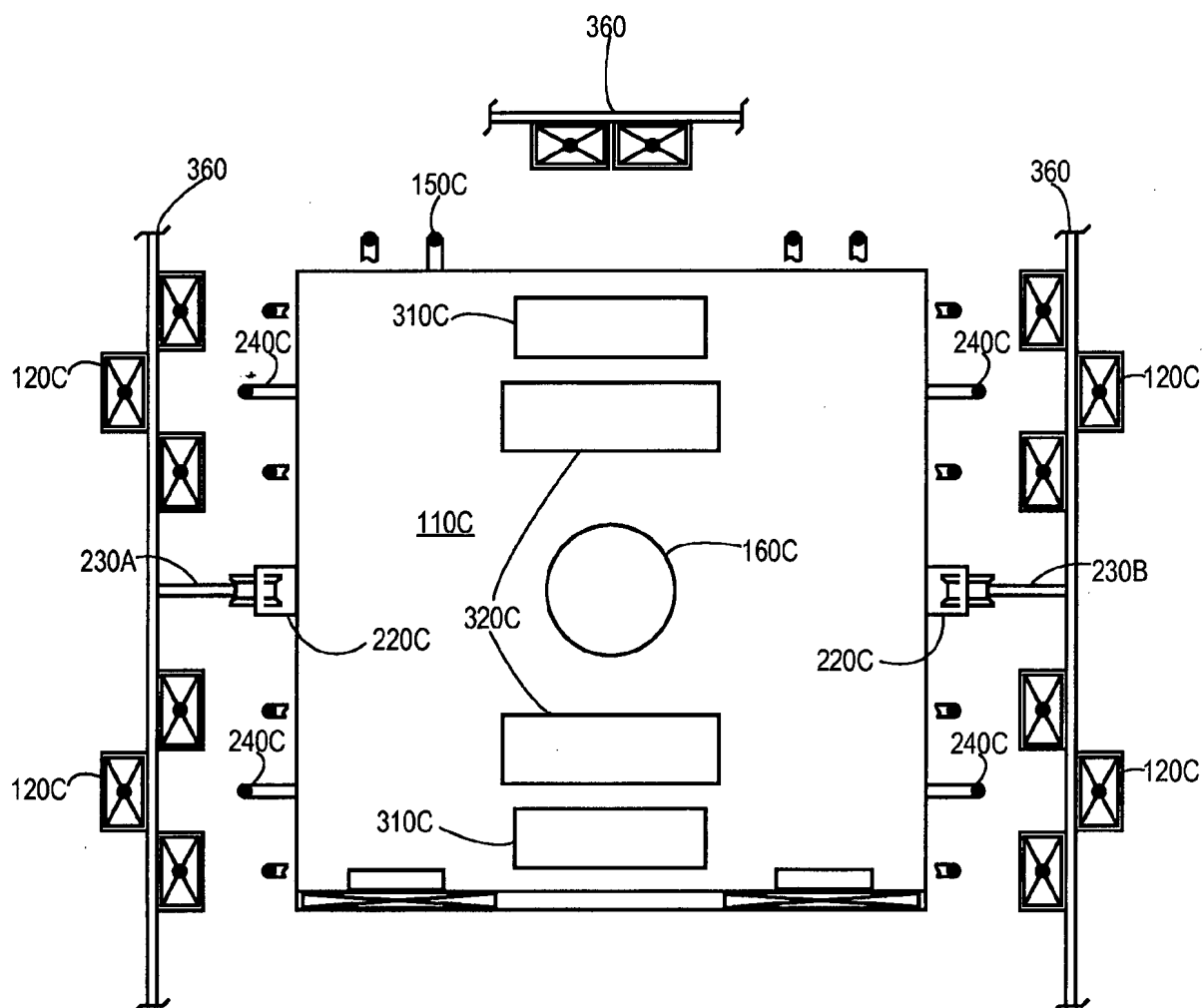


FIG. 3C

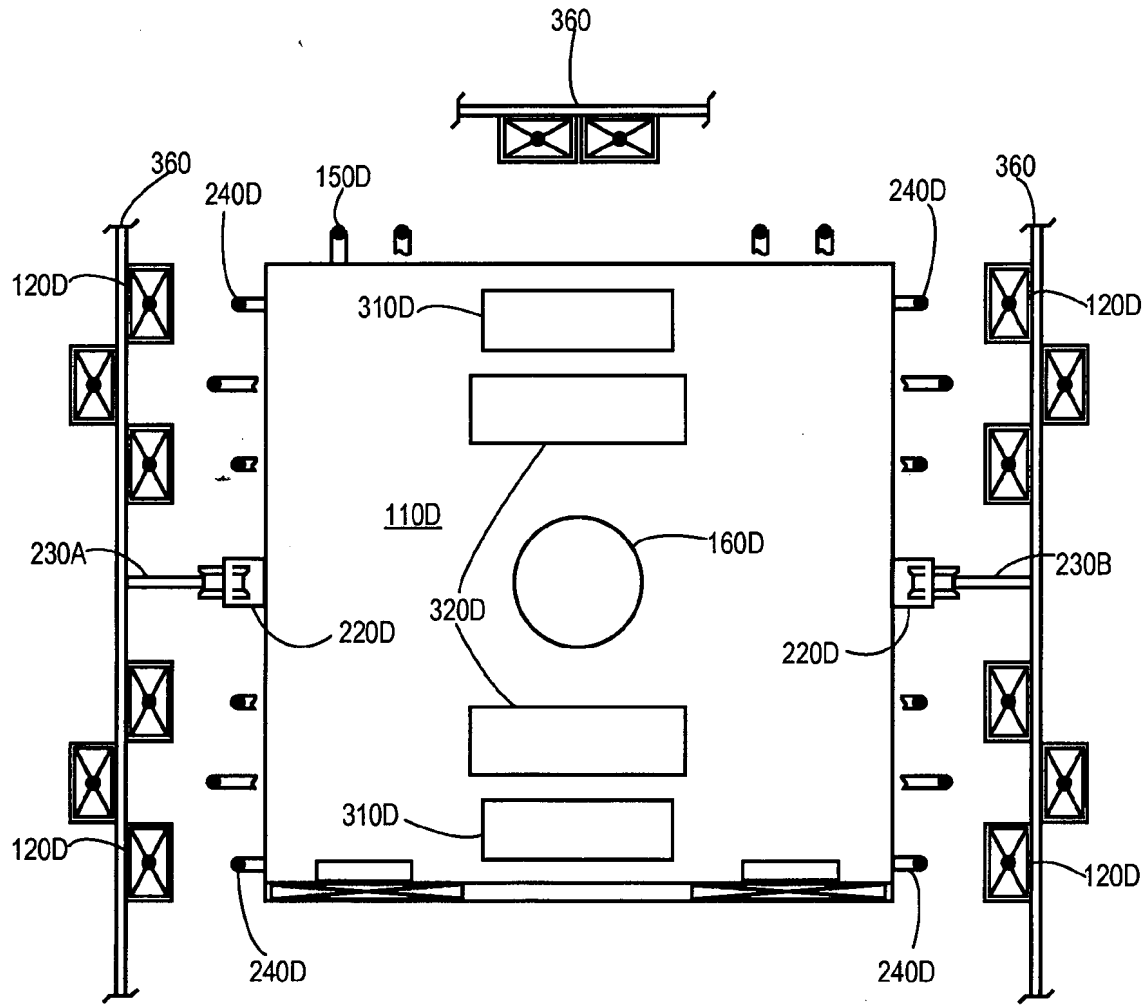


FIG. 3D

3f

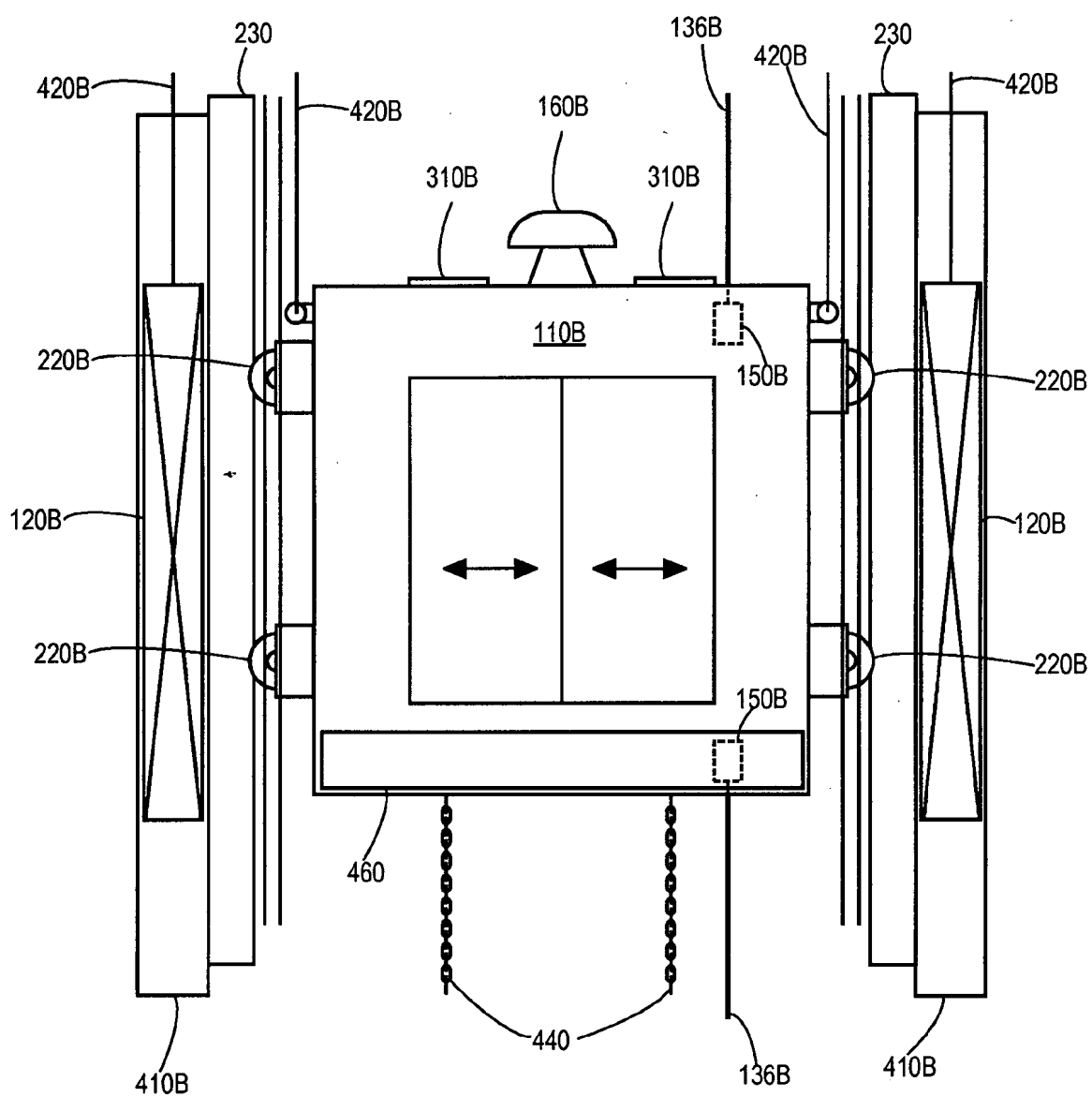


FIG. 4

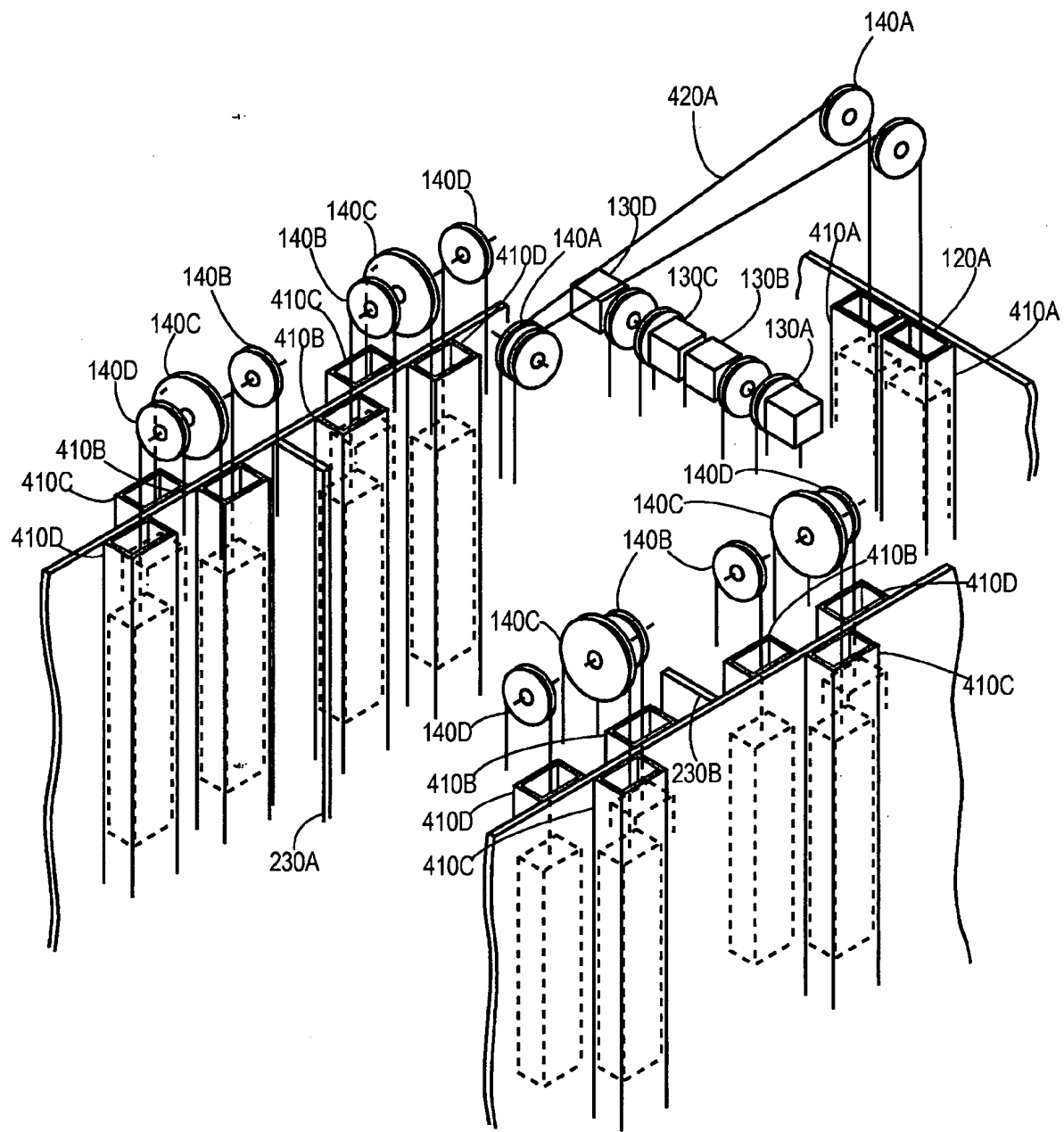


FIG. 5

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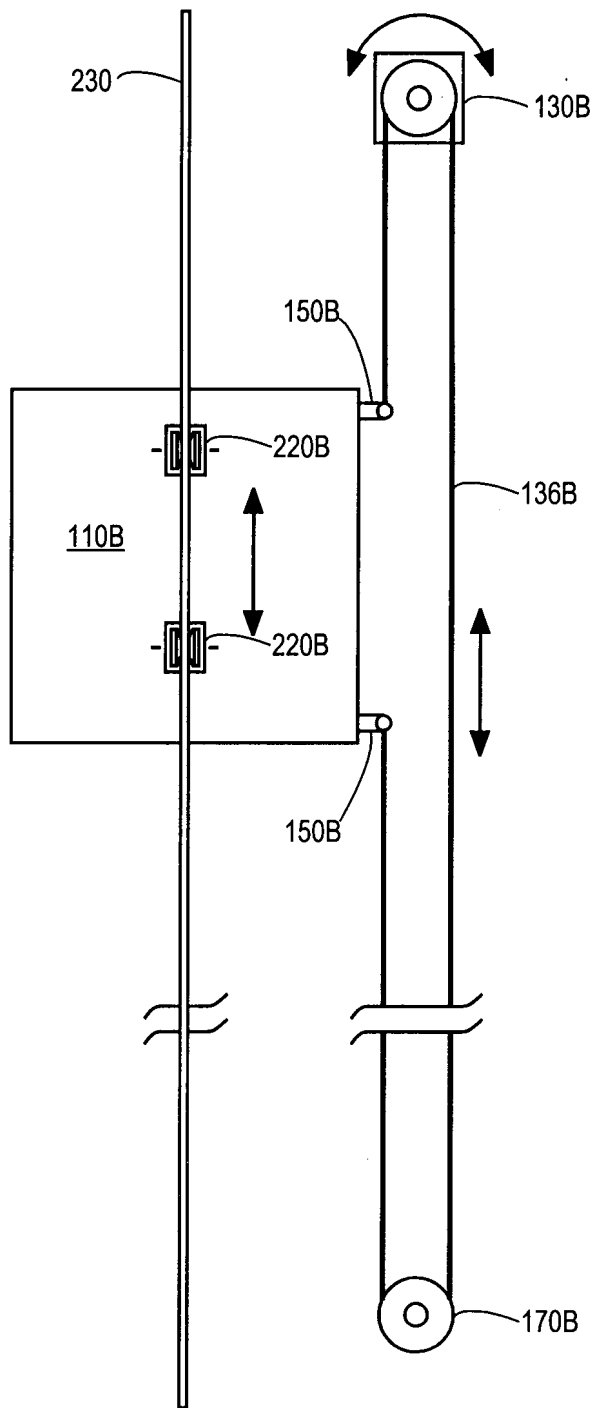


FIG. 6



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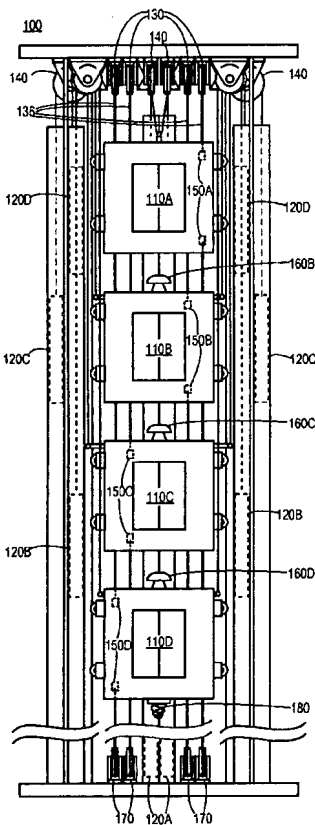
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## SYSTEM HAVING MULTIPLE CABS IN AN ELEVATOR SHAFT

### FIELD OF INVENTION

[0001] The invention relates generally to a multi-cab elevator system having cabs which move independently of each other in an elevator shaft.

### BACKGROUND

[0002] Reducing the number of elevator shafts used in a building has been attempted for years in order to increase the space available for profitable purposes. It is expected that the number of hoistways in some large buildings could be reduced by over 80%. For years, double deck cabs have been used in order to increase the passenger capacity of a hoistway, with each deck serving even or odd floors. However, double deck cabs can limit the freedom of travel provided to passengers. Some systems have used multiple one-way shafts with several cabs being transferred from one shaft to another in order to create a loop of travel. This has proven to be too costly due to complexity and increased energy usage.

[0003] Another way to accomplish this is by having multiple cabs in a single shaft. The number of cabs in an individual shaft has been limited to two or three cabs due to the auxiliary equipment used for operation of one cab interfering with another cab's operation. Placing counterweights for the various cabs that do not interfere with each other can be a significant problem as the number of cabs increases. Using one central counterweight or two counterweights on opposing corners of a cab can result in less than ideal balance of the cabs. In some instances, the space needed for the travel of counterweights can be reduced, but this may require cable storage outside of the existing footprint of the elevator shaft. This is a drawback, since a significant advantage of a multiple cab elevator system is reducing the footprint used.

[0004] Elevator systems capable of using multiple cabs are also usually incapable of operating in an existing elevator shaft without substantial modification. This can significantly increase the installation cost of such a system.

### SUMMARY

[0005] The present invention is an elevator system which allows four or more cabs to operate independently in a single elevator shaft. The cables used for various systems are generally restricted to areas outside the pathway of the cabs to eliminate interference. In an

embodiment, the top cab is connected to two counterweights, while the rest of the cabs are connected to four counterweights each. The connection points between the top cab and its counterweights are at the center of the top surface of the cab. The connection points between the lower cabs and the counterweights are located on either side (wall) of the cabs and horizontally shifted relative to one another in order to avoid interference between cables and provide unencumbered access to each of the counterweight channels and pulleys. As long as interference preventing the movement of any of the cabs is avoided, various numbers of cabs may be used, and various numbers of counterweights may be used for the top and lower cabs. The present invention does not require any storage of cables due to each counterweight having its own counterweight channel and traveling the length of the hoistway.

[0006] In an embodiment, the cabs use two tracks which are located on opposite sides of the elevator shaft for guidance and braking functions. The use of center side tracks provides more even weight distribution than other arrangements, such as one track near each of the four corners of the cab. The use of two tracks also creates less friction between the tracks and cabs, which results in energy savings. Each cab connects to a specific lift cable on the rear or one side of the cab. Each lift cable can be connected to, for example, a motor pulley and floor pulley to allow controlled movement of each cab independently.

[0007] The features and advantages described in the specification are not all inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0008] Figure 1 is an illustration of the front providing an overview of an elevator system in accordance with one embodiment of the present invention.

[0009] Figure 2 is an illustration of the cabs in the hoistway from another perspective highlighting the connections of the counterweights, motors and track elements to the cabs, in accordance with one embodiment of the present invention.

[0010] Figures 3A to 3D are illustrations of the top view of cabs 1, 2, 3 and 4 that show how each cab is connected to, among other things, the counterweights, vertical tracks, and motors, in accordance with one embodiment of the present invention.

[0011] Figure 4 is an illustration of a front view of cab 2 that shows how the counterweights and vertical tracks are attached to the cab in accordance with one embodiment of the present invention.

[0012] Figure 5 is an illustration of the top of the elevator shaft that shows the placement of the counterweights in their channels in accordance with one embodiment of the present invention.

[0013] Figure 6 is an illustration of the placement of the track and how the motor system is attached to each of the cabs in accordance with one embodiment of the present invention.

[0014] Figure 7 is an illustration the operation of an elevator shaft having multiple cabs in accordance with an embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

[0015] A preferred embodiment of the present invention is now described with reference to the figures where like reference numbers indicate identical or functionally similar elements. Also in the figures, the left most digit of each reference number corresponds to the figure in which the reference number is first used.

[0016] Reference in the specification to “one embodiment” or to “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least one embodiment of the invention. The appearances of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment.

[0017] In addition, the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the claims.

[0018] A view from the front of a preferred embodiment of the multi-cab elevator system is illustrated in Figure 1. A hoistway 100 is shown having four cabs 110. It should be recognized that the arrangement of the counterweight and motor systems allow for the operation of more than four cabs in other embodiments. Six, or more cabs can be operated in a single hoistway/shaft. This is made possible by the offset of counterweights and motors, as discussed below. The cabs 110 in the hoistway 100 are all aligned vertically. From top to bottom, the cabs are referred to as cab 1 (110A), cab 2 (110B), cab 3 (110C) and cab 4 (110D). Each of the cabs 110 is capable of moving throughout the hoistway 100

independently of one another, without passing another cab, due to each cab having an associated motor 130 and horizontally separated cables, pulleys 140 and counterweights 120.

[0019] The movement of the cabs 110 is driven by motors 130 positioned at the top of the hoistway 100, in the preferred embodiment. In alternate embodiments the motors 130 can be placed in different locations, such as the bottom of the hoistway or each motor can be placed at different locations. Each cab is connected to a motor 130 by a lift cable 136. Each lift cable 136 is attached to a cab 110 at two vertically aligned motor connection points 150 on the cab, e.g., on the rear face of the cab. Each cab can also have a single motor connection point 150 rather than the two illustrated. In this case, each end of a lift cable would attach to the same motor connection point. The motor connection points 150 of each cab are horizontally shifted to prevent interference (interaction) with another cables 136 from another cab 110. For example, in Figure 1, the motor connections points 150 shift from right to left as the cabs 110 become lower in the hoistway 100. This allows a plurality of cabs beyond the four in this embodiment to each be controlled by a dedicated motor without any obstruction caused by the lift cables 136. One end of each of the lift cables 136 connects to the upper motor connection point 150 on a cab. The lift cables 136 are then routed through the motors 130 near the ceiling of the hoistway. The lift cables 136 are then routed through floor pulleys 170 which are attached to the bottom of the hoistway. Finally, the other end of each of the lift cables 136 is attached to the lower of the two motor connection points 150.

[0020] In an embodiment, counterweights 120 are located on the sides and rear of the cabs 110 and travel along the length of the hoistway 100. Each of the counterweights 120 is connected to a cab by a counterweight cable running through one of the counterweight pulleys 140 located at the top of the hoistway 100. The counterweight pulleys 140 along the sides of the hoistway are aligned, in an embodiment, coaxially. Different sized pulleys account for different spacing between the cabs 110 and counterweights 120. Alternatively, multiple pulleys can be used to vary the spacing between the cabs 110 and counterweights 120. The counterweights 120 are all kept in individual counterweight channels in order to control the movement of the counterweights 120 and to avoid interaction/interference between counterweights 120. For example, the counterweights 120 and pulleys 140 can be horizontally shifted in order to provide unencumbered access to each of these systems and avoid interference with other equipment.

[0021] The bottom cab, cab 4 (110D), has a spring 180 or another collision dampening device on the bottom of the cab as a safety precaution. In the event of a collision between the bottom of the hoistway 100 and cab 4 110D, the spring mitigates the damage from impact.

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With the possible exception of the top cab, cab 1 100A, all cabs 110 have a bumper 160 or another collision dampening safety device on the top of the cab. The bumpers 160 are similarly used as a safety precaution to lessen the impact of a collision between two of the cabs 110.

[0022] Figure 2 is another perspective of the elevator system in accordance with one embodiment of the present invention. The cabs 110 move along two tracks 230 on each side of the hoistway that run the length of the hoistway 100. The cabs 100 are attached to the tracks 230 using guides 220. While illustrated as wheels, the guides 220 may also be double pronged guides which can serve as brakes. A mix of different types of guides can also be used, with some providing guidance and others providing brakes and guidance. Each of the depicted cabs 110 has four guides 220, two on opposite sides of the cab. In a preferred embodiment, each of the cabs has two guides 220, one on opposite sides of the cab. Various numbers of guides can be used. Having two tracks, rather than one at each corner as in some conventional systems, provides better weight distribution, e.g., more balanced weight distribution, and lower maintenance costs in certain situations. The use of two tracks also causes less friction between the guides and tracks which results in more efficient operation of the elevator system. In an embodiment two of the guides are positioned substantially along a center axis or plane of a first wall of the cab 110A and two guides are positioned substantially along a center axis or plane of a second wall of the cab 110A, wherein in one embodiment the first and second walls of the cab 110 are substantially parallel. The uppermost cab, cab 1 (110A), is connected to two counterweights 120 at the rear of the hoistway 100. In an embodiment, only one counterweight 120 is connected to cab 1 (110A). These counterweights are attached to cab 1 (110A) at counterweight connection point 240A, which is located at the center of roof of cab 1 (110A). In alternate embodiments cab 1 (110A) is connected to a different number of counterweights, e.g., one, four etc. In alternate embodiments cab 1 (110A) has multiple connection points, for example, similar to those described below.

[0023] In one embodiment, the remaining cabs, e.g., cab 2 (110B), cab 3 (110C) and cab 4 (110D), are connected to four counterweights each, with two located on either side of the cab. It is shown that the counterweight connection points 240 on the cabs 110 are horizontally shifted in order to avoid interference with one another. For instance, the cab 3 connections points 240C are shifted toward the front and rear of the hoistway 100 relative to the cab 2 connection points 240B.

[0024] Figures 3A, 3B, 3C, and 3D illustrate a top view of each of the cabs in one embodiment of the invention. As illustrated in Figure 3A and as described above, the location of the cab 1 counterweights 120A is different than that of the other three cabs. The counterweight connection point 240A for cab 1 (110A) is located at the middle of the top of the cab rather than on the sides. The counterweight connection point is not implemented in this fashion on the other cabs since there is a cab above which would interfere with the counterweight connection cable. The counterweight connection point 240A is attached to the counterweights 120A at the rear of the hoistway. As illustrated, counterweights 120 can be attached to dividing walls 360. Dividing walls 360 allow counterweights and other equipment to be attached to both sides of the dividing wall 360. This increases the amount of counterweights and cabs that can fit in a single hoistway. The rear dividing wall can be extended to span the width of the rear of the hoistway. Counterweights can also be attached to the outer hoistway wall rather than a dividing wall, if dividing walls are not included. However, dividing walls allow significant flexibility in the selection and placement of counterweights. By using a dividing wall, a large number of counterweights can be included which allows many cabs to fit into a single hoistway. In some instances, these counterweights can be long and narrow in order to reduce the horizontal space occupied. Wells might be included at the bottom of the hoistway to provide long counterweights, and therefore cabs, full range of motion. The counterweights used by the cabs do not need to be of the same size or shape as long as the counterweights are kept evenly balanced for each of the cabs. In addition, a large number of counterweights, e.g., 16, can be used for a single cab as long as the counterweights for each cab are kept balanced.

[0025] Figures 3B, 3C and 3D illustrate a top view of cabs 2, 3 and 4 respectively in accordance with one embodiment of the present invention. All of these cabs feature similar counterweight locations. Four counterweights 120 are placed horizontally near the sides of the cab, one in each quadrant of the cab. This arrangement, with four connection points to the counterweights, provides balance superior to conventional arrangements such as two counterweights in opposing corners. In one embodiment, in order to improve balance, the two counterweights 120 on each side of the cab are placed equidistant from the guides 220. As discussed above, the distance between the counterweights and the guides can be altered for each cab to prevent interference between counterweights, cables and pulleys. For example, the counterweight connection points 240B for cab 2 can be positioned so that an axis or plane formed between opposite connection points passes through or near the two-dimensional center of the cab 110B. That is, an imaginary axis or plane between

counterweight connection point 240B in the upper left of Figure 3B and counterweight connection point 240B in the lower right of Figure 3B passes at or near the two-dimensional center of cab 110B (for example, near the center of bumper 160B in the two-dimensional perspective of Figure 3B). Similarly an imaginary axis between counterweight connection point 240B in the upper right of Figure 3B and counterweight connection point 240B in the lower left of Figure 3B passes at or near the center of cab 110B. This assists in balancing the cabs and reducing the torque on the guides 220.

[0026] Similarly, the motor connection points 150 on the rear of each of the cabs are shifted on each cab in the hoistway to prevent interference between the motor systems and cables of each cab.

[0027] In one embodiment, as illustrated in Figure 3B, the counterweights 120B of cab 2 110B are located nearest the tracks 230 on either side of the elevator shaft. Four counterweight connection points 240B are aligned with the counterweights and connected to the counterweights by a cable. A motor connection point 150B connects to a motor 130B towards the rear of the of elevator shaft to enable movement of the cab. The motor connection point 150B is horizontally shifted from motor connection points from other cabs to avoid interference with other cables. Two guides 220B are in line with the tracks 230 and direct the cab as it moves along the length of the elevator shaft.

[0028] In accordance with one embodiment and as illustrated in Figure 3C, the counterweights 120C of cab 3 110C are located adjacent to the cab 2 counterweights 120B towards the outside of the hoistway. Four counterweight connection points 240C are aligned with the counterweights and connected to the counterweights by a cable. As discussed above, the distance between the counterweights and the guides can be altered for each cab to prevent interference between counterweights, cables and pulleys. For example, the counterweight connection points 240C for cab 3 can be positioned so that an axis or plane formed between opposite connection points passes through or near the two-dimensional center of the cab 110C. That is, an imaginary axis or plane between counterweight connection point 240C in the upper left of Figure 3C and counterweight connection point 240C in the lower right of Figure 3C passes at or near the two-dimensional center of cab 110C (for example, near the center of bumper 160C in the two-dimensional perspective of Figure 3C). Similarly an imaginary axis between counterweight connection point 240C in the upper right of Figure 3C and counterweight connection point 240C in the lower left of Figure 3C passes at or near the center of cab 110C. As described above, this assists in balancing the cabs and reducing the torque on the guides 220.

[0029] A motor connection point 150C connects to a motor 130C towards the rear of the of elevator shaft to enable movement of the cab. The motor connection point 150C is horizontally shifted from motor connection points of other cabs to avoid interference with other motors and cables. Two guides 220C are in line with the tracks 230 and direct the cab as it moves along the length of the elevator shaft.

[0030] As illustrated in Figure 3D, the counterweights 120D of cab 4 110D are located adjacent to the cab 3 counterweights 120C towards the outside of the hoistway. Four counterweight connection points 240D are aligned with the counterweights and connected to the counterweights by a cable. As discussed above, the distance between the counterweights and the guides can be altered for each cab to prevent interference between counterweights, cables and pulleys. For example, the counterweight connection points 240D for cab 4 are positioned so that an axis or plane formed between opposite connection points passes through or near the two-dimensional center of the cab 110D. That is, an imaginary axis or plane between counterweight connection point 240D in the upper left of Figure 3D and counterweight connection point 240D in the lower right of Figure 3D passes at or near the two-dimensional center of cab 110D (for example, near the center of bumper 160D in the two-dimensional perspective of Figure 3D). Similarly an imaginary axis between counterweight connection point 240D in the upper right of Figure 3D and counterweight connection point 240D in the lower left of Figure 3D passes at or near the center of cab 110D. As describe above, this assists in balancing the cabs and reducing the torque on the guides 220.

[0031] A motor connection point 150D connects to a motor 130D near the rear of the of elevator shaft to enable movement of the cab. The motor connection point 150D is horizontally shifted from motor connection points of other cabs in order to avoid interference with other motors and cables. In addition, it should be noted that in another embodiment any of the cabs may be connected to multiple motors at multiple motor connection points. Two guides 220D are in line with the tracks 230 and direct the cab as it moves along the length of the elevator shaft.

[0032] Bumpers 160 on cabs 2, 3, and 4 are also illustrated in Figures 3B, 3C and 3D respectively. As described above, these bumpers mitigate the impact in a collision between two cabs. Electric sensors 310 and chain landings 320 are also depicted on the top of all of the cabs 110. The electric sensors provide information regarding cab location and can also provide information about the status of the cab, e.g., movement, direction, power status etc. The chain landings 320 can be used as an additional safety device, for example. While not

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illustrated, in an embodiment, horizontally shifted electric power and data cables originate at the vertical midpoint of each hoistway in order to minimize the distance to the cabs at any given time, and to prevent interference or storage of such cables. The data cables can also provide information to a central location and receiving information from a central location to assist in cab control, environmental control, etc.

[0033] Figure 4 illustrates a perspective from the front of cab 2 (110B). The tracks 230 are shown on either side of the cab. The two front counterweights 120B are also on either side of the cab. Two additional counterweights connected to cab 2 110B are behind the tracks 230B, but are not illustrated in Figure 4. Each of the counterweights 120 in the system is guided by a channel which runs the length of the hoistway. As shown, the two counterweights 120B in Figure 4 are contained in the channels 410B. The counterweights 120B are connected to the cab 110B by cab 2 counterweight cables 420B. The counterweight cables 420B are attached at the counterweight connection points 240B as discussed above. The lift cable 136B is shown to be attached to the cab 110B at two vertically aligned motor connection points 150B. In some embodiments, the control equipment 460 is located in the bottom portion of the cab. The control equipment 460 can also be located in the top or side portions of the cab. Among other things, the control equipment governs breaking, opening and closing of doors, leveling of a cab with building floors, and the movement of a cab, ensuring passengers reach their destination without incident. Sensor chains 440 are attached to the bottom of the cab in order to help detect the location of other cabs in the system. Similarly, electric and optical sensors 310B keep track of obstructions that may be located above the cab 110B and can assist in identifying the location of the cab 110B in the elevator shaft. A previously mentioned bumper 160B is located on top of the cab should a collision occur between cab 2 110B and another cab from above.

[0034] Figure 5 illustrates the layout of the counterweights and counterweight channels, as well as the pulleys in accordance with one embodiment of the invention. The counterweight channels 410 and the cab 1 counterweights 120A are placed along the rear of the hoistway, in contrast to the placement of the other cabs' counterweights, in this embodiment. The cab 1 counterweights 120A are attached to cab 1 by counterweight cables 420A. Each of the counterweight cables runs through a pulley above the counterweight channel and a pulley above the center of cab 1 110A. The cab 1 counterweight channels are horizontally shifted from the motor assembly to prevent interference and allow unencumbered access to each i.e., the motor assembly 130 is between the cabs 110 and the cab 1 counterweights 120A. In the present embodiment, motor 130A is connected to cab 1 110A. This also preserves space and

allows additional motors to be mounted for additional cabs. The placement of cab 1's counterweights at the rear of the hoistway is due to preference only. Other embodiments are possible which do not restrict counterweights to the disclosed locations. In alternate embodiments the position of counterweights 120A and counterweight channels 410A for cab 1 (110A) can vary, for example, they can be similar to the orientation set forth below with reference to cabs 2-4. This might be useful to allow doors on both the front and rear of the cabs.

[0035] In one embodiment, as shown in Figure 5, the counterweight channels 410B of cab 2 110B are located near the tracks 230 on either side of the elevator shaft. In alternate embodiment the counterweight channels can be positioned elsewhere provided the channels, counterweights and related cables associated with the cabs do not interfere with each other. Pulleys 140B are located above the counterweight channels 410B and route the counterweight cables 420B from the counterweights 120B to the counterweight connection points 240B. Motor 130B, horizontally shifted from the other motors, is connected to the rear of cab 2 110B to enable movement of the cab.

[0036] The counterweight channels 410C of cab 3 110C are located adjacent to the counterweight channels 410B for cab 2 110B. Pulleys 140C are located above the counterweight channels 410C and route the counterweight cables 420C from the counterweights 120C to the counterweight connection points 240C. Motor 130C, horizontally shifted from the other motors, is connected to the rear of cab 3 110C to enable movement of the cab.

[0037] The counterweight channels 410D of cab 4 110D are located adjacent to the counterweight channels 410C for cab 3 110C and nearest the front and back of the elevator shaft. Pulleys 140D are located above the counterweight channels 410D and route the counterweight cables 420D from the counterweights 120D to the counterweight connection points 240D. Motor 130D, horizontally shifted from the other motors, is connected to the rear of cab 4 110D to enable movement of the cab.

[0038] The counterweight channels and counterweights for cabs 2, 3 and 4 can be stacked back-to-back on the sides of the hoistway. If preferred, the counterweights and their channels can be confined to the inside of the hoistway as well. While not shown in Figure 5, adjacent counterweight channels placed back-to-back can overlap as long as the counterweights are offset so that pulley systems do not interfere with one another. This can increase the number of cabs that the system is able to operate when counterweight space is a limitation. The counterweight pulleys along either side of the hoistway can be coaxial and horizontally

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shifted in the same manner as the counterweights in order to allow the addition of more cabs. In an alternate embodiment, the counterweights and counterweight channels 410 are positioned external to the hoistway/shaft.

[0039] Figure 6 illustrates a side view of the motor system used for each cab in accordance with one embodiment. In an embodiment, the motor illustrated here for cab 2 110B is similar for all cabs 110 although the particular positioning of the cables will vary. A vertical track 230 runs along each side of the hoistway and each track 230 connects to a cab at one or two guides 220B. The two guides 220B are attached to the track 230 and vertically aligned along the side of the cab 110B. Two motor connection points 150B are located on the back of the cab and vertically aligned. One end of a lift cable 136B is attached to the top motor connection point 150B. The lift cable 136B is then routed through the motor 150B, which is located near the top of the hoistway 100. The lift cable 136B then runs the length of the hoistway and is routed through the floor pulley 170B. Between the motor connection points 150B, the lift cable 136B is circular and continuous. Finally, the other end of the lift cable 136B is attached to the bottom motor connection point 150B. Like the counterweight system, this motor system eliminates the need for any cable storage.

[0040] While it is feasible in some embodiments for one hoistway to be used, e.g., in a deep mine shaft or a tall tower, two or more hoistways are used in the preferred embodiment for increased passenger convenience. With multiple hoistways, hoistways can alternate and coordinate the direction their cabs are traveling in effect creating a circular traffic pattern. Proper coordination of the directions cabs are traveling in can minimize the delay that passengers experience. The control system would ensure that enough cabs for service were traveling in each direction. Two hoistways with multiple cabs are expected to be sufficient for many buildings with 20 or more floors. In one embodiment, it is estimated that an additional hoistway is added for each additional 20 stories..

[0041] Figure 7 illustrates the general operation of a hoistway with four cabs 110A-D. A hoistway is shown at 7 different points in time, 9:05 through 9:11, in order to demonstrate operation of the system. At 9:05, Cab 1 (110A) is located at floor 1 and the rest of the cabs are located at basement slots 710. The basement slots 710 may be on floors used for car parking. At 9:06, cab 1 (110A) moves up to transport passengers and the other cabs move up 1 level in order to prepare to transport passengers. At 9:07, cab 2 (110B) begins transporting passengers and cab 3 (110C) moves to floor 1 in preparation. At 9:08 cabs 2 and 3 are still transporting passengers and cab 4 has moved to floor 1 in preparation for transporting passengers. Cab 1 (110A) has moved to the attic or mechanical equipment slots 720 in order

to allow the other cabs to service any of the floors in the hoistway. People transferring from parked cars on basement floors use cabs 2, 3 and 4 to arrive at their desired floors.

[0042] Attic 720 and basement 710 hoistway slots may be included to enable each cab to service all of the floors in the building, in this case, floors 1-10. For example, if attic hoistway slots A1-A3 were not present, only cab 1 (110A) would be able to service floor 10. Cab 1 (110A) would not be able to move out of the way and allow the other cabs to reach floor 10. The hoistway can still operate if the attic and basement slots are not included, but certain cabs would not be able to provide service to certain floors.

[0043] At 9:09, Cab 1 (110A) has moved to floor A3 in order to make room for cab 2 (110B) and cab 3(110C) in the attic slots. The cabs continue to travel upwards while transporting passengers and eventually moving to the highest floor possible. At this point, a similar process is begun in the opposite direction. In some situations, the cabs can reverse their direction of travel before all of the cabs have reached their highest or lowest point.

[0044] An advantage of this invention is that in addition to future buildings, many existing buildings can effectively and inexpensively be retrofitted for compatibility with the present invention. In an embodiment, the components can be contained within the existing hoistway and counterweights areas. In addition, the system may not need to store cables due to the arrangement of pulleys, counterweights and motors. In addition, some or most of the cables, pulleys, motors and other equipment can be located outside of the common hoistway, including above or below the hoistway. In an embodiment, by utilizing multiple cabs in a single shaft, a building can achieve additional elevator capacity while eliminating one or more shafts and converting those shafts to revenue producing space on each floor. The space used for elevator lobbies throughout a building can also be reduced by eliminating one or more shafts.

[0045] Modifications can be made to the system in order to allow opposing doors to be used on each of the cabs 110. For example, while not illustrated, all of the counterweights, motors and related equipment which would impede access to a rear door can be moved to the edges of the rear of the hoistway or cab or to the sides of the hoistway or cab alongside the lower cab counterweights. Similarly, counterweights, motors and related equipment can be placed on the front of the cab as long as they are towards the sides and do not affect use of the door. While useful for future buildings, the present invention is also compatible with existing buildings and elevator systems.

[0046] Each of the cabs moves independently due to each cab using separate counterweights and motors. In order to enable each cab to serve every floor of a building, cab storage levels

may be included above and/or below the floors that are serviced. For example, in order for cab 1 (110A) to service the lowest serviced floor, there must be enough room under the lowest serviced floor for cabs 2 through 4 to be stored. Attic and basement hoistway slots could also be used to store cabs and suspend operation of certain cabs. This can help reduce operating costs during low usage periods such as nights, weekends and holidays in an office building. The system can also select a cab to serve only a certain subset of floors, which can help with high traffic sections of some large buildings, or with a certain number of floors dedicated to one company.

[0047] The above describes various embodiments relative to a building. It is envisioned that in alternate embodiments the invention can be utilized with a mine (underground), a tower, or integrated with horizontal movement systems.

[0048] While particular embodiments and applications of the present invention have been illustrated and described herein, it is to be understood that the invention is not limited to the precise construction and components disclosed herein and that various modifications, changes, and variations may be made in the arrangement, operation, and details of the methods and apparatuses of the present invention without departing from the spirit and scope of the invention as it is defined in the appended claims.

[0049] What is claimed is:

1. An elevator system comprising:

a first elevator shaft;

at least four elevator cabs positioned within said first elevator shaft, said four elevator cabs including a first elevator cab positioned above a second elevator cab, said second elevator cab positioned above a third elevator cab and said third elevator cab positioned above said fourth elevator cab, each of said four cabs having a first and second wall that are substantially parallel;

a first set of four cables coupled to said second elevator cab, two cables of said first set of four cables positioned on said first wall of said second elevator cab and the remaining two cables of said first set of four cables positioned on said second wall of said second elevator cab, wherein each of said four cables is connected to one counterweight in a first set of counterweights;

a second set of four cables coupled to said third elevator cab, two cables of said second set of four cables positioned on said first wall of said third elevator cab and the remaining two cables of said second set of four cables positioned on said second wall of said third elevator cab, wherein each of said four cables is connected to one counterweight in a second set of counterweights, each of said second set of four cables positioned such that the cables do not interfere with said first set of four cables connected to said second elevator cab; and

a third set of four cables coupled to said fourth elevator cab, two cables of said third set of four cables positioned on said first wall of said fourth elevator cab and the remaining two cables of said third set of four cables positioned on said second wall of said fourth elevator cab, wherein each of said four cables is connected to one counterweight in a third set of counterweights, each of said third set of four cables positioned such that the cables do not interfere with either said first set of four cables connected to said second elevator cab or said second set of four cables connected to said third elevator cab.

2. The elevator system of claim 1, wherein said elevator cabs further comprise:

a first guide, positioned on said first wall, for engaging a first vertical path in the elevator shaft; and

a second guide, positioned on said second wall, for engaging a second vertical path in the elevator shaft.

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3. The elevator system of claim 2, where said first guide is positioned substantially along a center axis of said first wall and said second guide is positioned substantially along a center axis of said second wall.
4. The elevator system of claim 1, wherein a first axis is formed between one cable of said two cables of said first set of four cables positioned on said first wall and one cable of said two cables of said first set of four cables positioned on said second wall, and wherein said first axis passes substantially through the two-dimensional center of the second elevator cab.
5. The elevator system of claim 1, further comprising:
  - a first set of four pulleys, each pulley disposed to receive one cable of the first set of four cables;
  - a second set of four pulleys, each pulley disposed to receive one cable of the second set of four cables; and
  - a third set of four pulleys each pulley disposed to receive one cable of the third set of four cables.
6. The elevator system of claim 1, wherein said first set of counterweights are positioned external to the elevator shaft.
7. The elevator system of claim 1, wherein said first set of counterweights comprises four counterweights, each of said four counterweights in said first set of counterweights coupled to one of said cables in said first set of four cables.
8. The elevator system of claim 7, wherein said second set of counterweights comprises four counterweights, each of said four counterweights in said second set of counterweights coupled to one of said cables in said second set of four cables.
9. The elevator system of claim 8, wherein said third set of counterweights comprises four counterweights, each of said four counterweights in said third set of counterweights coupled to one of said cables in said third set of four cables.
10. The elevator system of claim 7, further comprising a set of four counterweight channels, each of said four counterweight channels for housing one of said first set of counterweights.

11. The elevator system of claim 1, further comprising a first set of counterweight channels, each counterweight channel in said first set of counterweight channels encloses one counterweight in said first set of counterweights.
12. The elevator system of claim 11, further comprising a second set of counterweight channels, each counterweight channel in said second set of counterweight channels encloses one counterweight in said second set of counterweights.
13. The elevator system of claim 12, further comprising a third set of counterweight channels, each counterweight channel in said third set of counterweight channels encloses one counterweight in said third set of counterweights,
14. The elevator system of claim 13, wherein said first, second and third counterweight channels are positioned such that the first set of counterweights do not interfere with the second or third set of counterweights during elevator operation.
15. The elevator system of claim 1 further comprising:  
a first lift cable coupled to a first location of said second cab and a first motor, said first lift cable capable of moving said second cab in response to activation of said first motor.
16. The elevator system of claim 15, wherein said first lift cable is also coupled to a second location of said second cab, wherein during movement of the second cab, said first lift cable moves and no portion of said first lift cable is stored.
17. The elevator system of claim 15 further comprising:  
a second lift cable coupled to a first location of said third cab and a second motor, said second lift cable capable of moving said third cab in response to activation of said second motor, wherein said second lift cables do not interfere with said first lift cables during operation.
18. The elevator system of claim 17, wherein said second lift cable is also coupled to a second location of said third cab, wherein during movement of the third cab, said second lift cable moves and no portion of said second lift cable is stored.
19. The elevator system of claim 17 further comprising:  
a third lift cable coupled to a first location of said fourth cab and a third motor, said third lift cable capable of moving said fourth cab in response to activation of said third motor,

wherein said third lift cables do not interfere with said first lift cables or said second lift cables during operation.

20. The elevator system of claim 19, wherein said third lift cable is also coupled to a second location of said fourth cab, wherein during movement of the fourth cab, said third lift cable moves and no portion of said third lift cable is stored.



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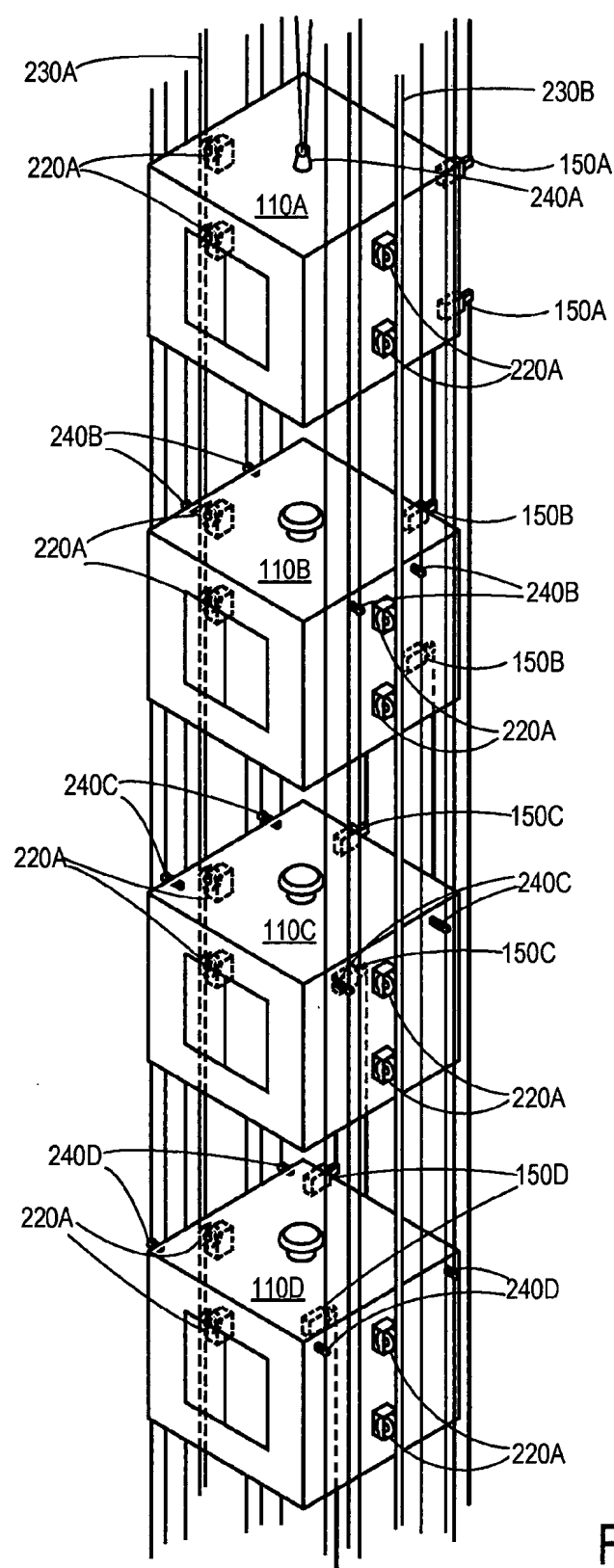


FIG. 2

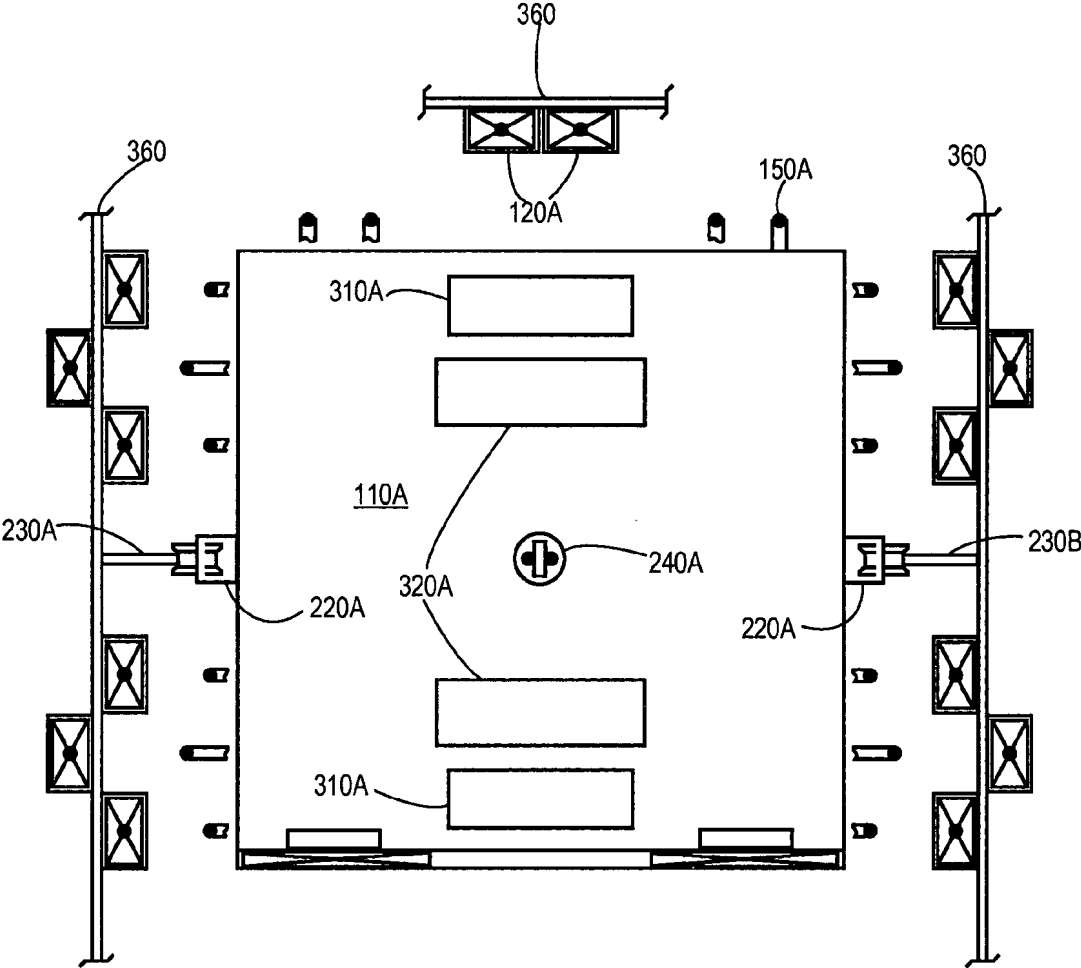


FIG. 3A

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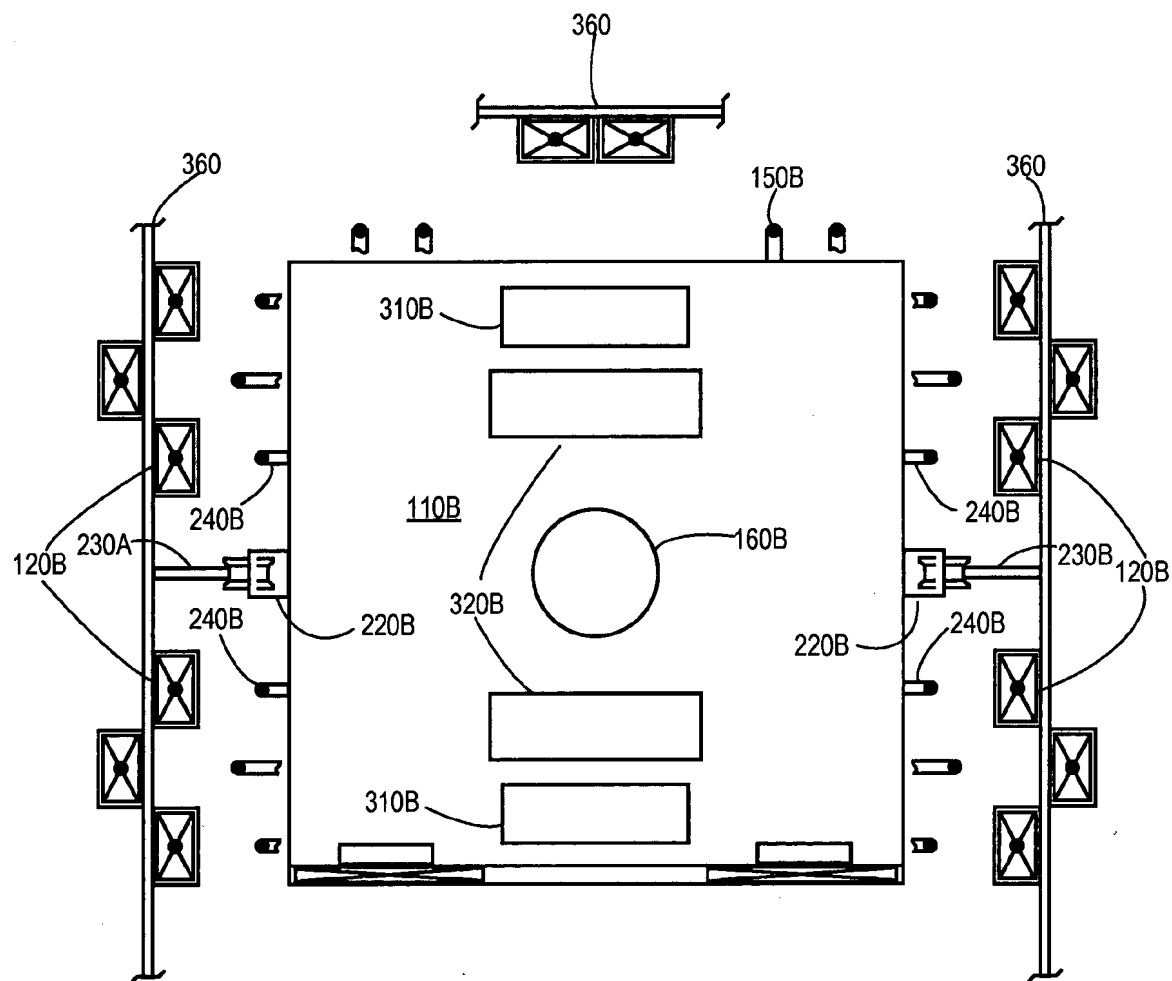


FIG. 3B

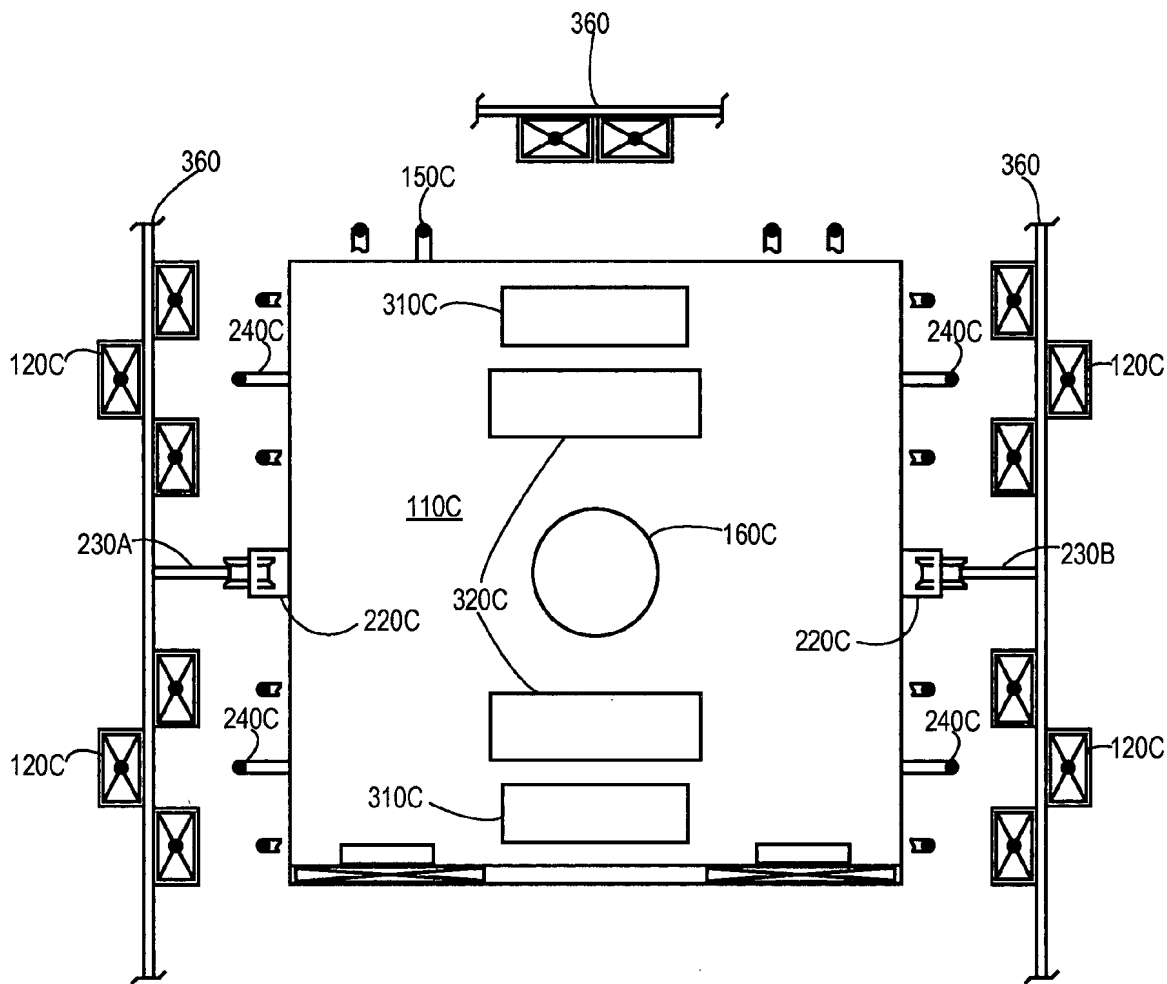


FIG. 3C

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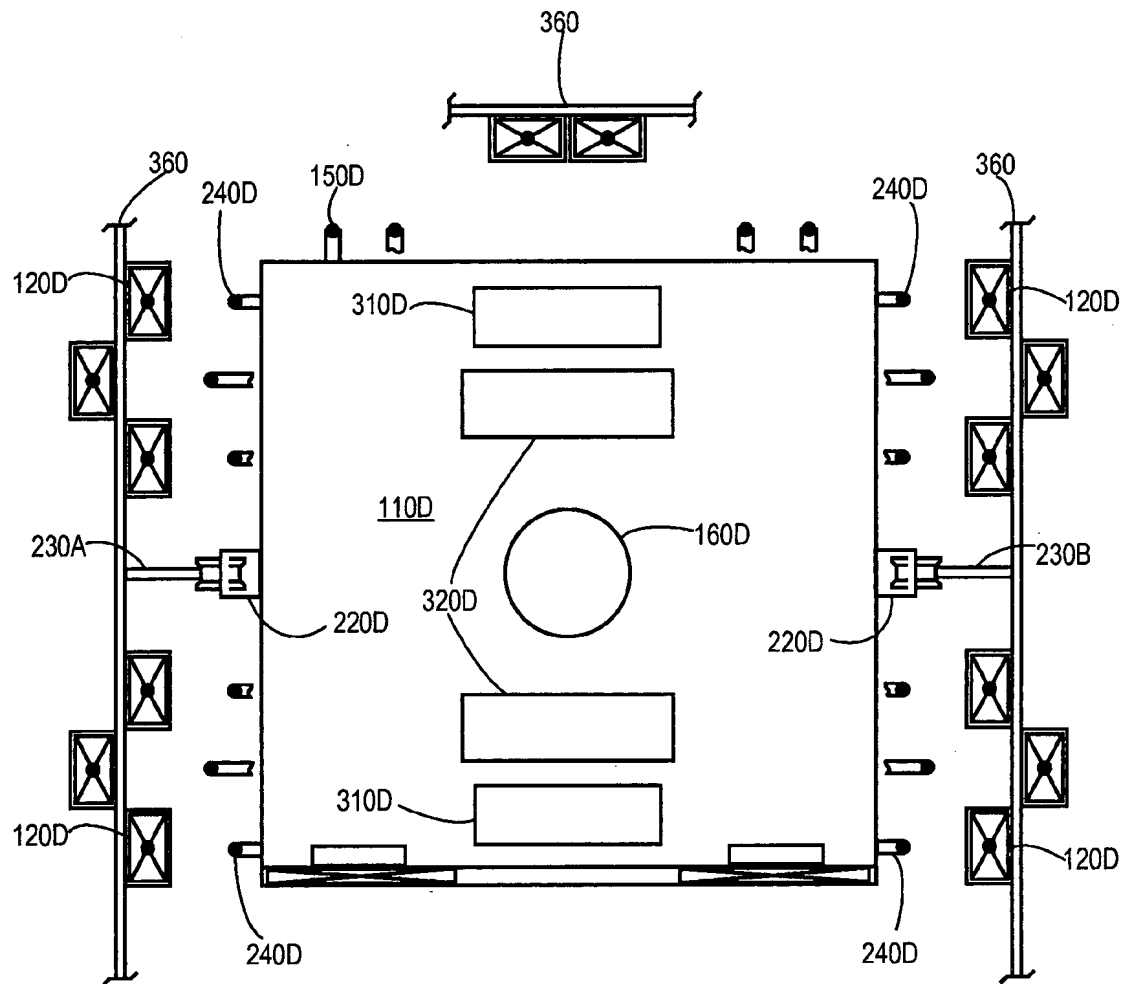


FIG. 3D

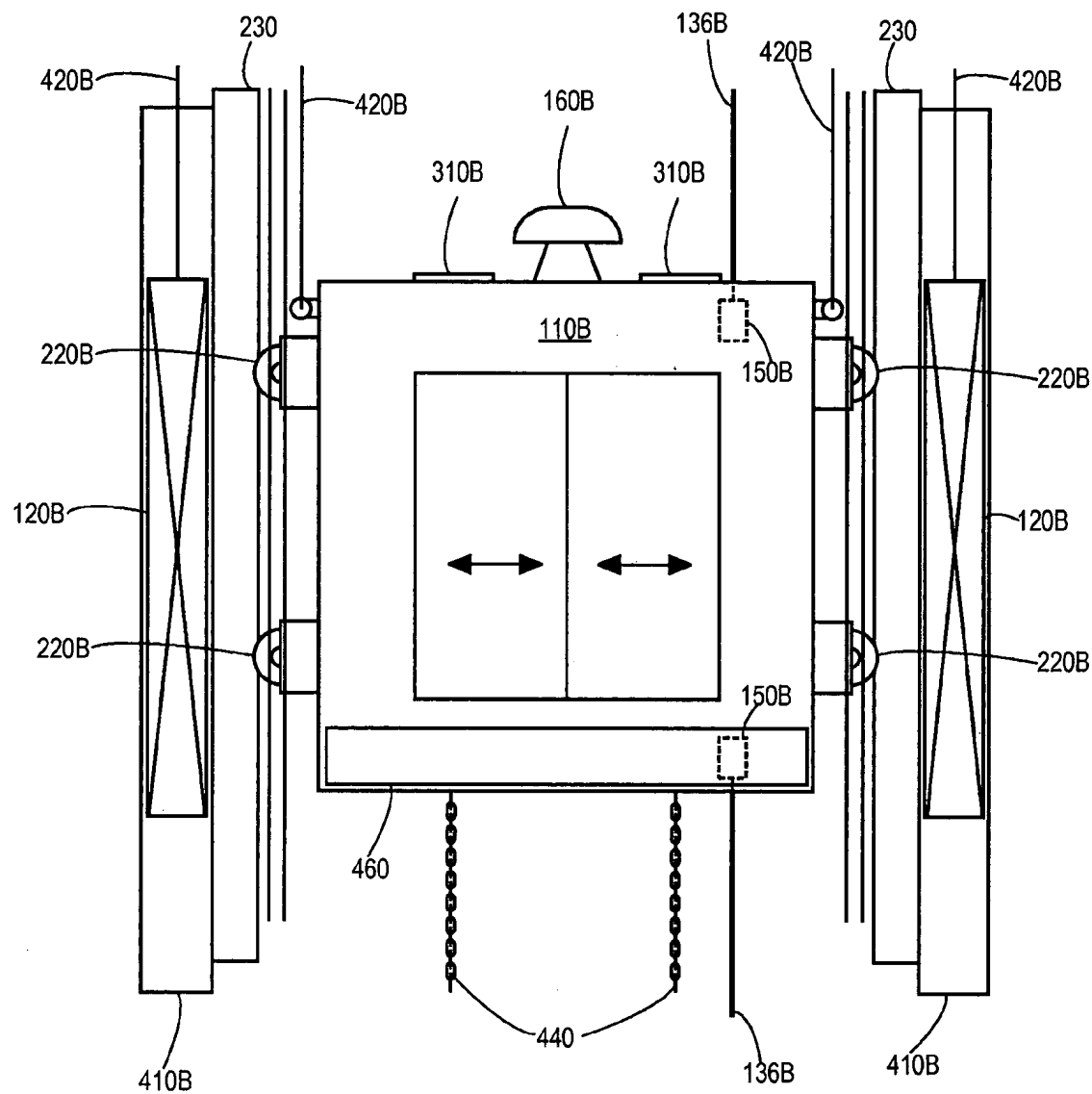


FIG. 4

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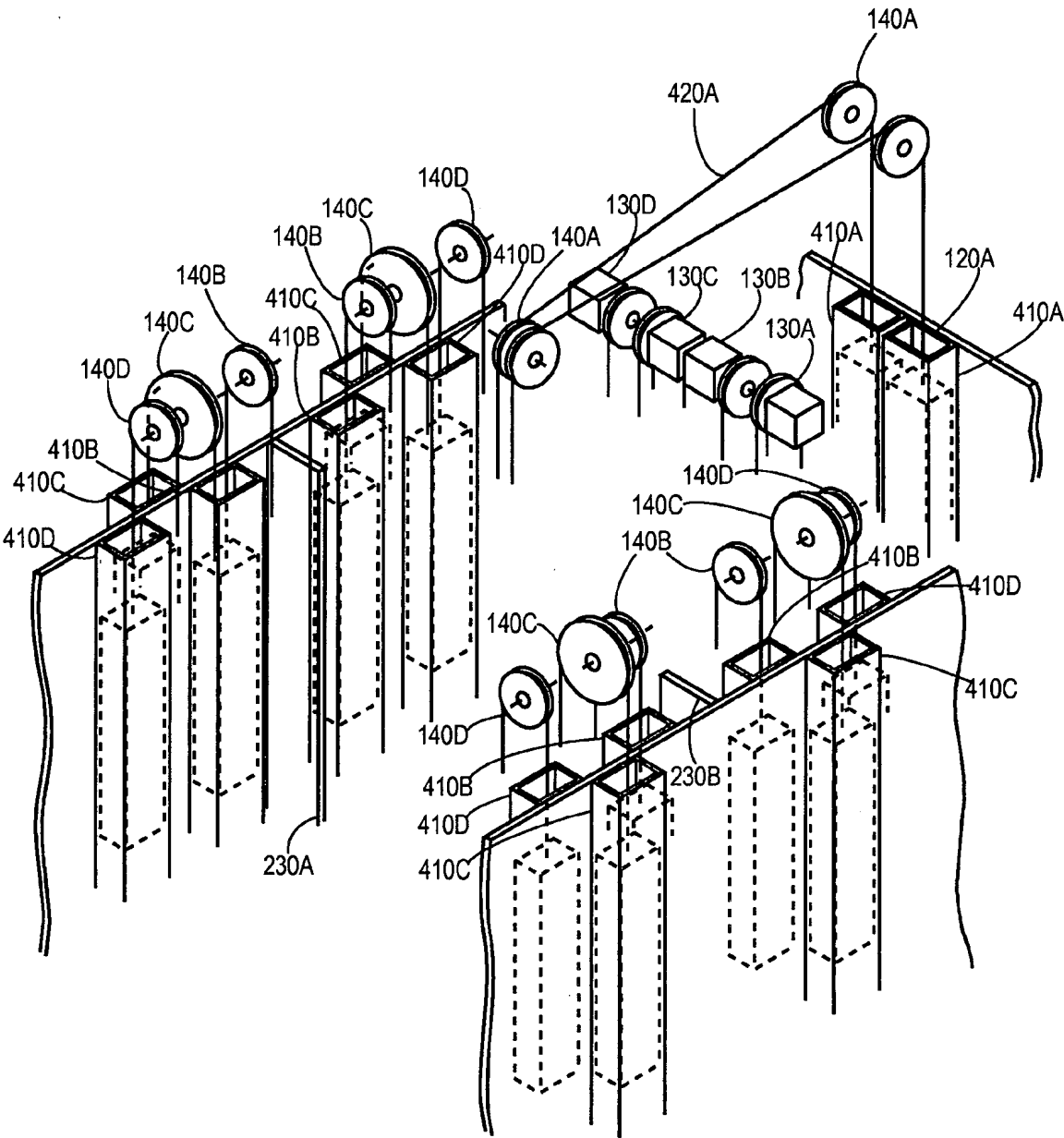


FIG. 5

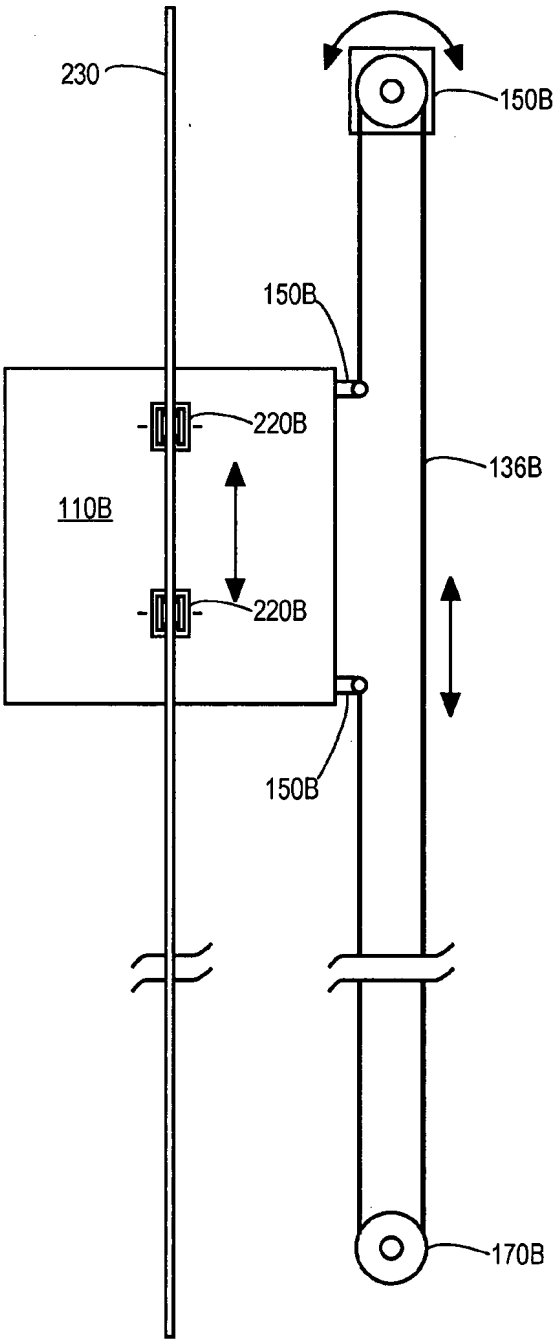


FIG. 6

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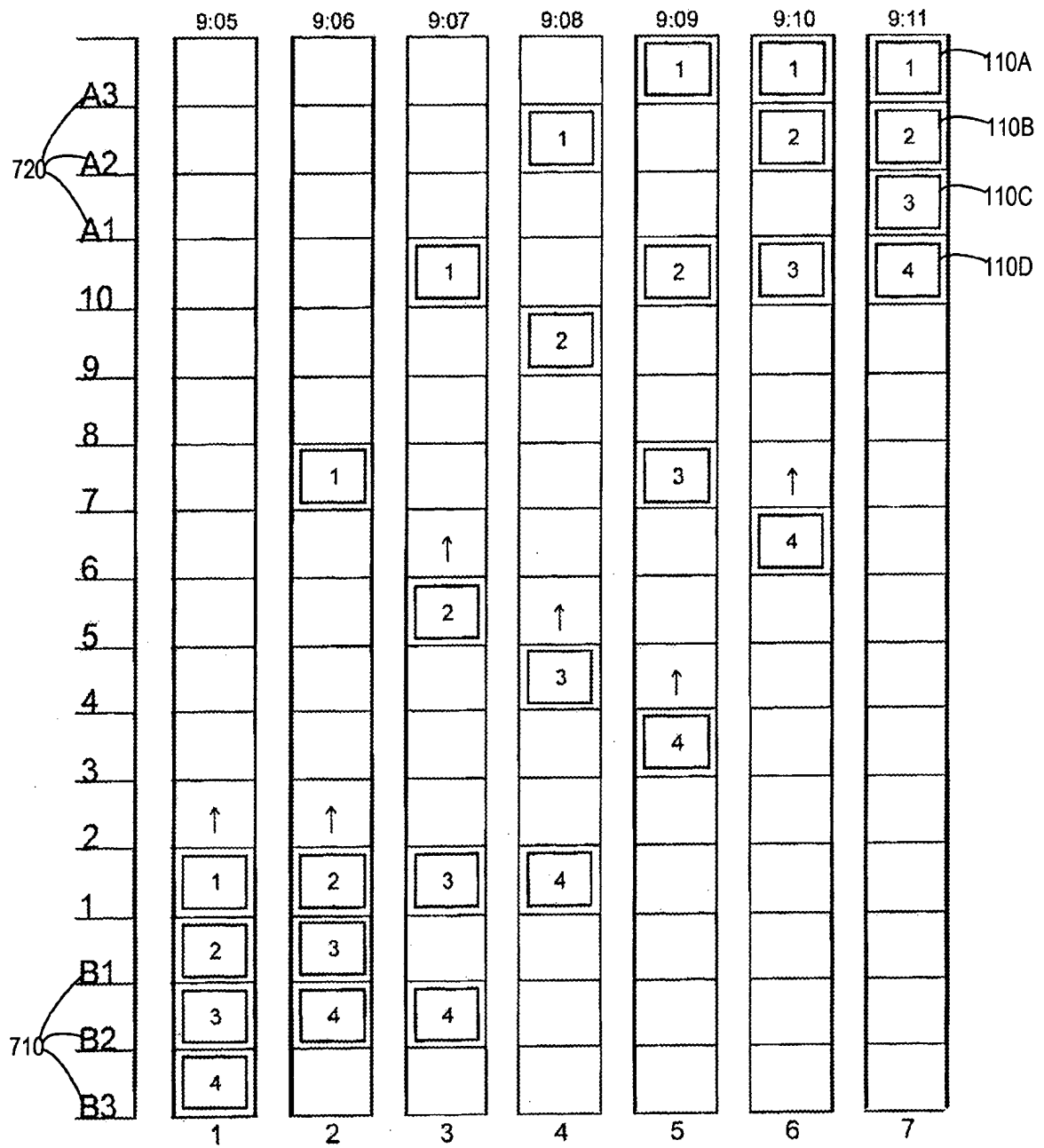


FIG. 7

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| <b>INTERNATIONAL SEARCH REPORT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | International application No.<br><b>PCT/US11/63210</b>                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>IPC: <b>B66B 9/00( 2006.01),11/08( 2006.01)</b><br><br>USPC: <b>187/249,257</b><br>According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>B. FIELDS SEARCHED</b><br><br>Minimum documentation searched (classification system followed by classification symbols)<br>U.S. : Please See Continuation Sheet<br><br>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br><br>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Category *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Relevant to claim No.                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 5,663,538 A (SAKITA) 3 September 1997 (03.09.1997), Col. 5, L. 51 0 Col. 6, L. 34, Fig. 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 - 20                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 4,458,788 A (LEPORE) 10 July 1984 (10.07.1984), Abstract, Col. 5, L. 33 - 46                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 - 20                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | JP 2004256275 A (KOSHIISHI ET AL) 16 September 2004 (16.09.2004), Abstract, Fig. 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US H000702 H (SHIVELY ET AL) 7 November 1989 (07.11.1989), Fig. 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7 - 14                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 1837643 A (NORMAN) 22 December 1931 (22.12.1931), Pg. 1, L. 80 - Pg. 3, L.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2 - 3 and 6                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | US 1896776 A (JAMES) 7 February 1933 (07.02.1933), Entire Document                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 - 20                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;">           * Special categories of cited documents:<br/><br/>           "A" document defining the general state of the art which is not considered to be of particular relevance<br/><br/>           "E" earlier application or patent published on or after the international filing date<br/><br/>           "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br/><br/>           "O" document referring to an oral disclosure, use, exhibition or other means<br/><br/>           "P" document published prior to the international filing date but later than the priority date claimed         </td> <td style="width: 50%; vertical-align: top;">           "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br/><br/>           "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<br/><br/>           "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<br/><br/>           "&amp;" document member of the same patent family         </td> </tr> </table> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                   | * Special categories of cited documents:<br><br>"A" document defining the general state of the art which is not considered to be of particular relevance<br><br>"E" earlier application or patent published on or after the international filing date<br><br>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br><br>"O" document referring to an oral disclosure, use, exhibition or other means<br><br>"P" document published prior to the international filing date but later than the priority date claimed | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br><br>"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<br><br>"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<br><br>"&" document member of the same patent family |
| * Special categories of cited documents:<br><br>"A" document defining the general state of the art which is not considered to be of particular relevance<br><br>"E" earlier application or patent published on or after the international filing date<br><br>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br><br>"O" document referring to an oral disclosure, use, exhibition or other means<br><br>"P" document published prior to the international filing date but later than the priority date claimed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br><br>"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<br><br>"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<br><br>"&" document member of the same patent family |                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Date of the actual completion of the international search<br><b>31 March 2012 (31.03.2012)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Date of mailing of the international search report<br><b>20 APR 2012</b>          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US<br>Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, Virginia 22313-1450<br>Facsimile No. (571) 273-3201                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Authorized officer<br><br><b>Michael Mansen</b><br><br>Telephone No. 571.272.3600 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| <b>INTERNATIONAL SEARCH REPORT</b>                                                                                                   | International application No.<br>PCT/US11/63210 |
| <div data-bbox="181 1061 673 1155"><p>Continuation of B. FIELDS SEARCHED Item 1:<br/>187/249,257<br/>B66B 9/00,11/04,11/08</p></div> |                                                 |



# PCT

From the INTERNATIONAL BUREAU

## NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:

LEE, Otto, O.  
12 South First Street, 12th Floor  
San Jose, CA 95113  
ETATS-UNIS D'AMERIQUE

|                                                                |                                                                             |
|----------------------------------------------------------------|-----------------------------------------------------------------------------|
| Date of mailing (day/month/year)<br>26 March 2013 (26.03.2013) |                                                                             |
| Applicant's or agent's file reference<br>17127 PCT             | IMPORTANT NOTIFICATION                                                      |
| International application No.<br>PCT/US2011/063210             | International filing date (day/month/year)<br>04 December 2011 (04.12.2011) |

1. The following indications appeared on record concerning:

☒ the applicant      ☐ the inventor      ☐ the agent      ☐ the common representative

Name and Address

United States of America

State of Nationality

State of Residence

Telephone No. \_\_\_\_\_

Facsimile No.

E-mail address

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person      ☐ the name      ☐ the address      ☐ the nationality      ☐ the residence

Name and Address

SMART LIFTS, LLC  
1164 Chestnut Street  
Menlo Park, CA 94025  
United States of America

State of Nationality

US

State of Residence

US

Telephone No. \_\_\_\_\_

Facsimile No.

E-mail address

☐ Notifications by e-mail authorized

3. Further observations, if necessary:

The person identified in box 2 is added to this application as applicant for all designated States

4. A copy of this notification has been sent to:

☒ the receiving Office

 the International Searching Authority

☐ the Authority(ies) specified for supplementary search

☐ the International Preliminary Examining Authority

☐ the designated Offices concerned

☒ the elected Offices concerned

☐ other:

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Authorized officer

Boccard Paulette

e-mail [pt02.pct@wipo.int](mailto:pt02.pct@wipo.int)

Telephone No. +41 22 338 74 02

Facsimile No. +41 22 338 89 65

From the INTERNATIONAL BUREAU

## PCT

NOTIFICATION CONCERNING SUBMISSION,  
OBTENTION OR TRANSMITTAL  
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

MCNELIS, John, T.  
Fenwick & West LLP  
Silicon Valley Center  
801 California Street  
Mountain View, CA 94041  
ETATS-UNIS D'AMERIQUE

|                                                                      |                                                                             |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Date of mailing (day/month/year)<br>10 January 2012 (10.01.2012)     |                                                                             |
| Applicant's or agent's file reference<br>17127 PCT                   | IMPORTANT NOTIFICATION                                                      |
| International application No.<br>PCT/US2011/063210                   | International filing date (day/month/year)<br>04 December 2011 (04.12.2011) |
| International publication date (day/month/year)<br>Not yet published | Priority date (day/month/year)<br>19 January 2011 (19.01.2011)              |
| Applicant<br>JACOBS, Justin                                          |                                                                             |

The applicant is hereby notified of the date of receipt (or of obtaining by the International Bureau) of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to the date of receipt, **the priority document concerned was submitted or transmitted to or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-bis)**. This Form replaces any previously issued notification concerning submission, transmittal or obtaining of priority documents.

| <u>Priority date</u>         | <u>Priority application No.</u> | <u>Country or regional Office<br/>or PCT receiving Office</u> | <u>Date of receipt<br/>of priority document</u> |
|------------------------------|---------------------------------|---------------------------------------------------------------|-------------------------------------------------|
| 19 January 2011 (19.01.2011) | 13/009,701                      | US                                                            | 06 January 2012 (06.01.2012)                    |

The letters "NR" denote a priority document which, on the date of mailing of this Form, had not yet been received or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-bis). Where the applicant has failed to either submit, request to prepare and transmit or obtain and transmit, or to request the International Bureau to obtain the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

An asterisk "\*" next to a date of receipt, denotes a priority document submitted or transmitted to or obtained by the International Bureau but not in compliance with Rule 17.1(a), (b) or (b-bis) (the priority document was received after the time limit prescribed in Rule 17.1(a); the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b) or the request to the receiving Office or the International Bureau to obtain the priority document was made after the applicable time limit under Rule 17.1(b-bis)). Even though the priority document was not furnished in compliance with Rule 17.1(a), (b) or (b-bis), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

|                                                                                               |                                                                                                     |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland | Authorized officer<br><br>Lingfei Bai<br>e-mail pt02.pct@wipo.int<br>Telephone No. +41 22 338 74 02 |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|

Facsimile No. +41 22 338 89 65

Form PCT/IB/304 (July 2010)

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO  
NIT : 800.176.089-2  
- / -

|                                                                                                                                      |                       |                                          |
|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------|
| <br><b>Industria y Comercio</b><br>SUPERINTENDENCIA | <b>RECIBO DE CAJA</b> | <b>No. 13 - 0071731</b>                  |
|                                                                                                                                      |                       | Bogotá D.C., Julio 18 de 2013 - 15:41:11 |

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| RECIBIDO DE : CUESTA Y ASOCIADOS LTDA |                 |           |           |            | NI 800.075.616 |  |
| *** Soporte del Pago ***              |                 |           |           |            |                |  |
| TIPO PAGO                             | BANCO           | CUENTA    | No. PAGO  | FECHA PAGO | VR. PAGO       |  |
| CONSIGNACION                          | BANCO DE BOGOTA | 062754387 | 590029672 | 18/07/2012 | 2.010.000.00   |  |

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|---------------------------|-------------------------|--------------------------------------------------|---------------|--------------|--|
| *** Conceptos Pagados *** |                         |                                                  |               |              |  |
| CANT.                     | RENTISTICO              | CONCEPTO                                         | Vr. UNDITARIO | Vr. CONCEPTO |  |
| 1                         | 50005-01-01 SOLICITUDES | 7 TTLOS-TRAMITES DE SOL. DE DISENOS INDUSTRIALES | 500.000.00    | 500.000.00   |  |
|                           |                         |                                                  |               | \$500.000.00 |  |
|                           |                         |                                                  | =====         |              |  |

SON: \*\*QUINIENTOS MIL PESOS MONEDA CORRIENTE\*\*

Responsable: \_\_\_\_\_  
\*\*\*\*\*  
Recibo de Caja Aplicado al Expediente No. \_\_\_\_\_

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO  
  
**No. 13-170703- -00000-0000**  
Fecha: 2013-07-18 15:48:49    Dep. 2020 DIR.NUEVASCR  
Tra. 11 PATENTEIYII    Eve: 378 FASENACIONALI  
Act. 411 PRESENTACION    Folios: 58



No. 13-170703- 00000-0000

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Fecha: 2013-07-18 15:48:49 Dep. 2020 DIR.NUEVASCR  
Tra. 11 PATENTEIYII Eve: 378 FASENACIONALI  
Act. 411 PRESENTACION Folios: 58

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PATENTE DE INVENCION ☐

MODELO

|                                   |                                                                                     |
|-----------------------------------|-------------------------------------------------------------------------------------|
| <input type="checkbox"/>          | Indicación que se solicita una patente.                                             |
| <input type="checkbox"/>          | Datos de identificación del solicitante o de la persona que presenta la solicitud   |
| <input type="checkbox"/>          | Descripción de la invención                                                         |
| <input type="checkbox"/>          | Dibujos de ser estos pertinentes                                                    |
| <input type="checkbox"/>          | Comprobante de pago de las tasas establecidas (De ser el caso formato de descuento) |
| Completa <input type="checkbox"/> | Incompleta <input type="checkbox"/>                                                 |

PATENTE DE INVENCION PCT ☐ MODELO DE UTILIDAD PCT ☐ Art.33 Decisión 486/00, Circular Única

|                                   |                                                                                                                         |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/>          | Indicación que se solicita una PCT                                                                                      |
| <input type="checkbox"/>          | Copia de la solicitud en español, tal como fue presentada inicialmente (capítulo descriptivo, reivindicatorio, resumen) |
| <input type="checkbox"/>          | Dibujos de ser estos pertinentes                                                                                        |
| <input type="checkbox"/>          | Comprobante de pago de las tasas establecidas (de ser el caso formato de descuento)                                     |
| Completa <input type="checkbox"/> | Incompleta <input type="checkbox"/>                                                                                     |

DISEÑO INDUSTRIAL ☐

(Art. 119 Decisión 486/00)

|                                   |                                                                                                           |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/>          | Indicación que se solicita Diseño industrial                                                              |
| <input type="checkbox"/>          | Datos de identificación del solicitante o de la persona que presenta la solicitud                         |
| <input type="checkbox"/>          | Representación gráfica y fotográfica del Diseño industrial o muestra del material que incorpora el diseño |
| <input type="checkbox"/>          | Comprobante de pago de las tasas establecidas                                                             |
| Completa <input type="checkbox"/> | Incompleta <input type="checkbox"/>                                                                       |

ESQUEMA DE TRAZADO ☐

(Art. 92 Decisión 486/00)

|                                   |                                                                                   |
|-----------------------------------|-----------------------------------------------------------------------------------|
| <input type="checkbox"/>          | Indicación que se solicita un esquema de trazado                                  |
| <input type="checkbox"/>          | Datos de identificación del solicitante o de la persona que presenta la solicitud |
| <input type="checkbox"/>          | Representación gráfica de un esquema de trazado                                   |
| <input type="checkbox"/>          | Comprobante de pago de las tasas establecidas                                     |
| Completa <input type="checkbox"/> | Incompleta <input type="checkbox"/>                                               |