

Señor Director
DIRECCION DE NUEVAS CREACIONES
Superintendencia de Industria y Comercio
E. S. D.

Referencia : Expediente No. 16-145928
Asunto : Solicitud de patente para SISTEMA Y MÉTODO DE AUTORIZACIÓN
 DE OCUPACIÓN DE RUTA
Solicitante : ALSTOM TRANSPORT TECHNOLOGIES

RESPUESTA A EXAMEN PRELIMINAR

ANDRÉS RINCÓN USCÁTEGUI, identificado como aparece al pie de mi firma, en mi condición de apoderado del solicitante de la patente de la referencia, doy respuesta dentro de la prórroga solicitada al Oficio 8141, notificado por fijación en lista el 28 de junio de 2016.

I. MODIFICACIONES AL PLIEGO REIVINDICATORIO

Con el fin de atender las observaciones realizadas por el examinador de manera preliminar al examen de patentabilidad, el solicitante decide aportar un nuevo capítulo reivindicatorio conformado por 19 reivindicaciones.

A pesar de eliminar materia del pliego reivindicatorio originalmente presentado, mi representada no renuncia a la protección que pueda obtener sobre dicha materia y se reserva el derecho de presentar una solicitud divisional que la contenga durante el trámite de la presente solicitud.

II. EN CUANTO AL DOCUMENTO DE PRIORIDAD

Se presenta junto con este memorial, copia certificada de la solicitud de patente No. US 62/170,250 cuya prioridad fue reivindicada con la solicitud de patente de la referencia.

III. EN CUANTO AL PODER

Presentó el correspondiente poder otorgado a mi favor por la solicitante, ALSTOM TRANSPORT TECHNOLOGIES.

IV. EN CUANTO AL DOCUMENTO DE CESIÓN

Presento copia del documento en donde consta la cesión del derecho a la patente del inventor en favor de mi representada.

“EXCELENCIA LEGAL EN UN MUNDO SIN FRONTERAS”

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CAVELIER

A B O G A D O S

V. EN CUANTO A LAS OBJECIONES DE SUPUESTA FALTA DE CLARIDAD

1. Mi representada ha modificado las expresiones “diferentes”, “plurales”, “una o más”, “uno o más”, en las reivindicaciones objetadas.

2. En cuanto a la objeción a la expresión “autorización de ocupación de ruta”, mi representada no comparte la apreciación del examinador, y considera que es suficientemente clara para una persona del oficio normalmente versada en la materia.

Lo anterior, considerando el hecho que la descripción proporciona suficiente información sobre el alcance del término, esto es, hace referencia a reservar uno o más trayectos para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de modo que se impida que otros sistemas de vehículos rueden en uno o más de dichos trayectos; de esta manera es evidente que puede ser fácilmente ejecutada.

Por lo tanto, la solicitante considera así superadas las objeciones formuladas en el Oficio No. 8141.

VI. EN CUANTO AL PAGO DE TASAS

Se efectúa el correspondiente pago por el valor de la tasa legal fijada por concepto de 9 reivindicaciones adicionales a las primeras 10.

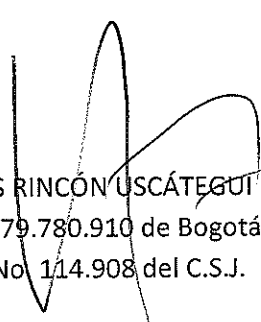
VII. PETICIÓN

Teniendo en cuenta que la presente solicitud cumple con los requisitos de los artículos 26 y 27 de la Decisión 486 de 2000 y considerando que se ha dado respuesta a las observaciones de la Dirección de Nuevas Creaciones con respecto a otros aspectos que tienen que ver con la patentabilidad de la invención, solicito a su Despacho continuar con el trámite administrativo correspondiente.

VIII. ANEXOS

1. Nuevo capítulo reivindicatorio conformado por 19 reivindicaciones
2. Poder de la sociedad ALSTOM TRANSPORT TECHNOLOGIES.
4. Documentos de cesión del inventor

Señor Director,


ANDRÉS RINCÓN USCÁTEGUI
C.C. No. 79.780.910 de Bogotá
T.P.A. No. 114.908 del C.S.J.

REIVINDICACIONES MODIFICADAS

1. Un método que comprende:

determinar varias rutas para un viaje de un primer sistema de vehículos desde un lugar de origen a un lugar de destino en una red de transporte formada por trayectos interconectados entre sí en nodos;

determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba que restringe la forma en que el primer sistema de vehículos transita en la red de transporte; y

determinar una autorización de ocupación de ruta para el primer sistema de vehículos basada en al menos una prueba, la autorización de ocupación de ruta reservando al menos uno de los trayectos para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de manera que se impida que otros sistemas de vehículos transiten al menos uno de los trayectos reservados por la autorización de ocupación de ruta.

2. El método de la reivindicación 1, en donde determinar varias rutas incluye determinar por lo menos una ruta desde el lugar de origen al lugar de destino que no es al menos un trayecto lineal o un trayecto de distancia más corta a lo largo de las rutas desde el lugar de origen al lugar de destino.

3. El método de la reivindicación 1, que comprende además determinar un primer nodo en la red de transporte, que está más cerca del lugar de origen que al menos uno de los otros nodos de los nodos en la red de transporte, y determinar un segundo nodo en la red de transporte, que está más cerca del lugar de destino que al menos uno de los otros nodos de los nodos en la red de transporte, en donde los trayectos se determinan para el viaje desde el primer nodo al segundo nodo.

4. El método de la reivindicación 1, en donde los nodos representan cambios de agujas en intersecciones entre los trayectos, y en donde la autorización de ocupación de ruta, que se determina, reserva al menos uno de los trayectos y al menos unos de los

cambios de agujas para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de manera que se impida que otros sistemas de vehículos transiten en al menos uno de los trayectos y al menos uno de los cambios de agujas reservados por la autorización de ocupación de ruta.

5. El método de la reivindicación 1, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa el menos una prueba incluye determinar si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos cambie la dirección transitando sobre por lo menos un cambio de agujas en cada uno de los cambios de agujas consecutivos de los cambios de agujas en al menos uno de los trayectos.

6. El método de la reivindicación 1, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba incluye determinar si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos transite a lo largo de un primer trayecto de los trayectos, cruce un primer cambio de agujas para transitar en un trayecto divergente de los trayectos, y cruce un segundo cambio de agujas subsiguiente para abandonar el trayecto divergente y transitar en un segundo trayecto de los trayectos, que forma un trayecto directo entre dos lugares con el primer trayecto.

7. El método de la reivindicación 1, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba incluye determinar si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos transite en un primer trayecto de los trayectos, que tiene al menos una restricción que prohíbe transitar en el primer trayecto por el primer sistema de vehículos.

8. El método de la reivindicación 1, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba incluye determinar si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos se devuelva y cambie la dirección muchas veces durante el tránsito sobre un cambio de agujas único.

9. El método de la reivindicación 1, en donde determinar si el tránsito por el

primer sistema de vehículos a lo largo de las rutas no pasa el menos una prueba incluye determinar si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos transite sobre un primer trayecto de los trayectos, que se extiende entre dos cambios de agujas consecutivos que están conectados únicamente por el primer trayecto.

10. El método de la reivindicación 1, en donde una región de vías en la red de transporte incluye dos o más cambios de agujas que están al menos uno dentro de una distancia designada de cada uno, o dentro de la distancia designada de una estación de vehículos, y en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba incluye determinar si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos entre a, o salga de, la región de vías a lo largo de un primer trayecto de los trayectos, que es el único trayecto que conduce a, o sale de, la región de vías.

11. El método de la reivindicación 1, que comprende además comunicar la autorización de ocupación de ruta al menos un cambio de agujas localizados en al menos uno de los nodos en la red de transporte y controlar automáticamente las posiciones de al menos uno de los cambios de agujas, con el fin de hacer que el primer sistema de vehículos transite a lo largo de al menos uno de los trayectos reservados por la autorización de ocupación de ruta.

12. Un sistema que comprende:

Al menos un procesador configurado para determinar varias rutas para un viaje de un primer sistema de vehículos desde un lugar de origen a un lugar de destino en una red de transporte formada por trayectos interconectados entre sí en nodos, al menos un procesador se configura además para determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba que restringe la forma en la que el primer sistema de vehículos transita en la red de transporte, en donde al menos un procesador se configura asimismo para determinar una autorización de ocupación de ruta por el primer sistema de vehículos basada en al menos una prueba, la autorización de ocupación de ruta reservando al menos un trayecto para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de modo que se impida que otros sistemas de vehículos transiten al menos uno de los trayectos reservados por la

autorización de ocupación de ruta.

13. El sistema de la reivindicación 12, en donde al menos un procesador se configura para determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba determinando si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos cambie la dirección transitando sobre por lo menos un cambio de agujas en cada uno de los cambios de agujas consecutivos de cambios de agujas en las rutas.

14. El sistema de la reivindicación 12, en donde al menos uno de los procesadores se configura para determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba determinando si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos transite a lo largo de un primer trayecto de los trayectos, cruce un primer cambio de agujas para transitar en un trayecto divergente de los trayectos, y cruce un segundo cambio de agujas subsiguiente para abandonar el trayecto divergente y transite en un segundo trayecto de los trayectos, que forma un trayecto directo entre dos lugares con el primer trayecto.

15. El sistema de la reivindicación 12, en donde al menos un procesador se configura para determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba determinando si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos transite en un primer trayecto de los trayectos, que tiene al menos una restricción que prohíben transitar en primer trayecto por el primer sistema de vehículos.

16. El sistema de la reivindicación 12, en donde al menos un procesador se configura para determinar si el tránsito por el primer sistema de vehículos a lo largo de las rutas no pasa al menos una prueba determinando si el tránsito a lo largo de las rutas hace que el primer sistema de vehículos se devuelva y cambie la dirección muchas veces durante el tránsito sobre un cambio de agujas único.

17. Un método que comprende:

determinar varias rutas para un viaje de un sistema de vehículos ferroviarios desde un

lugar de origen a un lugar de destino en una red de transporte formada por vías férreas interconectadas entre sí en cambios de agujas;

determinar si el tránsito por el sistema de vehículos ferroviarios a lo largo de las rutas no pasa al menos una prueba que restringe la forma en la que el sistema de vehículos ferroviarios transita en la red de transporte; y

determinar una autorización de ocupación de vía férrea para el sistema de vehículos ferroviarios basada en al menos una prueba, la autorización de ocupación de vía férrea reservando al menos una vía férrea y al menos uno de los cambios de agujas para tránsito por el sistema de vehículos ferroviarios desde el lugar de origen al lugar de destino, de modo que se impida que otros sistemas de vehículos ferroviarios transiten en al menos una de las vías férreas y al menos uno de los cambios de agujas reservados por la autorización de ocupación de vía férrea.

18. El método de la reivindicación 17, en donde determinar si el tránsito por el sistema de vehículos ferroviarios a lo largo de las rutas no pasa el menos una prueba incluye al menos uno de:

determinar si el tránsito a lo largo de las rutas hace que el sistema de vehículos ferroviarios cambie la dirección transitando sobre por lo menos uno de los cambios de agujas en cada uno de los conjuntos consecutivos de los cambios de agujas en al menos uno de los trayectos;

determinar si el tránsito a lo largo de las rutas hace que el sistema de vehículos ferroviarios transite a lo largo de una primera vía férrea de las vías férreas, cruce un primer cambio de agujas de los cambios de agujas para transitar en una vía férrea divergente de las vías férreas, y cruce un segundo cambio de agujas subsiguiente de los cambios de agujas para abandonar la vía férrea divergente y transitar en una segunda vía férrea de las vías férreas, que forma un trayecto directo entre dos lugares con la primera vía férrea;

determinar si el tránsito a lo largo de las rutas hace que el sistema de vehículos ferroviarios transite en una vía férrea de las vías férreas, que tiene al menos una

restricción que prohíben el tránsito en la primera vía férrea por el sistema de vehículos ferroviarios;

determinar si el tránsito a lo largo de las rutas hace que el sistema de vehículos ferroviarios se devuelva y cambie la dirección muchas veces durante el tránsito sobre un cambio de agujas único de los cambios de agujas;

determinar si el tránsito a lo largo de las rutas hace que el sistema de vehículos ferroviarios transite sobre una primera vía férrea de las vías férreas que se extiende entre dos cambios de agujas consecutivos de los cambios de agujas que se conectan únicamente por la primera vía férrea; o

determinar si el tránsito a lo largo de las rutas hace que el sistema de vehículos ferroviarios entre a, o salga de, una región de vías a lo largo de una primera vía férrea de las vías férreas, que es la única vía férrea que conduce a, o sale de, la región de vías.

19. El método de la reivindicación 17, que comprende además controlar automáticamente las posiciones al menos uno de los cambios de agujas, con el fin de hacer que el sistema de vehículos ferroviarios transite a lo largo de al menos una vía férrea y al menos uno de los cambios de agujas reservados por la autorización de ocupación de vía férrea.

CAVELIER

ABOGADOS
EDIFICIO SISKI
CARRERA 4a N° 72-35
BOGOTÁ, 8 - COLOMBIA

REPRESENTACION

REPRESENTATION

Yo (nosotros), abajo firmado (s)/I (we), the undersigned

ALSTOM TRANSPORT TECHNOLOGIES

domiciliado (s) 48 rue Albert Dhaenle 93400
en/of SAINT-OUEN France, Francia

Por el presente nombramos a CAVELIER ABOGADOS, sociedad colectiva constituida de conformidad con las leyes de la República de Colombia, mediante Escritura Pública No. 6233 del 10 de septiembre de 1974, otorgada en la Notaría Sexta del Círculo de Bogotá, domiciliada en Bogotá D.C., con matrícula mercantil No. 00820237 y NIT 860041367-3, domiciliada en la Carrera 4a N° 72-35, Bogotá, Colombia, como nuestra representante en todos los asuntos de Propiedad Industrial e Intelectual, con facultad para recibir notificaciones y nombrar apoderados judiciales o extrajudiciales.

CAVELIER ABOGADOS también podrá representarnos, con las mismas facultades arriba indicadas, ante cualesquiera entidades o personas, ejerzan o no jurisdicción, autoridades administrativas o jurisdiccionales, tribunales de arbitramento, en asuntos de naturaleza civil, comercial, penal, constitucional, competencia, competencia desleal, administrativa, contencioso administrativa, protección del consumidor, variedades vegetales, nombres de dominio, oposiciones u observaciones, cancelación administrativa y judicial, nulidad, medidas cautelares, concesión de licencias, acciones de tutela, la protección de secretos industriales, derecho regulatorio y en general para que nos represente en cualesquiera acciones y procesos que promovamos o se nos promuevan.

La representante podrá, en nuestro nombre, designar apoderados para actuar ante autoridades administrativas y judiciales, por vía extrajudicial y también procesalmente en nuestro nombre, como demandantes, como demandados, como litisconsortes, como agentes oficiosos, como terceros, por llamamiento en garantía o como intervinientes ad excludendum. Dentro de esta autorización, la representante podrá facultar a los

Do hereby appoint CAVELIER ABOGADOS, a general partnership organized under the laws of the Republic of Colombia by means of Public Deed No. 6233 of September 10, 1974, granted at Notary Sixth of the Bogota Circuit, domiciled in Bogota D.C., with Mercantile Registration No. 00820237 and Taxpayer Identification Number 860041367-3, domiciled at Carrera 4a N° 72-35, Bogota, Colombia, as our representative for all Industrial and Intellectual Property matters with faculty to receive notifications and appoint attorneys in and out of Court.

CAVELIER ABOGADOS may also represent us, with the same faculties stated above, before any entities or persons, with or without jurisdiction, administrative or jurisdictional authorities, courts of arbitration, in civil, commercial, criminal, constitutional, competition, unfair competition, administrative, administrative contentious, consumer protection, plant varieties, domain names, opposition or observation matters, administrative and Court cancellation, nullity, precautionary measures, licensing, action for writ mandamus, protection of trade secrets, regulatory law and in general represent us in any actions and suits instituted by us or against us.

The representative may, in our name, designate attorneys to act before administrative and judicial authorities, through out-of-court channels, and also procedurally in our name as plaintiff, defendant, joint litigant, representative without power of attorney, third party, when summoned to appear in court or as intervener ad excludendum. Under this authorization, the representative may empower the attorneys appointed

apoderados que ella designe para transigir, conciliar, admitir los hechos del proceso, desistir, cancelar, recibir, renunciar y sustituir el poder que se le otorgue. Así mismo, la representante tendrá la facultad para revocar el poder así otorgado en el momento que considere pertinente. La representante en todo caso podrá ratificar los actos de agentes oficiosos.

thereby to compromise, conciliate, admit the facts of the case, desist, cancel, receive, resign and substitute the power of attorney granted thereto. Likewise, the representative shall have the faculty of revoking the power of attorney thus granted at any time it may deem convenient. The representative may in any case ratify the acts of representatives without a power of attorney.

Dado y firmado hoy/Given and signed this May 31, 2016

En/in SAINT-OUEN

Por/by Gilles CHRETIEN

Intellectual Property Director

Firma/Signature

Señor Director

NUEVAS CREACIONES

Superintendencia de Industria y Comercio

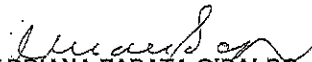
E. S. D.

Asunto : Solicitud de patente para: **SISTEMA Y MÉTODO DE AUTORIZACIÓN DE OCUPACIÓN DE RUTA.**
Expediente : 16.145.928
Solicitante : **ALSTOM TRANSPORT TECHNOLOGIES.**

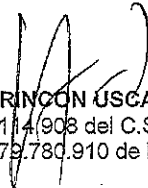
Yo, ADRIANA ZAPATA GIRALDO mayor de edad, vecina de esta ciudad, identificada con cédula de ciudadanía No. 51.680.061 de Bogotá, en mi calidad de representante legal de la sociedad CAVELIER ABOGADOS domiciliada en la Carrera 4 No. 72-35, en desarrollo de la representación que le fue otorgada por la sociedad **ALSTOM TRANSPORT TECHNOLOGIES**, confiero poder a los doctores ANDRÉS RINCÓN USCÁTEGUI, identificado con cédula de ciudadanía No. 79.780.910 de Bogotá, portador de la tarjeta profesional No. 114.908, LUZ CLEMENCIA DE PAEZ, identificada con cédula de ciudadanía No. 35.456.344 de Usaquén, portadora de la Tarjeta Profesional No. 23.555, JORGE CHAVARRO ARISTIZABAL, identificado con la cédula de ciudadanía No. 16.209.380 de Cartago (Valle), portador de la Tarjeta Profesional No. 40.119 y EDNA DARMELY SARMIENTO CHARRY identificada con la cédula de ciudadanía No. 52.006.265 de Bogotá, portadora de la Tarjeta Profesional No. 65.794, para continuar con el trámite de la solicitud indicada en la referencia.

Los apoderados quedan facultados para interponer recursos, transigir, conciliar, desistír, cancelar, recibir, renunciar, sustituir y revocar las sustituciones, y ratificar los actos de agentes oficiosos.

Señor Director,


ADRIANA ZAPATA GIRALDO
C.C. No. 51.680.061 de Bogotá

Acepto:


ANDRES RINCÓN USCÁTEGUI
T.P.A. No. 114.908 del C.S. de la J
C.C. No. 79.780.910 de Bogotá

"EXCELENCIA LEGAL EN UN MUNDO SIN FRONTERAS"

SCT/NCA/COLO-22827-804-004-9

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CESION

Yo, (nosotros) abajo firmado (s)
(1) HORNE Barry, Christopher

domiciliado(s) en

declaro(amos) bajo juramento ser único(s) y verdadero(s) inventor(es)
de la invención:

declaro(amos) así mismo que cedo(emos) y transfiero(erimos), sin
limitación, a favor de la sociedad
ALSTOM TRANSPORT TECHNOLOGIES

constituida y existente de conformidad con las leyes de

domiciliada en
48 rue Albert Dhalenne 93400,
SAINT-OUEN FRANCIA

todos los derechos inherentes a dicha invención y que la citada
Compañía queda facultada para solicitar en su nombre la patente de
invención correspondiente en la República de Colombia.

ASSIGNMENT

I (we), the undersigned
(1) HORNE Barry, Christopher

of SEBASTIAN, FLORIDA

state(s) under oath to be sole and true inventor(s) of the invention:

ROUTE WARRANT SYSTEM AND METHOD

state as well, that assign, without reservations or limitations in favour
of
ALSTOM TRANSPORT TECHNOLOGIES

a corporation constituted and existing in conformity with the laws of

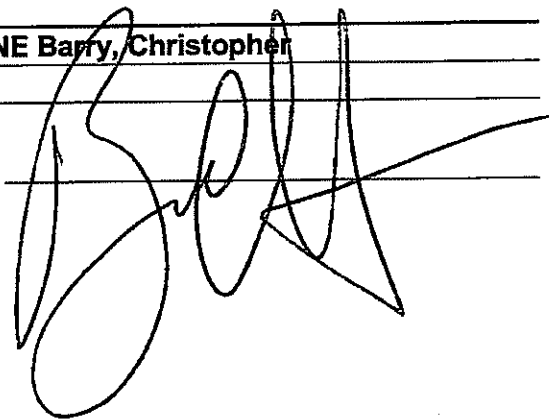
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48 rue Albert Dhalenne 93400,
SAINT-OUEN FRANCE

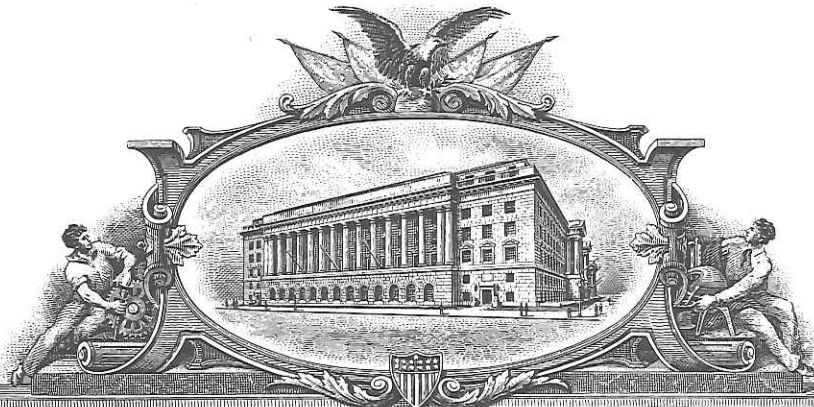
all rights inherent to said invention and that the above mentioned
company hereby is enabled to apply, in its name, for the corresponding
patent invention, in the Republic of Colombia

Dado y firmado hoy/Given and signed this 10th August 2016
en/in _____

por/by HORNE Barry, Christopher

Firma/Signature

A handwritten signature in black ink, appearing to read 'Barry Horne', written over a horizontal line.



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

May 25, 2016

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 62/170,250

FILING DATE: June 03, 2015

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US62/170,250

**By Authority of the
Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office**



JOHN A BURSON
Certifying Officer

Electronic Acknowledgement Receipt

EFS ID:	22506505
Application Number:	62170250
International Application Number:	
Confirmation Number:	2793
Title of Invention:	ROUTE WARRANT SYSTEM AND METHOD
First Named Inventor/Applicant Name:	Barry Christopher Horne
Customer Number:	91959
Filer:	John Kramer
Filer Authorized By:	
Attorney Docket Number:	281987-1
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1	Provisional Cover Sheet (SB16)	281987-1_US_CoverSheet.pdf	1477294 7f001c7040aea4189663b93fc835b1e5bc78fba	no	3

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2	Specification	281987-1_US_Specification.pdf	177961 624de5260e9aeebc33bdcc4a4f802ec472945dd3	no	27
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3	Drawings-only black and white line drawings	281987-1_US_Drawings.pdf	1305016 87cc96a30cdf13d7c490a04b313819f4f25e77f8	no	7
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4	Fee Worksheet (SB06)	fee-info.pdf	30051 134850f70599b469efbaab785bfea3b640f18408	no	2
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Inventor(s)

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Title of Invention ROUTE WARRANT SYSTEM AND METHOD

Attorney Docket Number (if applicable) 281987-1 (552-0302PR)

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ROUTE WARRANT SYSTEM AND METHOD

FIELD

[0001] Embodiments of the subject matter disclosed herein relate to determining route warrants for vehicle systems traveling in a transportation network.

BACKGROUND

[0002] Transportation networks formed from many interconnected routes may be concurrently traveled by several different vehicles. For example, networks of tracks may be traveled by many trains at the same time. In order to ensure safe and timely travel of the trains, track warranties may be issued for the trains. The track warrants can designate which tracks and switches are to be traveled over by the trains at various times. Typically, different dispatch facilities control movement of trains in areas governed by the different dispatch facilities use different track warrants to control where and when the trains move in the respective areas.

[0003] Track warrants currently are generated by finding a direct line between a starting location and an ending location for a scheduled trip of a train. Using this direct line, the tracks and switches that are closest to this direct line are included in a track warranty for the trip of the train. Other lines or paths between the starting and ending locations typically are not considered.

[0004] Because many trains may need to concurrently travel in the same network of tracks, many different trains may have track warrants that include the same tracks and/or switches. In order to prevent the trains from colliding, the schedules of the trains are established so that some trains are forced to wait for a track in the warrants of those trains is clear. As a result, the consideration of only the tracks and switches that are on or near the direct line between starting and ending locations for the trip can pose many scheduling problems.

BRIEF DESCRIPTION

[0005] In one embodiment, a method (e.g., for determining a route warranty for one or more vehicle systems) includes determining plural different paths for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes, determining whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network, and determining a route warranty for the first vehicle system based on the one or more tests. The route warranty reserves one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

[0006] In one embodiment, a system (e.g., for determining a route warranty for one or more vehicle systems) includes one or more processors configured to determine plural different routes for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes. The one or more processors also are configured to determine whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network. The one or more processors also are configured to determine a route warranty for the first vehicle system based on the one or more tests. The route warranty reserves one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

[0007] In one embodiment, a method (e.g., for determining a track warranty for one or more rail vehicle systems) includes determining plural different routes for a trip of a rail vehicle system from an origin location to a destination location in a transportation network formed from tracks interconnected with each other at switches, determining whether travel by the rail vehicle system along the different routes fails one or more tests that restrict how the rail vehicle system travels in the transportation network, and determining a track warranty for the rail vehicle system based on the one or more tests, the route warranty reserving one or more of the tracks and one or more of the switches for travel by the rail vehicle system from the origin location to the destination location such that other rail vehicle systems are

prevented from traveling on the one or more of the tracks and the one or more of the switches reserved by the track warranty.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Reference is made to the accompanying drawings in which particular embodiments and further benefits of the invention are illustrated as described in more detail in the description below, in which:

[0009] Figure 1 illustrates one embodiment of a route warranty system;

[0010] Figure 2 illustrates a vehicle system according to one embodiment;

[0011] Figure 3 illustrates a transportation network according to one embodiment;

[0012] Figure 4 illustrates several via switches between routes according to one example;

[0013] Figure 5 illustrates several via switches between routes according to another example;

[0014] Figure 6 illustrates several via switches between routes according to another example;

[0015] Figure 7 illustrates a switch between routes according to another example;

[0016] Figure 8 illustrates switches and routes for another potential path of the vehicle system according to another example;

[0017] Figure 9 illustrates switches and routes for another potential path of the vehicle system shown in Figure 2 according to another example; and

[0018] Figures 10A and 10B illustrate a flowchart of one embodiment of a method for determining a route warrant for a vehicle system.

DETAILED DESCRIPTION

[0019] Embodiments of the inventive subject matter described herein relate to methods and systems for determining route warrants for vehicle systems. Route warrants are used to authorize vehicle systems (such as trains) to occupy routes, such as main tracks located

outside of the limits of rail yards. Different authorities (e.g., scheduling systems, dispatchers, etc.) dictate movement of the vehicle systems in different areas (which may or may not overlap with each other). The systems and methods described herein provide validation logic to authorize vehicle systems for passage along the routes while ensuring that the limits of one authority do not overlap with another authority.

[0020] In one aspect, the systems and methods described herein can represent a transportation network formed of several interconnected routes as a series of associated nodes connected through paths stored in one or more memory structures (e.g., tables, lists, etc.). The nodes can represent intersections between paths and/or switches at such intersections. With a starting location and final or next destination location for a trip of a vehicle system provided to the systems and methods, the systems and methods can identify the nodes at or near the starting and destination locations, and then search through the nodes between these starting and destination nodes to find one or more routes that the vehicle system can traverse to reach the destination location. The systems and methods can return an indexed data set that represents the paths found between the starting and destination nodes. The systems and methods may translate the lists of nodes between the logical route topology, switches, and named locations along the routes and/or near the nodes.

[0021] Tables (or other memory structures) can store and provide the logical points (e.g., nodes) and the connections (e.g., routes) between the points. The nodes can be associated with a reference identification to a switch at or near the node, which can be used to identify physical location parameters associated for each route. The systems and methods can use this information to search through potential routes (e.g., paths and switches between the starting and destination locations) and nodes to determine whether a valid path exists between the nodes. The resulting data set from the search can include an indexed list of nodes traversed by the various routes. The physical location parameters can be used to allocate the tracks and switches associated with a selected path to a vehicle system in a route warrant. This warrant can assign the tracks and switches to the vehicle system during a trip of the vehicle system to ensure that no other vehicle systems occupy the same switch or same track segment at the same time as the vehicle system having the route warrant.

[0022] Figure 1 illustrates one embodiment of a route warranty system 100. The system 100 is responsible for creation and validation of the warrants for several vehicles traveling in a transportation network formed by several interconnected routes. The system 100 includes

one or more client workstations 102, which can represent one or more computing devices, such as one or more desktop computers, mobile computers (e.g., tablet computers, smart phones, etc.), that have one or more processors for performing the operations described herein. The system 100 supports simultaneous operation on multiple client workstations 102, which access a database server 104 for authority validation operations. The database server 104 represents one or more memory structures, such as computer servers, computer hard drives, or the like. The database server 104 can store information used by the client workstations 102 to determine route warrants for different vehicle systems, such as locations of routes, nodes (e.g., intersections or switches), speed limits, and the like. A communication server 106 represents one or more memory structures and processors that enable communication between the client workstations and the database server 104.

[0023] Figure 2 illustrates a vehicle system 200 according to one embodiment. The vehicle system 200 includes several vehicles 202, 204 that travel together along a route. The vehicles 202 can represent propulsion-generating vehicles, such as locomotives. Alternatively, the vehicles 202 can represent automobiles, marine vessels, or the like. The vehicles 204 can represent non-propulsion-generating vehicles, such as rail cars, trailers, or the like. The vehicles 202, 204 may be mechanically coupled with each other to travel together along a route, or may be separate from each other but communicate with each other to coordinate travel along a route.

[0024] Figure 3 illustrates a transportation network 300 according to one embodiment. The transportation network 300 is formed from several interconnected paths 302, such as tracks, roads, or the like. The paths 302 intersect one another at several nodes 304. The nodes 304 can represent switches between the paths 302 or other intersections between the paths 302. The system 100 shown in Figure 1 can determine potential routes for the vehicle system 200 (shown in Figure 2) to travel from an origin location 306 in the transportation network 300 to a destination location 308 in the transportation network 300.

[0025] In order to create a route warrant for a trip of the vehicle system 200 from the origin location 306 to the destination location 308, the client workstation 102 may identify the origin and destination locations, and the database server 104 can determine nodes 304 that are at or near the origin location and the destination location. The origin location may not be at the exact same location as a node 304, and the database server 104 can identify which node 304 is close or closest to the origin location and identify this node 304 as the origin location

306. Similarly, the database server 104 can identify which node 304 is close or closest to the destination location and identify this node 304 as the destination location 308.

[0026] The client workstation 102 and/or the database server 104 can then search through different combinations of paths 302 and nodes 304 in order to determine different potential routes from the origin location 306 to the destination location 308. Some of these routes may not extend along a straight line or may not represent the shortest possible distance between the origin and destination locations 306, 308 along the paths 302 and nodes 304.

[0027] For some types of vehicle systems 200 and paths 302, not all routes between the origin location 306 and destination location 308 may be traveled by the vehicle systems 200. For example, for rail vehicles, some paths 302 may restrict the direction in which the vehicle systems 200 travel, some switches may restrict the directions that the vehicle systems 200 can travel, or the like. Some paths 302 may already be reserved by other vehicle systems 200 in warrants for those vehicle systems 200. As a result, not all permutations of combinations of the paths 302 and nodes 304 can be used to form potential paths.

[0028] The client workstation 102 and/or the database server 104 can examine the routes that are determined in order to determine if any of the routes should be eliminated as possibilities for the trip of the vehicle system 200 from the origin location 306 to the destination location 308. In one aspect, the client workstation 102 and/or the database server 104 can perform a double via cross-over test on the routes to determine if any of the routes include the vehicle system 200 changing paths 302 by traveling over at least one switch in each of consecutive sets of two or more switches.

[0029] Figure 4 illustrates several via switches between routes according to one example. As shown in Figure 4, a first path 408 connects with a first switch 400, which is connected with second and third paths 410, 412 to a second switch 402. A fourth path 414 connects the second switch 402 with a third switch 404, which is connected with fifth and sixth paths 416, 418 to a fourth switch 406. The fourth switch 406 is connected with a seventh path 420. The switches 400, 402 are consecutive switches in a first set of switches and the switches 404, 406 are consecutive switches in a second set of switches. The first and second sets of switches are consecutive along the route being examined. For example, a vehicle system traveling along the route will pass over at least one of the switches in the first set and one or more of the switches in the second set before traveling over any other switches or sets of

switches. The paths 408, 410, 412, 414, 416, 418, 420 may represent some of the paths 302 shown in Figure 3 and the switches 400, 402, 404, 406 may represent some of the nodes 304 shown in Figure 3.

[0030] In one embodiment, the client workstation 102 and/or database server 104 can examine potential paths to determine if any of the paths include a double via cross-over. A double via cross-over occurs when a route includes a vehicle system 200 changing direction and moving from one path to another path by passing over at least one switch in each of consecutive sets of switches. For example, if a route includes the vehicle system 200 traveling on the path 408 to the switch 400, changing direction by crossing to the path 412 via the switch 400, traveling along the paths 412, 414, 418, and changing direction by crossing over to the path 420 via the switch 406, then such a route includes a double via cross-over. As another example, if a route includes the vehicle system 200 traveling on the path 408 to the switch 400, traveling on the path 410 to the switch 402, crossing over to the path 414 via the switch 402, crossing over to the path 416 via the switch 404, and then traveling on the paths 416, 420, then such a route includes a double via cross-over.

[0031] If a route includes a double via cross-over, then that route may be eliminated from the list of potential routes between the origin location 306 and the destination location 308. For example, an acceptable route may only include a single via cross-over in one embodiment. Alternatively, an acceptable route may include a larger number of via cross-overs. In another example, a route may include a double via cross-over so long as the double via cross-over does not violate any restrictions on directions of travel along paths 408, 410, 412, 414, 416, 418, 420 and/or switches 400, 402, 404, 406. For example, the path 410 and/or the route 416 may only allow travel in a right-to-left direction in Figure 4. A route that directs a vehicle system 200 to travel in a left-to-right direction in Figure 4 along the path 410 and/or the path 416 may be eliminated from the list of potential routes.

[0032] Figure 5 illustrates several via switches between paths according to another example. Another test that can be performed on a potential routes includes a direct path test. In this test, the client workstation 102 and/or database server 104 examines the paths and switches of a route to determine if the route includes a direct, non-divergent path or if the route includes a possible divergent path. For example, if the route includes a direct path segment between two locations separated from each other by one or more switches that connect the direct path segment with a divergent path segment, then this test can determine

whether the route causes the vehicle system 200 to travel directly between the two locations along the direct path segment or whether the route causes the vehicle system 200 to not travel directly between the two locations (e.g., by leaving the direct path segment by crossing over a switch, traveling over another path segment, and then returning to the direct path segment by crossing over another switch). The paths and switches shown in Figure 5 can represent some of the paths and nodes, respectively, shown in Figure 3.

[0033] In Figure 5, the route includes the vehicle system 200 traveling along the path 412 to the path 414 via the switch 402, to the path 418 via the switch 404, and to the path 420 via the switch 406. Because this path does not include a divergent path, such as a path that moves from the path 414 to the path 416 via the switch 404 and then back to the path 420 via the switch 406, this route may still be an acceptable route. A route that includes the divergent path, however, may not be an acceptable route. For example, a route that directs the vehicle system 200 to leave the direct path along paths 414, 418, 420 for travel on the path 416 may be an unacceptable divergent route. The client workstation 102 and/or the database server 104 may identify the divergent path by determining whether the route being examined includes two or more switches between two locations along the path, and the path causes the vehicle system to travel from one location, cross over one switch to leave a path and travel along a divergent path then cross over another switch to leave the divergent path to travel to the other location. Such a route may be eliminated from the list of potential routes.

[0034] Figure 6 illustrates several via switches between paths according to another example. Another test that can be performed on a potential path includes an unsupported route test. In this test, the client workstation 102 and/or database server 104 examines the paths and switches of a route to determine if the route includes a path that the vehicle system 200 is not permitted to travel along. Some paths can have restrictions that prevent certain or all vehicle systems from traveling on the paths. For example, a vehicle system 200 may be prevented from traveling along a path if the path is being repaired, if the path has an upper weight limit that is exceeded by the vehicle system 200, or the like. As another example, if the vehicle system 200 is an electric vehicle system 200 that is powered by an overhead catenary, an electrified rail, or the like, and a path does not have an overhead catenary, electrified rail, or other device for powering the vehicle system 200, then the vehicle system 200 may not be permitted for travel on the route. As another example, if the vehicle system 200 is carrying hazardous material and a route extends through an urban area where such

materials are prohibited, then the vehicle system 200 may not be permitted for travel on the route. If a route identified by the client workstation 102 and/or database server 104 includes a path that the vehicle system 200 is not permitted to travel along, then that route may be eliminated from the list of potential routes.

[0035] In Figure 6, a first path 600 connects with a first switch 602, which is connected with second and third paths 604, 606. The paths 604, 606 are connected with a second switch 608, which is connected with a fourth path 610. The path 610 is connected with a third switch 612, which is connected with a fifth path 614. The fifth path 614 is connected with a fourth switch 616, which is connected with a sixth path 618. The paths and switches shown in Figure 6 can represent some of the paths and nodes, respectively, shown in Figure 3.

[0036] The database server 104 may store restrictions associated with the path 606, and the client workstation 102 and/or database server 104 can determine if travel along the path 606 in a potential route will violate any of the restrictions. If the path 606 has one or more restrictions that prevent the vehicle system 200 from traveling on the path 606, then the client workstation 102 and/or database server 104 can eliminate the route that includes travel along the path 606 from consideration. As a result, the route including the path 606 may be discarded or otherwise removed from the list of potential routes. Another route (e.g., that does not include the path 606) may remain in the list of potential paths.

[0037] Figure 7 illustrates a switch 704 between paths according to another example. Another test that can be performed on a potential route includes an invalid normal "Z" reverse path test. In this test, the client workstation 102 and/or database server 104 examines the paths and switches of a route to determine if the route causes the vehicle system 200 to double back through a switch 704. For example, the switch 704 may include non-intersecting path segments 706, 710 joined by an intersecting segment 708. The intersecting segment 708 may be the part of the switch 704 that moves to change where the vehicle system 200 is directed toward upon traveling over the switch 704. The paths and switches shown in Figure 7 can represent some of the paths and nodes, respectively, shown in Figure 3.

[0038] A route that includes the switch 704 may direct the vehicle system 200 to enter into the switch 704 along a first direction (e.g., from a path 700 onto the segment 706), then turn to at least partially reverse direction (e.g., switch from travel over the segment 706 to travel over the segment 708), then turn to at least partially reverse direction again (e.g.,

switch from travel over the segment 708 to travel over the segment 710), and then exit the switch 704 along a path 702. For example, the path may direct the vehicle system 200 to enter the switch 704 through the normal switch leg and exit through the reverse switch leg, or enter through the reverse switch leg and exit through the normal switch leg. Because some vehicle systems may be unable to travel in this manner, this path will be excluded from the list of potential paths. For example, rail vehicles may be unable to reverse directions during travel over the switch 704. As a result, the path shown in Figure 7 fails the invalid normal "Z" reverse path test and is excluded from the list of potential paths.

[0039] Figure 8 illustrates switches and paths for another potential route of the vehicle system 200 according to another example. Another test that can be performed on a potential route includes a via region test. In this test, the client workstation 102 and/or database server 104 examines how close multiple switches 804, 806, 808, 810 are to each other and/or to a station (e.g., a train station) to determine whether a route warrant can be placed on the switches 804, 806, 808, 810. A route warrant for one vehicle system 200 can restrict travel on the same paths and/or switches in the route warrant by other vehicle systems. This test seeks to avoid reserving too many switches and/or routes that are close to each other and/or a station for only a single vehicle system 200.

[0040] In the illustrated example, a first path 812 leads into a first via region 800. The first via region 800 includes several switches 804, 806 that are connected by non-intersecting paths 814, 816. The first via region 800 is connected with a second via region 802 by a path 818. The second via region 802 includes several switches 808, 810 connected by non-intersecting paths 820, 822. The second via region 802 also is connected with a path 824. The via regions 800, 802 may be defined as an area encompassing switches that are within a designated distance of each other (e.g., 5 kilometers, 10 kilometers, or another distance) and/or within a designated distance of a station (e.g., 5 kilometers, 10 kilometers, or another distance). The paths and switches shown in Figure 8 can represent some of the paths and nodes, respectively, shown in Figure 3.

[0041] For those routes that extend through one or more via regions 800, 802, the client workstation 102 and/or database server 104 can examine the via regions 800, 802 to determine whether multiple paths 814, 816, 820, 822 extend through the via regions 800, 802. The client workstation 102 and/or database server 104 can look for the multiple paths 814, 816, 820, 822 through the via regions 800, 802 and, if multiple paths 814, 816, 820, 822 are

found, then the route may be a valid route and remain in the list of potential routes. In the example shown in Figure 8, each of the via regions 800, 802 has two non-intersecting paths 814, 816, 820, 822 between the switches 804, 806, 808, 810. For example, the via region 800 includes the paths 814, 816 between the switches 804, 806 and the via region 802 includes the paths 820, 822 between the switches 808, 810.

[0042] The presence of the plural paths between the switches in a via region 800, 802 can mean that a route warrant can be issued for a vehicle system 200 that reserves one of the paths in the via regions 800, 802. For example, a routes that includes the switch 804, one (but not both) of the paths 814, 816, the switch 806, the path 818, the switch 808, one (but not both) of the paths 820, 822, the switch 810, and the path 824 may be a valid route because reserving only one of the paths 814 or 816 and only one of the paths 820 or 822 in a route warrant keeps the other paths 816 or 814 and the other path 822 or 820 available for travel by another vehicle system. As a result, such a route would pass the via region test. But, if only a single route existed between the switches 804, 806 in the via region 800 or if only a single route existed between the switches 808, 810 in the via region 802, then a route that includes either of these single paths would fail the via region test. Such a route would fail the test because a route warrant that includes the route could create a traffic bottleneck at or near the via region 800, 802. As a result, the route would be excluded from the list of potential routes.

[0043] Figure 9 illustrates switches and paths for another potential route of the vehicle system 200 according to another example. Another test that can be performed on a potential route includes a single via switch region test. In this test, the client workstation 102 and/or database server 104 examines whether any via region includes a single path exiting out of or entering into a switch within the via region. Such a route may create a bottleneck in traffic if a route warrant reserves the route for one vehicle system 200.

[0044] In the illustrated example, three via regions 900, 902, 904 are provided. The via region 900 includes two paths 906, 908 leading into a switch 910 and a single path 912 leading out of the switch 910. The via region 902 includes three switches 914, 920, 926, with the single path 912 leading into the switch 914, two paths 916, 918 extending between the switch 914 and the switch 920, two paths 922, 924 extending between the switch 922 and the switch 926, and a single path 928 leading out of the switch 926. The via region 904 includes a switch 930 with the single path 928 leading into the switch 930 and two paths 932, 934

leading out of the switch 930. The paths and switches shown in Figure 9 may represent the paths 302 and nodes 304, respectively, shown in Figure 3.

[0045] For those routes that extend through one or more via regions 900, 902, 904, the client workstation 102 and/or database server 104 can examine the paths in the routes to determine if any of the routes include a single route leading into and/or out of a via region 900, 902, 904. These types of single paths can create traffic problems if the single paths are reserved in a route warrant for a vehicle system. For example, the client workstation 102 and/or database server 104 may not want to reserve either of the paths 912, 928 in a route warrant for the vehicle system 200 because doing so may create a bottleneck behind the reserved path 912, 928. Therefore, any route having a single route 912, 928 extending into or out of a via region 900, 902, 904 would fail this test because a route warrant that includes the path could create a traffic bottleneck at or near the via region. As a result, the route would be excluded from the list of potential routes.

[0046] After searching through the multiple potential routes through different combinations of the paths and the nodes (e.g., the switches), and then eliminating some routes that fail one or more of the tests described herein, the client workstation 102 and/or database server 104 may have a list of potential routes that will cause the vehicle system 200 to travel to the origin location to the destination location without violating the tests on the various paths. The client workstation 102 may present these routes to an operator of the system 100, such as in a list of routes. Each route may be represented by a list or table of the switches that the vehicle system 200 will travel through from the origin location to the destination location. Alternatively, the client workstation 102 may present these routes in another manner, such as on a map.

[0047] A route may be selected for the vehicle system 200, and one or more other routes may be selected for one or more other vehicle systems. The selected routes for the vehicle systems then become route warrants for the vehicle systems. The route warrants may then be communicated to one or more other locations for implementation. For example, the route warrants may be communicated to several different dispatch locations that separately control movements of vehicle systems within different areas of the transportation network. These different dispatch locations may all have the same route warrants so that all dispatch locations are aware of the movements of vehicle systems moving into and/or out of the areas controlled by the dispatch locations. Optionally, the route warrants may be used control operation of the

vehicle systems, switches, or the like. For example, the route warrants may be communicated to the vehicle systems for the vehicle systems to use in determining where the vehicle systems are to move and when the vehicle systems are to move throughout the transportation network. The route warrants may be communicated to the switches (or to systems that control operation of the switches) to cause the switches to change positions and connect the routes that are part of a route warrant for a vehicle system.

[0048] Figures 10A and 10B illustrate a flowchart of one embodiment of a method 1000 for determining a route warrant for a vehicle system. The method 1000 may be performed by one or more embodiments of the system 100 shown and described herein. At 1002, nodes that are at or near an origin location and a destination location for a trip of a vehicle system are determined. These nodes may be a node that is closer to the origin location than one or more (or all) other nodes and a node that is closer to the destination location than one or more (or all) other nodes. At 1004, paths and other nodes that are between the nodes of the origin and destination locations are determined. These nodes can include switches and the paths can include the paths that connect the switches.

[0049] At 1006, various potential routes between the nodes of the origin and destination locations are determined. These routes represent different combinations of the paths and nodes that will cause a vehicle system to travel from the node at or near the origin location to the node that is at or near the destination location. These routes may include one or more routes that do not extend along a straight path between the nodes of the origin and destination locations.

[0050] At 1008, a value of i is set to one. The value of i is used to iteratively examine and test the potential routes. At 1010, a determination is made as to whether the i^{th} potential route fails the double via cross-over test. As described above, this test examines whether the i^{th} potential route causes a vehicle system to moving across two switches to move between two paths in violation of a direction of travel restriction of any path. If the i^{th} potential route includes a double via cross-over, then that route may be eliminated from the list of potential routes between the origin location and the destination location. As a result, flow of the method 1000 can proceed toward 1024. But, if the i^{th} potential route does not include a double via cross-over, then that route may remain in the list of potential routes (subject to one or more other tests). As a result, flow of the method 1000 can proceed toward 1012.

[0051] At 1012, a determination is made as to whether the i^{th} potential route fails the direct path test. As described above, this test examines whether the i^{th} potential route causes a vehicle system to leave a first path, travel onto a divergent path, and then return to the first path (or a path that is an extension of the first path). For example, this test can examine whether the i^{th} potential route needlessly extends the length of the trip by having the vehicle system diverge from a shorter route between two consecutive switches. If the i^{th} potential route fails the direct path test, then that route may be eliminated from the list of potential routes between the origin location and the destination location. As a result, flow of the method 1000 can proceed toward 1024. But, if the i^{th} potential route passes the direct path test, then that route may remain in the list of potential paths (subject to one or more other tests). As a result, flow of the method 1000 can proceed toward 1014.

[0052] At 1014, a determination is made as to whether the i^{th} potential route fails the unsupported route test. As described above, this test examines whether the i^{th} potential route causes a vehicle system to travel along a path that the vehicle system is not permitted to travel along. If the i^{th} potential route fails the unsupported route test, then that route may be eliminated from the list of potential routes between the origin location and the destination location. As a result, flow of the method 1000 can proceed toward 1024. But, if the i^{th} potential route passes the unsupported route test, then that route may remain in the list of potential route (subject to one or more other tests). As a result, flow of the method 1000 can proceed toward 1016.

[0053] At 1016, a determination is made as to whether the i^{th} potential route fails the reverse path test. As described above, this test examines whether the i^{th} potential route causes a vehicle system to double back through a switch. For example, if the route causes the vehicle system to travel through a switch, then turn back and travel through the same switch again before exiting the switch, then the route fails the reverse path test. If the i^{th} potential route fails the reverse path test, then that route may be eliminated from the list of potential routes between the origin location and the destination location. As a result, flow of the method 1000 can proceed toward 1024. But, if the i^{th} potential route passes the reverse path test, then that route may remain in the list of potential routes (subject to one or more other tests). As a result, flow of the method 1000 can proceed toward 1018.

[0054] At 1018, a determination is made as to whether the i^{th} potential route fails the via region test. As described above, this test examines whether the i^{th} potential route includes a

path that extends through a via region as the only path between switches in the via region. If the i^{th} potential route fails the via region test, then that route may be eliminated from the list of potential route between the origin location and the destination location. As a result, flow of the method 1000 can proceed toward 1024. But, if the i^{th} potential route passes the via region test, then that route may remain in the list of potential routes (subject to one or more other tests). As a result, flow of the method 1000 can proceed toward 1020.

[0055] At 1020, a determination is made as to whether the i^{th} potential route fails the single via switch region test. As described above, this test examines whether the i^{th} potential route extends through a via region having only a single route exiting out of or entering into a switch within the via region. If the i^{th} potential route fails the single via switch region test, then that route may be eliminated from the list of potential routes between the origin location and the destination location. As a result, flow of the method 1000 can proceed toward 1024. But, if the i^{th} potential route passes the single via switch region test, then that route may remain in the list of potential paths. As a result, flow of the method 1000 can proceed toward 1022.

[0056] At 1022, the i^{th} route remains in the list of potential routes for generating route warrants. Once the i^{th} route has passed the various tests, the route may be used to generate a route warrant for one or more vehicle systems. At 1024, however, the i^{th} route is eliminated from being considered for generating a route warrant for one or more vehicle systems. For example, because the i^{th} route failed one or more tests, the route may not be suitable for generating a route warrant. Following 1022 or 1024, flow of the method 1000 can proceed toward 1026 in Figure 10B.

[0057] At 1026, the value of i is incrementally increased by one. This allows for the next potential route to be examined. Prior to examining the next potential route, however, at 1028, a determination is made as to whether the value of i is greater than the value of N . For example, if the value of i is more than the total number of potential route, then the last route may have been examined and there are no further routes to examine. As a result, flow of the method 1000 can proceed to 1030. But, if the value of i is not greater than N , then one or more additional potential routes may still need to be examined. As a result, flow of the method 100 can return to 1010 in Figure 10A.

[0058] At 1030, route warrants are assigned to one or more vehicle systems based on the remaining potential paths. For example, the list of potential routes that passed the tests can be displayed to an operator of the system 100. The operator may select a route for assignment to a vehicle system as a route warrant for that vehicle system. This process may be repeated for additional vehicle systems.

[0059] In one embodiment, a method (e.g., for determining a route warranty for one or more vehicle systems) includes determining plural different paths for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes, determining whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network, and determining a route warranty for the first vehicle system based on the one or more tests. The route warranty reserves one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

[0060] In one aspect, determining the plural different routes includes determining at least one route from the origin location to the destination location that is not one or more of a linear path or a shortest distance path along the routes from the origin location to the destination location.

[0061] In one aspect, the method also includes determining a first node in the transportation network that is closer to the origin location than one or more other nodes of the nodes in the transportation network and determining a second node in the transportation network that is closer to the destination location than one or more other nodes of the nodes in the transportation network, wherein the paths are determined for the trip from the first node to the second node.

[0062] In one aspect, the nodes represent switches at intersections between the paths, and the route warranty that is determined reserves the one or more of the routes and one or more of the switches for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths and the one or more of the switches reserved by the route warranty.

[0063] In one aspect, determining whether the travel by the first vehicle system along one or more of the paths fails the one or more tests includes determining whether the travel along the one or more of the paths causes the first vehicle system to change direction by traveling over at least one switch in each of consecutive sets of switches in the one or more of the paths.

[0064] In one aspect, determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether the travel along the one or more routes causes the first vehicle system to travel along a first path of the paths, cross over a first switch to travel on a divergent path of the paths, and cross over a subsequent second switch to leave the divergent path and travel on a second path of the paths that forms a direct path between two locations with the first path.

[0065] In one aspect, determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to travel on a first path of the paths that has one or more restrictions prohibiting travel on the first path by the first vehicle system.

[0066] In one aspect, determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to double back and change direction multiple times during travel over a single switch.

[0067] In one aspect, determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to travel over a first path of the paths that extends between two consecutive switches that are connected only by the first path.

[0068] In one aspect, a via region in the transportation network includes two or more switches that are one or more of within a designated distance of each other or within the designated distance of a vehicle station, and determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to one or more of enter into or exit out of the via region along a first path of the paths that is the only path leading into or exiting out of the via region.

[0069] In one aspect, the method also includes communicating the route warranty to one or more switches located at one or more of the nodes in the transportation network and automatically controlling positions of the one or more switches in order to cause the first vehicle system to travel along the one or more routes reserved by the route warranty.

[0070] In one embodiment, a system (e.g., for determining a route warranty for one or more vehicle systems) includes one or more processors configured to determine plural different routes for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes. The one or more processors also are configured to determine whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network. The one or more processors also are configured to determine a route warranty for the first vehicle system based on the one or more tests. The route warranty reserves one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

[0071] In one aspect, the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether the travel along the one or more of the routes causes the first vehicle system to change direction by traveling over at least one switch in each of consecutive sets of switches in the one or more of the routes.

[0072] In one aspect, the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether the travel along the one or more routes causes the first vehicle system to travel along a first path of the paths, cross over a first switch to travel on a divergent path of the paths, and cross over a subsequent second switch to leave the divergent path and travel on a second path of the paths that forms a direct path between two locations with the first route.

[0073] In one aspect, the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether travel along the one or more routes causes the first vehicle system to

travel on a first path of the paths that has one or more restrictions prohibiting travel on the first path by the first vehicle system.

[0074] In one aspect, the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether travel along the one or more routes causes the first vehicle system to double back and change direction multiple times during travel over a single switch.

[0075] In one embodiment, a method (e.g., for determining a track warranty for one or more rail vehicle systems) includes determining plural different routes for a trip of a rail vehicle system from an origin location to a destination location in a transportation network formed from tracks interconnected with each other at switches, determining whether travel by the rail vehicle system along the different routes fails one or more tests that restrict how the rail vehicle system travels in the transportation network, and determining a track warranty for the rail vehicle system based on the one or more tests, the route warranty reserving one or more of the tracks and one or more of the switches for travel by the rail vehicle system from the origin location to the destination location such that other rail vehicle systems are prevented from traveling on the one or more of the tracks and the one or more of the switches reserved by the track warranty.

[0076] In one aspect, determining whether the travel by the rail vehicle system along one or more of the routes fails the one or more tests includes one or more of: determining whether the travel along the one or more of the paths causes the rail vehicle system to change direction by traveling over at least one of the switches in each of consecutive sets of the switches in the one or more of the paths; determining whether the travel along the one or more paths causes the rail vehicle system to travel along a first track of the tracks, cross over a first switch of the switches to travel on a divergent track of the tracks, and cross over a subsequent second switch of the switches to leave the divergent track and travel on a second track of the tracks that forms a direct path between two locations with the first track; determining whether travel along the one or more paths causes the rail vehicle system to travel on a track route of the tracks that has one or more restrictions prohibiting travel on the first track by the rail vehicle system; determining whether travel along the one or more paths causes the rail vehicle system to double back and change direction multiple times during travel over a single switch of the switches; determining whether travel along the one or more paths causes the rail vehicle system to travel over a first track of the tracks that extends

between two consecutive switches of the switches that are connected only by the first track; and/or determining whether travel along the one or more paths causes the rail vehicle system to one or more of enter into or exit out of a via region along a first track of the tracks that is the only track leading into or exiting out of the via region.

[0077] In one aspect, the method also includes automatically controlling positions of one or more of the switches in order to cause the rail vehicle system to travel along the one or more tracks and the one or more switches reserved by the track warranty.

[0078] It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments (and/or aspects thereof) may be used in combination with each other. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the inventive subject matter without departing from its scope. While the dimensions and types of materials described herein are intended to define the parameters of the inventive subject matter, they are by no means limiting and are exemplary embodiments. Many other embodiments will be apparent to one of ordinary skill in the art upon reviewing the above description. The scope of the inventive subject matter should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects. Further, the limitations of the following claims are not written in means-plus-function format and are not intended to be interpreted based on 35 U.S.C. § 112, sixth paragraph, unless and until such claim limitations expressly use the phrase "means for" followed by a statement of function void of further structure.

[0079] This written description uses examples to disclose several embodiments of the inventive subject matter and also to enable a person of ordinary skill in the art to practice the embodiments of the inventive subject matter, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the inventive subject matter may include other examples that occur to those of ordinary skill in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include

equivalent structural elements with insubstantial differences from the literal languages of the clauses.

[0080] The foregoing description of certain embodiments of the inventive subject matter will be better understood when read in conjunction with the appended drawings. To the extent that the figures illustrate diagrams of the functional blocks of various embodiments, the functional blocks are not necessarily indicative of the division between hardware circuitry. Thus, for example, one or more of the functional blocks (for example, processors or memories) may be implemented in a single piece of hardware (for example, a general purpose signal processor, microcontroller, random access memory, hard disk, and the like). Similarly, the programs may be stand-alone programs, may be incorporated as subroutines in an operating system, may be functions in an installed software package, and the like. The various embodiments are not limited to the arrangements and instrumentality shown in the drawings.

[0081] As used herein, an element or step recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such exclusion is explicitly stated. Furthermore, references to "an embodiment" or "one embodiment" of the inventive subject matter are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising," "including," or "having" an element or a plurality of elements having a particular property may include additional such elements not having that property.

[0082] Since certain changes may be made in the above-described systems and methods without departing from the spirit and scope of the inventive subject matter herein involved, it is intended that all of the subject matter of the above description or shown in the accompanying drawings shall be interpreted merely as examples illustrating the inventive concept herein and shall not be construed as limiting the inventive subject matter.

The following clauses recite at least some inventive aspects of the subject matter described herein:

1. A method comprising:

determining plural different paths for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes;

determining whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network; and

determining a route warranty for the first vehicle system based on the one or more tests, the route warranty reserving one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

2. The method of any other clause, wherein determining the plural different routes includes determining at least one route from the origin location to the destination location that is not one or more of a linear path or a shortest distance path along the routes from the origin location to the destination location.

3. The method of any other clause, further comprising determining a first node in the transportation network that is closer to the origin location than one or more other nodes of the nodes in the transportation network and determining a second node in the transportation network that is closer to the destination location than one or more other nodes of the nodes in the transportation network, wherein the paths are determined for the trip from the first node to the second node.

4. The method of any other clause, wherein the nodes represent switches at intersections between the paths, and wherein the route warranty that is determined reserves the one or more of the routes and one or more of the switches for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths and the one or more of the switches reserved by the route warranty.

5. The method of any other clause, wherein determining whether the travel by the first vehicle system along one or more of the paths fails the one or more tests includes determining whether the travel along the one or more of the paths causes the first vehicle system to change direction by traveling over at least one switch in each of consecutive sets of switches in the one or more of the paths.

6. The method of any other clause, wherein determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether the travel along the one or more routes causes the first vehicle system to travel along a first path of the paths, cross over a first switch to travel on a divergent path of the paths, and cross over a subsequent second switch to leave the divergent path and travel on a second path of the paths that forms a direct path between two locations with the first path.

7. The method of any other clause, wherein determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to travel on a first path of the paths that has one or more restrictions prohibiting travel on the first path by the first vehicle system.

8. The method of any other clause, wherein determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to double back and change direction multiple times during travel over a single switch. ✓

9. The method of any other clause, wherein determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first vehicle system to travel over a first path of the paths that extends between two consecutive switches that are connected only by the first path.

10. The method of any other clause, wherein a via region in the transportation network includes two or more switches that are one or more of within a designated distance of each other or within the designated distance of a vehicle station, and wherein determining whether the travel by the first vehicle system along one or more of the routes fails the one or more tests includes determining whether travel along the one or more routes causes the first

vehicle system to one or more of enter into or exit out of the via region along a first path of the paths that is the only path leading into or exiting out of the via region.

11. The method of any other clause, further comprising communicating the route warranty to one or more switches located at one or more of the nodes in the transportation network and automatically controlling positions of the one or more switches in order to cause the first vehicle system to travel along the one or more routes reserved by the route warranty.

12. A system comprising:

one or more processors configured to determine plural different routes for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes, the one or more processors also configured to determine whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network, wherein the one or more processors also are configured to determine a route warranty for the first vehicle system based on the one or more tests, the route warranty reserving one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

13. The system of any other clause, wherein the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether the travel along the one or more of the routes causes the first vehicle system to change direction by traveling over at least one switch in each of consecutive sets of switches in the one or more of the routes.

14. The system of any other clause, wherein the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether the travel along the one or more routes causes the first vehicle system to travel along a first path of the paths, cross over a first switch to travel on a divergent path of the paths, and cross over a subsequent second switch to leave the divergent path and travel on a second path of the paths that forms a direct path between two locations with the first route.

15. The system of any other clause, wherein the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether travel along the one or more routes causes the first vehicle system to travel on a first path of the paths that has one or more restrictions prohibiting travel on the first path by the first vehicle system.

16. The system of any other clause, wherein the one or more processors are configured to determine whether the travel by the first vehicle system along one or more of the routes fails the one or more tests by determining whether travel along the one or more routes causes the first vehicle system to double back and change direction multiple times during travel over a single switch.

18. A method comprising:

determining plural different routes for a trip of a rail vehicle system from an origin location to a destination location in a transportation network formed from tracks interconnected with each other at switches;

determining whether travel by the rail vehicle system along the different routes fails one or more tests that restrict how the rail vehicle system travels in the transportation network; and

determining a track warranty for the rail vehicle system based on the one or more tests, the route warranty reserving one or more of the tracks and one or more of the switches for travel by the rail vehicle system from the origin location to the destination location such that other rail vehicle systems are prevented from traveling on the one or more of the tracks and the one or more of the switches reserved by the track warranty.

19. The method of any other clause, wherein determining whether the travel by the rail vehicle system along one or more of the routes fails the one or more tests includes one or more of:

determining whether the travel along the one or more of the paths causes the rail vehicle system to change direction by traveling over at least one of the switches in each of consecutive sets of the switches in the one or more of the paths;

determining whether the travel along the one or more paths causes the rail vehicle system to travel along a first track of the tracks, cross over a first switch of the switches to travel on a divergent track of the tracks, and cross over a subsequent second switch of the switches to leave the divergent track and travel on a second track of the tracks that forms a direct path between two locations with the first track;

determining whether travel along the one or more paths causes the rail vehicle system to travel on a track route of the tracks that has one or more restrictions prohibiting travel on the first track by the rail vehicle system;

determining whether travel along the one or more paths causes the rail vehicle system to double back and change direction multiple times during travel over a single switch of the switches;

determining whether travel along the one or more paths causes the rail vehicle system to travel over a first track of the tracks that extends between two consecutive switches of the switches that are connected only by the first track; or

determining whether travel along the one or more paths causes the rail vehicle system to one or more of enter into or exit out of a via region along a first track of the tracks that is the only track leading into or exiting out of the via region.

20. The method of any other clause, further comprising automatically controlling positions of one or more of the switches in order to cause the rail vehicle system to travel along the one or more tracks and the one or more switches reserved by the track warranty.

ABSTRACT

A system and method for determining a route warranty for one or more vehicle systems determine plural different paths for a trip of a first vehicle system from an origin location to a destination location in a transportation network formed from paths interconnected with each other at nodes, determine whether travel by the first vehicle system along the different routes fails one or more tests that restrict how the first vehicle system travels in the transportation network, and determine a route warranty for the first vehicle system based on the one or more tests. The route warranty reserves one or more of the paths for travel by the first vehicle system from the origin location to the destination location such that other vehicle systems are prevented from traveling on the one or more of the paths reserved by the route warranty.

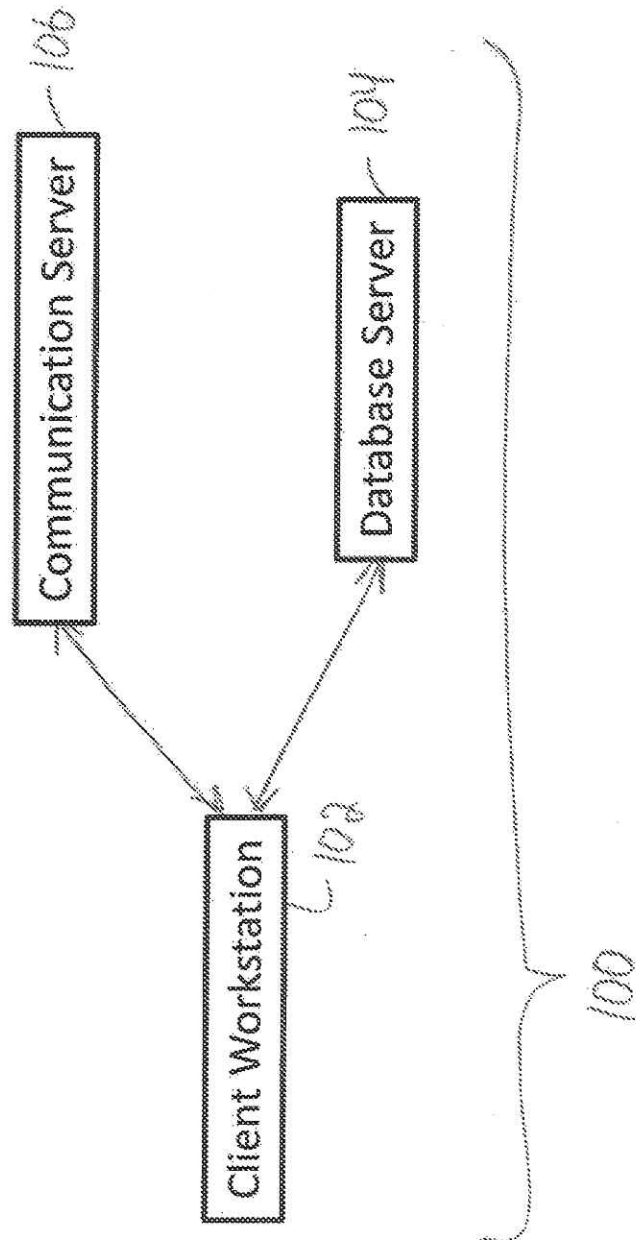


FIG. 1

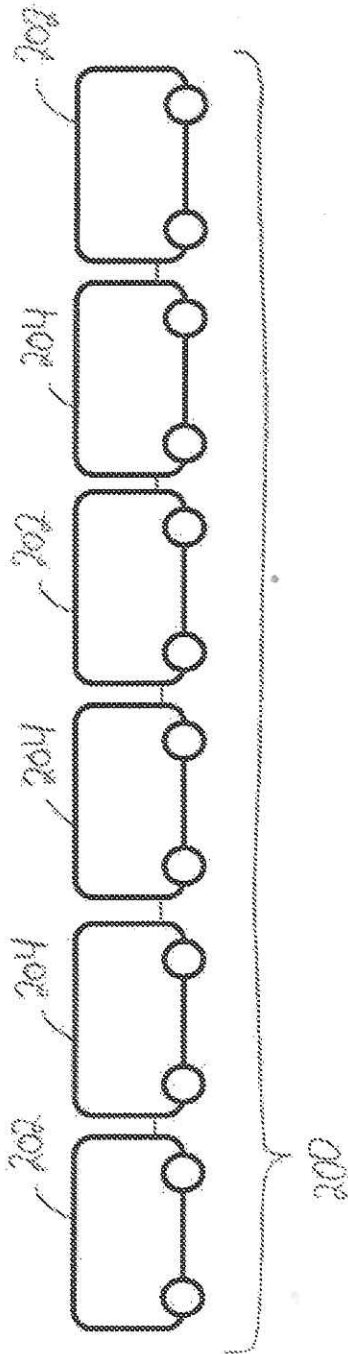


FIG. 2

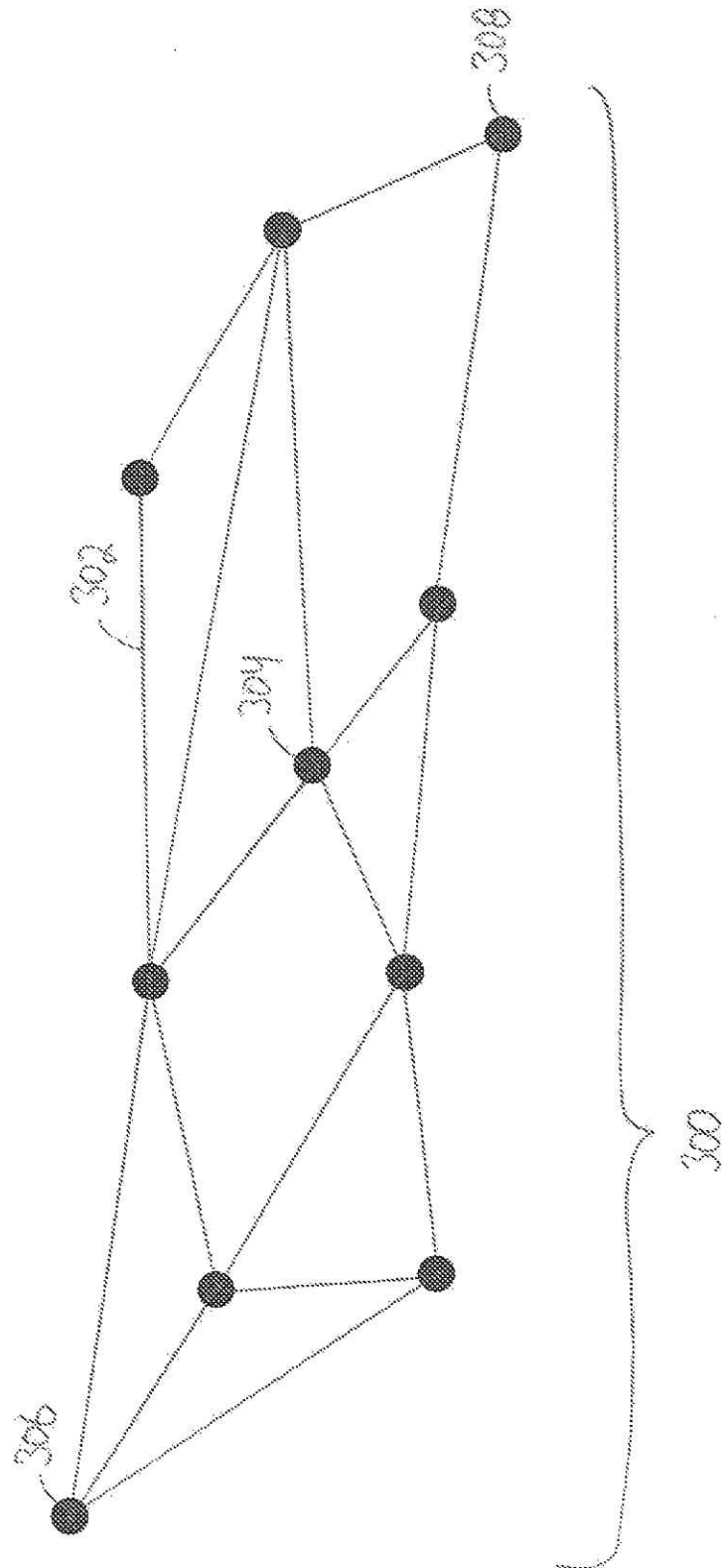


FIG. 3

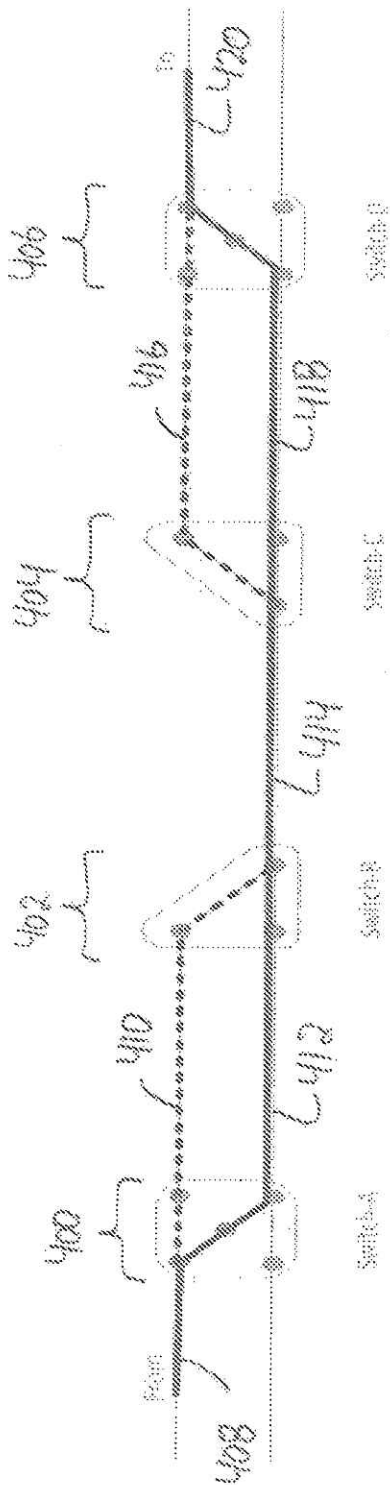


FIG. 4

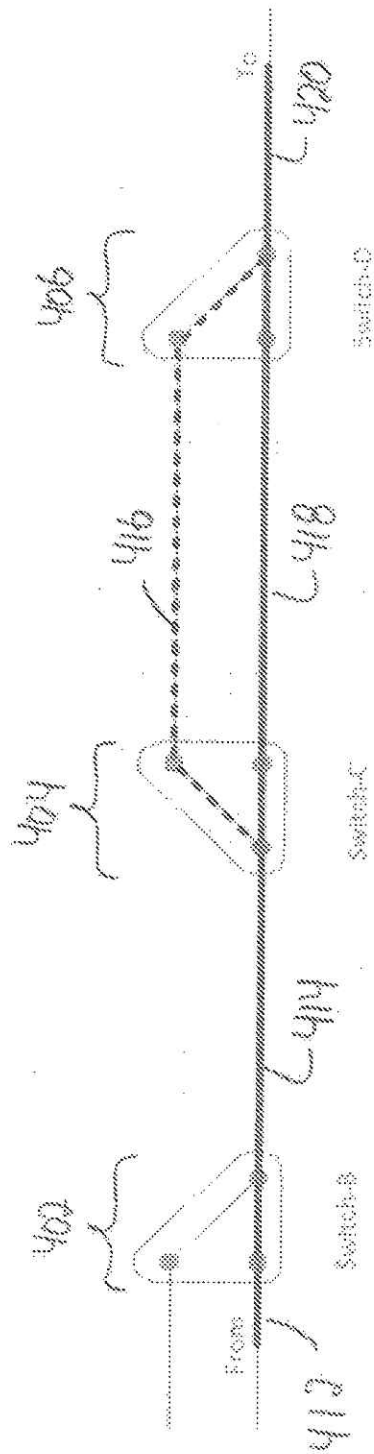


FIG. 5

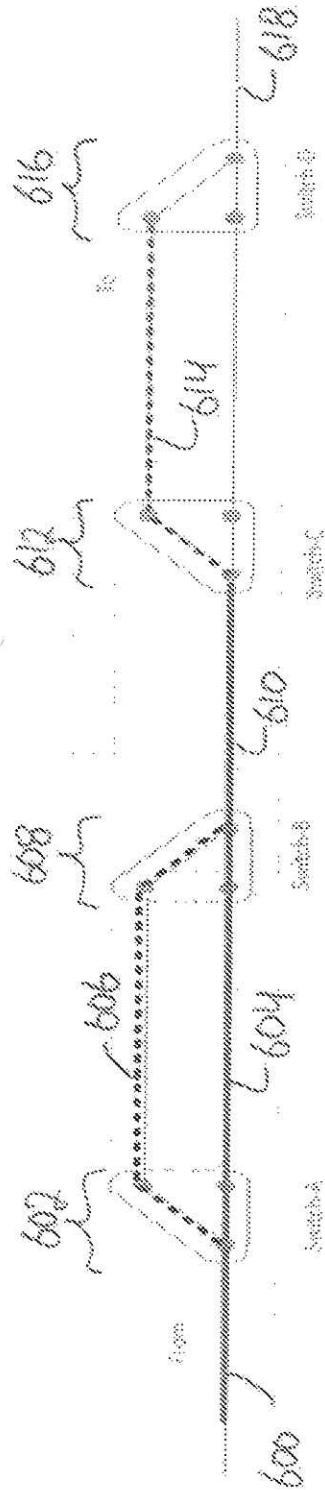


FIG. 6

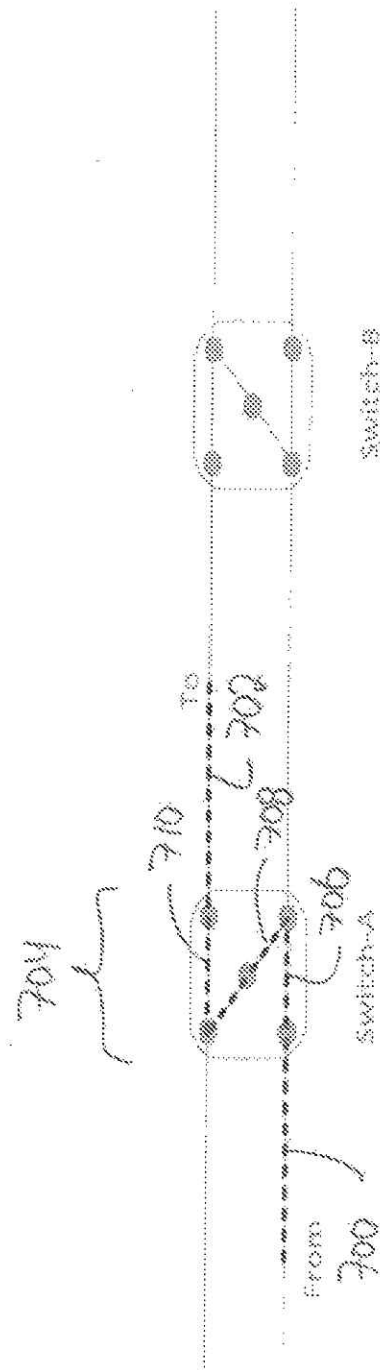


FIG. 7

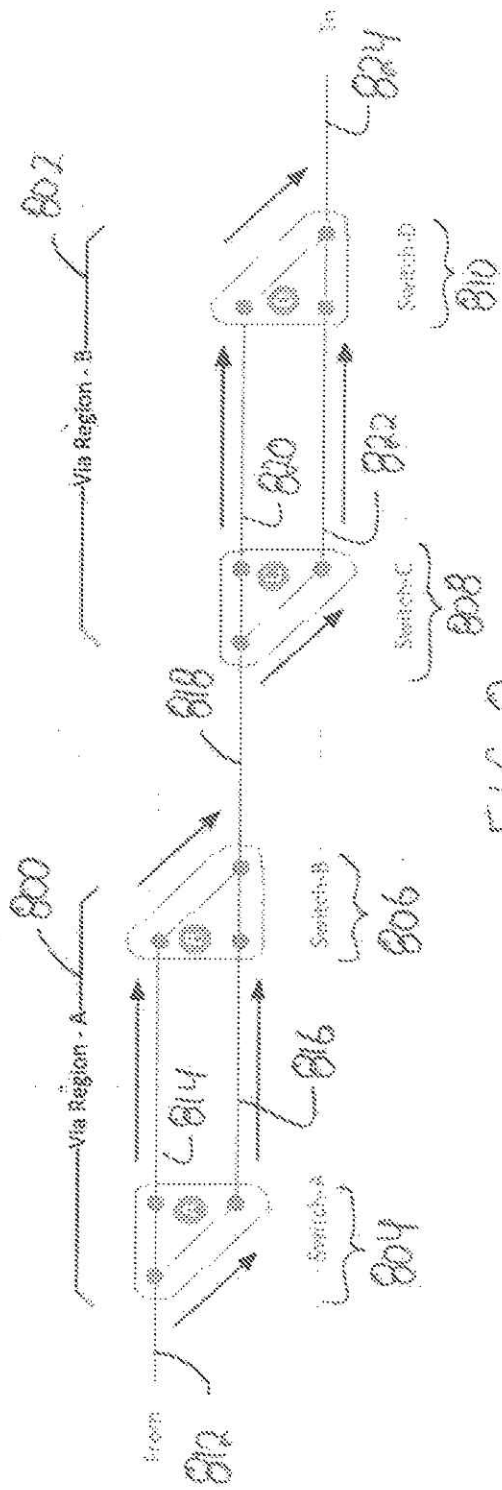


FIG. 8

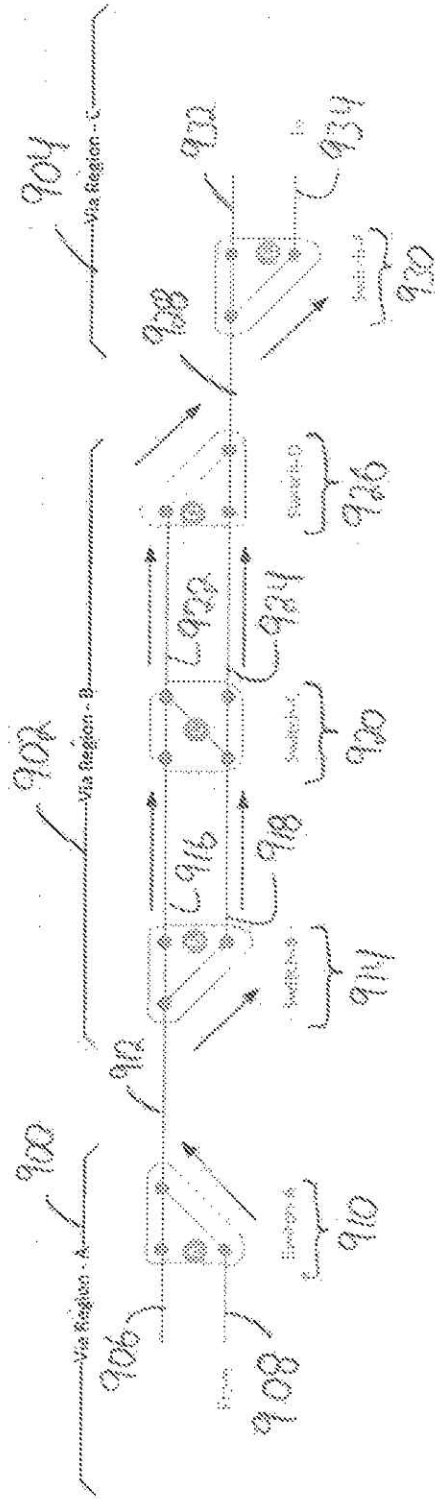


FIG. 9

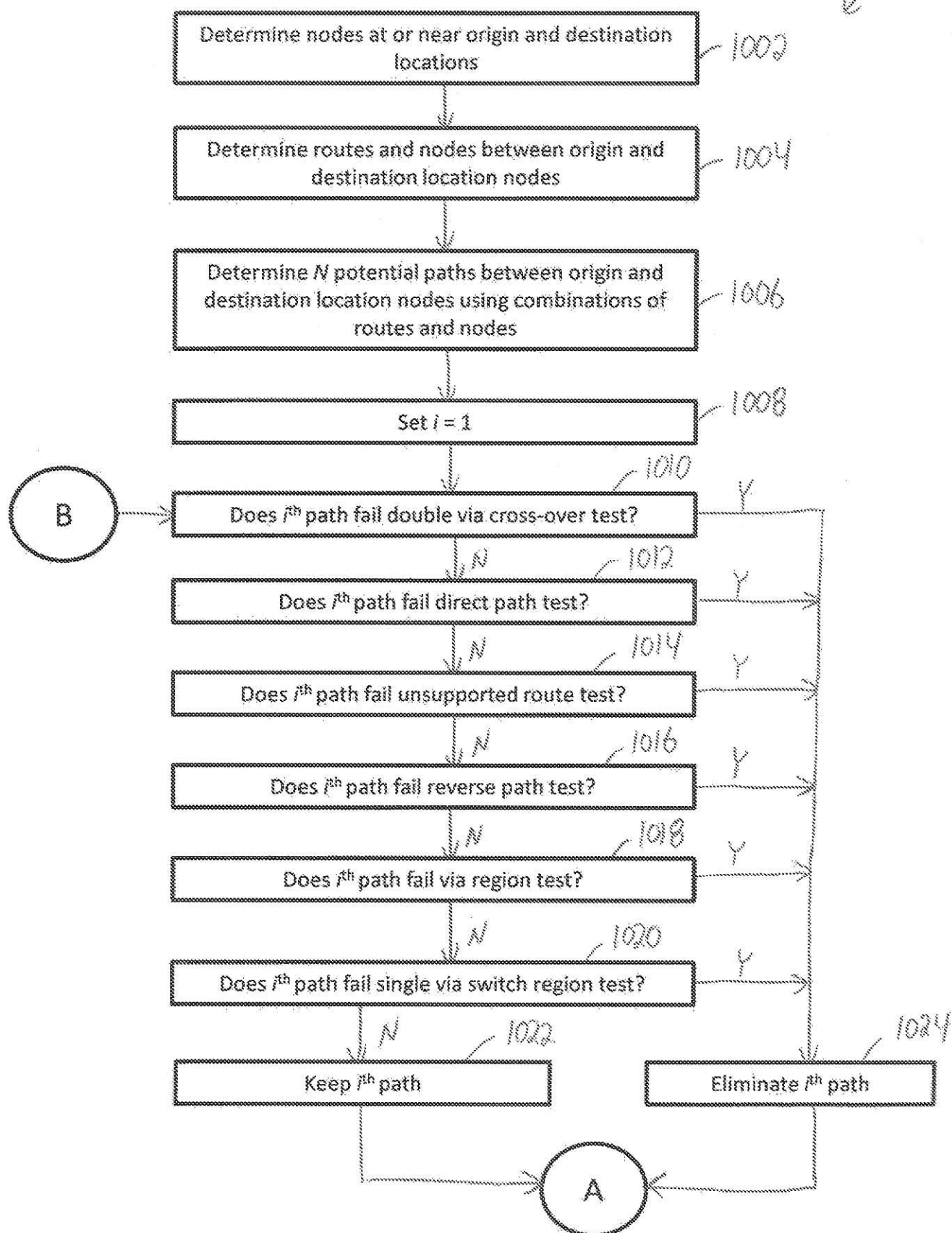
1000
↙

FIG. 10A

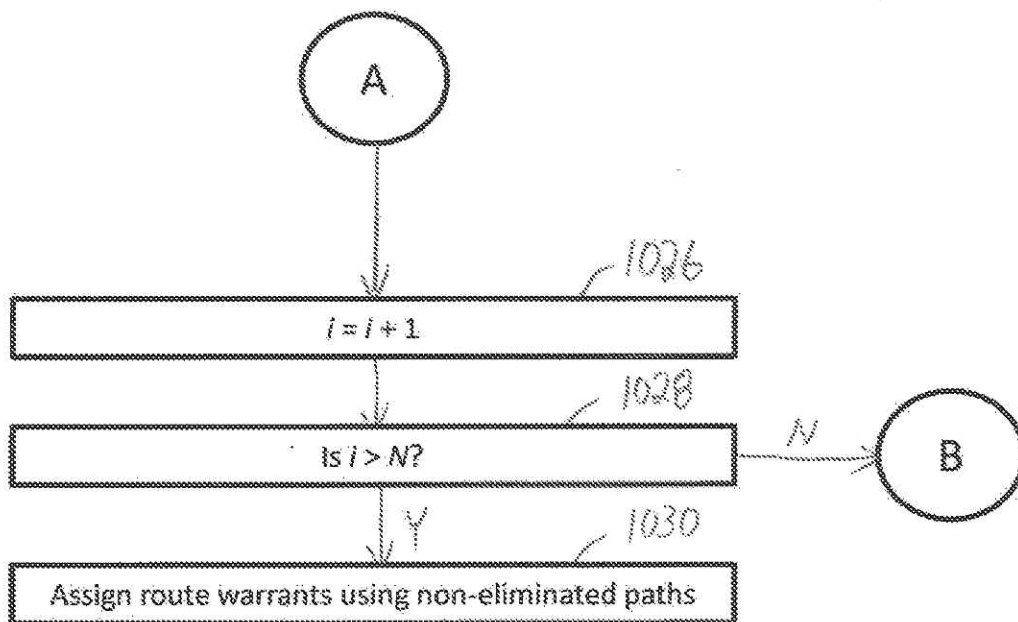


FIG. 10B

TRADUCCIÓN SIMPLE AL ESPAÑOL REALIZADA POR MELISSA AGUDELO
MAGALHÃES DEL SIGUIENTE DOCUMENTO, ESCRITO ORIGINALMENTE EN
INGLÉS.

ESTADOS UNIDOS DE AMÉRICA
A TODOS LOS QUE LA PRESENTE VIEREN, SABED:
DEPARTAMENTO DE COMERCIO DE LOS ESTADOS UNIDOS
Oficina de Marcas y Patentes de los Estados Unidos

25 de mayo de 2016

POR MEDIO DE LA PRESENTE SE CERTIFICA QUE EL DOCUMENTO QUE
FIGURA EN ANEXO ES UNA COPIA FIEL TOMADA DE LOS ARCHIVOS DE LA
OFICINA DE MARCAS Y PATENTES DE ESTADOS UNIDOS, CORRESPONDIENTE
A LA SOLICITUD DE PATENTE IDENTIFICADA A CONTINUACIÓN, LA CUAL
CUMPLIÓ CON LOS REQUISITOS PARA LA CONCESIÓN DE FECHA DE
SOLICITUD CONFORME A 35 USC 111.

SOLICITUD DE MARCA: *62/170,250*

FECHA DE SOLICITUD: *03 de junio de 2015*

EL CÓDIGO DE PAÍS Y EL NÚMERO DE SU SOLICITUD DE PRIORIDAD QUE SE
VAN A USAR PARA PRESENTAR LA SOLICITUD EN EL EXTERIOR BAJO EL
CONVENIO DE PARÍS ES *US62/170,250*

Con autorización del

Subsecretario de Comercio para la Propiedad Intelectual y
Director de la Oficina de Marcas y Patentes de los Estados
Unidos

(Firmado)

JOHN A. BURSON

Oficial de Registro

Sello: ilegible

1. Un método que comprende:

determinar varias rutas diferentes para un viaje de un primer sistema de vehículos desde un lugar de origen a un lugar de destino en una red de transporte formada por trayectos interconectados entre sí en nodos;

determinar si el tránsito por el primer sistema de vehículos a lo largo de las diferentes rutas no pasa una o más pruebas que restringen la forma en que el primer sistema de vehículos transita en la red de transporte; y

determinar una autorización de ocupación de ruta para el primer sistema de vehículos basada en la una o más pruebas, en donde la autorización de ocupación de ruta reserva uno o más de los trayectos para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de manera que se impida que otros sistemas de vehículos transiten en el uno o más de los trayectos reservados por la autorización de ocupación de ruta.

2. El método de cualquier otra reivindicación, en donde determinar las varias rutas diferentes incluye determinar por lo menos una ruta desde el lugar de origen al lugar

de destino que no es uno o más de un trayecto lineal o un trayecto de distancia más corta a lo largo de las rutas desde el lugar de origen al lugar de destino.

3. El método de cualquier otra reivindicación, que comprende además determinar un primer nodo en la red de transporte, que está más cerca del lugar de origen que uno o más de los otros nodos de los nodos en la red de transporte, y determinar un segundo nodo en la red de transporte, que esté más cerca del lugar de destino que uno o más de los otros nodos de los nodos en la red de transporte, en donde los trayectos se determinan para el viaje desde el primer nodo al segundo nodo.

4. El método de cualquier otra reivindicación, en donde los nodos representan cambios de agujas en las intersecciones entre los trayectos, y en donde la autorización de ocupación de ruta, que se determina, reserva el uno o más de los trayectos y uno o más de los cambios de agujas para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de manera que se impida que otros sistemas de vehículos transiten en el uno o más de los trayectos y el uno o más de los cambios de agujas reservados por la autorización de ocupación de ruta.

5. El método de cualquier otra reivindicación, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas incluye determinar si el tránsito a lo largo de la una o más rutas hace que el primer sistema de vehículos cambie la dirección transitando sobre por lo menos un cambio de agujas en cada uno de los cambios de agujas consecutivos en el uno o más trayectos.

6. El método de cualquier otra reivindicación, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de las diferentes rutas no pasa la una o más pruebas incluye determinar si el tránsito a lo largo de las diferentes rutas hace que el primer sistema de vehículos transite a lo largo de un primer trayecto de los trayectos, cruce un primer cambio de agujas para transitar en un trayecto divergente de los trayectos, y cruce un segundo cambio de agujas subsiguiente para abandonar el trayecto

divergente y transitar en un segundo trayecto de los trayectos, que forma un trayecto directo entre dos lugares con el primer trayecto.

7. El método de cualquier otra reivindicación, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas incluye determinar si el tránsito a lo largo de las diferentes rutas hace que el primer sistema de vehículos transite en un primer trayecto de los trayectos, que tiene una o más restricciones que prohíben transitar en el primer trayecto por el primer sistema de vehículos.

8. El método de cualquier otra reivindicación, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas incluye determinar si el tránsito a lo largo de la una o más rutas hace que el primer sistema de vehículos se devuelva y cambie la dirección muchas veces durante el tránsito sobre un único cambio de agujas.

9. El método de cualquier otra reivindicación, en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas incluye determinar si el tránsito a lo largo de la una o más rutas hace que el primer sistema de vehículos transite sobre un primer trayecto de los trayectos, que se extiende entre dos cambios de agujas consecutivos que están conectados únicamente por el primer trayecto.

10. El método de cualquier otra reivindicación, en donde una región de vías en la red de transporte incluye dos o más cambios de agujas que están uno o más de dentro de una distancia designada de cada uno, o dentro de la distancia designada de una estación de vehículos, y en donde determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas incluye determinar si el tránsito a lo largo de la una o más rutas hace que el primer sistema de vehículos entre a, o salga de, la región de vías a lo largo de un primer trayecto de los trayectos, que es el único trayecto que conduce a, o sale de, la región de vías.

11. El método de cualquier otra reivindicación, que comprende además comunicar la autorización de ocupación de ruta a uno o más cambios de agujas localizados en uno o más de los nodos en la red de transporte y controlar automáticamente las posiciones de los uno o más cambios de agujas, con el fin de hacer que el primer sistema de vehículos transite a lo largo del uno o más trayectos reservados por la autorización de ocupación de ruta.

12. Un sistema que comprende:

uno o más procesadores configurados para determinar varias rutas diferentes para un viaje de un primer sistema de vehículos desde un lugar de origen a un lugar de destino en una red de transporte formada por trayectos interconectados entre sí en nodos, en donde el uno o más procesadores se configuran además para determinar si el tránsito por el primer sistema de vehículos a lo largo de las diferentes rutas no pasa una o más pruebas que restringen la forma en la que el primer sistema de vehículos transita en la red de transporte, en donde el uno o más procesadores se configuran asimismo para determinar una autorización de ocupación de ruta por el primer sistema de vehículos basada en la una o más pruebas, en donde la autorización de ocupación de ruta reserva uno o más de los trayectos para tránsito por el primer sistema de vehículos desde el lugar de origen al lugar de destino, de modo que se impida que otros sistemas de vehículos transiten en el uno o más de los trayectos reservados por la autorización de ocupación de ruta.

13. El sistema de cualquier otra reivindicación, en donde los uno o más procesadores se configuran para determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas determinando si el tránsito a lo largo de la una o más rutas hace que el primer sistema de vehículos cambie la dirección transitando sobre por lo menos un cambio de agujas en cada uno de los cambios de agujas consecutivos de cambios de agujas en las diferentes rutas.

14. El sistema de cualquier otra reivindicación, en donde el uno o más procesadores se configuran para determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas determinando si

el tránsito a lo largo de la una o más rutas hace que el primer sistema de vehículos transite a lo largo de un primer trayecto de los trayectos, cruce un primer cambio de agujas para transitar en un trayecto divergente de los trayectos, y cruce un segundo cambio de agujas subsiguiente para abandonar el trayecto divergente y transite en un segundo trayecto de los trayectos, que forma un trayecto directo entre dos lugares con el primer trayecto.

15. El sistema de cualquier otra reivindicación, en donde el uno o más procesadores se configuran para determinar si el tránsito por el primer sistema de vehículos a lo largo de la una o más rutas no pasa la una o más pruebas determinando si el tránsito a lo largo de las diferentes rutas hace que el primer sistema de vehículos transite en un primer trayecto de los trayectos, que tiene una o más restricciones que prohíben transitar en el primer trayecto por el primer sistema de vehículos.

16. El sistema de cualquier otra reivindicación, en donde el uno o más procesadores se configuran para determinar si el tránsito por el primer sistema de vehículos a lo largo de las diferentes rutas no pasa la una o más pruebas determinando si el tránsito a lo largo de las diferentes rutas hace que el primer sistema de vehículos se devuelva y cambie la dirección muchas veces durante el tránsito sobre un único cambio de agujas único.

18. Un método que comprende:

determinar varias rutas diferentes para un viaje de un sistema de vehículos ferroviarios desde un lugar de origen a un lugar de destino en una red de transporte formada por vías férreas interconectadas entre sí en cambios de agujas;

determinar si el tránsito por el sistema de vehículos ferroviarios a lo largo de las diferentes rutas no pasa una o más pruebas que restringen la forma en la que el sistema de vehículos ferroviarios transita en la red de transporte; y

determinar una autorización de ocupación de vía férrea para el sistema de vehículos ferroviarios basada en la una o más pruebas, en donde la autorización de ocupación de vía férrea reserva una o más de las vías férreas y uno o más de los cambios de agujas para tránsito por el sistema de vehículos ferroviarios desde el lugar de origen al lugar de destino, de modo que se impida que otros sistemas de vehículos ferroviarios transiten en la una o más de las vías férreas y el uno o más de los cambios de agujas reservados por la autorización de ocupación de vía férrea.

19. El método de cualquier otra reivindicación, en donde determinar si el tránsito por el sistema de vehículos ferroviarios a lo largo de la una o más rutas no pasa la una o más pruebas incluye uno o más de:

determinar si el tránsito a lo largo de las diferentes rutas hace que el sistema de vehículos ferroviarios cambie la dirección transitando sobre por lo menos uno de los cambios de agujas en cada uno de los conjuntos consecutivos de cambios de agujas en el uno o más de los trayectos;

determinar si el tránsito a lo largo de las diferentes rutas hace que el sistema de vehículos ferroviarios transite a lo largo de una primera vía férrea de las vías férreas, cruce un primer cambio de agujas de los cambios de agujas para transitar en una vía férrea divergente de las vías férreas, y cruce un segundo cambio de agujas subsiguiente de los cambios de agujas para abandonar la vía férrea divergente y transitar en una segunda vía férrea de las vías férreas, que forma un trayecto directo entre dos lugares con la primera vía férrea;

determinar si el tránsito a lo largo de las diferentes rutas hace que el sistema de vehículos ferroviarios transite en una vía férrea de las vías férreas, que tiene una o más restricciones que prohíben el tránsito en la primera vía férrea por el sistema de vehículos ferroviarios;

determinar si el tránsito a lo largo de las diferentes rutas hace que el sistema de vehículos ferroviarios se devuelva y cambie la dirección muchas veces durante el tránsito

sobre un cambio de agujas único de los cambios de agujas;

determinar si el tránsito a lo largo de las diferentes rutas hace que el sistema de vehículos ferroviarios transite sobre una primera vía férrea de las vías férreas que se extiende entre dos cambios de agujas consecutivos de los cambios de agujas que se conectan únicamente por la primera vía férrea; o

determinar si el tránsito a lo largo de la una o más rutas hace que el sistema de vehículos ferroviarios entre a, o salga de, una región de vías a lo largo de una primera vía férrea de las vías férreas, que es la única vía férrea que conduce a, o sale de, la región de vías.

20. El método de cualquier otra reivindicación, que comprende además controlar automáticamente las posiciones de uno o más de los cambios de agujas, con el fin de hacer que el sistema de vehículos ferroviarios transite a lo largo de la una o más vías férreas y el uno o más cambios de agujas reservados por la autorización de ocupación de vía férrea.