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(54) Title: MOBILE SYSTEM FOR GENERATION, STORAGE, AND PROVISION OF ELECTRICAL POWER

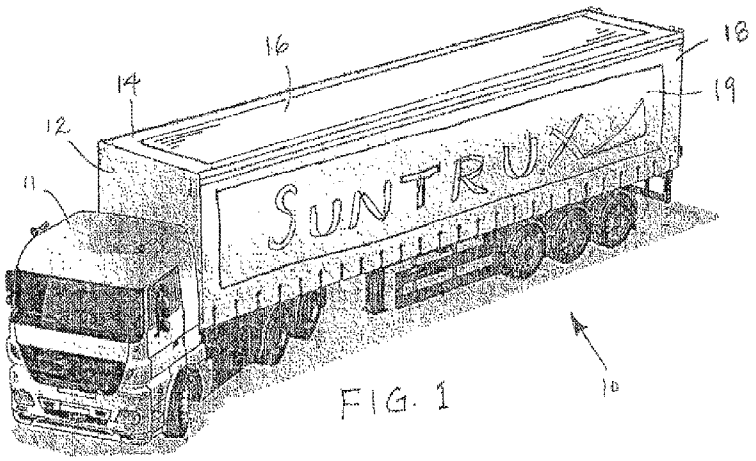


FIG. 1

(57) Abstract: A mobile electric charging system incorporated into an over-highway vehicle is disclosed. The system may include solar power generating panels provided on the vehicle outer surface and batteries electrically connected to the solar panels. An electric power dispensing system may be connected to the batteries. An electric vehicle may connect to the electric power dispensing system for recharging.

WO 2015/160937 A1

MOBILE SYSTEM FOR GENERATION, STORAGE AND PROVISION OF ELECTRICAL POWER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application relates to, and claims the benefit of the earlier filing date and priority of U.S. Provisional Patent Application No. 61/979,729, filed on April 15, 2014, entitled "Mobile System For Generation, Storage and Provision of Electrical Power."

FIELD OF THE INVENTION

[0002] The present invention relates generally to systems and methods for generating electrical power from solar energy using a mobile platform, as well as storing the electrical power on, and providing the electrical power from, the mobile platform.

BACKGROUND OF THE INVENTION

[0003] Electrically powered vehicles, and in particular passenger automobiles, are becoming more and more prevalent on nations' road systems. To date, such vehicles have been used mainly for local, largely urban, transportation needs. The limited range and protracted recharging time of electric vehicles has factored in restricting them to local use. Specifically, electric vehicles are disadvantaged, as compared with gasoline and diesel powered vehicles, due to the lack of conveniently located recharging stations incorporated into the nations' highway systems.

[0004] The desire to use electric vehicles on highways, as compared with local roads, is currently increasing. Electric vehicles are considered to be superior to gasoline and diesel powered vehicles because they are considered to have a less negative impact on the environment. However, the over highway use of such vehicles continues to be hindered by the limited range of such vehicles, as well as the underdeveloped distribution system for the electric power required by them. Accordingly, there is a need for systems and methods for providing electric power to recharge electric vehicles at convenient locations along major highways and roads.

[0005] The cost of providing a network of permanent recharging installations along all highways and major roads is prohibitive due to the limited number of electric vehicles currently in use. Accordingly, there is a need to provide recharging stations along the a

nation's highways and roads which reduces the need for the construction of permanent installations.

SUMMARY OF THE INVENTION

[0006] Responsive to the foregoing challenges, Applicant has developed a mobile electric charging system incorporated into an over-highway vehicle, said system comprising: an over-highway vehicle including outer surfaces; one or more solar power generating panels provided along a first vehicle outer surface; one or more batteries electrically connected to the one or more solar panels, said one or more batteries disposed in or on the over-highway vehicle; and an electric power dispensing system connected to the one or more batteries, said electric power dispensing system being disposed in or on the over-highway vehicle.

[0007] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only, and are not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In order to assist the understanding of this invention, reference will now be made to the appended drawings, in which like reference characters refer to like elements. The drawings are exemplary only, and should not be construed as limiting the invention.

[0009] Figure 1 is a pictorial view of a mobile electric charging system which is incorporated into a vehicle in accordance with an embodiment of the present invention.

[0010] Figure 2 is a schematic view of a mobile electric charging system which is incorporated into a vehicle in accordance with an embodiment of the present invention.

[0011] Figure 3 is a flow chart of a method of authorizing electric vehicle recharging using a mobile electric charging system which is incorporated into a vehicle in accordance with an embodiment of the present invention.

[0012] Figure 4 is a pictorial view of a mobile electric charging system which is incorporated into a vehicle in accordance with an alternative embodiment of the present invention.

[0013] Figure 5 is a pictorial view of a mobile electric charging system which is incorporated into a vehicle in accordance with a further alternative embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0014] Reference will now be made in detail to system and method embodiments of the present invention, examples of which are illustrated in the accompanying drawings. With reference to Fig. 1, in a first embodiment of the invention, an over-highway motor driven vehicle 10 may include a tractor 11 and a mobile charging portion 12 (i.e., mobile electric charging system) having outer surfaces exposed to sunlight. One or more of these surfaces, such as an upper surface 14, may have one or more solar power generating panels 16 attached thereto. With reference to Fig. 2, the solar panels 16 may be electrically connected to one or more batteries 20, which in turn are electrically connected to an electrical power dispensing system 30. The electrical power dispensing system 30 may include a cord 34 that includes a head end 32 which is adapted to connect to and recharge the battery pack of an electric vehicle.

[0015] The electrical power dispensing system 30 may include a mechanism for determining the location of the mobile charging portion 12, such as a gps locator, which is used to facilitate recharging of an electric vehicle. With reference to Fig. 3, in step 40, the locator may determine the location of the mobile charging portion 12. The determined location may be broadcast to a network of receivers associated with electric vehicles in step 42 either by the electric power dispensing system 30 or by an associated communication center (not shown) servicing a plurality of mobile charging portions. In response to the transmission, posting, or broadcast of the location of the mobile charging portion 12, an electric vehicle may automatically, or through operator activity, transmit a request for recharging, which is received at the mobile charging portion 12 or an associated communication center in step 44. A request for recharging may be automatically transmitted in response to a system onboard the electric vehicle determining that the charge of the batteries for the electric vehicle has fallen below a predetermined level. The request for recharging may include an identification code which is uniquely associated with the electric vehicle and other information, such as the amount of recharge needed or desired.

[0016] In step 46, the electrical power dispensing system 30 or an associated communication center may determine the identity of the electric vehicle requesting recharging from the identification code. Based on the identity of the electric vehicle, authorization for recharging may be made in step 48. Authorization may involve transmission of a notice of authorization to the electric vehicle, which may indicate the

amount of recharge available or permitted, the time the recharge is available at the current location, and the cost of recharge per unit of energy or for a full recharge.

[0017] Authorization may also permit recharging of the electric vehicle without involvement of an attendant at the mobile charging portion 12. For example, authorization may provide a code which the operator of the electric vehicle can use to plug into the electric power dispensing system 30, to receive a recharge.

[0018] In an alternative embodiment of the present invention, one or more of the outer surfaces of the mobile charging portion 12, such as a side surface 18, may have an electrically powered illuminated sign 19. The sign 19 may be powered by the solar panels 16. In such an embodiment, the motor driven vehicle may or may not include an electrical power dispensing system 30 in addition to the electrically powered sign 19.

[0019] The one or more solar power generating panels 16 and/or the batteries 20 may also power a wifi router/transmitter and satellite or terrestrial based transceiver in an alternative embodiment of the invention. The wifi service may be provided without charge based on revenue received in connection with advertising. The wifi communication system may also serve as an intranet for customers of the recharging network while the mobile charging portion 12 is on the highway connecting customers to each other and also potentially connecting to the Internet through cell towers or satellites.

[0020] It is appreciated that the one or more batteries 20 may be provided inside or outside of the mobile charging portion 12 or inside or outside of the tractor 11. In one embodiment of the present invention, the solar cells of the one or more solar power generating panels 16 may be imbedded in the outer surface, or skin, of the mobile charging portion 12. For example, imbedded solar cells may be provided by incorporating solar roofing shingles of the type manufactured by Global Solar Energy and sold by Dow Solar. Further, one or more of the batteries 20 may be incorporated into the structure of the mobile charging portion 12.

[0021] In a further alternative embodiment, the mobile charging portion 12 may be provided with a wireless electrical energy transmission system 50, for example of the type offered by WiTricity Corp. The wireless transmission system 50 may permit electric vehicles to recharge while both the mobile charging portion 12 and the electric vehicle being recharged are in motion.

[0022] In yet a further alternative embodiment, with renewed reference to Fig. 2, the

mobile charging portion 12 may provide recharging using an electric energy transmission surface 60 incorporated into an outer side surface 18. A retractable boom and cord may be extended from an electric vehicle and attached to the electric energy transmission surface 60 by a magnetic head.

[0023] With reference to Fig. 4, in another alternative embodiment of the present invention, a solar panel 70 may be movably attached to the mobile charging portion 12 upper surface 14 or along an edge formed between the upper surface and a side surface 18 so as to be movable relative to the upper surface. For example, the solar panel 70 may be attached to the edge formed between the upper surface 14 and a side surface by one or more hinges. Either side, or both sides of the solar panel 70 may include solar cells adapted to capture solar radiation and convert it to electrical energy. The solar panel 70 may be provided in addition to other solar panels 16, or alternatively, in lieu of such other solar panels. The solar panel 70 may be electrically connected to the one or more batteries 20, illustrated in Fig. 2, which in turn are electrically connected to an electrical power dispensing system 30.

[0024] The solar panel 70 in Fig. 4 may be set at various angles relative to the upper surface 14 to increase the effectiveness of solar radiation capture. The angle formed between the upper surface 14 and the solar panel 70 may be varied by varying the length of supports 72 which extend between the non-hinged edge of the solar panel and the upper surface 14. For example, the supports 72 for the solar panel 70 may be provided by cables extending to anchors 74. It is appreciated that these supports 72 may be flexible or rigid, and may have varying lengths which are adapted to set the solar panel 70 at different angles relative to the upper surface 14, which angles include, acute, obtuse, and right angles. It is also appreciated that more than one movable solar panel 70 could be used, and a single panel is shown in Fig. 4 for illustrative purposes only.

[0025] In a still further alternative embodiment, shown in Fig. 5, a solar panel 70 may be movably attached to the mobile charging portion 12 side surface 18 or along an edge formed between the side surface 18 and an underside of the mobile charging portion so as to be movable relative to the side surface. For example, the solar panel 70 may be attached to the edge formed between the side surface 18 and the underside of the mobile charging portion by one or more hinges. Like the Fig. 4 embodiment, either side, or both sides of the solar panel 70 may include solar cells adapted to capture solar

radiation and convert it to electrical energy. The solar panel 70 may be provided in addition to other solar panels, or alternatively, in lieu of such other solar panels. The solar panel 70 may be electrically connected to the one or more batteries 20, illustrated in Fig. 2, which in turn are electrically connected to an electrical power dispensing system 30.

[0026] The solar panel 70 in Fig. 5 may be set at various angles relative to the side surface 18 to increase the effectiveness of solar radiation capture. The angle formed between the side surface 18 and the solar panel 70 may be varied by varying the length of supports 76 which extend between the non-hinged edge of the solar panel and the ground. For example, the supports 76 may be provided by variable length posts. It is appreciated that these supports 76 may be flexible (i.e., when extending between the solar panel 70 and the mobile charging portion 12), or rigid, and may have varying lengths which are adapted to set the solar panel 70 at different angles relative to the side surface 18, which angles include, acute, obtuse, and right angles. It is also appreciated that more than one movable solar panel 70 could be used, and a single panel is shown in Fig. 5 for illustrative purposes only.

[0027] With reference to Figs. 4 and 5, it is also appreciated that the length of the supports 72 and 76 could be automatically varied, for example using electrically powered devices such as but not limited to wenches or jacks to optimize solar radiation capture over a period of time or throughout the course of a day.

[0028] As will be understood by those skilled in the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The functional elements and method steps described above are provided as illustrative examples of one technique for implementing the invention; one skilled in the art will recognize that many other implementations are possible without departing from the present invention as recited in the claims. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the invention. It is intended that the present invention cover all such modifications and variations of the invention, provided they come within the scope of the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. A mobile electric charging system incorporated into an over-highway vehicle, said system comprising:

an over-highway vehicle including outer surfaces;

one or more solar power generating panels attached to at least one over-highway vehicle outer surface;

one or more batteries electrically connected to the one or more solar panels, said one or more batteries disposed in or on the over-highway vehicle; and

an electric power dispensing system connected to the one or more batteries, said electric power dispensing system being disposed in or on the over-highway vehicle.

2. The mobile electric charging system of claim 1, further comprising:

a communication system connected to the over-highway vehicle, said communication system adapted to transmit a data signal indicating a location of the mobile electric charging system.

3. The mobile electric charging system of claim 2, wherein the communication system is further adapted to receive a recharging request data signal associated with an electric vehicle, and transmit a data signal indicating an ability to serve the recharging request in response to receipt of the recharging request data signal.

4. The mobile electric charging system of claim 3, wherein the communication system is further adapted to identify the electric vehicle associated with the recharging request data signal, determine whether the electric vehicle is authorized to be recharged, and transmit a data signal indicating whether the electric vehicle is authorized to be recharged.

5. The mobile electric charging system of claim 1, wherein the one or more solar power generating panels includes a solar power generating panel movably attached to:

a mobile charging portion upper surface, a mobile charging portion side surface, along an edge formed between the upper surface and the side surface, or an edge formed between the side surface and an underside of the mobile charging portion.

6. The mobile electric charging system of claim 5, wherein the solar power generating panel is movable to be set at various angles relative to the upper surface or side surface.

7. The mobile electric charging system of claim 6, further comprising a device for automatically varying the angle between the solar power generating panel and the upper surface or side surface to optimize solar radiation capture over a period of time.

8. The mobile electric charging system of claim 1, further comprising a wifi communication device powered by the one or more solar power generating panels.

9. The mobile electric charging system of claim 1, further comprising an electric sign powered by the one or more solar power generating panels.

10. The mobile electric charging system of claim 1, further comprising a communication and computer system adapted to:

determine a location of the mobile electric charging system;

transmit a data signal indicating the location of the mobile electric charging system;

receive a data signal indicating a request to recharge by an electric vehicle;

receive a data signal indicating the identity of the electric vehicle;

identify the electric vehicle;

determine the authorization of the electric vehicle to recharge at the mobile electric charging system; and

transmit a data signal indicating the authorization of the electric vehicle to recharge.

11. A method of recharging an electric vehicle using a mobile electric charging system, comprising:

determining a location of a mobile electric charging system using an electrically powered location mechanism;

transmitting a data signal indicating the location of the mobile electric charging system to a communication device associated with the electric vehicle using a transmitter associated with a communication network;

receiving a data signal indicating a request to recharge by the electric vehicle over the communication network;

receiving a data signal indicating the identity of the electric vehicle over the communication network;

identifying the electric vehicle using a computer associated with the mobile electric charging system;

determining the authorization of the electric vehicle to recharge at the mobile electric charging system based on the identity of the electric vehicle, using the computer; and

transmitting a data signal indicating the authorization of the electric vehicle to recharge to the communication device associated with the electric vehicle.

12. The method of claim 11 further comprising transmitting a data signal indicating an amount of recharge available for the electric vehicle.

13. The method of claim 11 wherein the data signal indicating a request to recharge is automatically generated by the communication device associated with the electric vehicle in response to a level of battery charge falling below a predetermined level.

14. The method of claim 11 wherein the data signal indicating a request to recharge indicates an amount of recharge needed or desired.

15. The method of claim 11 further comprising transmitting a data signal indicating a time at which recharging is available for the electric vehicle.

16. The method of claim 11 further comprising transmitting a data signal indicating cost information for recharging.

17. The method of claim 11 further comprising transmitting a data signal providing an access code to obtain recharging.

18. The method of claim 11 further comprising:

providing a movable solar power generating panel as part of the mobile electric charging system; and

automatically varying the position of the movable solar power generating panel to optimize solar radiation capture.

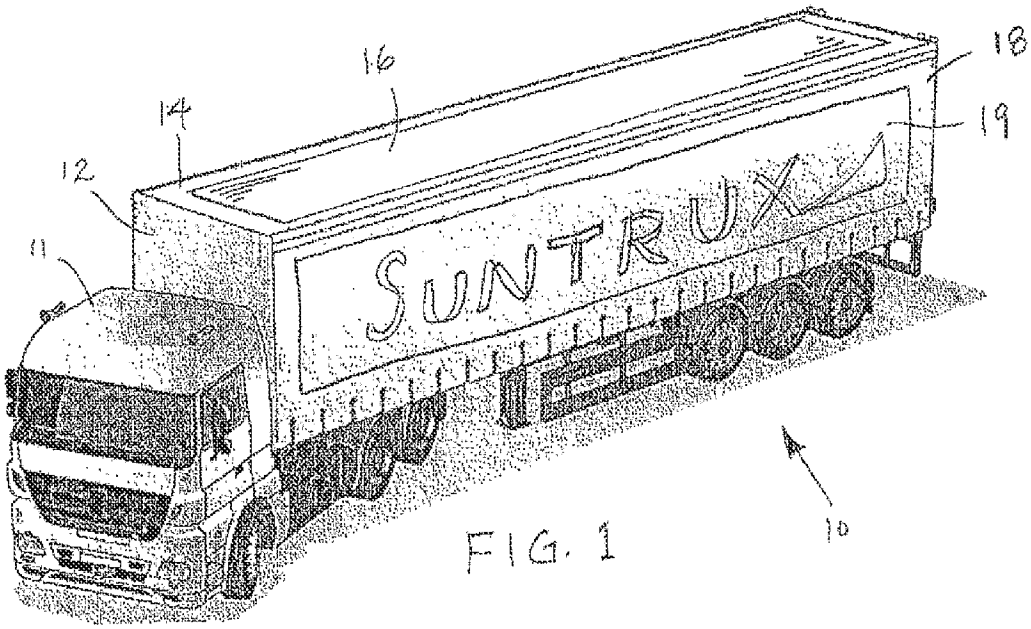


FIG. 1

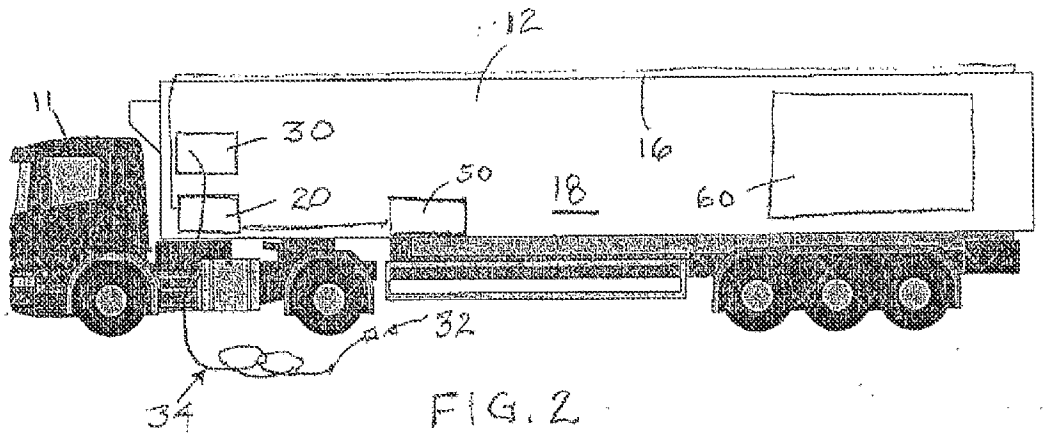


FIG. 2

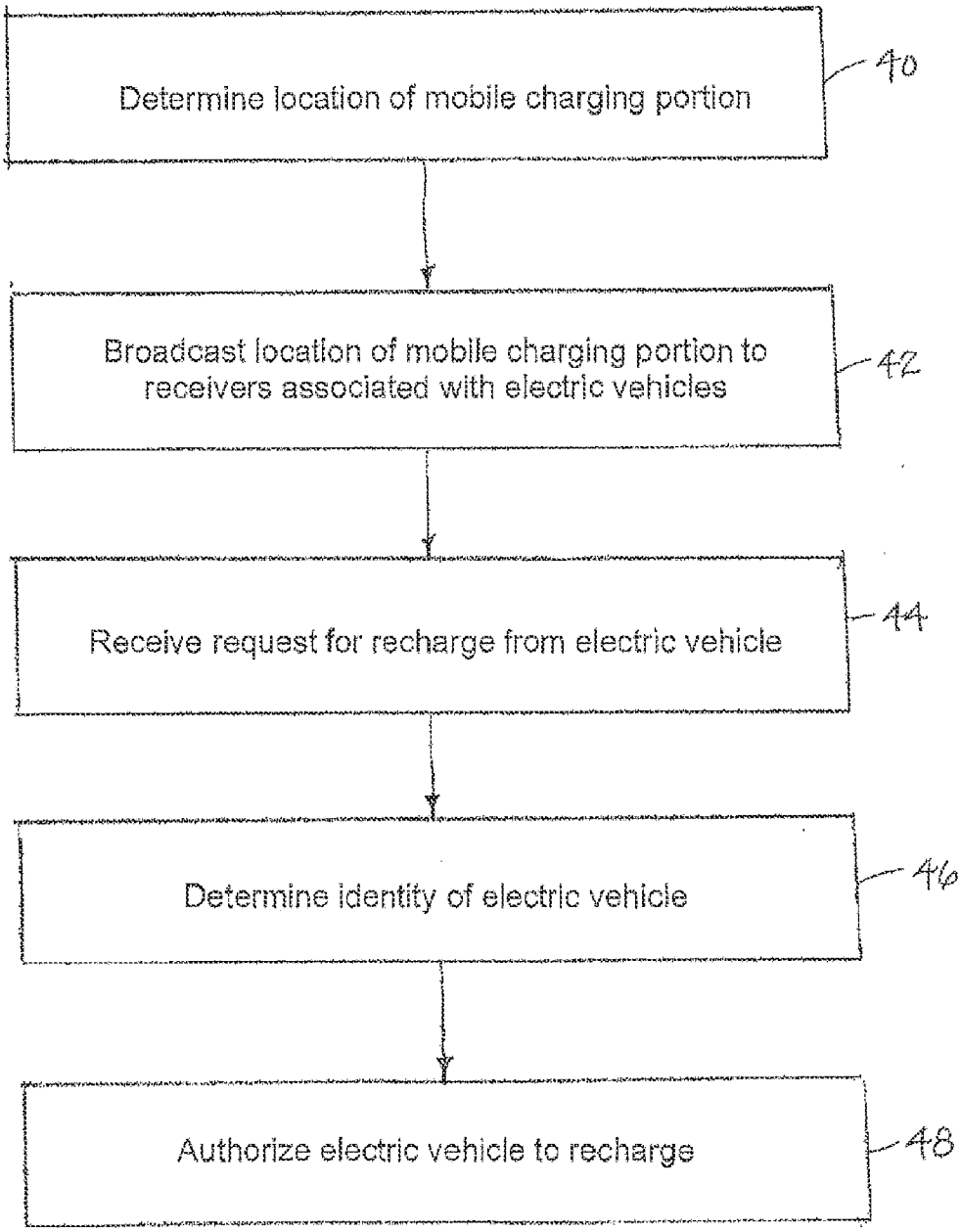

Determine location of mobile charging portion
40
Broadcast location of mobile charging portion to receivers associated with electric vehicles
42
Receive request for recharge from electric vehicle
44
Determine identity of electric vehicle
46
Authorize electric vehicle to recharge
48

FIG. 3

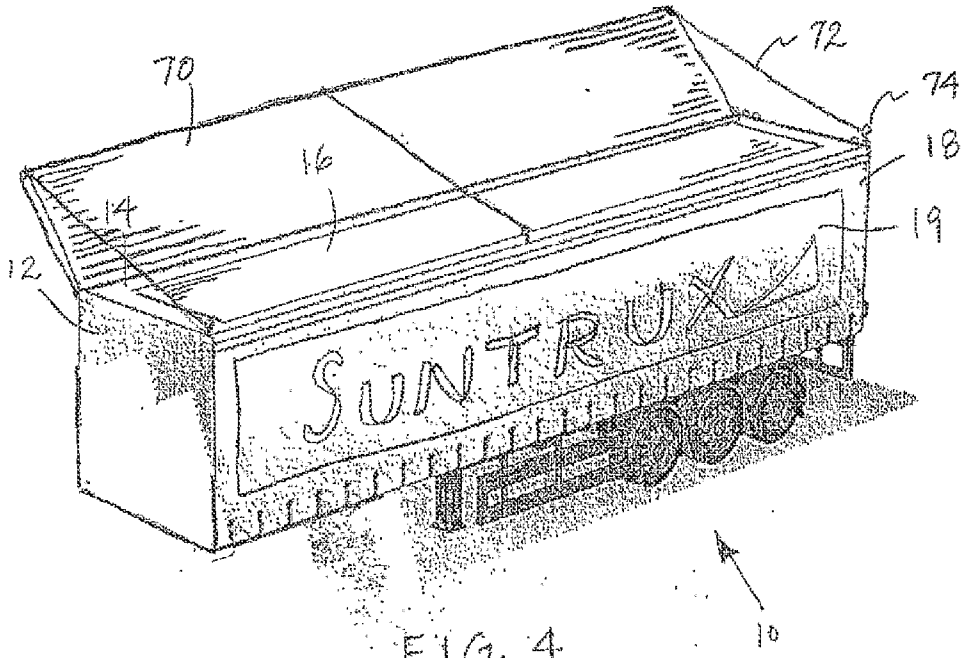


FIG. 4

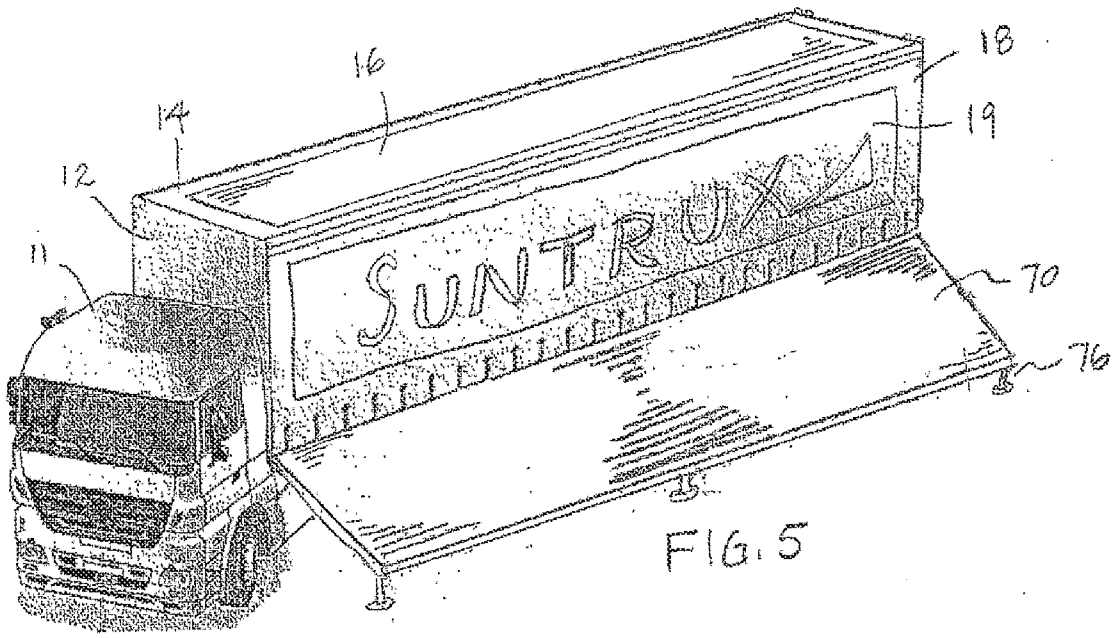


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/25952

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B60L 8/00, H02J 7/00 (2015.01)
CPC - B60L 8/003, H02J 7/0027, Y02T 90/12, Y04S 30/14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - B60L 8/00, H02J 7/00 (2015.01)
CPC - B60L 8/003, H02J 7/0027, Y02T 90/12, Y04S 30/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8) - B60L8/00, H02J7/00, H02J7/35, H01M10/44 (2015.01); CPC - B60L8/003, B60L11/1801, H02J7/0027, H02J17/00, Y02T10/7005, Y02T10/7083, Y02T90/12*, Y04S30/14; USPC - 180/313, 320/109, 361/235, 701/22

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Patbase, Proquest Dialog, Google Patents
Search terms used: electric, vehicle, car, automobile, mobile, station, highway, expressway, solar, photovoltaic, battery, charge, recharge, authorization, authentication, permission, location, identification, ID, request, wireless, radio, wifi, MPPT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,542,203 A (LUOMA et al.) 06 August 1996 (06.08.1996), Fig 1, abstract, col 2, ln 64-col 3, ln 40	1, 9
X --- Y	US 8,120,310 B2 (LITTRELL et al.) 21 February 2012 (21.02.2012), Fig 1, abstract, col 3, ln 21-58, col 4, ln 24-63	1, 2, 5-7 --- 8, 18
X --- Y	US 2012/0005031 A1 (JAMMER) 05 January 2012 (05.01.2012), Fig 3, 5B, abstract, para [0129], [0135], [0173], [0177], [0221], [0224], [0228]-[0231], [0254]-[0259], [0261]-[0263], [0274]-[0276]	1-3 --- 4, 8, 10, 13
Y	US 2012/0095594 A1 (GRIGORYAN et al.) 19 August 2012 (19.08.2012), Fig 1, 2, abstract, para [0024]-[0026]	4, 10-18
Y	US 2011/0025267 A1 (KAMEN et al.) 03 February 2011 (03.02.2011), Fig 1, abstract, para [0033], [0039], [0042], [0043]	11-18
Y	US 2013/0006677 A1 (ANGLIN et al.) 03 January 2013 (03.01.2013), Fig 1, 2, abstract, para [0057], [0059]	12, 14
A	US 2012/0299531 A1 (PROSSER et al.) 29 November 2012 (29.11.2012), entire document	1-18

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 August 2015 (26.08.2015)	16 SEP 2015
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/25952

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-10 drawn to a mobile electric charging system.

Group II: Claims 11-18, drawn to a method of recharging an electric vehicle.

-- see extra sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/25952

Continuation of Box No. III -- Observations where unity of invention is lacking

The inventions listed as Groups I through II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features
Group I includes the special technical feature of one or more solar power generating panels attached to at least one over-highway vehicle outer surface, not included in the other groups.

Group II includes the special technical feature of a transmitting a data signal indicating the authorization of the electric vehicle to recharge to the communication device associated with the electric vehicle, not included in the other groups.

Common Technical Features:
The only technical feature shared by Groups I and II that would otherwise unify the groups, is a mobile vehicle charging system. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is disclosed by US 6,114,834 A (Parise).

Parise discloses a mobile vehicle charging system (abstract).

As the technical feature was known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13.