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(54) **Fueling system**

Brennstoffzufuhrsystem

Système d'alimentation en carburant

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(73) Proprietor: **Hi-G-Tek Ltd**
Or Yehuda 60375 (IL)

(72) Inventors:
- **Haimovich, Yosef**
  Rishon le Zion 75258 (IL)
- **Armoni, Yehuda**
  Reut 71908 (IL)

(74) Representative: **Ungria Lopez, Javier et al**
Avda. Ramon y Cajal, 78
28043 Madrid (ES)

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Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to fuel management systems for use with motor vehicles and particularly to a wireless system for authorization and monitoring of fuel delivery according to the preamble of claim 1.

BACKGROUND OF THE INVENTION

[0002] Fuel management systems which monitor fuel usage by vehicles and record the identity and other particulars of vehicles being fueled are known. Patents showing fuel management systems include the following U.S. Patents: 5,156,198; 4,934,419; 4,846,233; 4,469,149; 4,263,945; 4,109,686 and 3,642,036. In addition, PCT published patent application WO 95/14612 describes a vehicle mounted fueling system identification unit which employs an inductive communication loop arranged to surround a fuel intake pathway of a vehicle. Circuitry is provided which transmits, via the loop, various parameters, such as vehicle identification number, credit information, and required fuel particulars.

[0003] A drawback to prior art systems is that they require wired connections to transmit the fuel/vehicle parameters.

[0004] European Patent Application 0 736 484 discloses a fluid delivery apparatus associated with a fluid delivery nozzle for wireless communication to either an active or a passive device located on a vehicle and for wireless communication from the fluid delivery apparatus to a central location for storage of vehicle data.

SUMMARY OF THE INVENTION

[0005] The present invention seeks to provide a wireless system for authorization and monitoring of fuel delivery with improved theft-safety features.

[0006] There is thus provided in accordance with the present invention a fueling system as defined by claim 1.

[0007] In accordance with a preferred embodiment of the present invention the authorization and monitoring assembly is also operative to communicate in a wireless manner with the fuel supply subsystem to authorize supply of fuel to the recipient.

[0008] Further in accordance with a preferred embodiment of the present invention the fueling communicator communicates with at least one of the authorization and monitoring assembly and the recipient identifier in an encrypted manner.

[0009] Still further in accordance with a preferred embodiment of the present invention the fueling communicator communicates with at least one of the authorization and monitoring assembly and the recipient identifier in a manner requiring authentication by at least one of the authorization and monitoring assembly and the recipient identifier.

[0010] Additionally in accordance with a preferred embodiment of the present invention the recipient identifier is mounted at the fill location of the recipient fuel store at least partially by means of an anti-theft tag including a monitored attachment mechanism which attaches the tag to the fill location of the fuel store and which provides an output indication of tampering with the attachment mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1A is a simplified illustration of a fueling system constructed and operative in accordance with a preferred embodiment of the present invention embodied in a filling station;

Fig. 1B is a more detailed illustration of components of the fueling system of Fig. 1A;

Fig. 2 is a simplified sectional illustration of an anti-theft tag used to mount certain components of the fueling system of Fig. 1 in accordance with the present invention; and

Fig. 3 is a simplified illustration of a fueling system different from the present invention embodied in mobile fueling system.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0012] Reference is now made to Figs. 1A and 1B which illustrate a fueling system 10 constructed and operative in accordance with a preferred embodiment of the present invention embodied in a filling station 12.

[0013] Fueling system 10 includes a fuel supply subsystem 14 which includes one or more fueling nozzles 16. In Fig. 1B, one of the fueling nozzles 16 is being used to supply fuel to a fuel intake pipe 18 of a fuel tank 20 of a vehicle 21, herein referred to as a fill location 18 of a recipient fuel store 20. A recipient identifier 22 is provided in association with fill location 18. Recipient identifier 22 is preferably mounted inside vehicle 21 in propinquity to fill location 18. Recipient identifier 22 preferably comprises a transceiver for wirelessly communicating recipient identification information to a fueling communicator 24 which is mounted on fueling nozzle 16. Typical recipient identification information may include vehicle license plate number, charge account number and credit status, for example.

[0014] Fueling communicator 24 comprises a transceiver for wirelessly communicating data, such as the recipient identification information, to an authorization and monitoring assembly 26. Assembly 26 preferably includes a transceiver 28 which communicates with a

CPU 30 which controls and manages operation of filling station 12.

[0015] A typical example of operation of fueling system 10 is as follows. Nozzle 16 is initially inserted in fill location 18. Recipient identifier 22 is activated, such as by the insertion of nozzle 16 or by some other mechanism, to wirelessly transmit the recipient identification information to fueling communicator 24. Fueling communicator 24 relays this information to assembly 26. Upon verification of the information by CPU 30, transceiver 28 of assembly 26 preferably wirelessly communicates with fuel supply subsystem 12 to authorize supply of fuel to vehicle 21.

[0016] In accordance with a preferred embodiment of the present invention, in order to increase communication security, fueling communicator 24 communicates with assembly 26 and/or recipient identifier 22 in an encrypted manner. For example, well known encryption algorithms, such as RC-5, DES or DVB, may be employed. To provide an even greater level of trust, mutual zero-knowledge interaction authentication sessions between fueling communicator 24, assembly 26 and/or recipient identifier 22 may be held, such as the so-called Fiat-Shamir authentication methods taught in US Patent 4,748,668 to Shamir and Fiat.

[0017] As one example, fueling communicator 24 may communicate with assembly 26 in a manner requiring authentication by recipient identifier 22. Additionally or alternatively, fueling communicator 24 may communicate with assembly 26 only upon authorization from assembly 26 itself. Similarly, fueling communicator 24 may communicate with recipient identifier 22 in a manner requiring authentication by assembly 26. Additionally or alternatively, fueling communicator 24 may communicate with recipient identifier 22 only upon authorization from recipient identifier 22 itself.

[0018] In accordance with the present invention fueling communicator 24 is mounted onto nozzle 16 at least partially by means of an anti-theft tag 32 including a monitored attachment mechanism 34 which attaches tag 32 to nozzle 16 and which provides an output indication of tampering with attachment mechanism 34.

[0019] Reference is now made to Fig. 2 which illustrates tag 32. Tag 32 is a tag of the type described in applicant/assignee's US Patent 6,002,343. Tag 32 preferably includes electronics (not shown) comprising a battery, a receiver antenna, receiver circuitry, a transmitter antenna, transmitter circuitry, a microprocessor, a timer, a logic and memory component, an analog-to-digital (A/D) converter and a current source, for example. The electronics of tag 32 is not limited to the above-mentioned components, and may include more or less components, depending upon the application.

[0020] The electronics of tag 32 are in electrical communication with an electrically resistive element 34, such as via I/O pads 36. Resistive element 34 is preferably bonded to a nozzle 16 with an adhesive 42 so as to define an electrical resistance. Any change in bonding of element 34 to nozzle 16 causes a change in the electrical resistance. Adhesive 42 may be a double sided adhesive tape or adhesive foam.

[0021] Resistive element 34 may be constructed in a variety of manners, as taught in US Patent 6,002,343. For example, resistive element 34 may be printed in any suitable pattern to provide a desired resistance value which may be adjusted after curing by laser trimming, abrasion or mechanical punching, for example. Resistive element 34 is preferably attached to tag 32 by means of a conductive adhesive 50, such as a metal impregnated adhesive. Preferably the adhesive strength of adhesive 42 is greater than the adhesive strength of conductive adhesive 50, so that removal of tag 32 from nozzle 16 causes shearing or other deformation of conductive adhesive 50, and alters the resistance of resistive element 34. Alteration of the resistance of element 34 may then alert fueling system 10 of tampering with the system.

[0022] Similarly, recipient identifier 22 may be mounted at fill location 18 by means of anti-theft tag 32.

[0023] Reference is now made to Fig. 3 which illustrates a fueling system 60 different from the present invention embodied in mobile fueling system. Fueling system 60 is substantially identical with fueling system 10, except that in fueling system 60, the fill location is a fuel intake pipe 62 and the recipient fuel store is a fuel tank 64 of a domicile. Fueling communicator 24 is mounted in a cabin or on top of a fuel delivery truck.

Claims

1. A fueling system (10, 60) comprising:

a fuel supply subsystem (14) including at least one fueling nozzle (16);

a recipient identifier (22) associated with a fill location (18, 62) of a recipient fuel store (20, 64);

a fueling communicator (24) associated with said at least one fueling nozzle (16) and communicating in a wireless manner with said recipient identifier (22), at least in order to obtain recipient identification information therefrom; and

an authorization and monitoring assembly (26) operative to communicate in a wireless manner with said fueling communicator (24) for receiving at least recipient identification information therefrom; **characterized by**

said fueling communicator (24) being mounted onto said at least one nozzle (16) at least partially by means of an anti-theft tag (32) including a monitored attachment mechanism (34) which attaches the tag (32) to said at least one nozzle (16) and which provides an output indication of tampering with said attachment

mechanism (34); and

an electrically resistive element in electrical communication with and attached to said tag (32), wherein tampering with the electrically resistive element causes a change in said electrical resistance, said change in electrical resistance being communicated to said tag (32), wherein said resistive element comprises a multiplicity of resistive wires, wherein only a random number of said wires are electrically connected to internal connection points in said tag (32) such that said resistive element has a statistically random electrical resistance.

2. The fueling system (10, 60) according to claim 1 further **characterized in that** said authorization and monitoring assembly (26) is also operative to communicate in a wireless manner with said fuel supply subsystem (14) to authorize supply of fuel to said fill location (18, 62).

3. The fueling system (10, 60) according to claim 1 further **characterized in that** said fueling communicator (24) communicates with at least one of said authorization and monitoring assembly (26) and said recipient identifier (22) in an encrypted manner.

4. The fueling system (10, 60) according to claim 1 further **characterized in that** said fueling communicator (24) communicates with at least one of said authorization and monitoring assembly (26) and said recipient identifier (22) in a manner requiring authentication by at least one of said authorization and monitoring assembly (26) and said recipient identifier (22).

5. The fueling system (10, 60) according to claim 1 further **characterized in that** said recipient identifier (22) is mounted at said fill location (18, 62) of said recipient fuel store (20, 64) at least partially by means of an anti-theft tag (32) including a monitored attachment mechanism (34) which attaches the tag (32) to said fill location (18, 62) of said fuel store (20, 64) and which provides an output indication of tampering with said attachment mechanism (34).

Patentansprüche

1. Tanksystem (10, 60), das umfasst:

ein Kraftstoffabgabe-Teilsystem (14), das wenigstens einen Tank-Zapfhahn (16) enthält;

eine Empfänger-Identifizierungseinrichtung (22), die mit einer Füllposition (18, 62) eines Empfänger-Kraftstoffspeichers (20, 64) verbunden ist;

eine Tank-Übertragungseinrichtung (24), die mit dem wenigstens einen Tank-Zapfhahn (16) verbunden ist und mit der Empfänger-Identifizierungseinrichtung (22) drahtlos in Übertragungsverbindung steht, um wenigstens Empfänger-Identifizierungsinformationen von dieser zu beziehen; und

eine Autorisierungs-und-Überwachungs-Anordnung (26), die mit der Tank-Übertragungseinrichtung (24) drahtlos in Übertragungsbeziehung tritt, um wenigstens Empfänger-Identifizierungsinformationen von dieser zu empfangen; **dadurch gekennzeichnet, dass**:

die Tank-Übertragungseinrichtung (24) an dem wenigstens einen Zapfhahn (16) wenigstens teilweise mittels eines Diebstahlsverhinderungs-Schildes (32) angebracht ist, das einen überwachten Anbringungsmechanismus (34) enthält, der das Schild (32) an dem wenigstens einen Zapfhahn (16) hält und der bei unbefugtem Manipulieren an dem Anbringungsmechanismus (34) eine Ausgabeanzeige erzeugt; und

ein elektrisches Widerstandselement, das mit dem Schild (32) in elektrischer Verbindung steht und daran angebracht ist, wobei unbefugtes Manipulieren an dem elektrischen Widerstandselement eine Veränderung des elektrischen Widerstandes bewirkt und die Veränderung des elektrischen Widerstandes zu dem Schild (32) übertragen wird, wobei das Widerstandselement eine Vielzahl von Widerstandsdrähten umfasst und lediglich eine zufällige Anzahl der Drähte elektrisch an innere Anschlusspunkte in dem Schild (32) angeschlossen sind, so dass das Widerstandselement einen statistisch zufälligen elektrischen Widerstand hat.

2. Tanksystem (10, 60) nach Anspruch 1, des Weiteren **dadurch gekennzeichnet, dass** die Autorisierungs-und-Überwachungs-Anordnung (26) des Weiteren mit dem Kraftstoffabgabe-Teilsystem (14) drahtlos in Übertragungsbeziehung tritt, um die Abgabe von Kraftstoff zu der Füllposition (18, 62) zu autorisieren.

3. Tanksystem (10, 60) nach Anspruch 1, des Weiteren **dadurch gekennzeichnet, dass** die Tank-Übertragungseinrichtung (24) wenigstens mit der Autorisierungsund-Überwachungs-Anordnung (26) oder der Empfänger-Identifizierungseinrichtung

(22) verschlüsselt in Übertragungsbeziehung steht.

4. Tanksystem (10, 60) nach Anspruch 1, des Weiteren **dadurch gekennzeichnet, dass** die Tank-Übertragungseinrichtung (24) wenigstens mit der Autorisierungsund-Überwachungs-Anordnung (26) oder der Empfänger-Identifizierungseinrichtung (22) auf eine Weise in Übertragungsbeziehung besteht, die Authentifizierung wenigstens durch die Autorisierungs-und-Überwachungs-Anordnung (26) oder die Empfänger-Identifizierungseinrichtung (22) erfordert.

5. Tanksystem (10, 60) nach Anspruch 1, des Weiteren **dadurch gekennzeichnet, dass** die Empfänger-Identifizierungseinrichtung (22) an der Füll-Position (18, 62) des Empfänger-Kraftstoffspeichers (20, 64) wenigstens teilweise mittels eines Diebstahlverhinderungs-Schildes (32) angebracht ist, das einen überwachten Anbringungsmechanismus (34) enthält, der das Schild (32) an der Füll-Position (18, 62) des Kraftstoffspeichers (20, 64) hält und der bei unbefugtem Manipulieren an dem Anbringungsmechanismus (34) eine Ausgabeanzeige erzeugt.

Revendications

1. Système d'alimentation en carburant (10, 60), comprenant :

   un sous-système (14) de transmission de carburant qui comprend au moins un pistolet (16) d'alimentation en carburant,
   un identificateur (22) de récepteur, associé à un emplacement (18, 62) de remplissage d'une réserve réceptrice de carburant (20, 64),
   un organe de communication (24) d'alimentation en carburant associé au pistolet au moins (16) d'alimentation en carburant et communiquant sans fil avec l'identificateur (22) de récepteur, au moins pour l'obtention depuis celui-ci d'informations d'identification de récepteur, et
   un ensemble d'autorisation et de contrôle (26) destiné à communiquer sans fil avec l'organe (24) de communication d'alimentation en carburant pour la réception depuis celui-ci au moins des informations d'identification de récepteur, **caractérisé par**
   le montage de l'organe (24) de communication d'alimentation en carburant sur au moins un pistolet (16) partiellement au moins avec une étiquette antivol (32) qui comprend un mécanisme contrôlé de fixation (34) qui fixe l'étiquette (32) au pistolet au moins (16) et qui donne une indication en sortie sur une falsification du mécanisme de fixation (34), et
   un élément électriquement résistif placé en communication électrique avec l'étiquette (32) et fixé à celle-ci, et tel qu'une falsification de l'élément électriquement résistif provoque un changement de résistance électrique, le changement de résistance électrique étant communiqué à l'étiquette (32), l'élément résistif comprenant plusieurs fils résistifs tels qu'un nombre aléatoire seulement de fils est connecté électriquement à des points internes de connexion dans l'étiquette (32), si bien que l'élément résistif a une résistance électrique statistiquement aléatoire.

2. Système d'alimentation en carburant (10, 60) selon la revendication 1, **caractérisé en outre en ce que** l'ensemble d'autorisation et de contrôle (26) est aussi destiné à communiquer sans fil avec le sous-système de transmission de carburant (14) pour autoriser la transmission du carburant à l'emplacement de remplissage (18, 62).

3. Système d'alimentation en carburant (10, 60) selon la revendication 1, **caractérisé en outre en ce que** l'organe (24) de communication d'alimentation en carburant communique de manière cryptée avec au moins l'ensemble d'autorisation et de contrôle (26) ou l'identificateur de récepteur (22).

4. Système d'alimentation à carburant (10, 60) selon la revendication 1, **caractérisé en outre en ce que** l'organe (24) de communication d'alimentation en carburant communique avec au moins l'ensemble d'autorisation et de contrôle (26) ou l'identificateur de récepteur (22) d'une manière qui nécessite une authentification par au moins un ensemble d'autorisation et de contrôle (26) et l'identificateur de récepteur (22).

5. Système d'alimentation en carburant (10, 60) selon la revendication 1, **caractérisé en outre en ce que** l'identificateur de récepteur (22) est monté à l'emplacement de remplissage (18, 62) de la réserve de carburant du récepteur (20, 64) au moins partiellement par une étiquette antivol (32) qui comporte un mécanisme contrôlé de fixation (34) qui fixe l'étiquette (32) ã l'emplacement de remplissage (18, 62) de la réserve de carburant (20, 64) et qui donne une indication en sortie relative à la falsification du mécanisme de fixation (34).

FIG. 1A

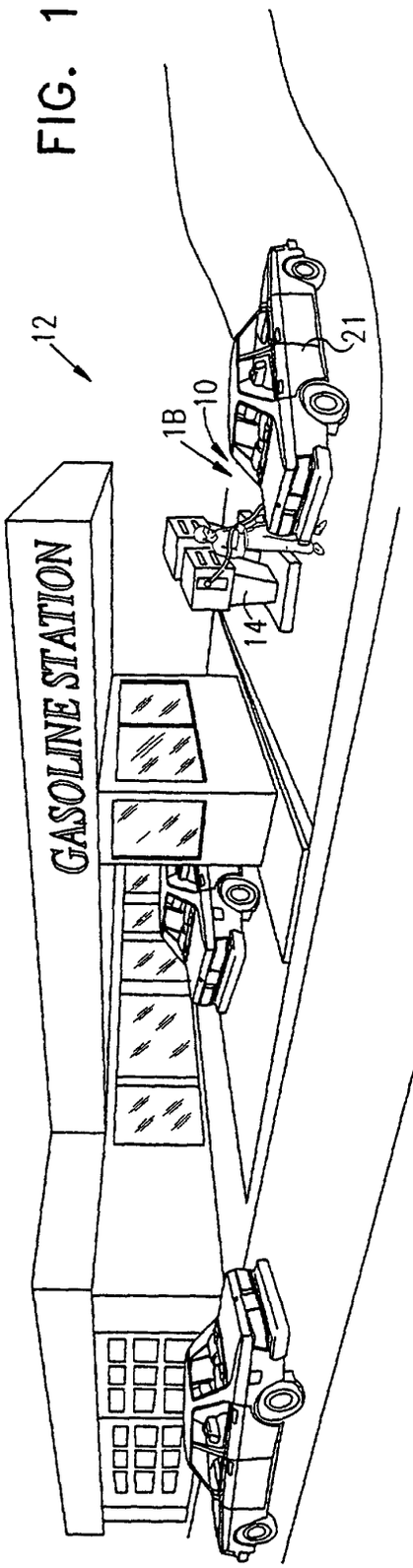

FIG. 1B

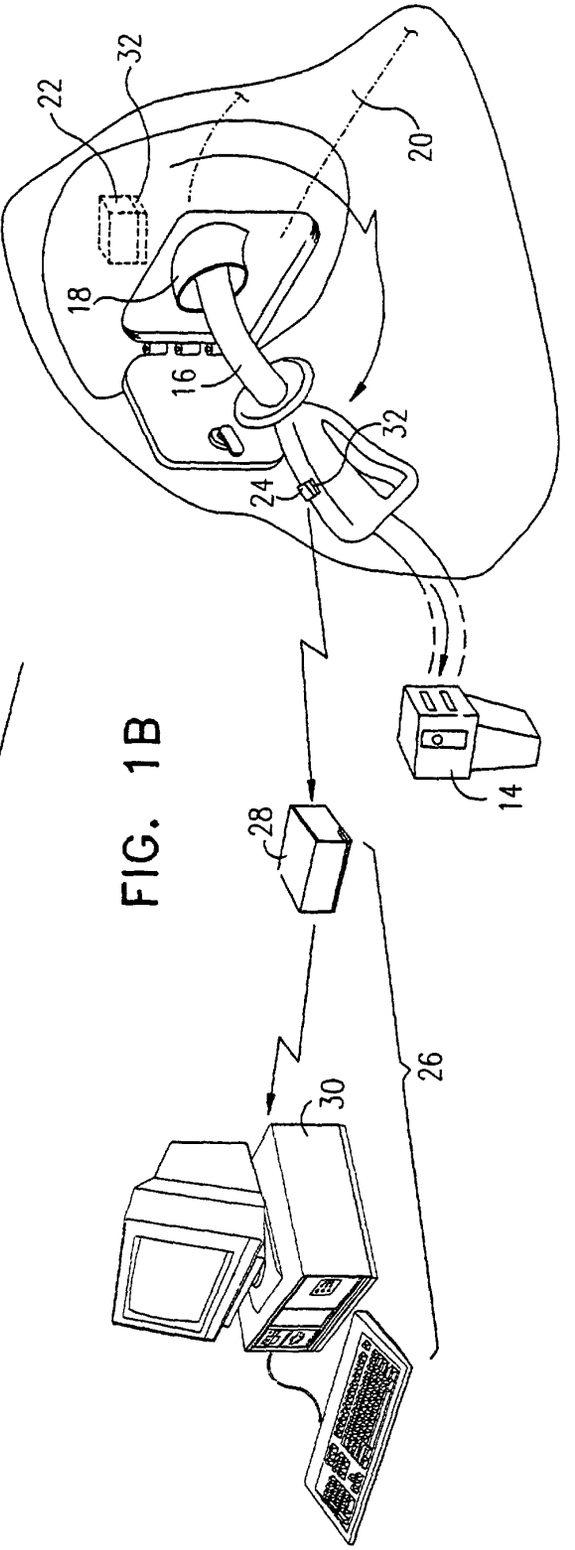

FIG. 2

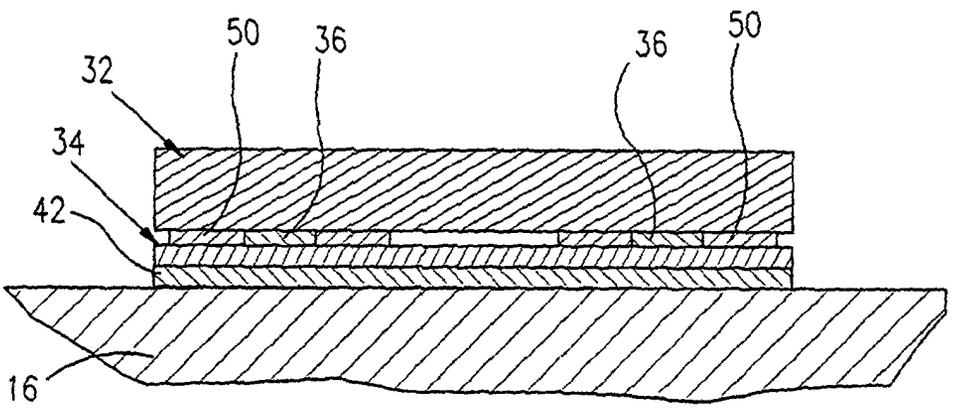

FIG. 3