

18 JUL 2000

AUTOMATED FUEL SUPPLY SYSTEM

BACKGROUND OF THE INVENTION1. Field of the Invention

The present invention relates to an automated fuel supply system used in a service station for supplying or dispensing a selected one of a plurality of transportation fuels to a customer's motor vehicle.

2. Description of the Related Art

The applicant of the subject Patent application has been already proposed a conventional fuel supply system provided with a fuel type/grade checking means for preventing a different type/grade fuel from being supplied to a customer's motor vehicle by mistake. This conventional system is disclosed in Japanese Patent Application Laid-Open Nos. Hei 6-115598 and Hei 8-169498 both belonging to the applicant. Further, also proposed by the applicant in Japanese Patent Application Laid-Open Nos. Sho 58-41095 and Sho 63-125196 both belonging to the applicant is a conventional type automated fuel supply system, which is provided with a fill-up means for automatically filling up a fuel tank of the motor vehicle. These conventional systems are effective. However, since any one of them itself is not capable of inserting its fuel dispensing nozzle into a fuel tank filler opening of the motor vehicle, the individual conventional system needs to be supported by a service station's attendant who is capable of inserting the fuel dispensing nozzle into the filler opening of the motor vehicle without fail. This is a drawback to the conventional systems.

SUMMARY OF THE INVENTION

Under such circumstances, the present invention was made. Consequently, it is an object of the present invention to provide an automated fuel supply system used in a service station for supplying or dispensing a selected one of a plurality of transportation fuels to a customer's motor vehicle, wherein the system, which is provide with both a fuel type/grade checking means and a fill-up means, need not accept any help from the attendant in fueling service.

In accordance with a first aspect of the present invention, the above object of the present invention is accomplished by providing:

In an automated fuel supply system including: a filler opening sensor for receiving a detection signal issued from a transmitter provided in the vicinity of a filler opening of a fuel tank of a vehicle; a data input/output unit for setting fuel supply data; and, a fuel supply unit provided with a fuel supply control means, wherein the control means is provided with a fuel type/grade checking means and a fuel tank fill-up means, the improvement wherein:

the control means receives an insertion signal issued from an insertion sensor provided in a front end portion of a fuel supply nozzle of the fuel supply unit, and actuates the checking means to determine whether or not the tank contains the same fuel as that identified by the data established in the data input/output unit;

when the checking means determines that the tank contains the same fuel as that identified by the data, the fill-up means is actuated to fill up the tank; and

the fill-up means stops delivery of the fuel to the tank when

a fill-up of the tank is detected.

In the system having the above construction, since all the fuel delivery services are automatically performed, the system need not accept any help from the attendant.

Further, the data input/output unit is provided with a portable type data input unit for inputting the data, wherein the data having been inputted from the portable data input unit is displayed on a display unit provided in the data input/output unit. This makes a data input operation easy with respect to the fuel supply data.

Further, a fuel delivery pipe has a selected one of a plurality of fuel supply nozzles projected therefrom, through which selected one the fuel having been set through the data input/output unit is supplied to the tank. Due to the presence of such fuel delivery pipe, there is no fear that the fuel spills from the filler opening of the fuel tank.

In this system, the data input/output unit data-communicates with an on-vehicle unit serving as a card reader/writer, and calculates the amount of a debit note for fuel delivery service on the basis of the fuel supply data inputted from the fuel supply control means. The use of a card such as credit card and the like to be inserted into the card reader/writer in the vehicle in payment of the fuel delivery service makes it possible for a customer to pay his account in an easy manner.

In accordance with a second aspect of the present invention, the above object of the present invention is accomplished by providing:

In an automated fuel supply system comprising a data input/output unit and a fuel supply unit, through which data

input/output unit fuel supply data is set, wherein the data input/output unit and the fuel supply unit are mounted on each of a plurality of elongated islands arranged side by side in a service station, and the fuel supply unit is actuated upon receipt of a signal issued from the data input/output unit, wherein a pair of adjacent ones of the elongated islands are spaced apart from each other by at least a distance equal to a width of a vehicle, the improvement wherein:

the data input/output unit mounted on one of the adjacent ones of the islands functions to disable a corresponding one of the data input/output units, the corresponding one being mounted on the other of the adjacent ones of the islands.

Consequently, in the system having the above construction, there is no fear that both of the adjacent ones of the data input/output units are actuated simultaneously with each other.

Further, the fuel supply unit mounted on one of the adjacent ones of the islands functions to disable a corresponding one of the fuel supply unit mounted on the other of the adjacent ones of the islands. Consequently, there is no fear that both of the fuel supply units are actuated simultaneously with each other.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, advantages and features of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a plan view of a service station provided with a first embodiment of the automated fuel supply system of the present invention;

Fig. 2 is an enlarged plan view of the automated fuel supply system of the present invention;

Fig. 3 is a front view of the automated fuel supply system of the present invention shown in Fig. 2;

Fig. 4 is a longitudinal sectional view of a fuel delivery pipe employed in the automated fuel supply system of the present invention;

Fig. 5 is a perspective view of a portable type data input unit employed in the automated fuel supply system of the present invention;

Fig. 6 is a block diagram of the automated fuel supply system of the present invention;

Fig. 7 is a front view of an essential part of a customer's motor vehicle, illustrating a filler opening portion of a fuel tank of the vehicle;

Fig. 8 is a flowchart illustrating the flow of data in the data input/output unit or system;

Fig. 9 is a flowchart of a fuel supply operation performed by the fuel supply system;

Fig. 10 is a front view of a second embodiment of the automated fuel supply system of the present invention;

Fig. 11 is a plan view of the second embodiment of the automated fuel supply system shown in Fig. 10;

Fig. 12 is an enlarged longitudinal sectional view of a fuel delivery pipe employed in the second embodiment of the automated fuel supply system shown in Fig. 10;

Fig. 13 is a side view of the second embodiment of the automated fuel supply system shown in Fig. 10, illustrating an automated fuel supply operation of the second embodiment;

Fig. 14 is a side view of the second embodiment of the automated fuel supply system shown in Fig. 10, awaiting operation;

Fig. 15 is a side view of the second embodiment of the automated fuel supply system of Fig. 10, held in stored position;

Fig. 16 is a block diagram of the second embodiment of the automated fuel supply system shown in Fig. 10;

Fig. 17 is a perspective view of a portable type data input unit employed in the second embodiment of the automated fuel supply system shown in Fig. 10;

Fig. 18 is a front view of an essential part of a customer's motor vehicle used in the second embodiment of the automated fuel supply system shown in Fig. 10, illustrating a filler opening portion of a fuel tank of the vehicle;

Fig. 19 is a flowchart illustrating the flow of data in the data input/output unit or system of the second embodiment of the automated fuel supply system shown in Fig. 10;

Fig. 20 is a flowchart of a fuel supply operation performed by the second embodiment of the automated fuel supply system shown in Fig. 10;

Fig. 21 is a side view of a third embodiment of the automated fuel supply system, illustrating an automated fuel supply operation of the third embodiment;

Fig. 22 is a front view of the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 23 is a plan view of the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 24 is a perspective view of a hose bending means or unit of the third embodiment of the automated fuel supply system shown in Fig. 21, illustrating the behavior of the hose bending means

or unit;

Fig. 25 is an enlarged longitudinal sectional view of a fuel delivery pipe employed in the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 26 is a perspective view of a portable type data input unit employed in the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 27 is a block diagram of the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 28 is a flowchart illustrating the flow of data in the data input/output unit or system of the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 29 is a flowchart of a fuel supply operation performed by the third embodiment of the automated fuel supply system shown in Fig. 21;

Fig. 30 is a side view of a fourth embodiment of the automated fuel supply system of the present invention, illustrating an automated fuel supply operation of the fourth embodiment;

Fig. 31 is a side view of a fifth embodiment of the automated fuel supply system of the present invention, illustrating an automated fuel supply operation of the fifth embodiment;

Fig. 32 is a perspective view of a sixth embodiment of the automated fuel supply system of the present invention;

Fig. 33 is a plan view of a front end portion of an arm member employed in the sixth embodiment of the automated fuel supply system shown in Fig. 32;

Fig. 34 is a front view of the fuel supply unit employed in the sixth embodiment of the automated fuel supply system shown in Fig. 32;

Fig. 35 is a block diagram of the sixth embodiment of the automated fuel supply system shown in Fig. 32;

Fig. 36 is a flowchart illustrating the flow of data in the data input/output unit or system of the sixth embodiment of the automated fuel supply system shown in Fig. 32; and

Fig. 37 is a flowchart illustrating the flow of data in the robot unit employed in the sixth embodiment of the automated fuel supply system shown in Fig. 32.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, with reference to the accompanying drawings, the best modes for carrying out the present invention will be described in detail using embodiments of an automated fuel supply system of the present invention.

FIRST EMBODIMENT

Figs. 1 to 9 show a first embodiment of the automated fuel supply system of the present invention.

As shown in Fig. 1, in general, a service station is provided with a car wash area 1, an office 2, a convenience store 3, a service area 4, and a fuel supply or dispensing area 5. Provided in the car wash area 1 is a car washing machine 6. Provided in the service area 4 are a maintenance unit 9, a cleaning unit 7, and a refuse container unit 8. Provided in the fuel supply area 5 are a plurality of elongated islands 11a, 11b, . . . , 11n. These islands, which are hereinafter denoted by the same reference numeral 11 for convenience in description, are arranged side by side, as shown in Fig. 1. A pair of adjacent ones of these islands 11 are spaced apart from each other by a distance equal to or more than a width of a customer's motor vehicle being fueled.

On the other hand, as shown in Figs. 2 and 3, mounted on each of the islands 11 of the fuel supply area 5 are: each of a plurality of fuel supply units 12a, 12b, . . . , 12n (hereinafter denoted by the same reference numeral 12); and, each of a plurality of data input/output units 13a, 13b, . . . , 13n (hereinafter denoted by the same reference numeral 13). Of these fuel supply units 12, adjacent ones 12a and 12b are combined with adjacent ones 13a and 13b of the data input/output units 13, respectively, to form an essential part of the automated fuel supply system of the present invention.

As shown in Fig. 3, a canopy 15 is fixedly mounted on an upper end portion of each of a plurality of upright posts 14. These posts 14 have their lower end portions fixedly mounted on the island 11. On the other hand, a spreader 16 is fixedly mounted between adjacent ones of these upright posts 14 to provide lateral support for such adjacent upright posts 14. Provided in a front surface of the canopy 15 is an approach lamp 17. As is clear from Fig. 3, a front one of the above-mentioned adjacent upright posts 14 is provided with an entrance sensor 18 in its lower portion. A vehicle stop (i.e., car stop) 19 is provided between adjacent ones of the islands 11.

As shown in Fig. 2, a housing 20 of the fuel supply unit 12, which is capable of horizontally traveling on a horizontal rail 22 fixedly mounted on the island 11, is driven by a horizontal traveler 21. Further, as shown in Fig. 3, the housing 20 is provided with a vertical rail 23. A vertical traveler 24, which is capable of traveling on this vertical rail 23, is provided with a nozzle mechanism 25. This nozzle mechanism 25 carries a plurality of fuel supply or delivery nozzles 26a, 26b and 26c (hereinafter denoted by the same reference numeral 26), which are connected with a

service station's fuel tank or reservoir (not shown) through hoses 27a, 27b and 27c (hereinafter denoted by the same reference numeral 27) and pipes 28a, 28b and 28c (hereinafter denoted by the same reference numeral 28), respectively, which pipes are provided with flow meters 29a, 29b and 29c (hereinafter denoted by the same reference numeral 29) and pumps 30a, 30b and 30c (hereinafter denoted by the same reference numeral 30), respectively. Incidentally, in this first embodiment, delivered from the fuel nozzles 26a, 26b and 26c are regular gasoline, high-octane gasoline and gas oil (i.e., diesel oil), respectively.

As shown in Fig. 4, the nozzle mechanism 25 is provided with a main body 31, mounted in which is a telescopic unit 32 for having a fuel delivery pipe 33 extended and retracted therefrom. The fuel nozzles 26 are mounted in this delivery pipe 33 side by side. These fuel nozzles 26a, 26b and 26c are connected with the hoses 27a, 27b and 27c through corrugated tubes 34a, 34b and 34c (hereinafter denoted by the same reference numeral 34) and shut-off valves 35a, 35b and 35c (hereinafter denoted by the same reference numeral 35), respectively. Further, as is clear from Fig. 4, the fuel delivery pipe 33 is provided with an insertion sensor 36 and a vapor suction port 37 in its front end portion. The vapor suction port 37 is connected with a suction pump 39 through a fuel type/grade sensor 38. Both the suction pump 39 and the fuel type/grade sensor 38 are mounted in the main body 31 of the nozzle mechanism 25. The main body 31 is provided with a filler opening sensor 40 in its front surface. This filler opening sensor 40 functions to detect a filler opening 56 (shown in Fig. 7) of the fuel tank (not shown) of the vehicle being fueled.

On the other hand, the data input/output unit 13 is provided

with: a display unit 41; an indicator 42; a portable type data input unit 44 connected with a communication line 43; and, a radio transmitting/receiving unit 61 provided with an antenna 60.

As shown in Fig. 5, the portable type data input unit 44 is provided with a display portion 45, a keyboard 46, a setting button 47, and an acknowledge button 48.

As shown in Fig. 6, the fuel supply unit 12 has its components (i.e., the pump 30, the flow meter 29, the shut-off valve 35, the fuel type/grade sensor 38, the suction pump 39, and the insertion sensor 36) connected with the fuel supply control means 50. This control means 50 is provided with a fuel tank fill-up means 51 and a fuel type/grade checking means 52. On the other hand, the vertical traveler 24, the horizontal traveler 21 and the telescopic unit 32 are connected with a mechanism control means 53, as is clear from Fig. 6.

The data input/output unit 13 has its components connected with a data control means 54, wherein the components comprises: the filler opening sensor 40; the entrance sensor 18; the vehicle stop 19; the approach lamp 17; the display unit 41; the indicator 42; the setting button 47, the acknowledge button 48, the keyboard 46 and the display portion 45 of the portable type data input unit 44; and, the radio transmitting/receiving unit 61. Data communication is established between the fuel supply units 12a and 12b and the data input/output unit 13a and 13b, respectively.

On the other hand, the motor vehicle 55 (shown in Fig. 7) carries an on-vehicle unit 62. As shown in Fig. 6, this on-vehicle unit 62 is constructed of: an on-vehicle card reader/writer 65, wherein data may be stored on, and read from a card 66 such as customer's credit cards, bank cards, fueling cards, prepaid cards, and the

like; and, an on-vehicle transmitting/receiving unit 64 provided with an on-vehicle antenna 63 through which balance data is transmitted and received. Consequently, a customer in his motor vehicle 55 carrying the on-vehicle unit 62 is capable of paying for his received amount of fuel using the card 66, without stepping out of the vehicle.

As shown in Fig. 7, the motor vehicle 55 fueled through the first embodiment of the automated fuel supply system is provided with: the filler opening 56 of the fuel tank (not shown) of the vehicle 55; and, a radio transmitter 57 in the vicinity of the filler opening 56, wherein the transmitter 57 issues a signal indicating a position of the filler opening 56. Preferably, the transmitter 57 is constructed of a transponder.

Now, with reference to Figs. 8 and 9, the first embodiment of the automated fuel supply system will be described in operation.

When there is no customer's vehicle to be fueled in the service station, the approach lamp 17 (shown in Fig. 3) is turned on in blue in a condition in which the vehicle stop 19 is retracted downward. On the other hand, when a first customer's vehicle to be fueled enters the service station, such entrance into the service station is detected by the entrance sensor 18 (shown in Fig. 3) which issues a detection signal to the data control means 54. Upon receipt of this detection signal (Fig. 8, ST1), the data control means 54 has the vehicle stop 19 projected upward to prevent the first customer's vehicle from moving backward. Under such circumstances, the approach lamp 17 is switched from blue to red so that entrance of a second customer's vehicle subsequent to the first one is prevented (Fig. 8, ST2). When a filler opening signal issued from the transmitter 57 (shown in Fig. 7) provided in the

vicinity of the filler opening 56 of the first vehicle is received by the filler opening sensor 40 (shown in Fig. 4) of the data input/output unit 13a (Fig. 8, ST3), the data control means 54 issues a disabling signal to the other 12b of the fuel supply units 12a, 12b (Fig. 8, ST4), so that the other fuel supply unit 12b is prevented from being actuated at a time when the corresponding fuel supply unit 12a is actuated, wherein the other fuel supply unit 12b is disposed adjacent to the first vehicle's side having no filler opening.

When the customer's card 66 (shown in Fig. 6) is inserted into the card reader/writer 65 of the on-vehicle unit 62 (Fig. 8, ST5), data is retrieved from the card 66, and transmitted to the service station's transmitting/receiving unit 61 through the on-vehicle transmitting/receiving unit 64 and the antennas 63, 60. On the other hand, in the service station, the data control means 54 issues another disabling signal to the other one 13b of the data input/output units 13a, 13b (Fig. 8, ST6), so that the other data input/output unit 13b is prevented from being actuated at a time when the corresponding data input/output unit 13a is actuated.

When fueling data such as fuel type/grade and the amount of fuel being supplied is inputted to a portable data input unit 44 of the service station through its keyboard 46 (Fig. 8, ST7), such fueling data is displayed on the display unit 41 in the island 11 of the service station, and also displayed on the display portion 45 of the portable data input unit 44. After that, when the customer depresses the acknowledge button 48 (Fig. 8, ST8) and the setting button 47 (Fig. 8, ST9) of the portable data input unit 44, the data control means 54 issues the fueling data to the fuel supply unit 12a (Fig. 8, ST10).

Upon receipt of the fueling data issued from the data control means 54 of the data input/output unit 13a, the mechanism control means 53 of the fuel supply (i.e., metering) unit 12a drives both the horizontal traveler 21 and the vertical traveler 24 on the basis of a signal issued from the on-vehicle transmitter 57 (Fig. 7), so that the nozzle mechanism 25 (Fig. 4) is moved to a position of the filler opening 56 of the customer's vehicle 55 to extend outward its telescopic unit 32, whereby the fuel delivery pipe 33 of the nozzle mechanism 24 is inserted into the filler opening 56 of the customer's vehicle (Fig. 9, ST2). Such insertion of the fuel delivery pipe 33 is detected by the insertion sensor 36 (Fig. 4). Due to such detection, the insertion sensor 36 issues an insertion signal to the fuel supply control means 50 (Fig. 9, ST3) so that the suction pump 39 is actuated, whereby vapor in the filler opening 56 is picked up and determined in fuel type/grade by the fuel type/grade sensor 38 which then issues a fuel type/grade signal. Thereafter, in the fuel type/grade checking means 52, it is determined whether or not the fuel indicated by the fuel type/grade signal is the same as that established by the keyboard 46 of the portable data input unit 44 (Fig. 9, ST4). When the fuel indicated by the fuel type/grade signal is the same as that established by the keyboard 46 of the portable data input unit 44 (Fig. 9, ST5), the shut-off valve 35 (Fig. 4) corresponding to the thus established fuel is opened by the fuel supply control means 50, and the corresponding pump 30 (Fig. 3) is actuated (Fig. 9, ST6).

As shown in Figs. 3 and 4, the fuel stored in the service station's fuel reservoir (not shown) is pumped by the pump 30, and supplied to the filler opening 56 of the vehicle 55 (Fig. 7) through the flow meter 29, the pipe 28, the hose 27, the shut-off valve

35, the corrugated tube 34, and the fuel supply nozzle 26. At this time, under the influence of a fuel pressure, the corrugated tube 34 extends longitudinally outward so that the fuel supply nozzle 26 is deeply inserted into the filler opening 56 of the vehicle 55 shown in Fig. 7. Consequently, there is no fear that fuel spills in the automated fuel supply system of the first embodiment. In operation, the amount of fuel measured in the flow meter 29 is displayed on both: the display unit 41 fixed to the island 11; and, the display portion 45 of the portable data input unit 44.

In fueling the customer's vehicle 55, the fill-up means 51 (Fig. 6) is actuated (Fig. 9, ST7). When a predetermined amount of fuel is supplied to the fuel tank (not shown) of the vehicle 55 and the tank is filled up (Fig. 9, ST8), the shut-off valve 35 is closed by the fuel supply control means 50, and the pump 30 is disabled (Fig. 9, ST9). Then, the fueling data is supplied to the data input/output unit 13a of the service station (Fig. 9, ST10). On the other hand, the mechanism control means 53 (Fig. 6) drives the telescopic unit 32, the vertical traveler 24 and the horizontal traveler 21 (Fig. 9, ST11), and moves the nozzle mechanism 25 back to its initial position (Fig. 9, ST12). Then, the indicator 42 (Fig. 3) on the island 11 is actuated to inform the customer of completion of such fueling operation of his vehicle 55 (Fig. 9, ST13).

The data input/output unit 13a (Fig. 8, ST11), which receives the fueling data in the step ST10 of Fig. 9, calculates a fueling charge of the vehicle 55 in a condition in which: data stored in the customer's card 66 is retrieved by the on-vehicle card reader/writer 65 and transmitted and received between the transmitting/receiving units 61, 64 (Fig. 8, ST12). After completion of payment of the fueling charge, the vehicle stop 19

is retracted downward to permit the first customer's vehicle 55 to move away. Then, the approach lamp 17 is switched from red to blue to permit the second customer's vehicle to enter the fueling spot (Fig. 8, ST13).

Incidentally, in the step ST5 of Fig. 9, when the detected vapor is not coincident in fuel type/grade with the fuel established by the keyboard 46 of the portable data input unit 44 of the service station (Fig. 9, ST14), the indicator 42 shown in Fig. 3 is actuated for a predetermined period of time (Fig. 9, ST15). This step ST15 of Fig. 9 is followed by the step ST7 of Fig. 8, so that a correct fuel type/grade is established by the keyboard 46 of the portable data input unit 44, whereby a correct fueling operation of the customer's vehicle is conducted.

SECOND EMBODIMENT

Figs. 10 to 20 show an automated fuel supply system 110 of a second embodiment of the present invention.

As shown in Fig. 10, the automated fuel supply system 110 of the second embodiment comprises an arm-moving type fuel supply unit 111 and a data input/output unit 140 both disposed on the fueling island 102 formed in the fuel supply area 101 of the service station. When the vehicle 103 enters the fuel supply area 101, the fuel supply nozzle of the fuel supply unit 111 of the automated fuel supply system 110 is automatically moved to the filler opening of the fuel tank of the vehicle 103 to fuel the vehicle 103.

As shown in Fig. 10, the fuel supply unit 111 comprises: an upright elongated post 113 which has its lower end portion fixedly mounted on an upper portion of a base plate 112 of the fueling island 102; a first arm 115 having one of its opposite end portions rotatably connected with an upper end portion of the post 113; a

second arm 115 having one of its opposite end portions rotatably connected with the other of the opposite end portions of the first arm 114; and, the nozzle mechanism 116.

In operation, the fuel supply unit 111 is driven by the horizontal traveler 117 to horizontally travel along a rail 118 which extends in a longitudinal direction of the elongated island 102. The post 113 is sufficiently higher than the vehicle 103, which makes it possible that the first arm 114 is capable of extending its front end portion up to a position above the vehicle 103 on the fuel supply area 101 when the first arm 114 is horizontally extended and rotated in a horizontal plane. On the other hand, the second arm 115 has a sufficient length, which enables the second arm 115 to reach the filler opening 104 (Fig. 18) of the vehicle 103 in a condition in which the second arm 115 obliquely extends from the first arm 114 even when the filler opening 104 is across the vehicle 103 from the post 113 as shown in phantom lines in Fig. 13.

Provided in a top portion of the post 113 is the approach lamp 134 providing a blue and a red signal light, wherein: the blue signal light permits the vehicle 103 to enter the fueling area; and, the red signal light rejects such entrance of the vehicle 103. The front end portion of the first arm 114 is provided with a fuel position sensor 135 for detecting a filler opening's side of the vehicle 103 in the fuel supply area 101 (Fig. 11). As shown in Fig. 10, the fueling island 102 is provided with the entrance sensor 136 in its elongated side surface. The entrance sensor 136 functions to detect the vehicle 103 ready to be fueled.

Provided under the island 102 are the individual fuel tanks or reservoirs of the service station for individually storing

therein corresponding regular gasoline, high-octane gasoline, and gas oil (i.e., diesel oil). These individual fuel reservoirs are connected with the corresponding fuel supply pipes 119a, 119b and 119c (hereinafter denoted by the same reference numeral 119), respectively, which pipes are provided with the pumps 120a, 120b and 120c (hereinafter denoted by the same reference numeral 120) and the corresponding flow meters 121a, 121b and 121c (hereinafter denoted by the same reference numeral 121), respectively. Further, as is clear from Fig. 10, the flow meters 121 are connected with the corresponding hoses 122a, 122b and 122c (hereinafter denoted by the same reference numeral 122), respectively. These hoses 122 are introduced into the post 113, and connected with the fuel supply or delivery nozzles 123a, 123b and 123c (hereinafter denoted by the same reference numeral 123) of the nozzle mechanism 116 through the corresponding fuel supply pipes 137, respectively. The fuel supply pipes 137 extend in each of the post 113, the first arm 114 and the second arm 115 have their joint portions constructed of rotary joints, flexible hoses and the like to as to be flexible.

As shown in Fig. 12, the nozzle mechanism 116 has its main casing 124 constructed of a short casing which is short in its axial direction. This main casing 124 has: one of its opposite axial end portions rotatably connected with a free end portion of the second arm 115; and, a central portion of the other of its opposite axial end portion reduced in outer diameter and axially extended forward to form a fuel delivery pipe 125 provided with a front end opening portion. Disposed inside this fuel delivery pipe 125 are the fuel delivery nozzles 123 which have their front end portion exposed to the atmosphere in the front end opening portion of the fuel delivery pipe 125, wherein the other end portions of the nozzles

123 are connected with the hoses 122 (Fig. 10) through the corrugated tubes 126a, 126b, 126c (hereinafter denoted by the same reference numeral 126), the shut-off valves 127a, 127b, 127c (hereinafter denoted by the same reference numeral 127), the fuel supply pipes 137. On the other hand, in a side surface of the front end portion of the fuel delivery pipe 125, there are provided both the insertion sensor 131 and the vapor suction port 128 which is connected with the suction pump 130 (Fig. 12) through the fuel type/grade sensor 129. Further, the main body 124 provided with this fuel delivery pipe 125 is provided with the filler opening sensor 132 for detecting the filler opening 104 (Fig. 18) of the vehicle 103.

As shown in Fig. 10, in the data input/output unit 140, the casing 142 is fixedly mounted on the top portion of an upright stand 141 which is fixedly mounted on an upper portion of the fueling island 102. This casing 142 is provided with the display unit 143, the indicator 144, and the portable type data input unit 146 which is connected with the data input/output unit 140 through the communication line 145. As shown in Fig. 17, the portable type data input unit 146 is provided with the display portion 147, the keyboard 148, the setting button 149, the acknowledge button 150, and the card reader/writer 151. In this card reader/writer 151, data may be stored on, and read from the card 66 (Fig. 6) such as customer's credit cards, bank cards, fueling cards, prepaid cards, and the like.

As shown in Fig. 16, for example, the fuel supply unit 111 is provided with the fuel supply control means 160. On the other hand, the fuel supply control means 160 is provided with the fuel tank fill-up means 161 and the fuel type/grade checking means 162, and connected with the pumps 120, the flow meters 121, the shut-off

valves 127, the fuel type/grade sensor 129, the suction pump 130, and the insertion sensor 131. Further, the fuel supply unit 111 is provided with an arm rotating unit 133 for independently and rotatably driving each of the first arm 114, the second arm 115, and the nozzle mechanism 116. In the fuel supply unit 111, the mechanism control means 163 is connected with the horizontal traveler 117, the arm rotating unit 133, the filler opening sensor 132 and a fuel supply position sensor 135. On the other hand, as shown in Fig. 16, the data input/output unit 140 is provided with the data control means 164 for controlling the individual components. The data control means 164 is connected with the approach lamp 134, the keyboard 148, the display unit 143, the card reader/writer 151, the indicator 144, the setting button 149, the acknowledge button 150, and the display portion 147 of the portable type data input unit 146. The fuel supply unit 111 is communicated with the data input/output unit 140 so that data is exchanged therebetween.

As shown in Fig. 18, in the vehicle 103 to be fueled through the automated fuel supply system 110 of the second embodiment, there is provided the transmitter 105 in the vicinity of the filler opening 104 of the on-vehicle fuel tank (not shown). This transmitter 105 functions to issue a signal indicating the position of the filler opening 104. Preferably, the transmitter 105 is constructed of a transponder.

Now, operation of the automated fuel supply unit 111 of the second embodiment will be described with reference to flowcharts shown in Figs. 19 and 20, wherein: Fig. 19 shows the flowchart illustrating the flow of data in the data input/output unit 140 of the second embodiment; and, Fig. 20 shows the flowchart of a

fuel supply operation performed by the automated fuel supply system of the second embodiment.

When there is no customer's vehicle to be fueled in the fuel supply area 101, the approach lamp 134 (Fig. 10) is turned on in blue. At this time, for example, as shown in Fig. 14, in the initial position of the fuel supply unit 111, in which the unit 111 is on standby: the first arm 114 is in its horizontal position in a condition in which the second arm 115 obliquely extends rearward toward the lower end portion of the post 113; and, the nozzle mechanism 116 has its fuel delivery pipe 125 directed toward the fuel supply area 101.

When a first customer's vehicle to be fueled enters the fuel supply area 101 (Fig. 11), such entrance into the fuel supply area 101 is detected by the entrance sensor 136 (shown in Fig. 10) which issues a detection signal to the data control means 164 (Fig. 19, ST101). Upon receipt of this detection signal, the data control means 164 has the approach lamp 134 switched from the blue signal light to the red signal light so that entrance of a second customer's vehicle subsequent to the first one is prevented (Fig. 19, ST102).

After that, when the customer inserts his card 66 (Fig. 6) into the card reader/writer 151 of the portable type data input unit 146 (Fig. 19, ST103), the data input/output unit 140 having received the fuel supply data makes it possible for the fuel supply unit 111 to automatically supply the fuel to the vehicle. More specifically, When the fuel supply data such as the fuel type/grade, the amount of the fuel being supplied, and like data are inputted to the data control means 164 through the keyboard 148 (Fig. 19, ST104), the fuel supply data is displayed on both the display unit 143 and the display portion 147 of the portable type data input

unit 146. Under such circumstances, when the customer depresses the acknowledge button 150 (Fig. 19, ST105) and then depresses the setting button 149 to establish the fuel supply data (Fig. 19, ST106). The fuel supply data thus established is then transmitted by the data control means 164 to the fuel supply unit 111.

When the fuel supply data transmitted from the data control means 164 of the data input/output unit 140 is inputted to the mechanism control means 163 of the fuel supply unit 111 (Fig. 20, ST111), firstly both: the fuel supply position sensor 135 provided in the end portion of the first arm 114 of the fuel supply unit 111 which is on standby; and, the filler opening sensor 132 provided in the nozzle mechanism 116 detect the position of the filler opening 104 (Fig. 18) of the vehicle 103 being fueled (Fig. 20, ST112), so that the mechanism control means 163 controls both the arm rotating unit 133 and the horizontal traveler 117, whereby the front end portion of the fuel delivery pipe 125 of the nozzle mechanism 116 is moved to a position where the nozzle mechanism 116 is oppositely disposed from the filler opening 104 of the vehicle 103 (Fig. 20, ST113). More specifically, firstly, the fuel supply position sensor 135 determines whether or not the filler opening 104 of the vehicle 103 faces the nozzle mechanism 116. Secondly, as shown in Fig. 14, when the filler opening 104 faces the nozzle mechanism 116 which is still on standby, the filler opening sensor 132 may receive the position signal issued from the on-vehicle transmitter 105. Consequently, on the basis of the position signal thus received by the filler opening sensor 132, the mechanism control means 163 controls the horizontal traveler 117 to have the fuel supply unit 111 horizontally moved along the rail 118, and to control the arm rotating unit 133 so that the second arm 115

and/or the nozzle mechanism 116 are/is rotatably driven, whereby the front end portion of the fuel delivery pipe 125 is moved to the filler opening 104 (Fig. 18) of the vehicle 103. On the other hand, when the filler opening 104 of the vehicle 103 is across the vehicle 103 from the nozzle mechanism 116 (shown in slid lines in Fig. 13), firstly the mechanism control means 163 controls the arm rotating unit 133 to have the first arm 114, the second arm 115, and the nozzle mechanism 116 rotatably driven in a manner such that the nozzle mechanism 116 is moved to a position shown in phantom lines in Fig. 13 (hereinafter referred to the phantom-line position). In this phantom-line position, the filler opening sensor 132 may receives the position signal issued from the on-vehicle transmitter 105 as described above. On the basis of the position signal thus received by the filler opening sensor 132, the mechanism control means 163 controls the horizontal traveler 117 to have the fuel supply unit 111 to horizontally moved, and also controls the arm rotating unit 133 to have the second arm 115 and the nozzle mechanism 116 rotatably driven in a manner such that the front end portion of the fuel delivery pipe 125 is moved to the filler opening 104 of the vehicle 103. Then, in a condition in which the front end portion of the fuel delivery pipe 125 is oppositely disposed from the filler opening 104 of the vehicle 103, the second arm 115 is rotatably driven so that the front end portion of the fuel delivery pipe 125 is inserted into the filler opening 104, whereby the insertion sensor 131 issues the detection signal to the fuel supply control means 160 (Fig. 20, ST114). Upon receipt of such detection signal, the fuel supply control means 160 actuates the suction pump 130 (Fig. 12) to remove the vapor contained in the filler opening 104, and also actuates the fuel type/grade checking

means 162 (Fig. 20, ST115), so that it is determined whether or not the fuel type/grade indicated by the detection signal issued from the fuel type/grade sensor 132 is coincident with the fuel type/grade established through the keyboard 148 (Fig. 20, ST116). When they are coincident with each other, the fuel supply control means 160 opens the shut-off valve 127 corresponding the fuel type/grade thus identified and actuates the corresponding pump 120 (Fig. 20, ST117).

The fuel contained in the fuel reservoir (not shown) of the service station is supplied to the vehicle 103 through its filler opening 104 under pressure by the pump 120 through the flow meter 121, the hose 122, the fuel supply pipes 137, the shut-off valve 127, the corrugated tube 126, and the fuel supply nozzle 123. At this time, under the influence of the fuel pressure, the corrugated tube 126 axially extends outward so that the front end portion of the fuel supply nozzle 123 is projected outward from the front end opening portion of the fuel delivery pipe 125, and therefore deeply inserted into the filler opening 104. Consequently, there is no fear that the fuel being delivered is spilled out of the filler opening 104. On the other hand, the amount of the fuel measured by the flow meter 121 is displayed on both the display unit 143 and the display portion 147 of the portable type data input unit 146.

As described above, the fueling operation of the vehicle 103 (Fig. 18) is performed, so that the tank fill-up means 161 is actuated when the on-vehicle tank (not shown) is filled up or a predetermined amount of the fuel is supplied to the on-vehicle tank (Fig. 20, ST119). When the on-vehicle tank is filled up (Fig. 20, ST120), the fuel supply control means 160 stops the pump 120, closes

the shut-off valve 127 (Fig. 20, ST121), and issues a signal to a signal or data indicating the amount of the supplied fuel to the data input/output unit 140 (Fig. 20, ST122). Subsequent to this, the mechanism control means 163 controls both the arm rotating unit 133 and the horizontal traveler 117, so that the fuel delivery pipe 125 is pulled out of the filler opening 104. At this time, the fuel supply unit 111 is returned to its initial position (Fig. 20, ST123). When the fuel supply unit 111 reaches its initial position (Fig. 20, ST124), the fueling operation of the vehicle 103 is completed so that the indicator 144 indicates completion of the fueling operation of the vehicle 103 (Fig. 20, ST125).

On the other hand, the data input/output unit 140 receives the data indicating the amount of the supplied fuel issued from the fuel supply unit 111 (Fig. 19, ST109), and calculates a fueling charge of the vehicle 103 using the customer's card 66 so that payment of the fueling charge thus calculated is done (Fig. 19, ST109). After completion of payment of the fueling charge, the approach lamp 134 is switched from red to blue to complete the fueling operation of the vehicle 103.

Incidentally, when the detected vapor is not coincident in fuel type/grade with the fuel established by the keyboard 148 of the portable type data input unit 146 (Fig. 20, ST116), the data control means 164 actuates the indicator 144 for a predetermined period of time (Fig. 20, ST118) to require the fuel supply data to be inputted again (Fig. 19, ST104), which makes it possible for the customer to input a correct type/grade of the fuel to the data control means 164 through the keyboard portion 148 of the portable type data input unit 146.

Incidentally, as shown in Fig. 14, preferably the fuel supply

unit 111 is always on standby in order to realize immediate supply of the fuel. However, it is also possible for the first arm 114 is in the phantom-line position when the fuel supply unit 111 is on standby. Further, as shown in Fig. 15, it is also preferable that the first arm 114 and the second arm 115 are positioned side by side in parallel to each other along the post 113 when the fueling operation of the vehicle 103 is completed.

In the automated fuel supply system 110 of the second embodiment having the above construction, when the vehicle 103 (Fig. 18) to be fueled enters the fuel supply area 101, the entrance sensor 136 automatically detects the vehicle 103 so that the approach lamp 134 is turned on in red to prevent a second vehicle from entering the fuel supply area 101 which is already occupied by the first vehicle 103.

When the customer uses the portable type data input unit 146 to input the fuel supply data such as the fuel type/grade, the amount of the fuel supplied, and like data to the data control means 164, both the fuel supply position sensor 135 and the filler opening sensor 132 detects the position of the filler opening 104 of the first vehicle 103, so that the mechanism control means 163 controls and actuates the horizontal traveler 117 and the arm rotating unit 133, whereby the first arm 114 and the second arm 115 are moved in a manner such that the nozzle mechanism 116 approaches the filler opening 104. When the fuel delivery pipe 125 of the nozzle mechanism 116 provided with the fuel delivery nozzles 123 is inserted into the filler opening 104 of the vehicle 103 and the insertion sensor 131 detects the insertion of the fuel delivery pipe 125 into the filler opening 104, the fuel type/grade is checked by the fill-up means 161 and the fuel type/grade checking means 160. When the fuel

type/grade is correct, the fueling operation of the vehicle 103 starts. When the on-vehicle fuel tank is filled up or the predetermined amount of the fuel is supplied to the on-vehicle fuel tank, the fueling operation of the vehicle 103 is completed. The data indicating the amount of the fuel supplied to the on-vehicle tank is issued to the data input/output unit 140, so that a fueling charge of the vehicle 103 is calculated. At this time, in the fuel supply unit 111, the mechanism control means 163 has both the horizontal traveler 117 and the arm rotating unit 133 returned to their initial positions. Due to this, the entire fueling operation of the vehicle 103 is automatically performed, which removes the need of the attendant of the service station.

Incidentally, in this second embodiment, though the first arm 114, the second arm 115 and the nozzle mechanism 116 are rotatably driven so that the nozzle mechanism is moved to the filler opening 104 of the vehicle 103, it is also possible to have three or more of the arms combined with each other to form an arm mechanism, wherein each of the arms may assume any shapes and have any length. Further, in place of the horizontal traveler 117, it is also possible to employ the post 113 which is capable of rotating.

Still further, both the sensors 132, 135 may detect any type of images, and may use visible light beams, infrared rays, or the remaining electromagnetic waves.

Further, in the second embodiment, there is not provided any vehicle stop such as the vehicle stop 19 of the first embodiment shown in Fig. 3. it is also possible for the second embodiment to use the vehicle stop (not shown), wherein: the vehicle stop is projected upward in the fuel supply area 101 when the entrance sensor 136 detects the vehicle 103; and, after completion of the fueling

operation of the vehicle 103, the vehicle stop is retracted from the fuel supply area 101.

Further, in the second embodiment, though the portable type data input unit 146 is connected through the communication line 145, it is also possible for the portable type data input unit 146 to radio-communicate with the data control means 164.

THIRD EMBODIMENT

Figs. 21 to 29 show a third embodiment of the automated fuel supply system of the present invention.

As shown in Fig. 21, the automated fuel supply system 210 of the third embodiment is provided with the fuel supply unit 211 of flexible hose type and the data input/output unit 250 both fixedly mounted on the fueling island 202 of the fuel supply area 201. In accordance with the position of the filler opening 204 of the vehicle 203 in the fuel supply area 201, the fuel supply nozzles of the fuel supply unit 211 are automatically moved to fuel the vehicle 203.

The fuel supply unit 211 comprises: the elongated upright post 213 fixedly mounted on the upper portion of the base plate 212 on the fueling island 202; a hose container casing 214 which has one of its opposite end portions rotatably connected with an upper end portion of the post 213 and the other of its opposite end portions extended toward the side of the fuel supply area 201; a hose moving mechanism 215 received inside the hose container casing 214; a hose bending means 216 mounted on the hose moving mechanism 215; the nozzle mechanism 217 rotatably mounted on a front end portion of the hose bending means 216; and, a post rotating unit 218 for rotatably driving the post 213.

The post 213 is much higher than the vehicle 203. On the other

hand, the hose container casing 214 assumes an elongated box-like shape having its base end portion be larger in size than its free end portion, wherein: the base end portion of the casing 214 is mounted on an upper end portion of the post 213; and, the free end portion of the casing 213 sufficiently extends outward beyond the roof of the vehicle 203. Further, the hose container casing 214 is provided with the approach lamp 234 in an upper portion of its base end portion, wherein the approach lamp 234 is turned on in blue to permit the vehicle 203 to enter the fuel supply area 201, and turned on in red to prevent the vehicle 203 from entering the fuel supply area 201. As shown in Fig. 21, the filler opening position sensor 235 for detecting the position of the filler opening 204 of the vehicle 203 is provided in a lower surface of an intermediate portion of the hose container housing 214. On the other hand, the entrance sensor 236 is provided in a side surface of the fueling island 202 disposed adjacent to the fuel supply area 201.

As shown in Fig. 21, the hose moving mechanism 215 is provided inside the hose container casing 214, and comprises: a hose reel 219 disposed above the post 213; a hose 229 wound around the hose reel 219 and extended forward therefrom; a hose supply bogie 221 for moving the hose 220; a rail 222 fixedly mounted on a bottom portion of the hose container casing 214, wherein the rail functions to guide the bogie 221; a hose joint 224 connected with an end portion of the hose 220 through the shut-off valve 223, wherein the end portion of the hose 220 is mounted on the bogie 221; and, the hose moving unit 225 for moving the bogie 221 along the rail 222.

As shown in Fig. 22, the fuel supply pipe 226 is provided underground, connected to the service station's fuel reservoir (not shown) through the pump 227 and the flow meter 228, introduced into

the post 213, and connected with the hose 220 of the hose reel 219 through the rotary joint 229, wherein: the service station's fuel reservoir (not shown) is provided beneath the lower portion of the fueling island 202; and, these components 227, 228, 220, 219, 229 and the like forms the fuel supply mechanism.

As shown in Fig. 24, the hose bending means 216 is constructed of a flexible sheath hose 231 and the fuel supply hose 230 disposed inside the flexible sheath hose 231. As is clear from Fig. 21, the hose bending means 216 having the above construction is connected with a lower portion of the bogie 221 through a connection portion 249, wherein the fuel supply hose 230 is communicated with the hose 220. The flexible sheath hose 231 is formed of fiber-reinforced rubber and like materials, has a sufficient inner diameter to receive the fuel supply hose 230 therein.

An annular space is defined between an outer peripheral surface of the sheath hose 231 and the fuel supply hose 230 in the interior of the sheath hose 231, and radially divided into three air chambers 231a. Each of the air chambers 231a assumes a sector shape in cross section, has its opposite axial end portions closed, and is therefore pressurized under the influence of pressurized airs supplied to these air chambers.

In other words, the flexible sheath hose 231 is capable of bending toward any direction under the influence of a difference between the pressurized airs individually supplied to these air chambers 231a since the air chamber 231a may individually axially extend when pressurized and may individually axially contract when reduced in pressure. Consequently, the flexible sheath hose 231 serves as a pneumatic actuator capable of bending toward any direction, which makes it possible for the flexible sheath hose

231 to move the nozzle mechanism 217 in any desired direction, wherein the nozzle mechanism 217 is mounted on the front end of the flexible sheath hose 231 and communicated with the fuel supply hose 230.

As shown in Fig. 25, in the nozzle mechanism 217, the front end portion of the fuel supply hose 230 projected outward from the flexible sheath hose 231 of the hose bending means 216 is connected with a nozzle opening adapter 240 through the telescopic corrugated tube 232. The nozzle opening adapter 240 is one of components of the fuel supply nozzle assembly.

On the other hand, the vehicle 203 is provided with a filler opening adapter 247 in the filler opening 204. The filler opening adapter 247 is adapted in shape to receive the nozzle opening adapter 240 therein. The nozzle opening adapter 240 has its rear tubular portion connected with the corrugated tube 232, and is provided with a conical surface 240a in its front tapered end portion in which an axial fuel delivery opening 240b is formed. In a front end portion of the conical surface 240a of the nozzle opening adapter 240 is provided with the vapor suction port 240c.

The vapor suction port 240c is connected with the fuel type/grade sensor 244 and the suction pump 245 through the corrugated tube 243. Mounted on the tubular portion of the nozzle opening adapter 240 is an exciting coil 241. The filler opening adapter 247 is provided in the vehicle 203's side in which the fuel oil is supplied to the vehicle 203. Further, as shown in Fig. 25, the filler opening adapter 247 is provided with a conical surface 247a which is brought into close contact with the front end portion of the nozzle opening adapter 240 when the nozzle opening adapter 240 is inserted into the filler opening adapter 247. More

specifically, the filler opening 247b is formed in the front end portion of the conical surface 247a. On the other hand, disposed in a position oppositely disposed from the exciting coil 241 is a magnet 248 which is fixedly mounted in an annular groove of a front surface of the filler opening adapter 247. As shown in Fig. 25, in a front end portion of the flexible sheath hose 231 disposed in the vicinity of the projected fuel supply hose 230, there is provided the filler opening sensor 246 which functions to detect the position of the filler opening 247b (Fig. 25) of the vehicle and also to determine whether or not the nozzle opening adapter 240 is properly engaged with the filler opening adapter 247.

As shown in Fig. 22, the data input/output unit 250 is provided with the casing 252. This casing 252 is mounted on the top portion of the upright stand 251 which is mounted on the upper portion of the fueling island 202. Provided in this casing 252 are: the display unit 253; the indicator 254; and, the portable type data input unit 256 provided with the communication line 255. As shown in Fig. 26, this portable type data input unit 256 is provided with: the display portion 257; the keyboard 258; the setting button 259; the acknowledge button 260; and, the card reader/writer 261, wherein data may be stored on, and read from the card 66 (Fig. 6) such as customer's credit cards, bank cards, fueling cards, prepaid cards, and the like.

As shown in Fig. 27, the fuel supply unit 211 is provided with the fuel supply control means 290. This control means 290 is provided with the fuel tank fill-up means 291 and the fuel type/grade checking means 292. Connected with the fuel supply control means 290 are: the pump 227; the flow meter 228; the shut-off valve 223; the fuel type/grade sensor 244; the suction pump 245; and, the filler opening

sensor 246. On the other hand, the fuel supply unit 211 is provided with the mechanism control means 293 for controlling the position of the nozzle mechanism 217. Connected with the mechanism control means 293 are: the post rotating unit 218; the hose moving unit 225; the hose bending means 216; the exciting coil 241; the fuel supply position sensor 235; and, the filler opening sensor 246. On the other hand, the data input/output unit 250 is provided with the data control means 294 for controlling the individual components. More specifically, connected with the data control means 294 are: the entrance sensor 236; the approach lamp 234; the keyboard 258; the display unit 253; the card reader/writer 261; the indicator 254; the setting button 259; the acknowledge button 260; and, the display portion 257 of the portable type data input unit 256. Data is exchanged between the fuel supply unit 211 and the data input/output unit 250.

Next, operation of the automated fuel supply system of the third embodiment will be described with reference to the flowcharts shown in Figs. 28 and 29, wherein: the flowchart of Fig. 28 illustrates the flow of data in the data input/output unit 250; and, the flowchart of Fig. 29 shows the fuel supply operation performed by the fuel supply unit 211 of the third embodiment.

When there is no vehicle 203 to be fueled in the fuel supply area 201, the approach lamp 234 (Fig. 21) is turned on in blue. At this time, in the fuel supply unit 211, the hose bending means 216 is on standby in its initial position shown in phantom lines in Fig. 21, wherein the hose bending means 216 is disposed adjacent to the post 213.

When a first customer's vehicle 203 to be fueled enters the fuel supply area 201, such entrance into the fuel supply area 201

is detected by the entrance sensor 236 which issues a detection signal to the data control means 294 (Fig. 28, ST201). Upon receipt of this detection signal, the data control means 294 (Fig. 27) has the approach lamp 234 switched from blue to red (Fig. 28, ST202), so that entrance of a second customer's vehicle subsequent to the first vehicle is prevented.

When the customer's card 66 (Fig. 6) is inserted into the card reader/writer 261 of the portable type data input unit 256 of the data input/output unit 250 (Fig. 28, ST203), the fueling data is retrieved from the card 66, and transmitted to the fuel supply unit 211, which makes it possible to automatically fuel the vehicle 203.

When the fueling data such as fuel type/grade and the amount of fuel being supplied is inputted to the portable type data input unit 256 through its keyboard 258 (Fig. 28, ST204), such fueling data is displayed on the display unit 253 and the display portion 257 of the portable type data input unit 256. After that, when the customer depresses the acknowledge button 260 (Fig. 28, ST205) and the setting button 259 (Fig. 28, ST206) of the portable type data input unit 256, the data control means 294 issues the fueling data to the fuel supply unit 211 (Fig. 28, ST207).

In a condition in which the fueling data issued from the data control means 294 of the data input/output unit 250 is received by the mechanism control means 293 (Fig. 29, ST211), both the fuel supply position sensor 235 (which is provided in the lower portion of the hose container casing 214) and the filler opening sensor 246 provided in the nozzle mechanism 216 of the front end portion of the hose bending means 216 (which is on standby) detect the position of the filler opening 247b (Fig. 29, ST212).

Then, the mechanism control means 293 controls the hose moving

unit 225, the hose bending means 216 and the post rotating unit 218 in a manner such that the nozzle mechanism 216 is moved to a position in which the nozzle mechanism 216 is oppositely disposed from the filler opening 247b of the vehicle 203 (Fig. 29, ST213).

More specifically, firstly, it is necessary for the fuel supply position sensor 235 to detect or determine whether or not the filler opening 247b of the vehicle 203 is in the side of the fueling island 202. Secondly, when the filler opening 247b of the vehicle 203 is in the side of the fueling island 202, in the position shown in phantom lines in Fig. 21 in which the nozzle mechanism 217 is on standby, the filler opening 247b of the vehicle 203 is detected by the filler opening sensor 246 which then issues a detection signal to the mechanism control means 293 of the fuel supply unit 211.

On the basis of the detection signal thus received, the mechanism control means 293 controls the post rotating unit 218 to rotate the hose container casing 214 about the post 213, and also controls the hose bending means 216 to bend the flexible sheath hose 231, so that the nozzle adapter 240 of the nozzle mechanism 217 is moved to the position in which the nozzle adapter 240 is oppositely disposed from the filler opening adapter 247 of the vehicle 203.

On the other hand, as shown in solid lines in Fig. 21, when the filler opening 247b of the vehicle 203 is across the vehicle 203 from the side of the fueling island 202, firstly, the mechanism control means 293 controls the hose moving unit 225 (which forms the hose moving mechanism) to move the bogie 221 to the front end portion of the hose container casing 214. After that, as is in the above, the mechanism control means 293 controls the post rotating

unit 218 to rotate the hose container casing 214 about the post 213, and also controls the hose bending means 216 to bend the flexible sheath hose 231, so that the nozzle adapter 240 of the nozzle mechanism 217 is moved to the position in which the nozzle adapter 240 is oppositely disposed from the filler opening adapter 247 of the vehicle 203.

Then, when the exciting coil 241 is energized (Fig. 29, ST214) with electric current, the exciting coil 241 thus energized is attracted by the magnet 248. Due to this, the corrugated tubes 232, 243 are extended so that the front end portion of the nozzle adapter 240 is inserted into the filler opening adapter 247 of the vehicle 203. Under such circumstances, when the filler opening sensor 246 detects the filler opening adapter 247 having been connected with the nozzle opening adapter 240 (Fig. 29, ST215), the fuel supply control means 290 actuates the suction pump 245 to remove the vapor from the filler opening 247b of the vehicle 203.

After that, the fuel type/grade checking means 292 is actuated (Fig. 29, ST216) to determine whether the fuel type/grade indicated by the fuel type/grade signal issued from the fuel type/grade sensor 244 is coincident with the fuel type/grade having been inputted by the customer through the keyboard 258 of the portable type data input unit 256 (Fig. 29, ST217).

When there is no difference in fuel type/grade between the fuel type/grade signal and the data inputted to the portable type data input unit 256 through its keyboard 258, the fuel supply control means 290 opens the shut-off valve 223 and actuates the pump 227 (Fig. 29, ST218).

On the other hand, the fuel oil received in the fuel reservoir of the service station is supplied under pressure by the pump 227

to the filler opening 247b of the vehicle 203 through the flow meter 228, the hose 220, the shut-off valve 223, the fuel supply hose 230, the corrugated tube 232, and the nozzle opening adapter 240. The amount of the supplied fuel measured through the flow meter 228 is displayed on the display unit 253 and the display portion 257 of the portable type data input unit 256.

The fueling operation of the vehicle 203 is performed in a manner described above. In the above fueling operation, the fuel tank fill-up means 291 is operated (Fig. 29, ST220). When the predetermined amount of the fuel is supplied or the on-vehicle fuel tank is filled up (Fig. 29, ST221), the fuel supply control means 290 stops the pump 227, closes the shut-off valve 223, and de-energizes the exciting coil 241 (Fig. 29, ST222), so that the data indicating the amount of the supplied fuel is issued to the data input/output unit 250 (Fig. 29, ST223). Due to such de-energization of the exciting coil 241, the nozzle opening adapter 240 is released from the filler opening adapter 247. Subsequently to this, the mechanism control means 293 controls the hose bending means 216, the hose moving unit 225, and the post rotating unit 218 so that the nozzle mechanism 217 is moved further away from the filler opening 247b of the vehicle 203 (Fig. 29, ST224). When the nozzle mechanism 217 reaches its initial position (Fig. 29, ST225), the fueling operation of the vehicle 203 is completed so that the indicator 254 is actuated to indicate completion of the fueling operation of the vehicle 203 (Fig. 29, ST226).

After that, the data input/output unit 250, which receives the fuel supply data from the fuel supply unit 211 (Fig. 28, ST208), calculates a fueling charge of the vehicle 203 in a condition in which the data stored in the customer's card 66 (Fig. 6) is retrieved

by the card reader/writer 261. After completion of payment of the fueling charge using the card 66 (Fig. 28, ST208), the approach lamp 234 is switched from red to blue to permit a second customer's vehicle 203 to enter the fuel supply area 201.

Incidentally, when the detected vapor is not coincident in fuel type/grade with the fuel established by the keyboard 258 of the portable type data input unit 256 (Fig. 29, ST217), the data control means 294 actuates the indicator 254 for a predetermined period of time (Fig. 29, ST219) to require a correct fuel type/grade to be established through the keyboard 258 of the portable type data input unit 256, whereby the fueling operation of the customer's vehicle is properly conducted.

Incidentally, as shown in phantom lines in Fig. 21, through the fuel supply unit 211 is preferably always on standby, it is also possible for the hose bending means 216 to be disposed in the opposite position shown in solid lines in Fig. 21, wherein the opposite position shown in the solid lines is across the vehicle 203 from the initial position shown in phantom lines in Fig. 21.

In the automated fuel supply system 210 of the third embodiment having the above construction, when the vehicle 203 (Fig. 21) to be fueled enters the fuel supply area 201, the entrance sensor 236 automatically detects the vehicle 203 so that the approach lamp 234 is turned on in red to prevent a second vehicle 203 from entering the fuel supply area 201 which is already occupied by the first vehicle 203.

When the customer uses the portable type data input unit 256 of the data input/output unit 250 to input the fuel supply data such as the fuel type/grade, the amount of the fuel supplied, and like data to the data control means 294, both the fuel supply

position sensor 235 and the filler opening sensor 246 detects the position of the filler opening 247b of the vehicle 203, so that the mechanism control means 293 controls and actuates the post rotating unit 218, the hose moving unit 225, and/or the hose bending means 216 in a manner such that the nozzle opening adapter 240 approaches the position in which the nozzle opening adapter 240 is oppositely disposed from the filler opening adapter 247 of the vehicle 203. Under such circumstances, when the exciting coil 241 is energized with electric current, the exciting coil 241 is attracted by the magnet 248 so that the nozzle opening adapter 240 is connected with the filler opening adapter 247 of the vehicle 203 to permit the vehicle 203 to be fueled. Subsequently to this, the fuel type/grade checking means 292 checks the fuel type/grade. When the fuel type/grade is correct, the fueling operation of the vehicle 203 starts. When the on-vehicle fuel tank is filled up or the predetermined amount of the fuel is supplied to the on-vehicle fuel tank, the fueling operation of the vehicle 203 is completed. The data indicating the amount of the fuel supplied to the on-vehicle tank is issued to the data input/output unit 250, so that a fueling charge of the vehicle 203 is calculated. At this time, in the fuel supply unit 211, the mechanism control means 293 de-energizes the exciting coil 241 so that the nozzle opening adapter 240 is released from the filler opening adapter 247. Further, the mechanism control means 293 controls and actuates the hose bending means 216, the hose moving unit 225, and the post rotating unit 218 to return to its initial position. Due to this, the entire fueling operation of the vehicle 203 is automatically performed, which removes the need of the attendant of the service station.

FOURTH EMBODIMENT

Fig. 30 shows a fourth embodiment of the automated fuel supply system of the present invention. In Fig. 30, the parts which are the same as ones shown in the third embodiment have been given the same reference numerals, and are not further described here.

As shown in Fig. 30, the fourth embodiment of the fuel supply unit 271 of the automated fuel supply system 270 comprises a second hose container casing 273 which is mounted on a lower portion of a third hose container casing 272, wherein the third hose container casing 272 has one of its opposite end portions mounted on the top portion of the post 213 and the other of its opposite end portions extended toward the fuel supply area 201. The bogie 221 is driven by the hose moving unit 225 to travel on the rail 222 in the interior of the second hose container casing 273. As is clear from Fig. 30, the fuel supply pipe 226 extends up to an intermediate portion of the third hose container casing 272, and has its front end portion connected with the fuel supply hose 230 (Fig. 24) through the hose 220, the shut-off valve 223, and the rotary joint 274. The remaining construction of the fourth embodiment is the same as that of the third embodiment.

In the automated fuel supply system 270 of this fourth embodiment, when the hose moving unit 225 is driven, the hose 220 is bent. The rotary joint 274 functions to change the direction of the hose 220. Except for the above features, there is no difference in operation between the third and the fourth embodiment. In other words, the fourth embodiment is capable of automatically performing the fueling operation of the vehicle 203 without accepting any help from the attendant of the service station. In this fourth embodiment, any hose reel such as one 219 (Fig. 21) of the third embodiment is not required.

FIFTH EMBODIMENT

Fig. 31 shows a fifth embodiment of the automated fuel supply system of the present invention. In Fig. 31, the parts which are the same as ones shown in the third and the fourth embodiments have been given the same reference numerals, and are not further described here.

As shown in Fig. 31, in the fifth embodiment of the fuel supply unit 281 of the automated fuel supply system 280, the hose container casing 282 has one of its opposite end portions mounted on the top portion of the post 213 and the other of its opposite end portions extended toward the fuel supply area 201. The bogie 221 is driven by the hose moving unit 225 to travel on the rail 222 in the interior of the hose container casing 282. As is clear from Fig. 31, a mobile casing 284 is suspended from a lower portion of the bogie 221 through a support member 283. The connection portion 249 is mounted on this mobile casing 284. The hose 220 is connected with the fuel supply hose 230 through the shut-off valve 285 which is disposed between the connection portion 249 and the rotary joint 274. The remaining construction of the fifth embodiment is the same as those of the third and the fourth embodiment.

In the automated fuel supply system 280 of this fifth embodiment, when the hose moving unit 225 is driven, the hose 220 is bent. The rotary joint 274 functions to change the direction of the hose 220. Except for the above features, there is no difference in operation between the fifth and the fourth embodiment. In other words, the fifth embodiment is capable of automatically performing the fueling operation of the vehicle 203 without accepting any help from the attendant of the service station. In this fifth embodiment, any hose reel such as one 219 (Fig. 21) of

the third embodiment is not required as is in the fourth embodiment.

Incidentally, in each of the above embodiments, the hose bending means 216 has its flexible sheath hose 231 (Fig. 24) bent upon receipt of the individual pressurized air to move the entire nozzle mechanism 216. However, it is also employ a suitable mechanism in place of the hose bending means 216. The above suitable mechanism may comprises an actuator constructed of a spring made of a so-called "shape memory alloy", wherein the spring is mounted on a portion of an outer surface of a hose containing the fuel supply hose 230 therein. In bending operation of the fuel supply hose 230, an electric current is applied across the spring to heat the spring, which results in the bending operation of the fuel supply hose 230. Further, it is required for the hose moving mechanism only to permit the hose to move inside the hose container casing which has, at least, one of its opposite end portions mounted on the tip portion of the post 213 and the other extended across the vehicle from the fuel island 202. Further, it is also possible to employ a suitable horizontal moving unit in place of the post rotating unit 218. The above horizontal moving unit is capable of forcing the post 213 to horizontally travel.

Further, both the sensors 235, 246 for detecting the filler opening 247b of the vehicle 203 may detect any type of images, and may use visible light beams, infrared rays, or the remaining electromagnetic waves.

Still further, in some of the above embodiments, though there is not provided any vehicle stop, it is also possible to provide a vehicle stop such as one 19 (shown in Fig. 3) in these embodiments. In operation, the vehicle stop is projected upward to prevent the vehicle from moving backward when the entrance sensor 236 detects

the vehicle. After completion of the fueling operation of the vehicle, the vehicle stop is retracted downward from the fuel supply area 201.

Further, in the above embodiments, the exciting coil 241 has been described. It is also possible to replace this exciting coil 241 with any other suitable joint means which is capable of coupling the nozzle opening adapter 240 with the filler opening adapter 247. More specifically, the exciting coil 241 may be replaced with a joint mechanism using a spring.

Further, the portable type data input unit 256 has been described to have the communication line 255. However, it is also possible for the portable type data input unit 256 to radio-communicate with the data control means 294 without using the communication line 255.

SIXTH EMBODIMENT

Figs. 32 to 37 show a sixth embodiment of the automated fuel supply system 310 of the present invention.

As shown in Fig. 32, in the fuel supply area 301, there is provided the elongated fueling island 302, provided on which is the sixth embodiment of the automated fuel supply system which comprises the fuel supply unit 311, a robot unit 330, and the data input/output unit 340. In the fueling operation of the vehicle having entered the fuel supply area 301, the robot unit 330 automatically catches the fuel supply or delivery nozzle 317 of the fuel supply unit 311 to automatically move the nozzle 317 to the filler opening of the vehicle, so that the vehicle is automatically fueled.

More specifically, in the fuel supply unit 311, the main casing 312 is disposed in an end portion of the island 302. As shown

in Fig. 34, mounted inside this main casing 312 is the fuel supply pipe 313 which is connected with the shut-off valve 316 through the pump 314 and the flow meter 316, and extends outward from a side surface of the main casing 312 to reach the fuel delivery nozzle 317 of the fuel supply hose 318.

The fuel delivery nozzle 317 is adapted to be hung on a nozzle receptacle 319. As is clear from Fig. 34, the nozzle receptacle 319 assumes a horizontal plate-like shape fixedly mounted on the side surface of the main casing 312. The fuel delivery pipe 317a of the fuel delivery nozzle 317 is disposed adjacent to an upper surface of the nozzle receptacle 319. At this time, the grip portion of the fuel delivery nozzle 317 is directed toward the robot unit 330. The fuel delivery nozzle 317 is provided with a suction port (not shown) for detecting the fuel type/grade, wherein the suction port is provided in the same side as that of the fuel delivery pipe 317a. In operation, the vapor received through this suction port is returned to the underground reservoir (not shown) through the hose 321 disposed adjacent to the fuel supply hose 318, and further through the fuel type/grade sensor 322 and the suction pump 323 both provided in the main casing 312.

Further, the insertion sensor 324 for detecting insertion of the fuel delivery nozzle 317 into the filler opening of the vehicle is provided in the front end portion of the fuel delivery pipe 317a of the nozzle 317. Further, as shown in Fig. 32, the approach lamp 325 is mounted on the top portion of the main casing 312 to indicate in blue or red (light) whether or not the vehicle is permitted to enter the fuel supply area 301.

On the other hand, the fuel supply unit 311 actuates the pump 314 and the suction pump 323 both contained in the main casing 312,

controls the shut-off valve 316, and receives a signal issued from the flow meter 315 to measure the amount of the fuel supplied to the vehicle. Further, the fuel supply unit 311 is provided with the tank fill-up means 326 together with the fuel supply control means 320 which is provided with the fuel type/grade checking means 327.

As shown in Fig. 32, the robot unit 330 is mounted on the fueling island 302 so as to be disposed adjacent to the nozzle receptacle 319, and assumes a sleeve-like shape containing therein the vertical traveler 332 capable of vertically moving in the interior of the robot unit 330. The main body 331 of the robot unit 330 is fixedly mounted on the island 302.

Further, the robot unit 330 comprises: the first arm 333 which has one of its opposite end portions mounted on an upper portion of the main casing 331 and is rotatable in a horizontal plane; the second arm 334 which has one of its opposite end portions mounted on the other of the opposite end portions of the first arm 333 and is rotatable in a horizontal plane; and, a third arm 335 which has one of its opposite end portions mounted on the other of the opposite end portions of the second arm 334 and is rotatable in a horizontal plane, wherein the other of the opposite end portions of the third arm 335 is provided with a grip portion 336 for grasping the grip portion 317a of the fuel delivery nozzle 317.

These arms 333, 334, 335 and the grip portion 336 form an arm rotating unit 338. As shown in Fig. 32, a camera 337 constructed of a CCD (i.e., Charge Coupled Device) and the like for detecting the position of the filler opening of the vehicle is mounted on an upper portion of the third arm 335. As shown in Fig. 32, provided in the interior of the main casing 331 are: an image processing

means 338 (shown in dotted lines) for processing an image supplied from the camera 337 to detect the filler opening of the vehicle; and, the mechanism control means 339 for controlling the vertical traveler 332 and/or the arm driving unit 338 on the basis of the data indicating the position of the filler opening of the vehicle, wherein the data is stored in the card 350 (Fig. 32) which will be described later. Further, the entrance sensor 351 is provided in the side surface of the fueling island 302, wherein the side surface faces the fuel supply area 301.

As shown in Fig. 32, the data input/output unit 340 is provided with the casing 342 mounted on the top portion of the upright stand 341 which is fixedly mounted on the upper portion of the fueling island 302. The casing 342 is provided with: the display unit 343; the keyboard 345 and the card reader/writer 345 through which the fuel supply data and like data is inputted; a printer 346; the indicator 347; the button 348; and, the data control means 349 for controlling the individual components. As shown in Fig. 32, the card reader/writer 345 receives the customer's card 350 (which stores the position data of the filler opening of the customer's vehicle), for example such as credit cards, bank cards, fueling cards, prepaid cards, and the like to retrieve/input necessary data from/to the card 350, so that a fueling charge of the vehicle is calculated to enable the customer to make payment of the fueling charge.

As shown in Fig. 35, necessary data communication is established between the fuel supply control means 320 of the fuel supply unit 311 and the mechanism control means 339 of the robot unit 330, and between the fuel supply control means 320 of the fuel supply unit 311 and the data control means 349 of the data input/output unit 340.

Now, operation of the automated fuel supply system 310 of the sixth embodiment will be described with reference to flowcharts shown in Figs. 36 and 37. Fig. 36 shows the flowchart illustrating the flow of data in the data input/output unit 340 of the sixth embodiment. Fig. 37 shows the flowchart illustrating the flow of data in the robot unit 330 employed in the sixth embodiment.

When there is no vehicle to be fueled in the fuel supply area 301, the approach lamp 325 (Fig. 34) is turned on in blue. At this time, as shown in Fig. 32, when the fuel supply unit 311 is on standby, the arm rotating unit 338 has its grip portion 336 directed toward the nozzle receptacle 319, and is on standby.

when the vehicle to be fueled enters the fuel supply area 301, such entrance into the fuel supply area 301 is detected by the entrance sensor 351 which issues a detection signal to the data control means 349 (Fig. 36, ST301). Upon receipt of this detection signal, the data control means 349 (Fig. 32) has the approach lamp 325 switched from blue to red (Fig. 36, ST302), so that entrance of another into the fuel supply area 301 is prevented.

When the customer's card 350 (Fig. 32) is inserted into the card reader/writer 345 of the data input/output unit 340 (Fig. 36, ST303), the position data of the filler opening of the vehicle stored in the card 350 is retrieved from the card 350, and transmitted to the mechanism control means 339 of the robot unit 330. At this time, the fuel supply data (i.e., fueling data) is inputted to the data control means 349 through the keyboard 344 of the data input/output unit 340, which makes it possible for the sixth embodiment of the automated fuel supply system to automatically fuel the vehicle.

When the fueling data such as fuel type/grade and the amount

of fuel being supplied is inputted through the keyboard 344 (Fig. 36, ST304), such fueling data is displayed on the display unit 343. After that, when the customer depresses a button 348 (Fig. 36, ST305) to establish the fueling data (Fig. 36, ST306), the data control means 349 issues the fueling data to each of: the fuel supply control means 320 of the fuel supply unit 311; and, the mechanism control means 339 of the robot unit 330.

In a condition in which the fueling data issued from the data control means 349 of the data input/output unit 340 is received by the mechanism control means 339 of the robot unit 330 (Fig. 37, ST311), firstly, the arm rotating unit 338 of the robot unit 330 which is on standby is moved toward the fuel delivery nozzle 317 corresponding to the fuel type/grade, wherein the nozzle 317 is hung on the nozzle receptacle 319.

After that, the grip portion 336 of the front end portion of the third arm 335 catches the grip portion 317b of the nozzle 317. Subsequently to this, on the basis of the position data of the filler opening of the vehicle, the fuel delivery nozzle 317 is moved toward the filler opening of the vehicle staying in the fuel supply area 301. When the camera 337 catches an image of the filler opening of the vehicle and the image processing means 338 determines a precise position of the filler opening of the vehicle (Fig. 37, ST313), the fuel supply control means 339 controls the arm rotating unit 338 and the vertical traveler 332 so that the front end portion of the fuel delivery pipe 317a of the fuel delivery nozzle 317 is inserted into the filler opening of the vehicle (Fig. 37, ST312).

When the insertion sensor 324 (Fig. 35) is actuated upon insertion of the front end portion of the fuel delivery pipe 317a of the nozzle 317 into the filler opening of the vehicle (Fig. 37,

ST314), the fuel supply control means 320 actuates the suction pump 323 to remove the vapor contained in the filler opening of the vehicle, which actuates the fuel type/grade checking means 327 (Fig. 37, ST315) in which: it is judged as to whether or not the fuel type/grade identified by the fuel type/grade signal issued from the fuel type/grade sensor 322 is coincident with the fuel type/grade established through the keyboard 344 of the data input/output unit 340 (Fig. 37, ST316). When there is no difference in fuel type/grade between the fuel type/grade signal and the fueling data inputted through the keyboard 344, the fuel supply control means 320 opens the shut-off valve 316 corresponding to the fuel type/grade thus established through the keyboard 344, and actuates the pump 314 (Fig. 37, ST317).

On the other hand, the fuel oil received in the fuel reservoir of the service station is supplied under pressure by the pump 314 to the filler opening of the vehicle through the flow meter 315, the shut-off valve 316, the fuel supply hose 318, and the fuel delivery nozzle 317. The amount of the supplied fuel measured through the flow meter 315 is displayed on the display unit 343.

The fueling operation of the vehicle is performed in a manner described above. In the above fueling operation, the fuel tank fill-up means 326 is operated (Fig. 37, ST319). When the predetermined amount of the fuel is supplied or the on-vehicle fuel tank is filled up (Fig. 37, ST320), the fuel supply control means 320 stops the pump 314 and closes the shut-off valve 316 (Fig. 37, ST321), so that the data indicating the amount of the supplied fuel is issued to the data input/output unit 340 (Fig. 37, ST322). Subsequently to this, the mechanism control means 339 controls the arm rotating unit 338 and the vertical traveler 332, so that the

fuel delivery pipe 317a of the fuel delivery nozzle 317 is pulled out of the filler opening of the vehicle to permit the robot unit 330 to return to its initial position (Fig. 37, ST323). When the robot unit 330 reaches its initial position (Fig. 37, ST324), the fueling operation of the vehicle is completed so that the indicator 347 is actuated to indicate completion of the fueling operation of the vehicle (Fig. 37, ST325). At this time, since the fuel delivery nozzle 317 is provided with a valve which may close when the fuel is released from pressure, there is no fear that the fuel remaining in the interior of the fuel supply hose 318 spills therefrom.

After that, the data input/output unit 340, which receives the fuel supply (i.e., fueling) data from the fuel supply unit 311 (Fig. 36, ST308), calculates a fueling charge of the vehicle in a condition in which the data stored in the customer's card 350 (Fig. 32) is retrieved by the card reader/writer 345. After completion of payment of the fueling charge using the card 350 (Fig. 36, ST308), the approach lamp 325 is switched from red to blue to complete the fueling operation of the vehicle, which permits another customer's vehicle to enter the fuel supply area 301.

Incidentally, when the detected vapor is not coincident in fuel type/grade with the fuel established by the keyboard 344 of the data input/output unit 340 (Fig. 37, ST316), the data control means 349 actuates the indicator 347 for a predetermined period of time (Fig. 37, ST318) to require a correct fuel type/grade to be established through the keyboard 344 of the data input/output unit 340 (Fig. 36, ST304), whereby the fueling operation of the customer's vehicle is properly conducted.

In the automated fuel supply system 310 of the sixth embodiment

having the above construction, when the vehicle to be fueled enters the fuel supply area 301, the entrance sensor 351 automatically detects the vehicle so that the approach lamp 325 is turned on in red to prevent another vehicle from entering the fuel supply area 301 which is already occupied by the first vehicle.

When the customer inputs the fueling data such as the fuel type/grade, the amount of the fuel supplied, and like data to the data control means 349 through the keyboard 344 and the fueling data stored in the card 350 is retrieved by the card reader/writer 345, the mechanism control means 339 controls and actuates the arm rotating unit 338 and the vertical traveler 332 in a manner such that the grip portion 336 of the third arm catches the grip portion 317a of the fuel delivery nozzle 317.

More specifically, the fuel delivery nozzle 317 is moved toward the filler opening of the vehicle staying in the fuel supply area 301. At this time, the image signal of the filler opening of the vehicle issued from the camera 337 is processed by the image processing means so that the precise position of the filler opening of the vehicle is determined, which makes it possible to insert the fuel delivery pipe 317a of the nozzle 317 into the filler opening of the vehicle. Upon insertion of the the fuel delivery pipe 317a into the filler opening of the vehicle, the insertion sensor 324 is actuated, which makes it possible for the fuel type/grade control means 320 (which is provided with the fuel tank fill-up means 326 and the fuel type/grade checking means 327) to judge as to whether or not the fuel type/grade is correct. When the fuel type/grade is correct, the fueling operation of the vehicle starts. When the predetermined amount of the correct fuel is supplied to the vehicle or the on-vehicle fuel tank is filled up, the fueling operation

of the vehicle is completed.

The data indicating the amount of the fuel supplied to the on-vehicle fuel tank is issued to the data input/output unit 340, so that a fueling charge of the vehicle is calculated. At this time, in the robot unit 330, the mechanism control means 339 actuates the arm rotating unit 338 and the vertical traveler 332 to have the fuel delivery nozzle 317 return to its initial position. Due to this, the sixth embodiment is capable of automatically fueling the vehicle without accepting any help from the attendant of the service station. Further, since the fuel supply unit 311 is separated from the robot unit 330 in construction, it is possible for the fuel supply unit 311 to have the same construction as that of a conventional fuel supply unit. Due to this, the simplest piping may be employed in the automated fuel supply system of the present invention in a condition in which the robot unit 330 is quite free from any piping for forming the flow passages of the fuel, which may contribute to a considerable reduction in the manufacturing cost of the automated fuel supply system of the present invention.

Incidentally, in the sixth embodiment described above, though the camera 337 is mounted on the arm rotating unit 338 and the image signal issued from the camera 337 is processed by the image processing means (not shown) to detect the precise position of the filler opening of the vehicle, it is also possible to use a suitable transmitter such as a transponder provided in the vicinity of the filler opening of the vehicle, wherein: the transmitter issues a signal; and, based on such signal having been received, the precise position of the filler opening of the vehicle is determined.

Further, in the sixth embodiment, the robot unit 330 is constructed of the first arm 333, the second arm 334, the third arm

335, and the grip portion 336. However, it is possible for these arms 333, 334, 335 to change the number thereof and their shapes, if necessary. For example, it is possible for the automated fuel supply system of the present invention to have no arm.

Further, in order to detect the filler opening of the vehicle, in the automated fuel supply system of the present invention, it is possible to use any types of filler opening detection means in which any types of image processing operations are permitted to be performed for detecting the position of the filler opening using visible light beams, infrared rays, or the remaining electromagnetic waves.

As described above, the automated fuel supply system of the present invention includes: the filler opening sensor 40 for receiving the detection signal issued from the on-vehicle transmitter 57 provided in the vicinity of the filler opening 56 of the fuel tank (not shown) of the motor vehicle 55; the data input/output unit 13 for setting the fuel supply data; and, the fuel supply unit 12 provided with the fuel supply control means 50, wherein the control means 50 is provided with the fuel type/grade checking means 52 and the fuel tank fill-up means 51. In this automated fuel supply system of the present invention, the control means 50 receives the insertion signal issued from the insertion sensor 36 provided in the front end portion of the fuel supply nozzle 26 of the fuel supply unit 12, and actuates the checking means 52 to determine whether or not the fuel tank (not shown) of the vehicle 55 contains the same fuel as that identified by the fuel supply data established in the data input/output unit 13. In operation, when the checking means 52 determines that the fuel tank of the vehicle 55 contains the same fuel as that identified by the fuel

supply data, the fill-up means 51 is actuated to fill up the fuel tank of the vehicle 55. Then, the fill-up means 51 stops delivery of the fuel to the fuel tank of the vehicle 55 when a fill-up of the tank is detected. In the above automated fuel supply system of the present invention, since all the fuel delivery services are automatically performed, the system need not accept any help from the attendant of the service station.

Finally, the present application claims the Convention Priority based on Japanese Patent Application Nos.: Hei 11-328535 filed on November 18, 1999; Nos.: 2000-43783 filed on February 22, 2000; Nos.: 2000-43784 filed on February 22, 2000; Nos.: 2000-167102 filed on June 5, 2000, which are herein incorporated by reference.

What is claimed is:

1. In an automated fuel supply system including: a filler opening sensor for receiving a detection signal issued from a transmitter provided in the vicinity of a filler opening of a fuel tank of a vehicle; a data input/output unit for setting fuel supply data; and, a fuel supply unit provided with a fuel supply control means, wherein said control means is provided with a fuel type/grade checking means and a fuel tank fill-up means, the improvement wherein:

said control means receives an insertion signal issued from an insertion sensor provided in a front end portion of a fuel supply nozzle of said fuel supply unit, and actuates said checking means to determine whether or not said tank contains the same fuel as that identified by said data established in said data input/output unit;

when said checking means determines that said tank contains the same fuel as that identified by said data, said fill-up means is actuated to fill up said tank; and

said fill-up means stops delivery of said fuel to said tank when a fill-up of said tank is detected.

2. The system as set forth in claim 1, wherein said data input/output unit is provided with a portable type data input unit for inputting said data, wherein said data having been inputted from said portable data input unit is displayed on a display unit provided in said data input/output unit.

3. The system as set forth in claim 1, wherein a fuel delivery



pipe (33) has a selected one (26) of a plurality of fuel supply nozzles (26) projected therefrom, through which selected one (26) said fuel having been set through said data input/output unit is supplied to the tank.

4. The system as set forth in claim 1, wherein said data input/output unit data-communicates with an on-vehicle unit serving as a card reader/writer, and calculates the amount of a debit note for delivery service of said fuel on the basis of said fuel supply data inputted from said fuel supply control means.

5. In an automated fuel supply system comprising a data input/output unit and a fuel supply unit, through which data input/output unit fuel supply data is set, wherein said data input/output unit and said fuel supply unit are mounted on each of a plurality of elongated islands arranged side by side, and said fuel supply unit is actuated upon receipt of a signal issued from said data input/output unit, wherein a pair of adjacent ones of said elongated islands are spaced apart from each other by at least a distance equal to a width of a vehicle, the improvement wherein:

said data input/output unit mounted on one of said adjacent ones of said islands functions to disable a corresponding one of said data input/output units, said corresponding one being mounted on the other of said adjacent ones of said islands.

6. The automated fuel supply system as set forth in claim 5, wherein said fuel supply unit mounted on one of said adjacent ones of said islands functions to disable a corresponding one of said fuel supply unit mounted on the other of said adjacent ones of said



islands.

