FORM 25 (12) PATENT granted by (19) AP

AFRICAN REGIONAL INDUSTRIAL PROPERTY ORGANISATION (ARIPO) 981

(11) (A)

(21) Application Number: AP/P/98/01296
(22) Filing Date: 19961218
(24) Date of Grant & (45) Publication: 20010704

(30) Priority Data
(33) Country: US
(31) Number: 60/009,369
(32) Date: 19951229

(84) Designated States:
KE LS MW SD SZ UG

(73) Applicant(s):
DRESSER INDUSTRIES, INC
41st Floor
2001 Ross Avenue
Dallas, Texas 75201
U.S.A(See Overleaf)

(72) Inventors:
Joseph A GIORDANO
15344 Oakmere Place
Centreville
VA 22020
U.S.A
(See Overleaf)

(74) Representative
FISHER CORMACK & BOTHA
P O BOX 74
BLANTYRE
MALAWI

(51) International Patent Classification (Int.Cl.7): G06F 17/60, 7/04, G06G 7/52, G07D 7/00

(54) Title: Dispensing System And Method With Radio Frequency Customer Identification

(57) Abstract: A system and method for providing a fuel dispenser (14) with radio frequency customer identification capabilities. The system and method determines whether a transponder (23, 25) containing customer identification data is within range of a dispenser (14) that requires activation by the customer to initiate a transaction and has an associated reader (20) for emitting radio frequency signals and receiving customer identification data from the transponder (23, 25) responsive to the emitted radio frequency signals. When the transponder (23, 25) is within range of the dispenser, an in-range indication is provided to the customer. Upon activation of the dispenser (14) following a determination that the transponder (23, 25) is within range, the customer identification data received by the reader (20) is associated with a transaction at the activated dispenser. The transaction at the activated dispenser (14) is then permitted and charged to the customer according to the customer identification data.

(56) Documents Cited: US-5072380

Applicants Continued

2. MOBIL OIL CORPORATION
   3225 Gallows Road
   Fairfax, VA 22037
   U.S.A

3. TEXAS INSTRUMENTS INCORPORATED
   P O Box 655474
   13500 North Central Expessway
   Dallas, TX 75265
   U.S.A

Inventors Continued

2. Karen Scott GUTHRIE
   1952 Weybridge Lane
   Reston VA 20191
   U.S.A

3. Samuel S. HENDRICKS
   7800 San Felipe Boulevard
   N0. 402
   Austin TX 78729
   U.S.A

4. Carl R JACOBS
   P. O. Box 215
   Bertram TX 78605
   U.S.A

5. Thomas L MAYS
   11266 Taylor Draper Lane
   No. 2324
   Austin TX 78759
   U.S.A

6. Don C. MACCALL
   2709 Creek Bend Circle
   Round Rock TX 78681
   U.S.A

7. Geeta B. NADKARNI
   4430 Eagles Landing Drive
   Austin TX 78735
   U.S.A

8. Lloyd G SARGENT
   Route 4, 236A
   Elgin TX 78621
   U.S.A

9. Jeffrey L TURNER
   2200B Monteclaire Street
   Austin TX 78704
   U.S.A

10. Deborah T WILKINS
    905 El Jiejo Camino
    Austin TX 78733
    U.S.A

DISPENSING SYSTEM AND METHOD WITH RADIO FREQUENCY CUSTOMER IDENTIFICATION

Cross Reference

This application claims the benefit of U.S. Provisional Application No. 60/009,369, filed December 29, 1995.

Background of the Invention

The present invention relates to dispensers and, more particularly, to fuel dispensers that uses radio frequency identification technology to automatically identify a customer with little or no customer interaction in order to authorize the sale of products or services to the customer and to subsequently bill the customer's charge account for the products or services. The present invention is particularly useful in a service station environment where customers may purchase fuel for their vehicles, obtain a car wash, or purchase other items such as food, drinks, or sundries from a convenience store, or drive-through window, that may be located on the premises.

Typically, when a customer purchases fuel at a service station, the customer presents payment, in the form of cash or credit/debit card, to the service station attendant either before or after fueling. The attendant controls the activation of the dispenser to allow fueling. If payment is required before fueling may begin, the attendant must activate a switch, typically near the cash register, in order to unlock the dispenser to allow fueling to begin. Once fueling has been completed and the dispenser nozzle has been returned to its seat, the attendant manually resets the dispenser again through activation of a switch at the cash register.

An example of an existing service station control system that integrates dispenser control and cash register control is the Wayne Plus/2 control system available from Wayne Division, Dresser Industries, Inc. of Austin, Texas. The Wayne Plus/2 system includes a host computer or site controller and a point-of-sale terminal that interfaces with the attendant.

The Wayne Plus/2 host computer is provided with a microprocessor and a pump controller board that is electrically linked to the various dispensers of the station to provide pump control. The pump controller board turns the dispensers on or off, controls the flow rate, and keeps track of the amount of fuel dispensed. The host computer is also provided with memory, communication ports, and a serial input/output board ("SIO") that may be linked to a remote customer-authorization computer network.

The point-of-sale terminal (also known as a Wayne Plus brand Retail Control System) includes a card reader for reading and identifying credit/debit cards, a keyboard for use by the attendant, and a display. The attendant can use the point-of-sale terminal to process payments and to control the activation of the dispensers. Should a customer choose to use a credit/debit card for payment, the attendant runs the card through the card reader, and the credit/debit card information is forwarded to the remote customer-authorization network for verification and billing.

Many service stations, however, are now equipped with credit/debit card readers at the dispensers for direct use by the customer. An example of a service station system that integrates dispenser control, cash register control, and credit/debit card processing that may be originated at the dispenser is the Wayne Plus/3™ system available from Wayne Division, Dresser Industries, Inc. of Austin, Texas. The Wayne Plus/3 system is similar to the Wayne Plus/2 system described above; however, the host computer or site controller has been modified to accommodate dispensers equipped with customer-activated-terminals (CATs) electronically linked to the host computer.

The customer-activated-terminals (CATs) each have a card reader, a display which displays messages to the customer, a key pad for use by the customer to make fueling and payment selections, a printer for printing receipts, and individual price displays corresponding to the individual fuel dispensing nozzles of the dispenser. Examples of dispensers equipped with such customer-activated terminals (CATs) are the Vista brand fuel dispensers available from Wayne Division, Dresser Industries, Inc. of Austin, Texas.

The Wayne Plus/3 host computer is loaded with a software driver (also referred to herein as a "primitive") for controlling and interfacing with the CATs. Before a customer begins fueling, the customer uses the keyboard of the CAT to select the type of payment desired (*e.g.*, cash or credit/debit card). If the customer chooses to pay with a credit/debit card, the customer inserts the credit/debit card into the card reader at the CAT. The customer then waits for a message to display indicating that the customer may begin fueling. The CAT forwards the credit/debit card information to the host computer which in turn forwards the credit/debit card information to the remote customer authorization network for verification and billing. U.S. Patent No. 5,340,969 issued August 23, 1994 to Dresser Industries, Inc. describes a method and apparatus for approving or disapproving fuel dispensing transactions using credit cards.

In both types of systems described above, the customer is required to interact (for payment purposes) with either the service station attendant or with the customer-activated terminal (CAT) at the dispenser. U. S. Patent No. 5,072,380 issued to Robert E. Randelman et al. describes an automatic vehicle recognition and customer billing system that may be used in a service station

environment. The system automatically recognizes vehicles and correlates the purchase of products and services with the vehicle.

The system of the '380 patent includes an antenna embedded in the ground near a gasoline dispensing pump. The antenna is connected to a controller located in a housing near the antenna. The controller controls the output of a radio frequency signal from the antenna and can detect an RF input signal. The antenna is always energized and, therefore, creates an electromagnetic field at a predetermined radio frequency in the fueling area.

The system of the '380 patent also includes an emitter (or card) affixed to a vehicle. The card comprises an RF coil and integrated circuit component. When the card crosses the electromagnetic field, the electromagnetic field energizes the card. The activated card then emits an encoded electromagnetic pulse signal. The controller receives the signal and converts it into a data bit stream. A computer receives the data bit stream from the controller and in turn utilizes the data for displaying information on the pump display, for controlling the fuel dispenser, and for billing purposes.

One disadvantage of the '380 patent is that the antenna which emits the electromagnetic field is embedded in the ground near the fuel dispenser. The installation of such an antenna (or antennas where there is more than one dispenser) can be costly and can create a fire hazard from fueling spills or leaks from the fuel storage tanks typically located under ground near the fuel dispensers. Furthermore, where multiple dispensers are present and therefore multiple antennas and controllers are present, the system does not adequately prevent a vehicle card from being activated by more than one antenna at a time and detected by more than one controller at a time, such as may happen where antennas are positioned near each other and therefore interfere with one another. Furthermore, the system does not prevent the inadvertent detection of vehicle cards not intended to be used in a fueling transaction.

Many service stations provide for separate fueling on both sides of a dispenser and/or have several closely-spaced rows of dispensers. With such a dispenser arrangement and the system of the '380 patent, the vehicle card of a vehicle stopped between antennas may be detected by the wrong controller, *i.e.*, one not associated with the dispenser where the vehicle is actually receiving fuel, or may wrongly be detected by a controller, *i.e.*, where the vehicle is stopped near an antenna but is not fueling.

Other automatic identification systems exist that employ radio frequency technology. For example, Texas Instruments Incorporated of Dallas, Texas, markets a number of radio frequency identification systems referred to commercially as its TIRIS™ (Texas Instruments Registration and

Identification Systems) product line. The TIRIS™ product line includes radio frequency transponders (read-only as well as read/write) that may be low frequency or high frequency in their operation and which may be attached to or embedded in objects or may be hand-held. Readers, through antennas, send out radio frequency waves to the transponders, and the transponders broadcast stored data back to the reader for processing. Suggested applications of the TIRIS™ product line include an automatic access system for parking lot entrance and exit barriers, anti-theft systems for vehicles (where a transponder is placed in the ignition key and a transceiver module is positioned near the ignition), and a fuel dispensing system (where a transponder is mounted beside the vehicle's fuel tank and a transceiver is mounted on the fuel dispensing nozzle). The fuel dispensing system application, however, is not desirable because maintenance of the fuel dispensing nozzle with the transceiver can present a service problem as well as a replacement problem and, furthermore, the location of the transponder and transceiver can create a fire hazard.

Application of the above-described radio frequency customer identification (RF-CID) technology to a service station environment is fraught with heretofore unresolved problems. In large service stations with multiple islands of two-sided pumps and heavy, unpredictable traffic patterns, the potential exists for unintended crosstalk, i.e., "cross-reads," of an RF-CID transponder attached to a vehicle by the wrong antenna/reader. Crosstalk can result in the erroneous billing of a customer for services never received. While commercially available readers can be physically linked or otherwise operated to synchronize their transmission pulses, a system and strategy has not yet been developed for effectively synchronizing multiple readers in a service station environment to minimize, if not eliminate, cross-reads. The problem of implementing a synchronization strategy, once determined, is further complicated by individual readers dropping out of synchronization in the course of detecting transponders.

In addition to transponder crosstalk, other aspects of the customer identification process are less than ideal when RF-CID technology is used in a service station environment. As mentioned previously, the vehicle recognition system of the '380 patent, in addition to providing an impractical antenna/controller arrangement, uses a vehicle identification method that begins to activate the account when it is determined that the vehicle in proximity to the antenna has stopped moving, and upon such determination, locks out other antennas (and their respective pump controllers) from reading the same customer's transponder. While the foregoing may be adequate in an idealized service station environment with predictable vehicle flow patterns, this method of activation is unreliable in a station with multiple islands of two-sided pumps and can result in improper or problematic customer activation.

What is needed, therefore, is a radio frequency customer identification (RF-CID) system for a service station that reliably and accurately identifies and charges customers for purchases of services or products in an environment having multiple dispensers and/or sale sites.

Summary of the Invention

A dispensing system and method of the present invention, accordingly, utilizes radio frequency customer identification capabilities in a service station environment to reliably and accurately identify and charge customers for their purchases.

To this end, the dispensing system and method of the present invention determines whether a transponder containing customer identification data is within range of a dispenser, the dispenser requiring activation by the customer to initiate a transaction and the dispenser including a reader associated therewith for emitting radio frequency signals within the dispenser range, and for receiving customer identification data from the transponder responsive to the emitted radio frequency signals received by the transponder. When the transponder is within range of the dispenser, an in-range indication is provided to the customer. A determination is made whether the dispenser has been activated by the customer following a determination that the transponder is within the dispenser range. Upon activation of the dispenser following the determination that the transponder is within the dispenser range, the customer identification data received by the reader is associated with a transaction at the activated dispenser, whereupon the transaction at the activated dispenser is permitted and charged to the customer according to the customer identification data.

In another aspect, the present invention is embodied as a dispensing system that includes a transponder containing customer identification data; a dispenser for providing a customer transaction within a dispensing area; antennas each associated with the dispensing area of the dispenser, the antennas including a long range antenna located relative to the dispenser for use by the transponder of a type mounted to a vehicle, and a short range antenna located relative to the dispenser for use by the transponder of a type that is hand-held; at least one reader connected to the antennas for emitting radio frequency signals from the long range antenna within a selected long range of the dispensing area, and from the short range antenna within a selected short range of the dispensing area, and for receiving customer identification data from the transponder, the customer identification data being received by the reader responsive to the emitted radio frequency signals when the transponder is within its range of the dispensing area; and a processor arrangement connected to the at least one reader and to the dispenser for associating customer identification data received at the

dispensing area with a transaction at the dispenser, whereupon the transaction at the dispenser is charged to the customer according to the customer identification data.

The present invention overcomes the above-noted problems with the prior art by providing a reliable, safe, customer-friendly identification system that can automatically identify a customer purchasing services or products at a service station, and bill the customer's account for any purchases made. The system of the present invention interfaces smoothly with existing service station systems to provide overall customer identification, billing, account status, and pump control.

With the customer identification system of the present invention, the customer is provided the flexibility of using either a long-range, vehicle-mounted transponder and/or a short-range, hand-held transponder for automatic customer identification and billing, or may override the use of a transponder and select a more conventional method of payment. Both types of transponders contain personal customer identification data which is broadcast in response to predetermined radio frequency ("RF") waves.

The system can include long-range antennas that are mounted to the tops of the fuel dispensers and short-range antennas that are mounted to the sides of the fuel dispensers. Readers housed in the dispensers send radio frequency power pulses to the antennas which in turn direct the power pulses to create electromagnetic fields. The antennas are optimally positioned so that the electromagnetic fields cover predetermined areas near the dispenser. The frequency, power, and antenna design have been selected to insure a proper read area and to eliminate reflective signals that are present at UHF frequencies. The areas are set so that there is little or no overlap with electromagnetic fields that may be created at adjacent or nearby dispensers. In the case of a long-range antenna, the electromagnetic field may cover an area that extends several feet from the dispenser; whereas in the case of a short-range antenna, the electromagnetic field may extend several inches from the dispenser.

The antennas also pick-up customer identification data that is broadcast by the transponders. In particular, if a vehicle-mounted transponder enters the electromagnetic field created by a long-range antenna, the vehicle-mounted transponder will become activated and broadcast its customer identification ("CID") code. The long-range antenna detects the CID code and sends the code to the associated reader for decoding and processing. Similarly, if a hand-held transponder enters the electromagnetic field created by a short-range antenna such as when a customer waves the transponder in front of the short-range antenna, the hand-held transponder will become activated and broadcast its customer identification ("CID") code. The short-range antenna detects the CID code and sends the code to the associated reader for decoding and processing.

In order to further minimize the potential for interference between antennas of adjacent or nearby dispensers, the system of the present invention coordinates the transmission of the pulse waves from the various readers. In general, the readers selectively send out pulse waves so that only antennas facing the same direction send out pulse waves at the same time. Other pulse timing arrangements could be used for other antenna configurations to eliminate interference from nearby dispensers. The system uses sync pulses and timing to coordinate the transmission of power pulses through the various antennas of the system.

The system of the present invention also provides an alert indication for alerting the customer when a transponder has been detected and the customer is authorized to begin fueling. The alert may be in the form of a light positioned on the dispenser which turns on and off in response to various triggers such as the detection or non-detection of a transponder by an associated antenna, the removal or return of an associated fuel nozzle to its seat, the selection of an alternate payment method (*e.g.*, credit/debit card or cash), the recent detection and use of a transponder at the service station, the approval of credit, or the denial of credit.

A technical advantage of the invention is that it integrates easily with the user interface of existing service station equipment.

Another advantage of the invention is that it provides the customer flexibility in selecting payment methods without eliminating options available with existing payment processing systems.

Another advantage is that it can be safely and unobtrusively installed in a service station.

Brief Description of the Drawings

Fig. 1 is a schematic block diagram illustrating an overhead view of a service station equipped with the customer identification system of the present invention.

Fig. 2 is a graph plotting transponder capacitor voltage with respect to time for a transponder used with the system of Fig. 1.

Fig. 3A is a partial rear perspective view of the back end of a vehicle illustrating the placement of a vehicle-mounted transponder used with the system of Fig. 1.

Fig. 3B illustrates a card hand-held transponder and a key ring hand-held transponder used with the system of Fig. 1.

Fig. 4A is a side view of a dispenser used with the system of Fig. 1.

Fig. 4B is an end view of the dispenser of Fig. 4A.

Fig. 5A is a side view of another embodiment of a dispenser used with the system of Fig. 1.

Fig. 5B is an end view of the dispenser of Fig. 5A.

Figs. 6A and 6B are schematic block diagrams illustrating components of a dispenser for connection to a host computer used with the system of Fig. 1.

Fig. 7 is a schematic block diagram of the site wiring between readers and the host computer of the system of Fig. 1.

Fig. 8 is a schematic representation of a service station environment and the arrangement of dispensers therein illustrating a reader synchronization strategy for the system of Fig. 1.

Figs. 9A - 9C are timing diagrams of communications signals on the synchronization line between master and slave readers of the system of Fig. 1.

Figs. 10A and 10B are detailed timing diagrams showing communications to and from a master reader of the system of Fig. 1.

Figs. 11A - 11I and 12 are flowcharts illustrating the user operation of the system of Fig. 1.

Fig. 13 is a diagram illustrating the major software tasks and subsystems involved in the handling of a customer identification (CID) transaction for the system of Fig. 1.

Fig. 14 is a diagram illustrating the Transponder Reader Task's Data Flow for the system of Fig. 1.

Fig. 15 is a diagram illustrating the Return on Status Change interface for the system of Fig. 1.

Fig. 16 is a diagram illustrating the Authorization Request and Reply Handling for the system of Fig. 1.

Figs. 17A - 17N and 17Q are flowcharts illustrating the customer identification primitive tasks of the system of Fig. 1.

Detailed Description of the Preferred Embodiment

In Fig. 1, the reference numeral 10 refers to a customer identification (CID) system embodying features of the present invention. The system 10 electronically identifies a customer, authorizing a transaction involving the purchase of goods or services by that customer, and subsequently bills the customer's account for the services. In one embodiment the system 10 identifies, authorizes, and bills customers for services provided at a service station. Generally, the system 10 allows customers to drive up to a fuel dispenser and immediately begin pumping fuel (or have fuel pumped for them) without having to go inside the service station building to pay for the fuel or having to insert a credit card into a card reader at the fuel dispenser. As explained further below, the system 10 may also be used for other services at the station such as a car wash or for making payments inside a convenience store.

I. SYSTEM OVERVIEW

In one embodiment (Fig. 1), the system 10 is implemented in a service station environment that includes two service islands 12, each having two dispensers or fuel pumps 14, it being understood that the number of islands and pumps, as well as their geometry and relationship to one another, may vary according to the requirements of the environment. Communication and synchronization lines, discussed more fully below, connect the dispensers 14 to a host computer 16 for controlling operation of the dispensers. An additional site 18, representing a car wash, food service, payment station or other amenity, is also connected to the computer 13. It is understood that each of the dispensers 14 includes a dispensing area on each of the opposing sides of the dispenser, each of which has at least one fuel nozzle (not shown) and a customer activated terminal (CAT) (shown in Figs. 4A and 5A) for performing traditional dispensing functions as well as the functions to be described in detail below. It is also understood that the computer 16 may be connected to a network (not shown) for performing functions including, but not limited to, customer billing verification.

Radio frequency customer identification (RF-CID) readers 20 are included with each of the dispensers 12 and with the site 18 (not shown). Connected to each reader 20, and mounted to each fuel dispenser 14, are four antennas: two (2) long-range antennas 22A, 22B mounted to the top of the dispenser 14 (on each opposing side thereof) for detecting vehicle-mounted customer transponders 23, and two (2) short-range antennas 24A, 24B mounted inside the head of the dispenser 14, one on each side of the dispenser, for detecting hand-held customer transponders 25. As discussed in detail below, each reader 20 polls the four antennas 22A, 22B, 24A, 24B of each dispenser 14, sending power pulses to the antennas, reading the customer identification (CID) data detected by the antennas from the transponders (e.g., the transponders 23 or 25) and sending the data to the host computer 16. For example, it is contemplated that a vehicle 28 entering a dispensing area in front of one of the fuel dispensers 14 will include a transponder 23 mounted thereto such that the long-range antenna 22B (as shown in Fig. 1) on the dispenser 14 nearest the vehicle will read the CID data contained in the transponder.

The transponders 23, 24 are radio frequency identification tags (RFID tags) that may either be mounted to the customers' cars or may be hand-held, key ring/chain or credit card style units. The transponders 23, 25 contain customer identification (CID) data that is broadcast in response to receiving a predetermined radio frequency ("RF") wave (i.e., a power pulse). The RF wave is sent by a reader 20 housed in one or more of the dispensers 14. The antennas 22A, 22B, 24A, 24B mounted to the dispensers 14 read the broadcast data and send the data to the readers 20 for

decoding and further transmission to the host computer 16 or also to a network where the data can be verified and the customer billed after completion of the fueling or other purchase.

Suitable transponders 23, 25, antennas 22A, 22B, 24A, 24B, and readers 20 used in the system 10 are available from Texas Instruments Incorporated of Dallas, Texas under the TIRIS™ (Texas Instruments Registration and Identification Systems) product line. Some of the TIRIS™ product line is described in a brochure entitled "Texas Instruments Registration and Identification Systems", Document Number 22-27-008 (1994), which is incorporated herein by reference. Information about these components is publicly available from Texas Instruments Incorporated and should enable those of ordinary skill in the art to make and use the system 10, following the description set forth in this specification to achieve desired functionalities.

In one preferred embodiment, the readers are low frequency readers that send out periodic power pulses of approximately 134.2 kHz to the antennas 22A, 22B, 24A, 24B and receive signals at about 900 MHZ. Other suitable parameters are also contemplated. Such a reader is the Series 2000 Reader System available from Texas Instruments, Inc. of Dallas, Texas. Alternatively, the reader may be a high frequency reader. The long range antennas are preferably gate antennas such as the G03, G02, or G01 model antennas available from Texas Instruments, Inc. The long-range antennas may also be custom antennas that blend with the appearance of the dispenser 14. The short range antennas are preferably ferrite rod antennas available from Texas Instruments or alternatively may be constructed from a printed circuit board that includes a coil having an appropriate inductance.

The readers 20 send out periodic, low frequency, power pulses of approximately 134.2 kHz to the antennas 22A, 22B, 24A, 24B. The antennas 22A, 22B, 24A, 24B in turn direct the electromagnetic fields generated by the power pulses to particular areas adjacent the dispensers. A power pulse lasts approximately 50 milliseconds (ms) and may be generated every 90 ms to 140 ms. When a transponder 23, 25 enters the electromagnetic field, the energy is collected by an antenna (not shown) in the transponder and stored in a small capacitor (also not shown). After the power pulse is completed, the transponder 23, 25 transmits the customer identification data using the energy stored in the capacitor. The antennas 22A, 22B, 24A, 24B mounted to the dispensers 14 read the data broadcast from the transponder 23 or 25 and send the data to the readers 20 for decoding and further transmission to the host computer 16 or a network where the data can be verified and the customer billed after completion of the fueling or other purchase.

Fig. 2 graphically illustrates the operation of a transponder 23 or 25 in cooperation with a reader 20. Responsive to a reader 20 emitting a power pulse (typically occurring for 50 ms), the