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(54) Title: ADULTERATION CONTROL DEVICE FOR RETAIL OUTLET (ACD-R)

(57) Abstract: The adulteration control device for retail outlet to restrain and identify cases of adulteration and provide information on real time basis by way of continuous intelligent interaction between the retail sale point and the dispatch station comprising a logic processing unit, a memory unit consisting of electrically erasable and programmable ROM, a real time clock, a crystal for clock generation, a reset unit to provide a power on delayed reset, a communication module with wireless communication support on default and wired communication support as back up, a plurality of input ports including a tank input providing information regarding the volume of the fuel in the tank, a dispensing unit input providing the information about the volume dispensed and other additional inputs, LED indicators to show the status of the device, a rectifier to provide the required DC power supply and an inverter with battery back up; all the said parts, the data interfaces and the connectors being arranged on printed circuit boards and kept inside tamper proof boxes.

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DESCRIPTION OF INVENTION

1. Title of Invention:

Adulteration Control Device for Retail Outlet ("ACD-R").

2. Field of Invention:

The present invention relates to adulteration control device for the retail end, which can be integrated with the dispatch station. The device can be used in any field where problem of mixing / adulteration is encountered. Particularly so in the field of petroleum products like mixing of non-standard products with the standard products supplied by petroleum companies. Adulteration is a major problem for these industries. ACD-R addresses this problem on the retail end very effectively.

3. Background of the Invention:

The invention addresses the major problems of getting the information about the adulteration instantly i.e. on real time basis and without interference from any human element.

Earlier the adulteration detection was possible only by way of a lucky tip off or by way of reconciling historical data. The historical data can be and is manipulated by the interested parties and therefore the action could not be taken. Hence, no effective real time adulteration control system exists currently.

The invention logs all the information on the retail end and communicates it to the dispatch station resulting in instant information to the concerned official(s) if there is any adulteration material added to the storage tanks, and this it does without any human intervention, thus addressing the most difficult hurdles of human manipulation, and timely information.

4. Objects of Invention:

The principle object of the present invention is to restrain and identify cases of adulteration and provide information to concerned officials / persons on real time

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basis by way of continuous intelligent interaction between the retail sale point and the dispatch station using convergence of, instrumentation, software, hardware telecommunication technologies to achieve the desired results and keep the system functional on real time basis devoid of any human intervention thus eliminating possibility of tampering & manipulations.

Further objects of the invention:

- To reconcile all the receipts at the Retail end with the Dispatch Station on real time basis and to generate alerts for any mismatch, and send it to the specified recipients.
- To log - process the sales, inventory and any other data at the retail end.
- To deploy various methods to keep the system tamper proof and maintain the integrity.
- To have a pollution free environment by way of providing standard fuels to motor vehicles.
- To get better efficiencies for motor vehicles by way of providing standard fuels.
- To be a cost effective solution for adulteration control.
- To communicate the adulteration alerts on real time basis.
- To take in following inputs: -
 - Multiple Tank input to communication port via tank processing unit. This will be protocol-based communication. Communication Unit can pull the information based on inventory from the required tank by sending the respective command to the tank-processing unit.
 - Electronic Dispensing Unit Interface with the Communication Unit is enabled via Volume Pulser Output.
 - Inputs from sources measuring temperature, density etc. can be captured and processed by the Communication Unit.
- To give out following Outputs: -
 - A wireless alert is to be sent to the depot whenever there is input to the tank.
 - A wired alert to follow, if the receipt of the wireless alert is not received in a specified time.

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- The log is maintained on event basis as well as set time frequency basis.
- The logs to be sent to the Depot Module once every 24 hours or on a preset time frequency.
- Logging Unit will maintain log back-up for any desired number of hours.
- Dispensing Unit readings will be sent to the control station on a preset time frequency.
- Depot Module will generate acknowledgement for every wireless data received.
- Power failure alert will be sent to the communication number whenever power is restored.

5. A Summary of Invention:

The invention aims to restrain and identify cases of adulteration and provide information to concerned officials / persons on real time basis by way of continuous intelligent interaction between the retail sale point and the dispatch station using convergence of, instrumentation, software, hardware telecommunication technologies to achieve the desired results and keep the system functional on real time basis devoid of any human intervention thus eliminating possibility of tampering & manipulations.

Typically, the Gasoline/HSD/LDO / All Petroleum Product selling units are known as Retail Outlets / Gas Stations / Petrol Pumps etc.

The adulteration occurs at these places by way of addition of non-standard fuel to the storage tank, which is later on dispensed through the dispensing unit to the vehicles, which come for refueling.

In principle the adulterant has to go through the storage tanks to be sold to the customer. Hence, we propose to control these tanks by way of convergence technologies (Software, Instrumentation, Telecommunication etc.,) and by connecting them with the Dispatch Station / Dispatch Location System on real time basis to detect any non-standard product coming from the illegal source.

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ACD-R is used for reporting of data to Terminal / Regional Sales Office, data such as inventory, total fuel dispensed, stock updates and any other data required to be collected and compared with the data at the dispatch location. Data is logged and transmitted to Dispatch Station modules using "ACD-R" which can use a variety of communication channels including but not limited to GSM / CDMA / TDMA / PSTN / Leased lines / VSAT/ RF networks etc.

6. A brief description of accompanying drawings:

Drawing No.1 shows Adulteration Control Device for Retail Outlet (ACD-R) in a block diagram. At the Retail Outlet there are underground storage tanks equipped with Tank Gauging System. This system gives output in electronic standard forms, which is carried to the ACD-R through the cable. The diagram shows the ports for tank inputs, which is routed through volume processing unit.

Similarly there are Dispensing Units to dispense the product to customers, from the dispensing unit with electronic output or equipped with a device which converts mechanical to electronic pulse, electronic output is taken by cable to the ACD-R to register the sales as shown in the figure, the third port for dispensing unit inputs which goes to the DU interfacing unit.

Any other inputs like temperature, density from the storage tanks can be taken up through additional input port.

The processed output from these units go to the Logic Processing Unit which in turn is connected to data logger, real time clock, a battery back-up and inverter and the communication modem for various type of wireless and wired telecommunications.

Drawing No.2 shows the Adulteration Control Device for Retail Outlet in a construction diagram. This diagram describes the components in the communication unit, component details and how components work together is also explained.

7. Detailed Description of the invention with reference to the drawings:

The Invention aims to restrain and identify cases of adulteration and provide information to concerned officials / persons on real time basis by way of continuous intelligent interaction between the retail sale point and the dispatch station using convergence of, instrumentation, software, hardware telecommunication technologies to achieve the desired results and keep the system functional on real time basis devoid of any human intervention thus eliminating possibility of tampering / manipulations.

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In principle, the adulterant has to go through the storage tanks to be sold to the customer. Hence, we propose to control these tanks by way of convergence technologies (Software, instrumentation, telecommunication etc) and by connecting them with the Dispatch Station / Dispatch Location System on real time basis to detect any non-standard product coming from the illegal source.

ACD-R is used for reporting of data to Terminal / Regional Sales Office, data such as inventory, total fuel dispensed, stock updates and any other data required to be collected and compared with the data at the dispatch location. Data is logged and transmitted to Dispatch Station modules using "ACD-R which can use a variety of communication channels including but not limited to GSM, CDMA, TDMA, PSTN, Leased lines, VSAT, RF networks etc.

RO Module: (Please refer drawing number 1 & 2)

There are three major components of the RO Module as shown in Figure / Drawing No. 2. There are three major components of the RO Module.

Tank Gauging System:

Tank gauging system, which provides digital output of inventory or other source of information, can be connected to “ACD-R” using intrinsically safe boxes. The ACD-R collects every stock in and out of tank for data logging or initiating alerts.

Dispensing Unit Integration:

ACD-R can be interfaced directly with electronic dispensers to automatically access metered sales information. This data is used for reconciliation of volumes report, like short deliveries, leak detection etc.

Adulteration Control Device for Retail end “ACD-R”:

ACD-R is the heart of the system; it takes Input from tanks and multiple Dispensing Unit as well as the Tank Gauging System and is capable of interfacing with any other module like POS (Point of Sale System). It is equipped with more than 3 types of communication ports.

Inputs: -

- Multiple Tank input to communication port via tank processing unit, this will be protocol-based communication. ACD-R can pull the information based on inventory from the required tank by sending the respective command to the tank-processing unit.
- Electronic Dispensing Unit Interface with the ACD-R is enabled via volume pulse output.
- Inputs from sources measuring Temperature, Density etc. can also be captured and processed by the ACD-R.

Outputs: -

- The Communication Port is capable of transmitting wireless data / alerts to Dispatch Station / Head Office for further processing using ACD-R which can use a variety of communication channels including but not limited to GSM, CDMA, TDMA, PSTN, Leased lines, VSAT, RF networks etc.
- ACD-R communicates with dispensers, tank probes and other electronic devices in the network. If the input data reveals a situation requiring urgent investigation or action e.g. Inventory update, power off, pumps off-line, possible leakage, etc., the ACD-R can automatically send alerts to the Dispatch Station Module.

Features of ACD-R as shown in Figure / Drawing No. 1 & 2):

- A wireless alert is to be sent to the Dispatch Station whenever there is input to the tank.
- A wired alert to follow, if the receipt of the wireless alert is not received in a specified time.
- The log is maintained on event basis as well as set time frequency basis.
- The logs to be sent to the Dispatch Station Module once every 24 hours or on a preset time frequency.
- Logging unit will maintain 24 hours sent log back up for any desired number of hours.
- Dispensing Unit readings will be sent to the control station on a preset time frequency.
- Dispatch Station Module will generate acknowledgement for every wireless data received.
- Power failure alert will be sent to the communication number whenever power is restored.

Figure / Drawing No.2 shows Adulteration Control Device for Retail Outlet ACD-R in a block diagram.

At the Retail Outlet there are underground storage tanks equipped with Tank Gauging System. This system gives output in electronic standard forms, which is carried to the ACD-R through the cable, the diagram shows the ports for Tank Inputs, which is routed through volume processing unit.

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Similarly, there are dispensing units to dispense the product to customers, from the dispensing unit with electronic output or equipped with a device which converts mechanical to electronic pulse, electronic output is taken by cable to the ACD-R to register the sales as shown in the figure, the third port for dispensing unit inputs which goes to the DU Interfacing Unit.

Any other inputs like temperature, density from the storage tanks can be taken up through additional input port.

The processed output from these units go to the logic processing unit which in turn is connected to data log Real Time Clock, a battery back up and inverter and the communication modem for various type of wireless and wired telecommunications.

Figure / Drawing No. 2 shows the Adulteration Control Device for Retail Outlet ACD-R in a construction diagram. This diagram describes the components in the communication unit, component details and how components work together is also explained.

The present invention of Adulteration Control Device for Retail end comprises of the following components:

- (a) **Rectifier** as shown in Figure No.1 (1). The rectifier converts alternating current / voltage into pulsating direct current / voltage arranged on a board within a tamper proof box. It connects to the power system of the ACD-R.
- (b) **Battery Backup with Inverter** as shown in Figure No. 1(2) provides power backup of 2 (two) hours and is provided with Inverter. It connects to the Power System of the ACD-R with an automatic switching in case of power failure.
- (c) **Crystals** shown in Figure No. 1(3) are connected to Logic Processing Unit and real time dock unit.
- (d) **Real Time Clock** shown in Figure No. 1(4) is arranged on a board, the DS1307 Serial Real-Time Clock is a low power, full binary-coded decimal (BCD) Clock / Calendar plus 56 bytes of SRAM. Address and data are transferred serially via a 2-wire bi-directional bus. The clock / calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month, date is

automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power sense circuit that detects power failures and automatically switches to the battery supply.

- (e) **Reset Unit** shown in Figure No. 1(5) resets the Communication Unit. It provides power-supply malfunction exception and a guaranteed power-up reset delay, while typically consuming 1/27th the power from a +5V supply. It monitors the power supply in Communication Unit. The device offers excellent circuit reliability and low cost by eliminating external components and adjustments.
- (f) **Communication Module** shown in Figure No. 1(6) arranged on a board within a tamperproof box provides default support for available wireless network (GSM / CDMA / RHF / VHF / VSAT / SATPHONE etc.) with PSTN line / leased line as backup.
- (g) **Logic Processing Unit (LPU)** shown in Figure No. 1(7) arranged on a board within a tamperproof box. The LPU is a low power micro-controller. By executing powerful instructions in a single clock cycle the device optimizes power consumption versus processing speed.
- (h) **Memory Unit (MU)** - shown in Figure No. 1(8) arranged on a board within a tamperproof box. The device provides electrically erasable and programmable read only memory (EEPROM). The devices cascable feature allows number of devices to share a common 2-wire bus. The device is optimized to use in circuits like communication units, where low power and low voltage operation are essential.
- (i) **Data Interfaces** - shown in Figure No. 1(9) arranged on a board within a tamperproof box. The DI is intended for RS232 or other form of input communications interfaces, particularly applications where $\pm 12V$ is not available. These parts are especially useful in battery-powered systems, since their low power shutdown mode reduces power dissipation to less than $5\mu W$.
- (j) **DU Connectors / Additional inputs** shown in Figure No. 1(10) arranged on a board within a tamperproof box RS232 / other data format input connectors are provided for interfacing dispensing unit and add inputs like temperature control, densitometer, etc. can be picked up by the unit.

- (k) **Probe or Volume Processing Connectors** shown in Figure No. 1(11) arranged on a board within a tamperproof box RS232 / other data format connector is provided for interfacing volume processing unit or probes.
- (l) **LED indicators** shown in Figure No. 1(12) arranged on a board within a tamperproof box, showing outside, LED indicates status and processing happening inside the communication unit.
- (m) **Tank Input Ports** shown in Figure No. 1(13) arranged on a board within a tamperproof box they can take the direct input from the probe with RS232 / other data format standard or an input from the volume processing unit.
- (n) **Dispensing Unit Input** shown in Figure No. 1(14) arranged on a board within a tamperproof box. This is input from dispensing unit or additional devices like temperature control, densitometer etc.

How these components are connected?

All of the components are arranged on PCB (Printed Circuit Board) shown in Figure No.1 within a tamperproof box. The heart of Communication Unit is Logic Processing Unit (LPU). Every input from the peripheral components is processed by LPU.

Event/Time based behavior:

The system is Event / Time based i.e., every action or processing starts as response to Events / Time schedule. The following are some of the events/ time schedules which when triggers action are taken by the Integrated Circuit.

- Tank event: Input to the tank or Output from the tank causes this event and as a response event is logged or alert is sent.
- DU event: Whenever preset time is crossed, this event is fired and as a response the reading are logged.
- Timeouts: Timeouts for log sending is event that is responded by sending all the logs.
- Request: Any request from remote system is event that is responded by fulfilling that request.

Configuration of communication unit:

Configuration can be done locally as well as remotely. Remote system or the site engineer can also configure the configuration unit with the help of protocols. Currently proposed configurable parameters are to which many other can be added, if required.

- Tanks.
- Dispensing Units.
- Additional Inputs.
- Log sending time.
- Exception sending time.
- Slab Interval for tank gauging.
- Polling time intervals for gathering reading from Tanks / DU's / Addl. Inputs.
- Admin PIN.
- User PIN.
- Communication number of remote system.

Typically but not limiting to Communication unit sends data packets for every

- Fuel addition.
- Sending sales log to remote system.
- Sending DU Log.
- Sending Exception Log.
- Requesting current tank reading & responding tank reading.
- Requesting DU reading & responding DU reading.
- Configuration Request (ADMIN ONLY).
- Sending Backup sales log.
- Sending backup sending DU Log.

The data packet typically but not limited to contains:

Data Packet includes – Request

- Header having information about the configuration request.

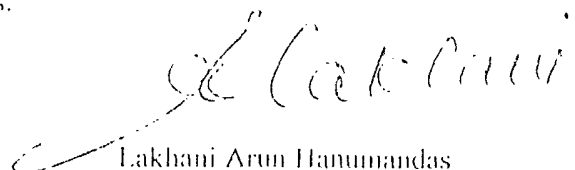
Data Packet includes – Response

- Header having information about the enclosed data.
- Response code.
- Tanks.
- Tank codes.
- Dispensing Units.
- Additional inputs.
- Log sending time.
- Exception sending time.
- Slab Interval for tank gauging.
- Polling time intervals for gathering reading form Tanks /DUs/
Addl. Inputs.
- Admin PIN.
- User PIN.
- Communication number of remote system.

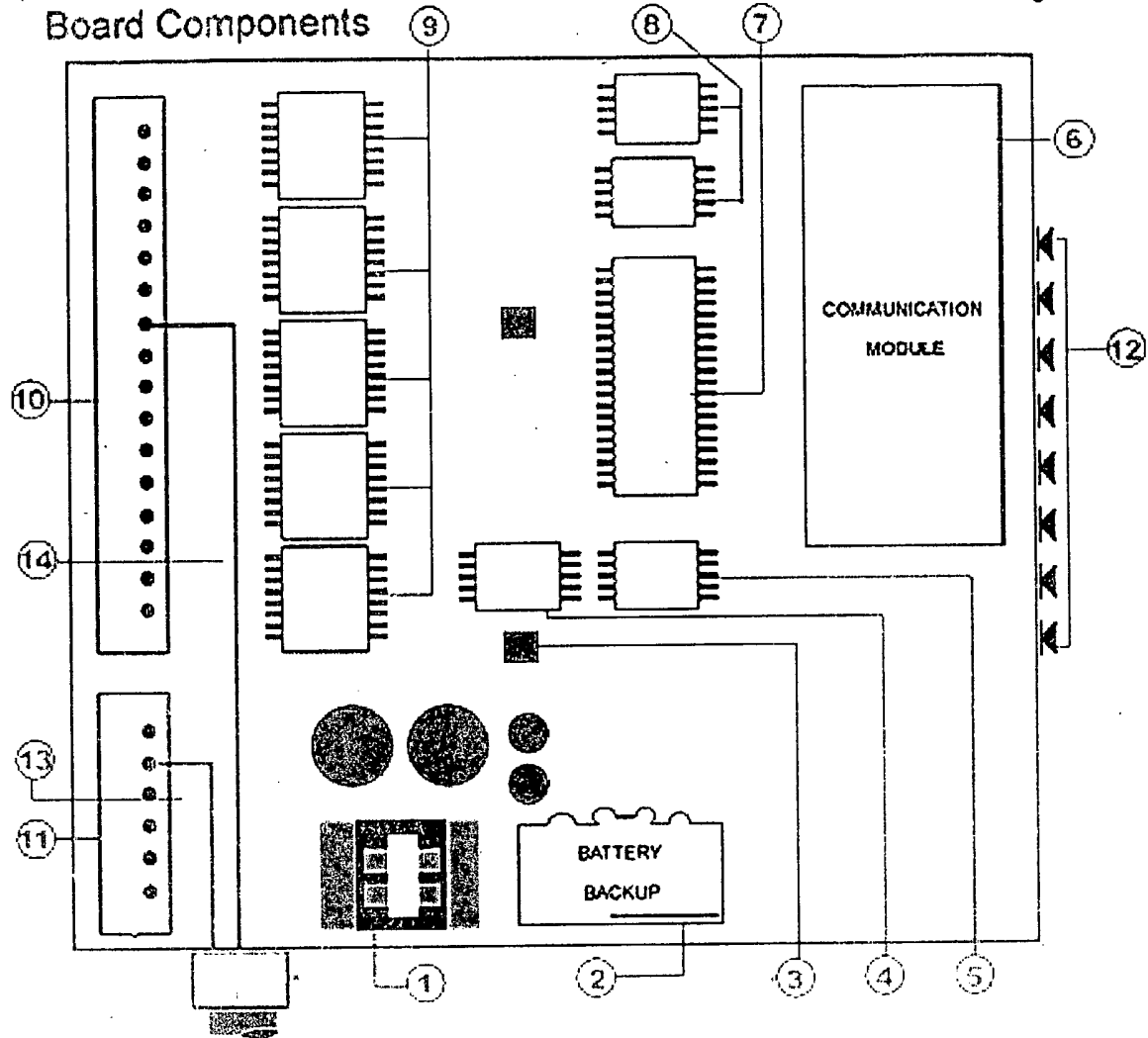
I Claim: -

1. The adulteration control device for retail outlet to restrain and identify cases of adulteration and provide information on real time basis by way of continuous intelligent interaction between the retail sale point and the dispatch station without human interference / assistance comprising a logic processing unit, a memory unit consisting of electrically erasable and programmable ROM, a real time clock, a crystal for clock generation, a reset unit to provide a power on delayed reset, a communication module with wireless communication support on default and wired communication support as back up, a plurality of input ports including a tank input providing information regarding the volume of the fuel in the tank, a dispensing unit input providing the information about the volume dispensed and other additional inputs, LED indicators to show the status of the device, a rectifier to provide the required DC power supply and an inverter with battery back up; all the said parts, the data interfaces and the connectors being arranged on printed circuit boards and kept inside tamper proof boxes.
2. The adulteration control device for retail outlet as claimed in Claim 1 where in the wireless communication support is based on GSM / CDMA / RHF / VHF / VSAT / SATPHONE.
3. The adulteration control device for retail outlet substantially described as here in with reference to the accompanying drawings.

Dated this 29th August 2003


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Drawing NO: 1



Drawing No: 2

ACD - R Block Diagram

