

M&C FOLIO: 230P65777

WANGDOC: 1053s

AN AUTOMOTIVE FUEL ADDITIVE DISPENSING
AND BLENDING SYSTEM

This invention provides an automatic fuel additive dispensing system that can be incorporated into service station fuel dispensers which will automatically blend a preset amount of one or more additives into the fuel as it is being delivered into the motorist's gas tank. The preset amount of each additive to be blended will be in terms of a specified mix ratio according to the desires of the fuel marketer and environmental regulators. The additive dispenser system will allow the mix ratio for each additive to be set independently, and easily changed from time to time as the additive formulations are changed. Likewise, the additive dispenser will allow the mix ratios for the additives to be set differently for each fuel grade, according to the desires of the marketer.

The simplest and preferred method is for additive addition is to inject the additive into the fuel at a point that is upstream of the meter in the fuel dispenser. In that way the additive is measured along with the fuel.

In this system, the choice of the additives becomes that of the gasoline marketer, and not that of the

gasoline buying customer. Accordingly, the dispensed additive will not be the subject of a separate sales transaction. Instead, the additives simply become a part of each of the graded fuel products that the marketer wishes to sell as his proprietary fuel products, and at the posted prices as usual. This invention may be applied to any and all fuel additives, and to fuel components which are generally of larger volume ratios to the fuel volume. The term "additive" is used hereafter in this specification for all such substances to simplify the wording.

A first aspect of the present invention provides an automotive fuel additive dispensing and blending system for a service station dispensing unit, comprising:

- (a) a minimum of one fuel additive storage tank and a minimum of one fuel storage tank;
- (b) an additive pumping and measuring means for each different fuel additive, a distribution system for each different fuel additive, a fuel dispenser computer in said dispensing unit, said computer acting to select and regulate fuel flow from said storage tank, and a fuel measuring means; and
- (c) a controller programmable for setting additive mix ratio, said controller being activated by activation of said fuel dispenser computer of said dispensing unit and acting to activate said additive pumping and measuring means to pump from said additive storage tank through

said distribution system into fuel flowing to a chosen outlet nozzle of said fuel dispensing unit in response to data received from said fuel dispenser computer relating to the fuel selected and the flow rate of said fuel through said fuel measuring means, said fuel additive entering into said fuel upstream of said fuel measuring means whereby the fuel measuring means measures the combined volume of the fuel and additive, said controller receiving input from said fuel additive pumping and measuring means and said fuel measuring means and activating and regulating said additive pumping and measuring means to control additive flow to said fuel flow according to the output of said fuel measuring means to maintain a preset ratio of said additive to said fuel which has been entered into said controller.

A second aspect of the present invention provides a method for fuel additive dispensing and blending for a service station comprising:

- (a) starting a flow of chosen grade of fuel into a tank thereby activating equipment comprising:
 - (1) a controller programmable for setting additive mix ratios and a fuel dispenser computer, said computer acting to select and regulate fuel flow;
 - (2) a minimum of one fuel pump to pump from a minimum of one fuel storage tank;
 - (3) a minimum of one additive pumping and measuring

means; and

(4) a minimum of one fuel flowmeter which measures the combined flow of additive and fuel;

(5) a distribution system, said controller taking input from said minimum of one fuel flowmeter and said additive pumping and measuring means and in response to data received from said fuel dispensing computer relating to the fuel selected and the flow rate of said fuel reacting through said distribution system and said additive pumping and measuring means to feed a preset ratio of said additive to said fuel upstream of said fuel flowmeter while said fuel is being dispensed;

(b) closing a delivery valve to stop said flow of fuel and said fuel dispenser computer to display a total measure of amount of said fuel and additive delivered along with total cost thereof.

This invention disclosed herein may be used with fuel blending retail dispensers. In these fuel blending dispensers a premium grade of gasoline is blended with a lower grade of gasoline to form one or more selectable intermediate grades of gasoline. In such cases the ability to dispense and blend the fuel additives into both of the flowing streams of fuel according to preset mix ratios, or into the blended fuel stream according to preset mix ratios for each selectable grade is provided.

An overall objective of this invention is to allow a

bulk gasoline shipper selling to service stations to provide for blending of additives, and normal blending of fuels and then additive addition, as the fuel is dispensed to a customer. The system provides for blending different amounts of different additives into differing grades of fuel sold to customers in service stations including intermediate grades of fuel that are achieved by blending at the gasoline dispenser unit of the service station.

A preferred embodiment of the system disclosed herein may include the following major functional elements:

1. one or more additive fluid storage tanks with these storage tanks properly sized relative to the gasoline storage for normal additive use;
2. a minimum of one additive pump and drive mechanism for each additive storage tank;
3. an additive fluid meter for each different additive to measure additive flow into the gasoline as the gasoline additive mixture is dispensed;
4. a distribution system with control valve that may be controlled to direct additives as measured to the fuel line activated by the customer to dispense fuel;
5. plumbing as required for the additives from the storage tank to the pump and meter, through the distribution system, and to the point where it is injected into the fuel stream;

6. a controller that:

(a) monitors the existing fuel dispenser system to detect which fuel has been selected by the customer and the fuel flow rate in real time;

(b) sets the distribution system so as to deliver additive to the proper fuel line being used;

(c) and regulates the motor and/or drive mechanism in such a way that the additive pump delivers additive in chosen amounts proportional to the fuel flow rates as the fuel is delivered to the customer's gas tank.

The controller function includes the capability to be preset to provide mix ratios of additive/fuel that are fixed thereafter, until changed once again. It is also capable of controlling multiple additive blender pumping systems as described above, each with independently set mix ratios as required for each of multiple additive fluids.

The additive fluids can be delivered and injected into the fuel stream at some point within the hydraulic section of the fuel dispenser.

In some service stations intermediate grades of fuel are formulated from a high grade fuel and a low grade fuel. There may be one or more intermediate grades. Usually this formulation is accomplished using a valve called a blend control valve. The blend control valve operates in conjunction with electronic controls to measure a preset ratio of high grade fuel with its

additives to low grade fuel with its additives. With fuel blending dispensers, two lines lead to the dispenser nozzle to mix the fuels at the nozzle. The two lines are necessary so that each customer will get only the properly mixed fuel and additive that he chooses and not first a line full of another mixed fuel that was left by the prior customer.

Fig. 1 shows internal components for fuel additive blending at the retail gasoline pump at preset but resettable ratios of additives to gasoline dispensed from the gas pump.

Fig. 2 shows internal components for fuel additive blending at the retail gasoline pump at preset but resettable ratios of additives to gasoline dispensed from the gas pump when the gas pump is of the fuel blending type that can produce intermediate grades of gasoline at the service station.

Fig. 3 shows a second embodiment for internal components when the gas pump is of the fuel blending type that can produce intermediate grades of gasoline at the service station.

We may best described details of the invention by a description of the drawings.

In Fig. 1 we show a service station fuel dispensing unit 1 with a fuel dispenser computer 2 and display panel 3. Displayed is price per fluid volume, fluid volume dispensed and price of the selected and dispensed

fuel. In a preferred embodiment of this invention fuel dispenser computer 2 acts normally to include the cost and amount of the additive or additives blended into the fuel and includes amount of the additives in the amount of fuel displayed and includes cost of the additives in the total cost displayed. Note that fuel dispenser computer 2 may be connected and programmed to interact with a remote operator terminal and other modern service station transaction equipment.

Dispenser computer 2 also acts normally to activate fuel flow of one of three from storage tanks 28, 29, or 30 as chosen by the customer and delivers the selected fuel to the customer's fuel tank, while receiving measured flow data from the respective fuel meter, and computes and displays the transaction data.

The functional elements of this embodiment of this invention are shown in schematic form. One or more additive storage tanks 25 are placed for storing the additives that the fuel marketing company wishes to blend and dispense with the fuel. The additives are pumped and metered by pumping and metering unit 26, which may be one or more separate devices and are shown here combined in a preferred embodiment inside the fuel dispensing unit housing. Additives then pass through a distribution system 27 controlled by controller 4 to cause the additives to be directed through appropriate plumbing and fittings to injection points in the fuel

lines of the different grades of fuel, upstream of the fuel meters 32, 33 or 34 so that the dispensed additive volume is measured along with the fuel. The distribution system 27 is controlled to cause the additive to flow only to the one fuel line that is being used in any fuel dispensing transaction.

The controller 4 is a second computer which receives information from the fuel dispenser computer 2 indicating which fuel grade is being taken, and the rate of fuel flow on a real time basis during the fuel dispensing operation. The controller 4 includes means for presetting the additive mix ratios for each additive, and differently for each fuel grade if so desired by the marketer. This setting can include setting at the unit, or by remote programming from a console.

With the selected fuel 28, 29 or 30 and fuel flow rate information from fuel dispenser computer 2, and with the marketer's preset mix ratios, the controller 4 activates additive pumping and measuring units 26, and distribution system 27 to pump and blend appropriate proportional amounts of the additives with the selected fuel flowing through one of flowmeter 32, 33, or 34 as the fuel is pumped by one of pumps 23 and dispensed into the motorist's fuel tank through nozzle 38.

The controller 4 can be a separate electronic module as drawn, or the controller 4 functions might be

combined with those of the fuel dispenser computer 2 as a single unit.

In Fig. 2 we show a second embodiment of the invention wherein additives are added at the dispensing unit 6 in a service station where the dispensing unit is a fuel blending type unit. The blending type dispensing unit 6 may be used to minimize number of fuel storage tanks and/or allow dispensing one or more intermediate fuel grades. Although additives may be used in all grades, additives alone are not usually sufficient to transform the lower or regular type fuel sold to a premium grade. In the blending type service station fuel dispenser, normally a premium grade fuel and lower grade fuel may be sold separately or mixed to give intermediate grades. This invention provides for having the proper additives for premium grade fuel and lower grade fuel in the fuel hoses at all times as well as proportional amounts of additives in the intermediate grade fuels.

The functional elements of the automated fuel additive dispenser system for the fuel blending type dispenser is shown schematically. With this fuel dispenser type there are two fuel tanks 28 and 30 with pumps 24, each having their respective fuel meters 20 and 22. There is also the typical fuel blend valve 36 that is controlled by the blending dispenser computer 5. The blending dispensing computer 5 is programmed to

allow customer choices of regular or lower grade or premium grade or one of one or more intermediate fuel grades and receives flow rate signals in real time from the two fuel meters 20 and 22 during the fuel delivery. With this information, the computer 5 controls the fuel blend valve 36 so as to maintain the fuel blend ratio to the selected value throughout the fuel delivery.

In a preferred embodiment of this invention, there are one or more storage tanks 25 placed for storing the additive, pumping and measuring units 26, distribution system 27, and respective plumbing to carry the pumped, measured and distributed additive to the injection points upstream of the fuel meters. The controller 4 receives fuel flow information from the fuel dispenser computer 5 and regulates the flow of additives being dispensed to maintain a preset mix ratio. However, in this case there are two fuels flowing with their two meters operating simultaneously. Therefore, this invention includes the added programmed ability of the fuel dispenser computer 5 and the controller 4 to communicate and receive, respectively, the real time fuel flow data from the two operating meters simultaneously. Controller 4 in this embodiment will cause additive amounts to be dispensed by pumping and measuring units 26 for each additive and alternately as required through distribution systems 27 for each additive to each of the two fuel line injection points

upstream of the fuel meters 20 and 22 so as to maintain the additive to fuel ratio to the correct preset value for each additive and for each of the two flowing fuels throughout the delivery.

As with the embodiments of Fig. 1, the functions of controller 4 might be combined and made a part of dispenser computer 5.

In the blending type service station unit 6 the dispenser nozzle 35 is fed from a line for lower grade fuel and a line for premium grade fuel. Blend control valve 36 controls ratio fed to the nozzle 35 so that a lower grade, one or more intermediate grades, or premium grade fuels may be dispensed with one nozzle.

In Fig. 3 we show a second embodiment for dispensing unit 6 that is a fuel blending type unit. In this second embodiment, two sets of controlled pumping and measuring units 26 are provided for each additive with each unit 26 of each set delivering additive under control of controller 4 at a preset ratio of additive to fuel to one of the two fuels 28 and 30 upstream of fuel meters 20 and 22. With this design, the distribution systems 27 as shown in Fig. 2 are modified. As in Fig. 2 blend control valve 36 acts to allow pumping a single fuel grade from tank 28 or tank 29 or mixtures thereof to form intermediate grades with a preset ratio of additives to fuel being added to each grade. Dual lines lead to dispenser nozzle 35 with mixing in the nozzle

for intermediate fuel grades.

In addition to embodiments as outlined, one pump for each additive, pumping through each of two control valves to add a controlled measured flow of additive to each stream flowing through flowmeters 20 and 22 may be utilised.

CLAIMS:

1. An automotive fuel additive dispensing and blending system for a service station dispensing unit, comprising:

(a) a minimum of one fuel additive storage tank and a minimum of one fuel storage tank;

(b) an additive pumping and measuring means for each different fuel additive, a distribution system for each different fuel additive, a fuel dispenser computer in said dispensing unit, said computer acting to select and regulate fuel flow from said storage tank, and a fuel measuring means; and

(c) a controller programmable for setting additive mix ratio, said controller being activated by activation of said fuel dispenser computer of said dispensing unit and acting to activate said additive pumping and measuring means to pump from said additive storage tank through said distribution system into fuel flowing to a chosen outlet nozzle of said fuel dispensing unit in response to data received from said fuel dispenser computer relating to the fuel selected and the flow rate of said fuel through said fuel measuring means, said fuel additive entering into said fuel upstream of said fuel measuring means whereby the fuel measuring means measures the combined volume of the fuel and additive, said controller receiving input from said fuel additive pumping and measuring means and said fuel measuring



means and activating and regulating said additive pumping and measuring means to control additive flow to said fuel flow according to the output of said fuel measuring means to maintain a preset ratio of said additive to said fuel which has been entered into said controller.

2. An automatic fuel additive dispensing and blending system as in claim 1, wherein said fuel dispenser computer acts to calculate and to activate a display of total dispensed volume and total cost of said fuel plus said additive dispensed.

3. An automotive fuel additive dispensing and blending system as in claim 1 or 2, wherein functions of said controller and said fuel dispenser computer are combined in one unit.

4. An automotive additive dispensing and blending system as claimed in claim 1,

comprising respective fuel storage tanks for premium grade fuel and lower grade fuel,

a respective fuel measuring means for fuel flowing from each storage tank,

said additive distribution system being arranged to deliver the or each additive to each grade of fuel upstream of said respective fuel measuring means and the



respective fuel additive pumping and measuring means being controlled according to the output of the respective fuel measuring means to maintain the preset ratio of said additive to said respective fuel, and

means for mixing in a preselected ratio the premium grade fuel and lower grade fuel to a minimum of one intermediate grade of fuel.

5. A method for fuel additive dispensing and blending for a service station comprising:

(a) starting a flow of chosen grade of fuel into a tank thereby activating equipment comprising:

(1) a controller programmable for setting additive mix ratios and a fuel dispenser computer, said computer acting to select and regulate fuel flow;

(2) a minimum of one fuel pump to pump from a minimum of one fuel storage tank;

(3) a minimum of one additive pumping and measuring means; and

(4) a minimum of one fuel flowmeter which measures the combined flow of additive and fuel;

(5) a distribution system, said controller taking input from said minimum of one fuel flowmeter and said additive pumping and measuring means and in response to data received from said fuel dispensing



computer relating to the fuel selected and the flow rate of said fuel reacting through said distribution system and said additive pumping and measuring means to feed a preset ratio of said additive to said fuel upstream of said fuel flowmeter while said fuel is being dispensed;

(b) closing a delivery valve to stop said flow of fuel and said fuel dispenser computer to display a total measure of amount of said fuel and additive delivered along with total cost thereof.

6. A method for fuel additive dispensing and blending for a service station as in claim 5 wherein functions of said controller and of said fuel dispenser computer are combined in one unit.

7. A method for fuel additive dispensing and blending as claimed in claim 5 or 6,

wherein a premium grade fuel and a lower grade of fuel are dispensed simultaneously,

the ratio of premium grade and lower grade of fuel being adjusted by a blend control valve to dispense at least one intermediate grade of fuel,

a fuel flow meter being provided for each of the premium grade fuel and lower grade fuel, and the or an additive being added to each of the premium grade fuel and lower grade fuel upstream of the respective



flowmeter according to the preset ratio.

8. An automotive fuel additive dispensing and blending system substantially as hereinbefore described with reference to, and as illustrated in, Fig. 1, Fig. 2 or Fig. 3 of the accompanying drawings.

9. A method for fuel additive dispensing and blending system substantially as hereinbefore described with reference to Fig. 1, Fig. 2 or Fig. 3 of the accompanying drawings.



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