The History of CNG Flow Control

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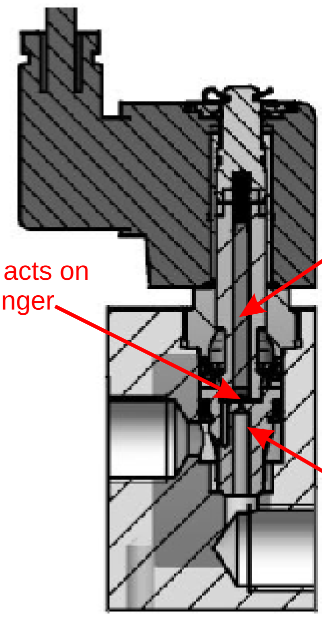
A detailed look at past and present systems used to control the flow of gas in a CNG dispenser

For such a relatively young industry, the NGV dispenser has already seen a number of revolutions in its technology. As the industry continues to develop, so do the standards and requirements of the equipment used. This constant refinement has lead to numerous product improvements, including the control of gas flow inside a CNG dispenser.

Throughout NGV's short history we have already seen several drastic changes in the way a dispenser controls the flow of gas for vehicle filling applications, for example, the very first electronic dispensers were equipped with direct acting solenoid valves. These valves were a simple solution and a logical first step in the control of gas. As with any new product, the dispensers using this type of valve did have a few issues; the direct acting nature of the valve meant the solenoid plunger was used directly to control the full flow of gas. These valves were very expensive and in order to continue operating reliably a large amount of power was required to operate them.

To overcome this hizgh power consumption problem, the concept of using a pilot piston was introduced. Unfortunately, these first pilot driven solenoids had several short comings - the solenoids had their pistons positioned above the main plunger and acted directly on it. Because of this, both the plunger and pilot piston overlapped pathways when in use, and the movement of the main plunger had to be restricted in order to prevent the pilot circuit closing as the main plunger opened. However, this restriction of the main plunger resulted in a reduced flow rate through the valve.



One way of allowing more movement of the main plunger was to increase the pilot piston travel distance. However, this reduced the amount of opening force acting on the pilot piston. To ensure that this reduced force was still large enough to open the pilot circuit, the diameter of the pilot hole had to be reduced. This caused small foreign particles to often block the pilot hole and adversely affect the operation of the valve. At times this lead to the availability of free gas for the customer. Coils were also prone to burning out because of the fine balance required in these earlier valves. Unfortunately the reliability and low flow rate issues were not addressed, and the solenoid developed a bad reputation.

In order to increase flow rates through the dispenser, manufacturers adopted actuated ball valve systems. These systems consisted of standard ball valves, equipped with pneumatic actuators (these work to convert energy, in the form of compressed gas, into motion) which ran off the compressed natural gas feed into the dispenser, or a separate pneumatic air circuit. Solenoids were still required to control the actuator.

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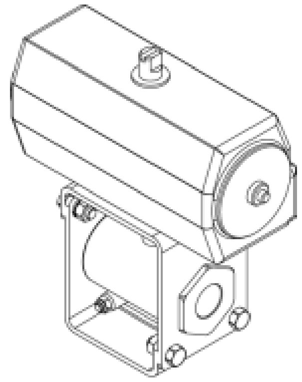
These types of systems greatly increased flow rates during filling but also had their limitations. The first was the significant cost increase to the dispenser; solenoid valves were still required, meaning these actuated valves were an additional expense over previous dispenser designs, and with up to 6 valves per dispenser these extra costs soon added up. A separate compressed air supply was also required to operate the valves, which added further expense. This requirement could be removed by using the CNG pressure itself to actuate the valves, but this gas then had to be vented out, raising wastage and safety issues.

Actuated Ball Valve

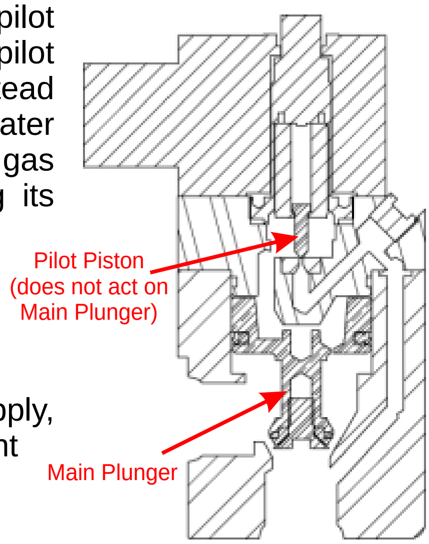


There were also issues with tampering of the actuated valves. The exposed nature of their design meant that they could be opened easily with a spanner or other tools, (without authorisation from the dispenser) allowing clever attendants and service staff to give away gas and negotiate their own terms for payment.

As the industry developed, consumers began demanding the preset facility on dispensers, allowing them to predetermine the exact quantity of gas they received before filling commenced. In our last paper, "The Trouble with presets" we discussed the limitations of such a facility and some of the steps that can be taken to reduce them. Unfortunately, the response time of actuated valve systems can often extend beyond 0.5 seconds. It is too inconsistent to make compensations for, making it impossible to accurately deliver exact amounts of gas when using the preset facility. This raised requirements for a new type of valve; taking into account the lessons learnt from the earlier direct acting pilot systems, the notion of a new generation pilot controlled valve was conceived. This newly improved design offers the benefits of high flow from the actuated system, while still maintaining the cost effectiveness of the earlier solenoids.

There are several differences that make this latest solenoid design a major advance in technology from the earlier pilot driven solenoids. The main difference being that the control pilot piston does not seal against the main plunger, but instead controls the gas above the valve. This system allows for greater movement of the main plunger. Using this design, full gas pressure is used to open and close the valve, keeping its operation consistent and reliable, also making it ideal for use in conjunction with a dispenser preset facility. The full bore of the large main plunger gives flow rates similar to actuated systems, while the small pilot valve keeps power requirements to a minimum. In addition, this style of valve removes the requirement for a separate compressed air supply, (as in the case of an air actuated system) or the need to vent and waste CNG from gas actuated valves.

Latest Pilot Solenoid



This all in one compact nature of the design removes unnecessary complexity from the dispenser, and reduces overall costs involved with the initial dispenser purchase and ongoing maintenance.

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