

Vehicle Fuel Tank Arrangement

The invention relates to a vehicle fuel tank arrangement.

Motor vehicles have a petrol tank of sufficient capacity to provide a source of fuel for an acceptable mileage range. Saloon passenger cars, for example are normally produced by the manufacturer with a fuel tank having typically 30 to 80 litres of capacity to provide an acceptable range before refuelling is necessary.

Where vehicles have been designed or modified to run on compressed natural gas the size of the gas tank has to be larger than the equivalent size petrol tank to provide the same range. The size, for example, could be 3.8 times that of the petrol tank, assuming the stored compressed gas is at a pressure of 200 bar.

If a gas tank equivalent in size to the petrol tank is utilised then this would provide only a range of about 26% of the petrol equivalent tank.

Because of the cylindrical construction of the gas tank which is of a substantial size, it is typical that this is housed in the boot/trunk of the car, so reducing the carrying capacity of the car.

The present invention is concerned with providing an adequate storage capacity whilst keeping dimensions low.

According to the invention there is provided a combination vehicle fuel tank arrangement including a first tank portion for receiving and storing a first combustible liquid fuel and a second pressurised tank portion for receiving and storing a second combustible gaseous fuel under pressure.

Preferably the first portion is configured to at least partially surround the second portion to allow the second portion to be protected from impact by the first portion.

According to a further aspect of the invention there is provided a fuel tank for a combination fuel vehicle including a first tank portion for a first combustible liquid and having a region defining a location for receiving and retaining a second tank portion capable of storing a second combustible gas fuel under pressure, the first tank portion at least partially surrounding the second tank portion when located to act as a support and as a buffer against impact damage.

Preferably the first tank region includes a location which is at least partially concave to accommodate a

cylindrical second tank portion.

Further according to the invention there is provided a method of providing fuel storage for a dual fuel vehicle comprising the steps of providing a first fuel tank portion for receiving and storing a first combustible liquid fuel and providing a second pressurised tank portion for receiving and storing a second combustible gaseous fuel under pressure.

The invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a standard known petrol tank mounted between the rear wheels of a car;

Figure 2 shows a standard known petrol tank mounted between the front and rear wheels of a car, but towards the rear of the car;

Figure 3 shows one embodiment of the combined tank of the invention;

Figure 4 shows a second embodiment; and

Figure 5 shows a third embodiment.

The petrol (gasoline) tank 3 of Figure 1 is mounted beneath the vehicle by means of several mountings 5 in known manner, two of which are shown. The tank is positioned between the rear wheels 1 but behind the axle line. The boot or trunk houses the spare wheel 2. A petrol filling point 4 is provided to replenish the tank. The tank capacity is shown as 40 litres.

In a second version, for a larger vehicle, a 60 litre petrol tank is shown in Figure 2 which is mounted by mounts 5 so as to extend from a region in front of the rear wheels 1 towards the front of the car in a position beneath the car floor over which the rear seats 2 are mounted.

It is seen that the shape of the tank is not uniform but is contoured to fit in the available space.

Petrol tanks, fitted by the vehicle manufacturer, are moulded to shape usually in a plastic material and can be made in almost any profile to fit the available space under the vehicle. They store the petrol in liquid form but will accommodate any liquid vapour pressure associated with the fuel storage.

In order to deal with the requirements of a dual fuel

vehicle, the existing tank is replaced by a combination tank 20, as shown in figure 3 and the new tank includes a petrol tank portion 3 which partially surrounds a gas tank 6. The overall dimensions of the original petrol tank are thus not substantially altered and this allows the hybrid tank 20 to fit within the space which would have been occupied by the 40 litre tank of Figure 1.

The petrol region of the hybrid tank 20 includes a concave well or recess 26 for receiving the cylindrical gas tank 6. The resilient nature of the moulded tank 3 allows the wall portions 22 and 23 to grip the inserted gas tank 3 (in a jawlike action). The tank 3 serves as a buffer to any impacts in use. The interior portion 25 of the petrol tank, beneath the gas tank, still allows passage of petrol arriving within the smaller region 27 to reach the larger region 28 from the filling point 4.

The petrol in use will be removed under pump action (not shown) from a suitable exit point in the tank, as in earlier systems.

In this example, the hybrid tank now has a petrol tank capacity of 28 litres and a gas tank capacity of 12 litres, allowing the vehicle to operate on dual fuels without the need to sacrifice large areas of vehicle

space, typically within the vehicle storage area.

Hence the petrol capacity will be substantially retained and the volume displaced by the gas tank will only cause a small reduction in the combined fuel range. This will provide the optimum fuel density, for the 'gas + petrol' operation, within the permissible space. The small cylindrical gas tank is of sufficiently robust construction to store the pressurised gas in a quantity useful for small everyday journeys.

Although the liquid fuel is described as petrol, it could be diesel or other liquid hydrocarbon fuel.

The gas tank 6 could be recharged regularly, e.g. overnight, to provide an adequate supply for 30-35 miles round trips with the 17 litre tank providing a petrol equivalent of 4.5 litres, for a saloon car.

The gas tank 6 may be made from steel either in heavyweight section or alternatively of lightweight section for reduced cost and mass. The latter is assisted by relying on the underlying protection afforded by the petrol tank 3. Drawn steel, externally reinforced along the cylindrical section by over wrapping with fibreglass material, can also be utilised. These steel

tanks require protection from water entering the tank and causing corrosion. Aluminium tanks are an alternative if fully wrapped with carbon fibre. Non metallic tanks could be employed using a non permeable polyethylene liner fully wrapped with carbon fibre. An important consideration with non metallic reinforced tanks is that they will expand and contract with changing internal gas pressure and are more vulnerable to impact damage if knocked. The configuration of the tanks assists in protecting the gas tank from impact damage.

Although more costly, non metallic tanks are more lightweight and less vulnerable to corrosion. The small capacity of tank 6 helps to keep costs down.

The tank mountings 5 and petrol filling point 4 are retained enabling the combined tank to be supplied to the vehicle manufacturer without requiring any changes to the manufacture of the vehicle underbody. By surrounding the gas tank with the petrol tank, the gas tank is protected from impact damage as the gas tank 3 sits within the well or recess 26 within the petrol tank and also is located beneath the vehicle body which provides topmost protection. This particularly important where a non metallic composite gas tank is used.

In the Figure 4 arrangement, the hybrid tank 20 replaces that of Figure 2 and is mounted as before in front of the axle line of the rear wheels 1 under the body floor beneath the rear seats 2.

The 60 litre petrol tank is replaced by a 50 litre petrol tank and the gas tank 6 is now provided with a capacity of 17 litres. The original mounting points 5 are employed making fixing and accommodation straightforward and the overall external dimensions of the hybrid tank are not significantly different to the petrol only tank.

The gas filling point 7 on the exterior of the vehicle body is shown connected to the gas tank 6 via a cartridge type dryer 8 which contains a desiccant material to remove any moisture from the high pressure gas when using a steel tank. It is intended that the dryer cartridge can be replaced at normal vehicle service intervals.

In a further embodiment shown in Figure 5, the hybrid tank is such that the cylindrical gas tank 6 is elongate in the vertical rather than horizontal plane, but once again the petrol tank partially surrounds the gas tank to retain the gas tank and provide protection to the embedded gas tank. Although of shorter length, the increased width of the tank still overall gives a

capacity of 17 litres for the gas, the petrol tank being of 40 litres.

It would also be possible to provide a configuration where the petrol tank also cushions the gas tank from above by providing a circular aperture in the petrol tank to allow the cylindrical gas tank to be inserted through the opening. The gas tank would be retained with the assistance of the resilient nature of the petrol tank wall abutting the gas tank wall.

The gas tank described in the embodiments could be designed to be withdrawn from the hybrid tank to allow periodic integrity checks to be made.

Whichever arrangement is used, the design of the tank is such that as the volume of the petrol surrounding the gas tank falls, there is adequate passageway for the petrol to reach the fuel offtake pipe at the bottom of the tank.

Such a hybrid tank provides dual fuels in sufficient quantities to provide capacity for typical daily trips as shown in the following chart.

Typical Tank Capacities and Refill Frequencies			
Vehicle Size		Small	Medium
'Petrol Only' Tank Capacity	Litres	40	60
Petrol Capacity in Combined Tank	Litres	28.6	42.9
Gas Capacity in Combined Tank*	Litres of Petrol Equivalent	3	4.5
Total Capacity in Combined Tank	Litres of Petrol Equivalent	31.6	47.4
Reduction in Petrol Capacity	Litres	11.4	17.1
	%	28.5	28.5
Reduction in Combined Fuel Capacity	%	21	21
Typical Vehicle Mileage	km/annum	16,000	20,000
Fuel Consumption	km/litre	12.5	11
'Petrol Only' Forecourt Refills*	Refills/annum	40	38
Typical Mileage on Gas**	km/annum	9,750	12,870
Combined Tank Forecourt Refills**	Refills/annum	22	19
Reduction in Forecourt Refills**	%	45	50
* When filled with natural gas at 200bar pressure ** Assuming petrol tank is refilled when fuel level is down to 20% capacity *** Assuming vehicle is used 5 days per week and gas tank is emptied once per day			

Overnight gas refuelling provides a easy mechanism to maintain gas capacity.

Typically, between 2 to 4kg of gas (3 to 6 litres petrol equivalent) will be supplied overnight depending upon the vehicle size and gas tank capacity. The above table indicates the reduction in fuel capacity for a combined

tank verses a petrol tank of similar external volume. Some of this capacity could be retained in vehicles where there is space to enlarge the combined fuel volume.

If a 60 litre, 'petrol only' tank is replaced by a combined tank having the same external shape and volume but containing 3kg of gas (4.5 litres petrol equivalent), the reduction in fuel storage (equivalent petrol) will be about 12.5 litres (21%). The reduction in actual petrol storage will be 28.5%. Whilst more forecourt refuelling stops would be required on long daily journeys, when used predominantly for short daily journey, forecourt refuelling would be significantly reduced by overnight home refuelling with gas. For the examples given, daily journeys of less than 35 miles could be achieved without the use of petrol.

CLAIMS

1. A combination vehicle fuel tank arrangement including a first tank portion for receiving and storing a first combustible liquid fuel and a second pressurised tank portion for receiving and storing a second combustible gaseous fuel under pressure.
2. A fuel tank as claimed in claim 1 wherein the first portion is configured to at least partially surround the second portion to allow the second portion to be protected from impact by the first portion.
3. A fuel tank as claimed in claim 2 wherein the first portion is formed of plastic moulded material of flexible characteristic to absorb impacts received in use to acts as a buffer to the second portion.
4. A fuel tank as claimed in any one of claims 1, 2 or 3 wherein the first tank portion includes mounting means for both the first and second tank portions beneath the vehicle floor, the second portion being of generally cylindrical form.
5. A fuel tank as claimed in any preceding claim wherein the gas portion has an inlet which includes a

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cartridge type filter for removing moisture from the gas supplied to the tank.

6. A fuel tank as claimed in any preceding claim wherein the ratio of the gas storage to petrol storage in the tank portions is selected to be in the region of $\frac{V_g}{V_p - 3.8 \times V_g}$, where V_g is the amount of gas storage capacity measured in equivalent litres of petrol and V_p is the petrol volume in litres of a petrol only tank of similar combined external volume.
7. A fuel tank for a combination fuel vehicle including a first tank portion for a first combustible liquid and having a region defining a location for receiving and retaining a second tank portion capable of storing a second combustible gas fuel under pressure, the first tank portion at least partially surrounding the second tank portion when located to act as a support and as a buffer against impact damage.
8. A fuel tank as claimed in claim 7 wherein the first tank region includes a location which is at least partially concave to accommodate a cylindrical second tank portion.
9. A fuel tank as claimed in claim 8 wherein the first





tank portion is constructed to allow the second portion to be removable.

10. A method of providing fuel storage for a dual fuel vehicle comprising the steps of providing a first fuel tank portion for receiving and storing a first combustible liquid fuel and providing a second pressurised tank portion for receiving and storing a second combustible gaseous fuel under pressure.

11. A method as claimed in claim 10 including the step of at least partially surrounding the second portion with the first portion and gripping the second portion therewith.

12. A combination vehicle tank substantially as described herein with reference to any embodiment shown in figures 3 to 5 of the accompanying drawings.

13. A method of providing a combination fuel tank substantially as described herein.

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