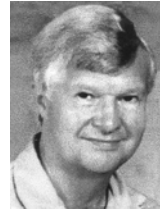


# POPPET VALVES UNDER THE MICROSCOPE - PART 1



By **Doug Leeming**

## History

Poppet or mushroom valves were developed by early steam engineers prominently by Serpollet on his variety of single acting engines. They were successfully borrowed and adapted to internal combustion engine use.

## Main Attributes

Ability to pass large volume of steam for relatively small openings, exhaust and inlet valves are separated which increases efficiency as the inlet valve is not cooled by the exhaust. Separate cams or valve opening devices can be optimised to give the best results over the whole operating speed range. Able to obtain ultra short cut-off necessary for economical running.

## Potential

The best radial valve gears have difficulty in successfully operating at less than 15% opening, also wire drawing (throttling of the steam) occurs at less than 15% starving the cylinder. Result; lower than boiler pressure in the steam chest. Poppet valves can go down to as low as 3% cut-off, which removes the added complications of compounding to achieve desired economy. The trade off higher rotational speeds will further aid efficiency.

## Proof of Gains in Economy

So little documented research exists for small steam engines but fortunately Britain's most advanced steam locomotive, the Duke of Gloucester, was fully tested and documented and shows the true potential of poppet valves and is likely to be the most steam efficient locomotive to date. The all-important steam rates make very interesting reading.

### Steam Consumption Rates in lbs/hr at a Constant Speed of 75mph

<u>Cut-off</u>	<u>Recorded Pressure in Steam Chest</u>	<u>Steam Rate per I.H.P.</u>
20	250	12.98
15	250	12.28
10	250	12.72
7	250	12.69
5	200	13.04
3	200	12.00

At a constant 60mph at 3% cut-off the water rate was recorded at 11.40lbs, which is considerably less than any other British locomotive and approaches figures obtained by White and Doble and eclipses the best figures obtained by Chapleon, who used compound rather than simple expansion

It tells us that in an ideal world Steam Car should be always at full throttle and adjustments should only be made for power or speed by varying the cut-off if economy is a goal.

Maximum power of 2310 HP was achieved at 75 miles per hour at only 20% cut-off. On the same setting 90mph was surpassed with an output of 1400HP.

## Shortfalls of Performance

The boiler of Duke of Gloucester was not fully developed, but great strides have been made since its preservation. However some weaknesses were found in the Cuprotti valve gear. At 5%, 3% boiler pressure of 250psi could not be realised in the steam chest. Three possible reasons can be proposed.

- Insufficient steam inlet time, wire drawing (doubtful)
- Length of steam passage from regulator (more likely)