

## VVT technology

- Variable cam phasing
  - Many companies (Fiat, Nissan, Toyota ...)
- Cam switching
  - Honda VTEC
- Valve-lift geometry control
  - BMW Valvetronic
- Hydraulic/electro-hydraulic lift control
  - Jacobs VVT
  - Lotus/Eaton
- Electromagnetic valve
  - FEV EMV, Visteon EVA

# VVT technology

Toyota VVT-i  
(SAE Paper 960579)

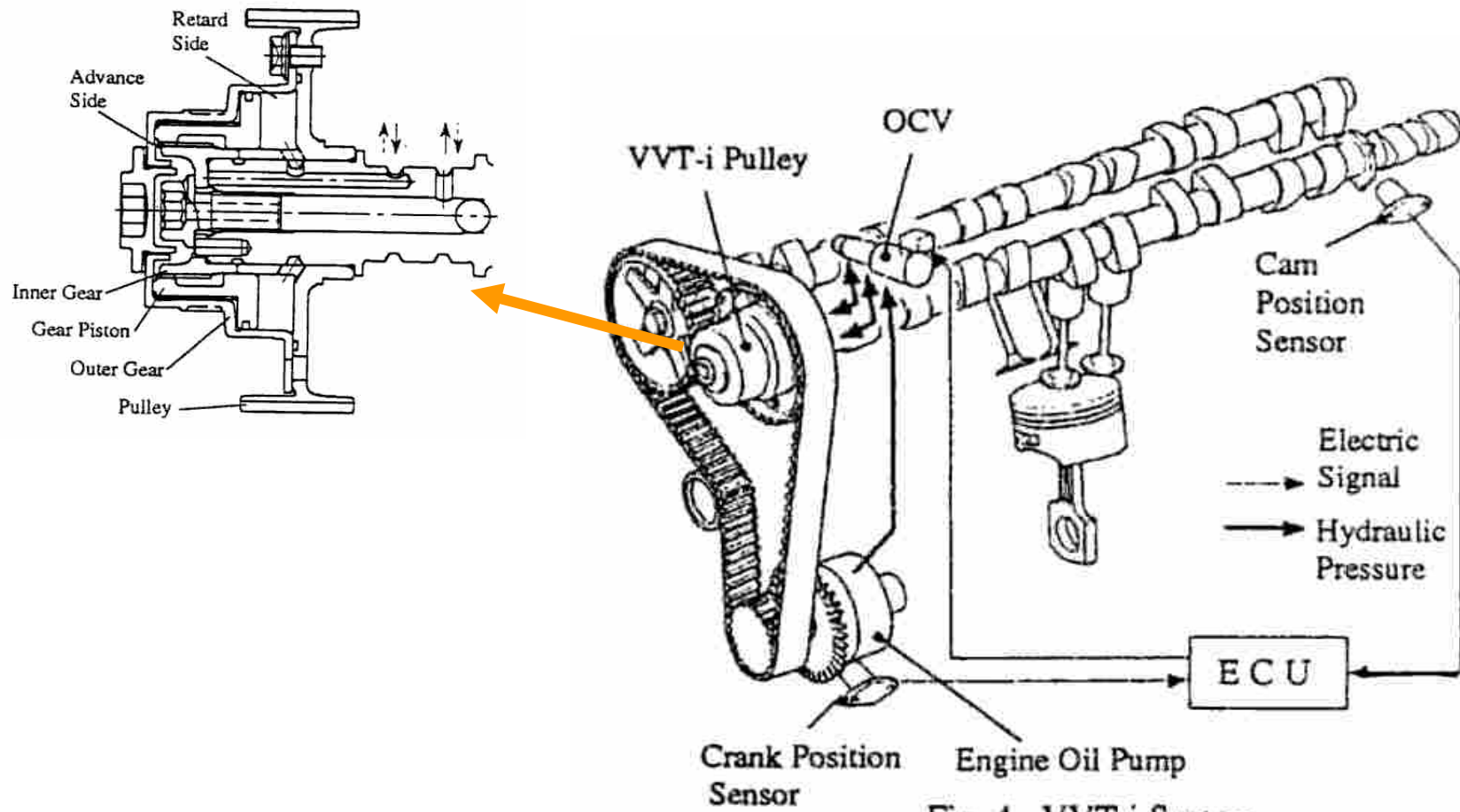


Fig. 4 VVT-i System

# VVT technology

Honda VTEC (SAE 910008)

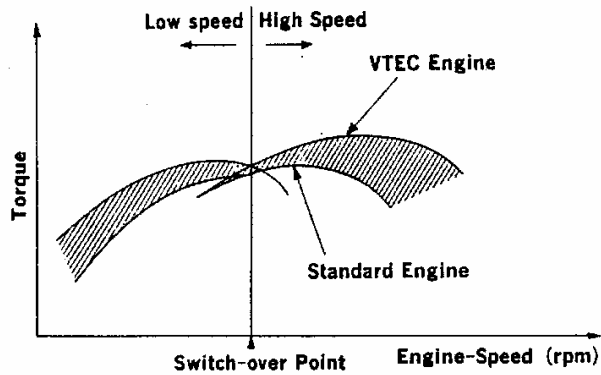
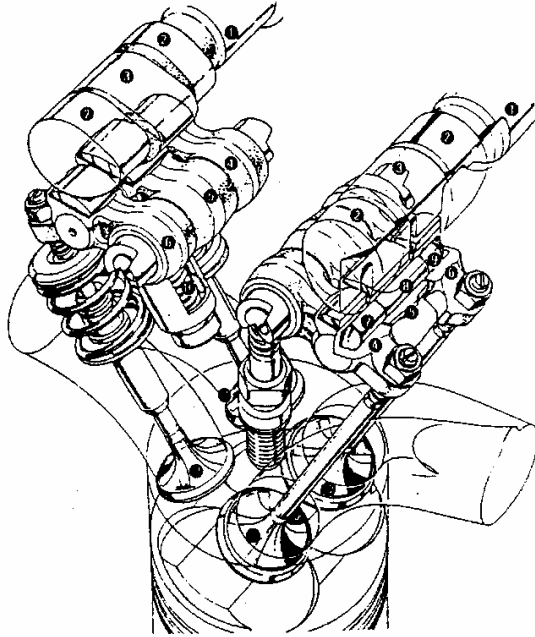


Fig 6 Output and Switch-over of Low speed and High speed



Nissan NVCS (SAE 910677)

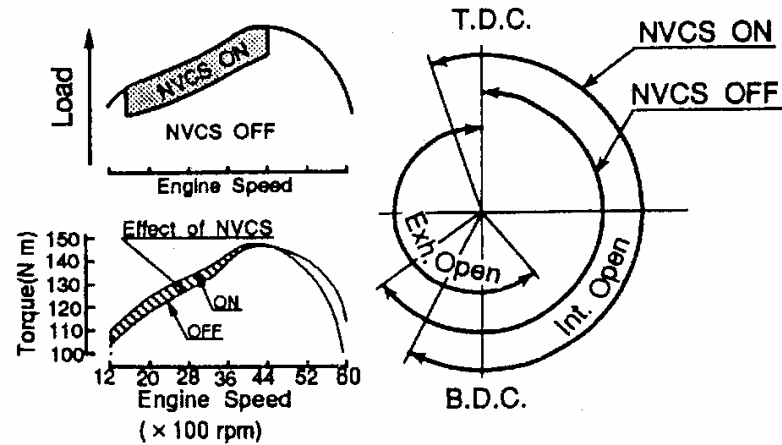
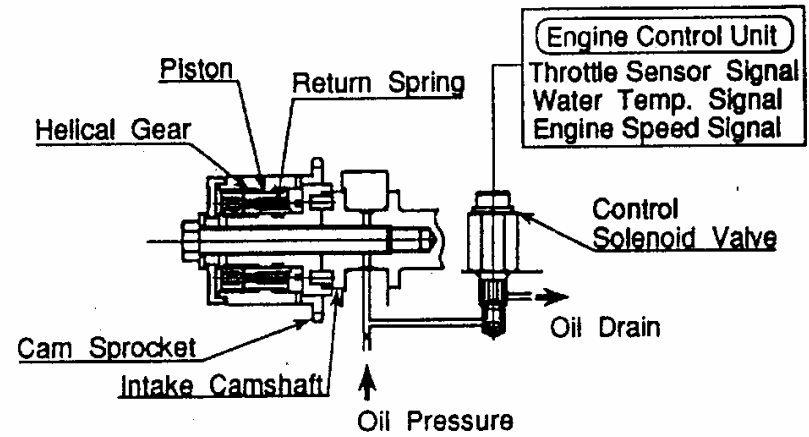
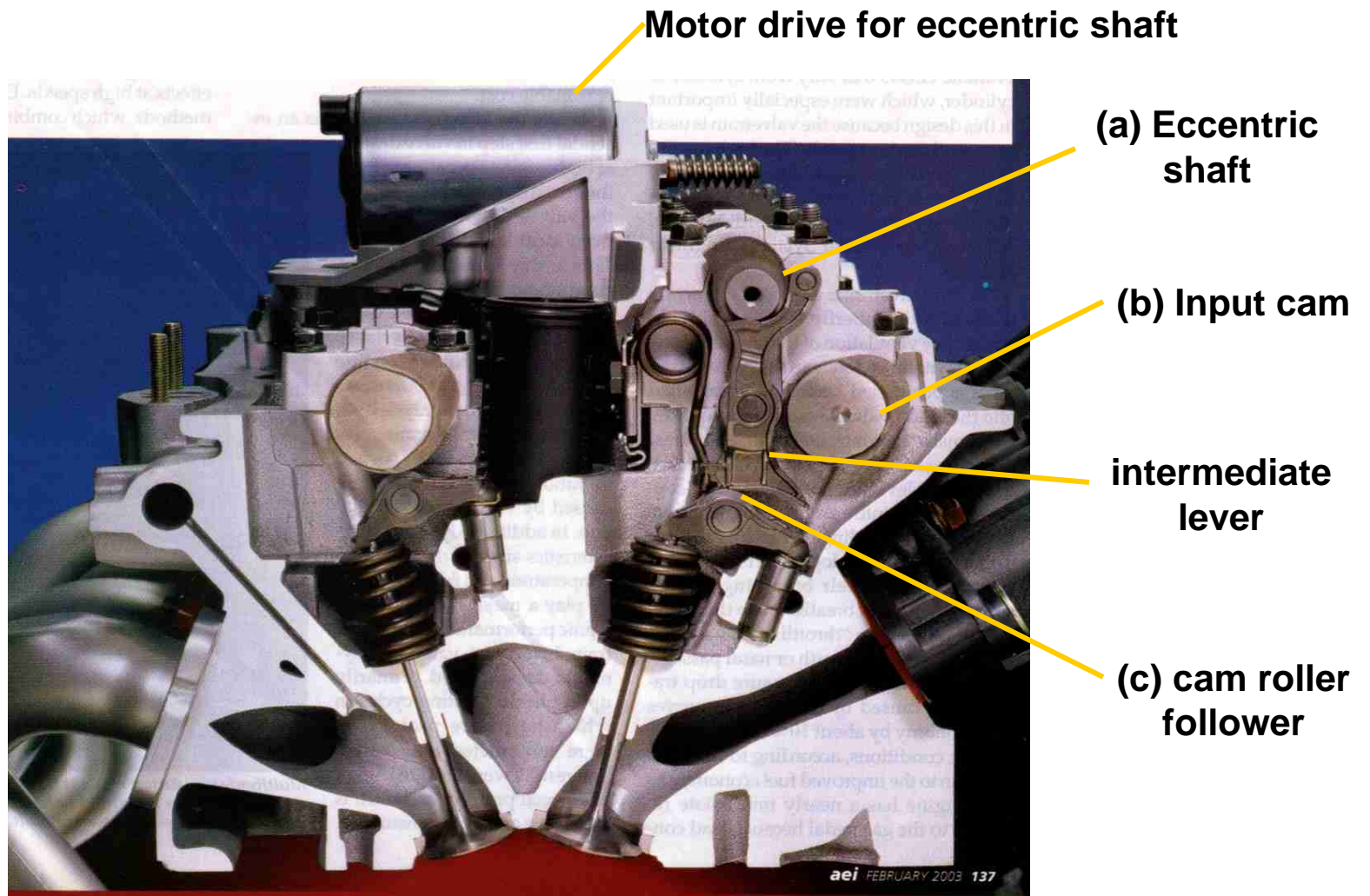
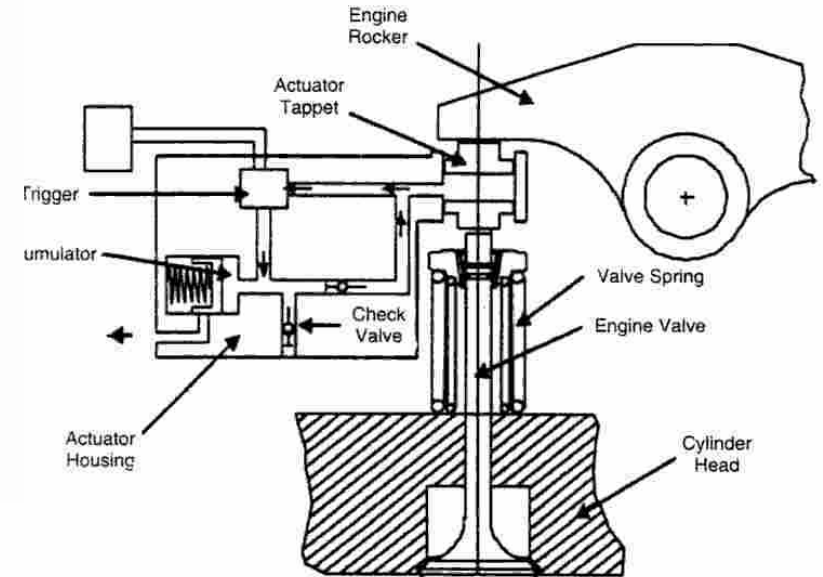
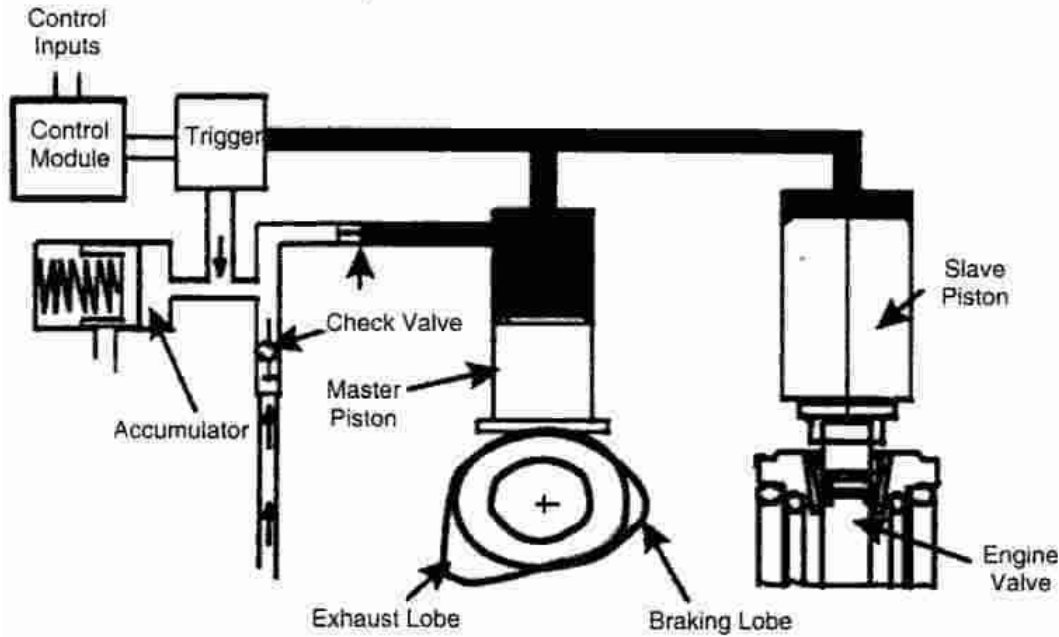


Figure 11 Configuration of NVCS  
NVCS (Nissan Valve timing Control System)

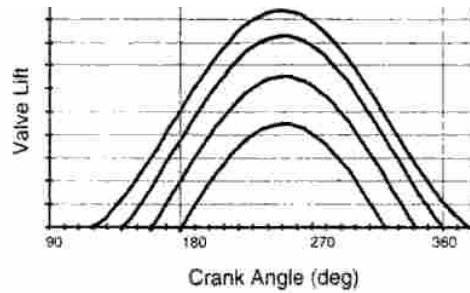
# BMW Valvetronic



# The Jacobs VVT – loss motion system



Centered valve lift



Early valve closing

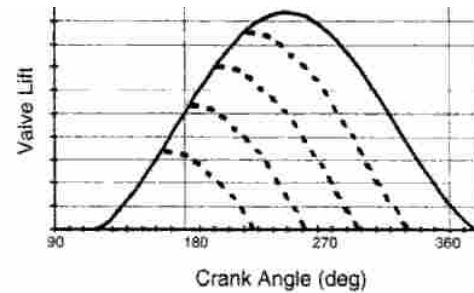
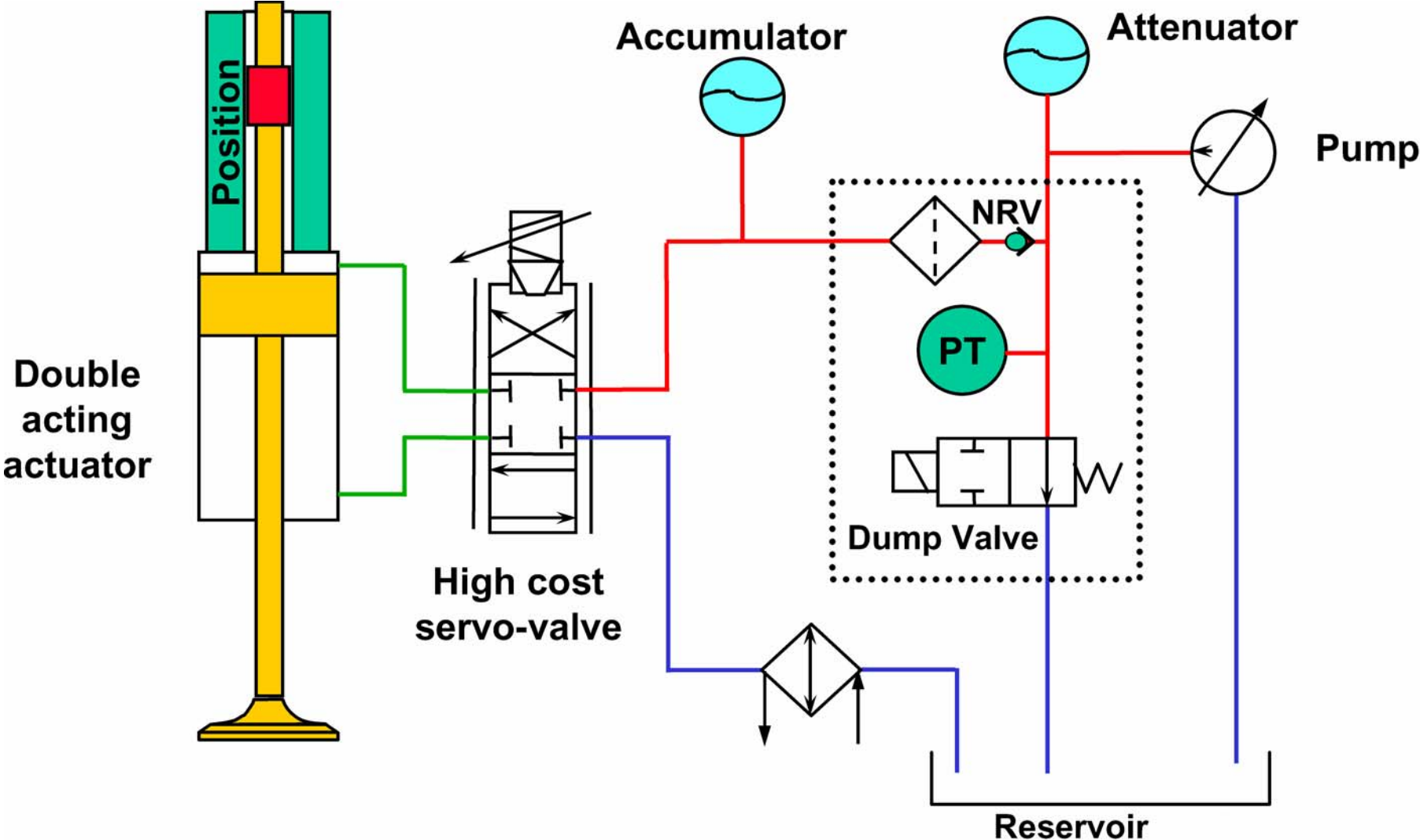
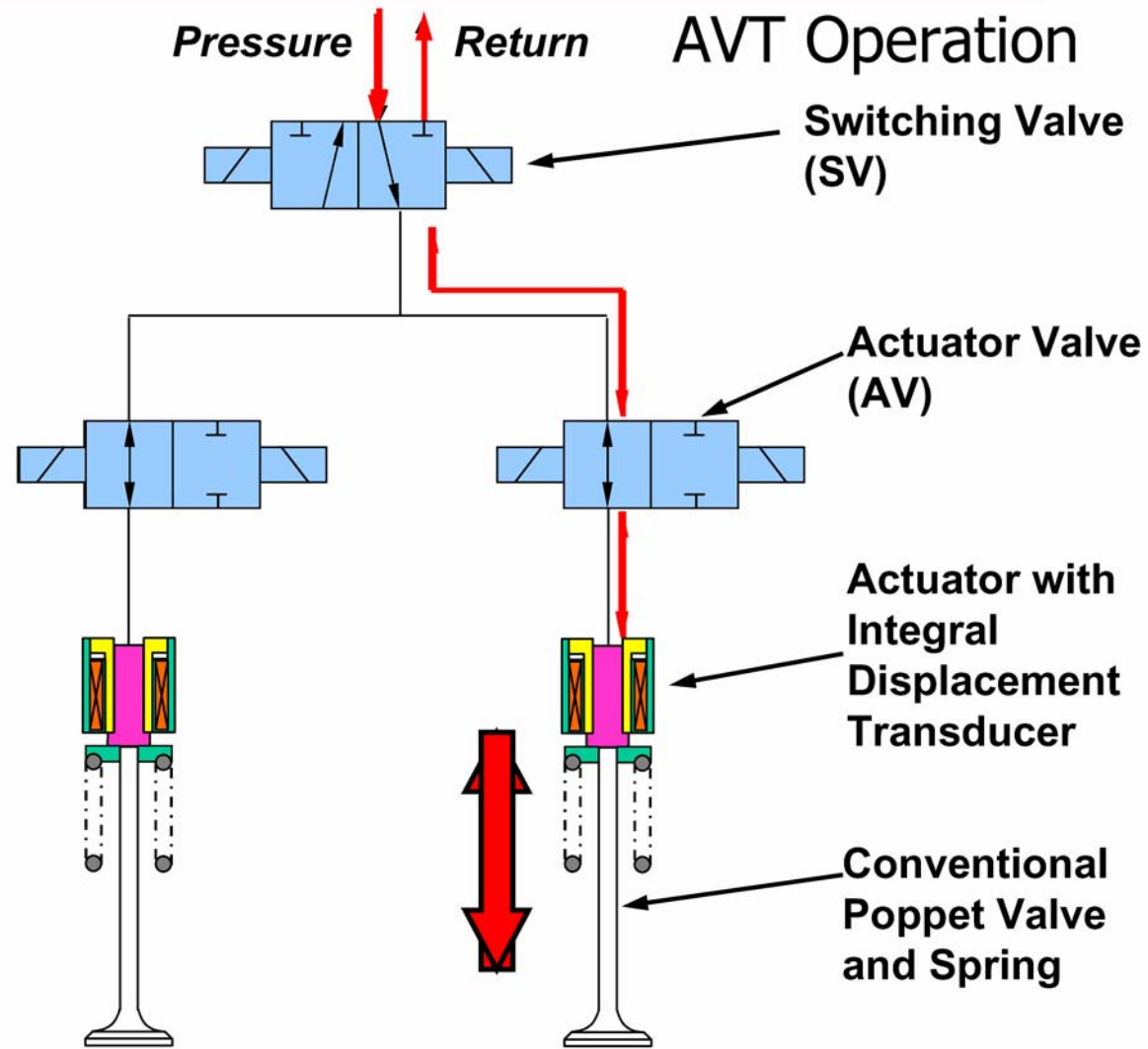


Figure 2. Lost-motion valve lift profiles. Centered valve lift is generated by absorbing the first portion of valve motion. Early valve closing is generated by releasing hydraulic link in valve train.

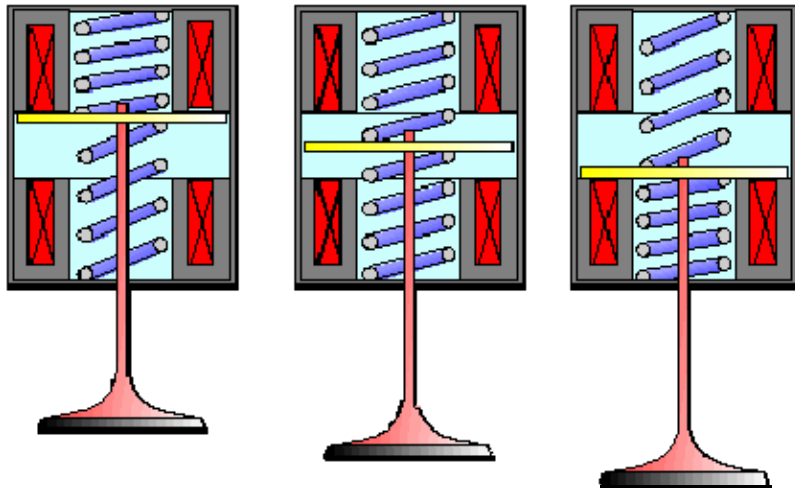
# Lotus research AVT



# Lotus/Eaton electro-hydraulic system



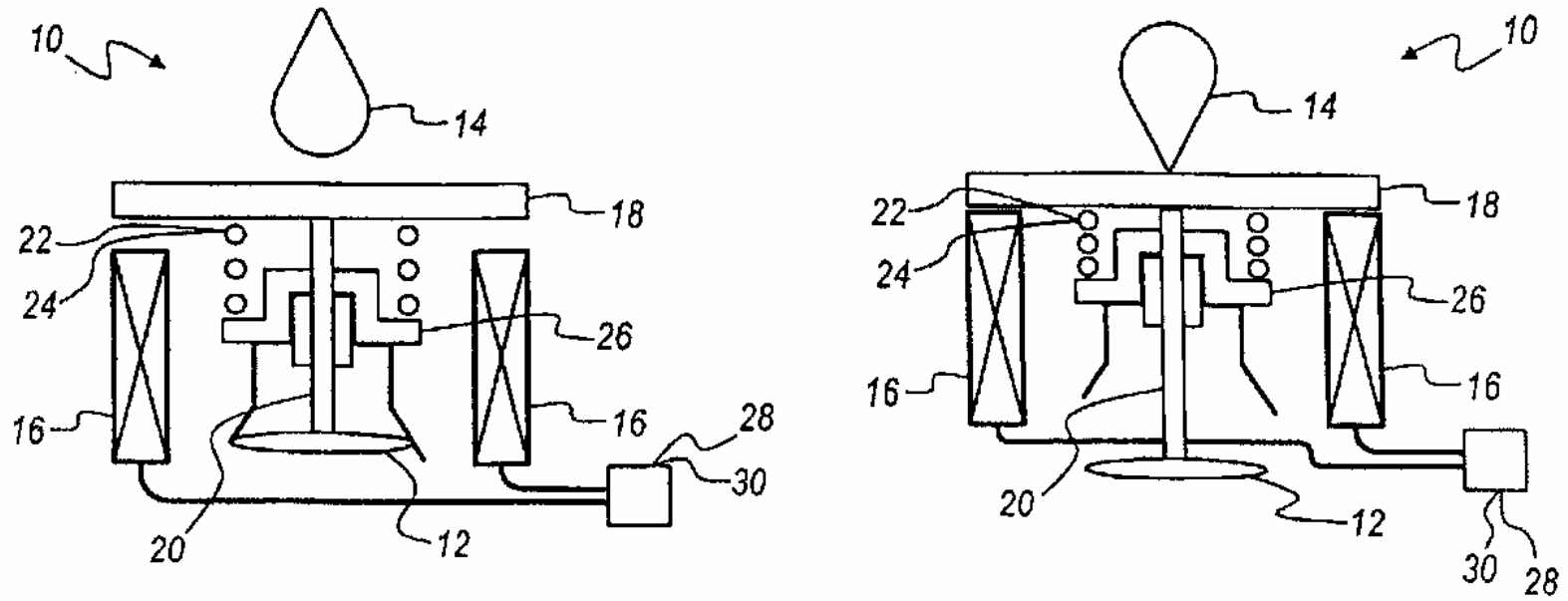
# Electromagnetic Valves



- Advantage
  - flexibility
- Challenges
  - Significant force required
    - $F \propto (\text{RPM})^2$
  - Seating velocity
  - Noise
  - Packaging
  - Cost



# Visteon VVT System



US Patent 6,681,731 B2