



# The Sturman Digital Engine

San Diego, CA  
February 20, 2008

Sturman Industries

**What would the internal Combustion  
Engine look like...**

*...if it were*

***invented TODAY ?***

**It would be**

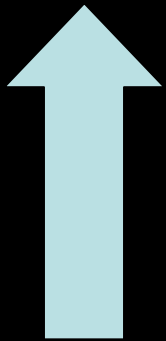
**FLEXIBLE !!!**

- **multi-fuel**
- **multi-cycle**
- **multi-hybrid**

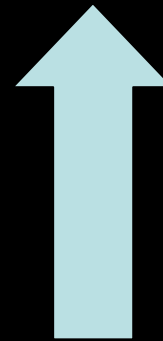
***in order to...***

**...reach The Destination**

**Power**

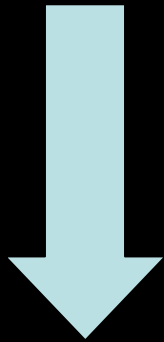


**Efficiency**

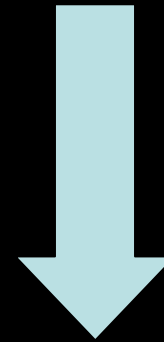


**After-  
Treatment**

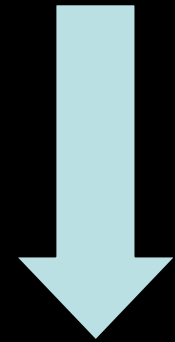
**NO<sub>x</sub>, PM, CO<sub>2</sub>**

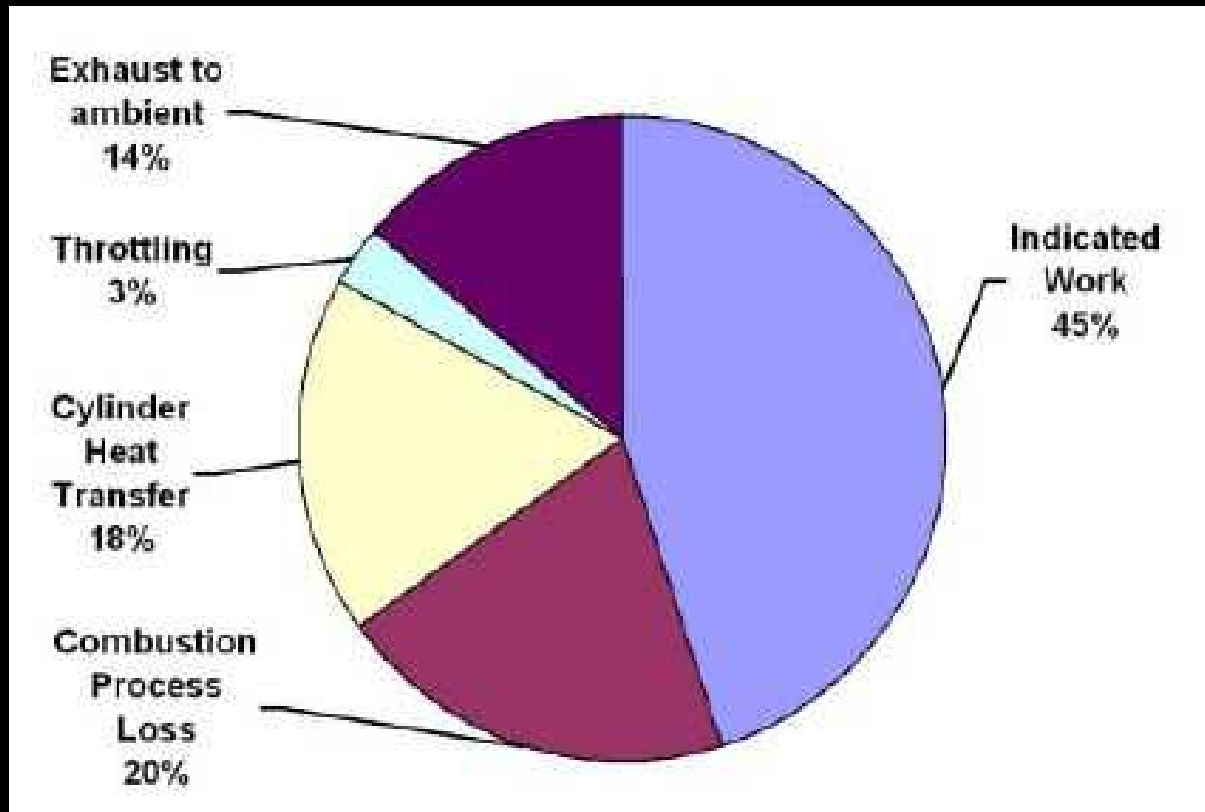


**Cost**



**Engine  
Size**





**The “modern” engine,  
featuring 100-year-old camshaft “technology”,  
loses 20% of it’s potential work  
during the combustion process !!**

## Reaching the Destination

### *Controlling the Combustion*

- fuel control
- air control
- temperature control

### *Efficient Hybridization*

- hydraulic
- pneumatic
- electric

# Controlling Combustion

## 1. Fuel Control

Fuel control has already become “camless” in the industry...

...yet multi-fuel capability and more precise metering is required.

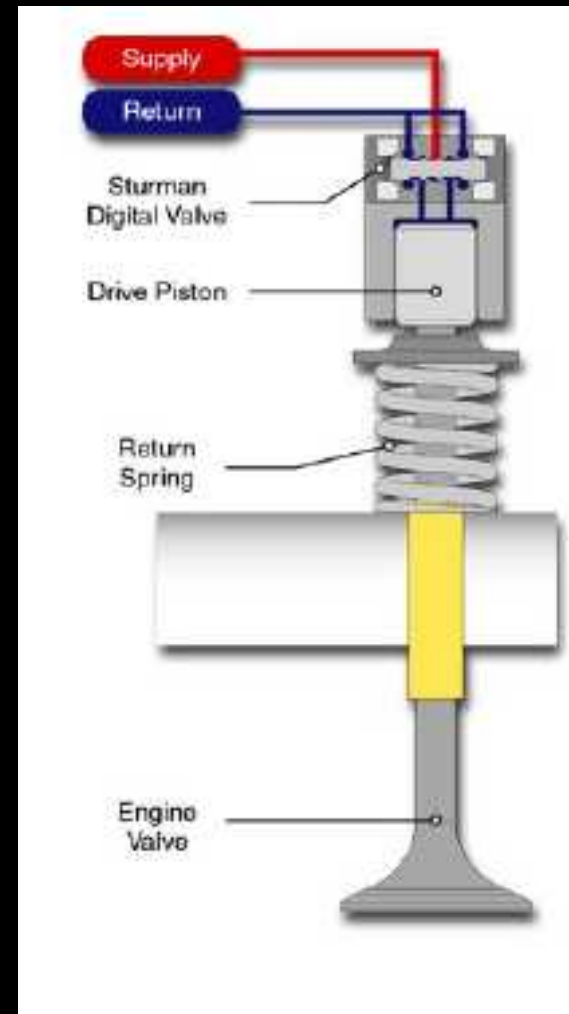


# Controlling Combustion

## 2. Air Control

**Unfortunately, air control is not yet “camless” in industry.**

***To control combustion, both air and fuel must be controlled.***

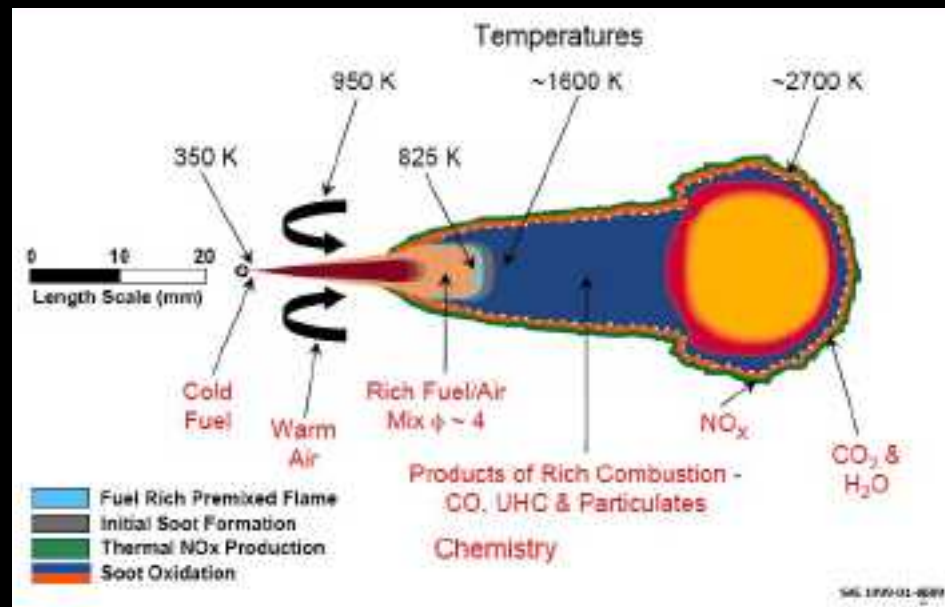




# Controlling Combustion

## 3. Temperature Control

Control of the air and fuel allows for the control of combustion temperature...



... to eliminate NO<sub>x</sub> and PM formation

## **Efficient Hybridization**

**A combination of 1-3 techniques to store and release energy in mobile applications:**

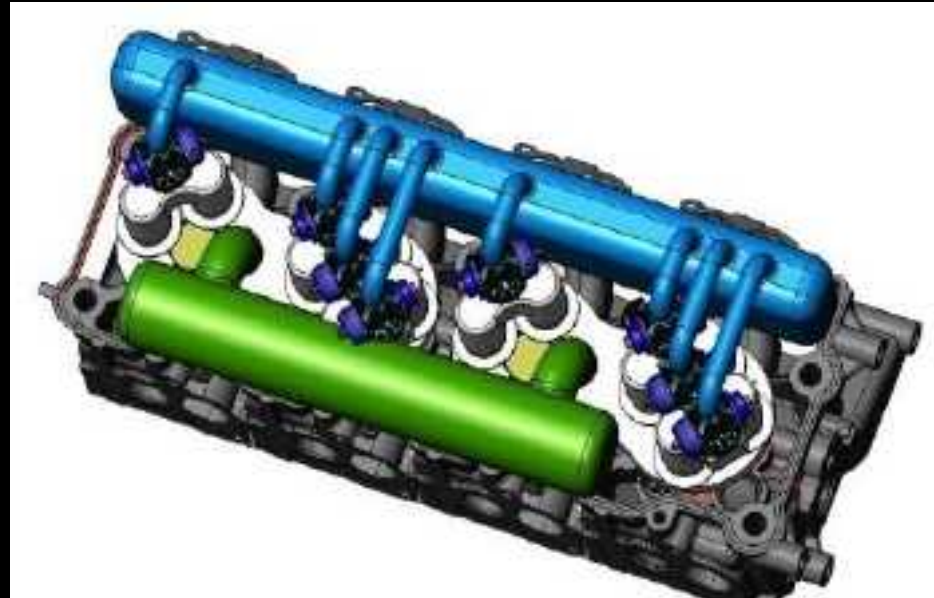
- **Hydraulic**
- **Pneumatic**
- **Electric**

*How is*  
***Sturman Industries***

*Reaching*

***The Destination ?***

# ***The Sturman Digital Engine***

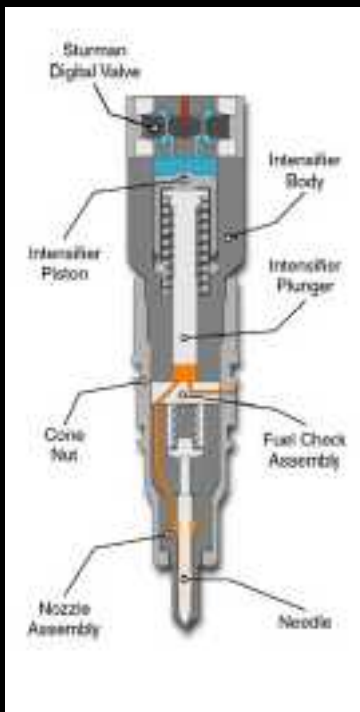
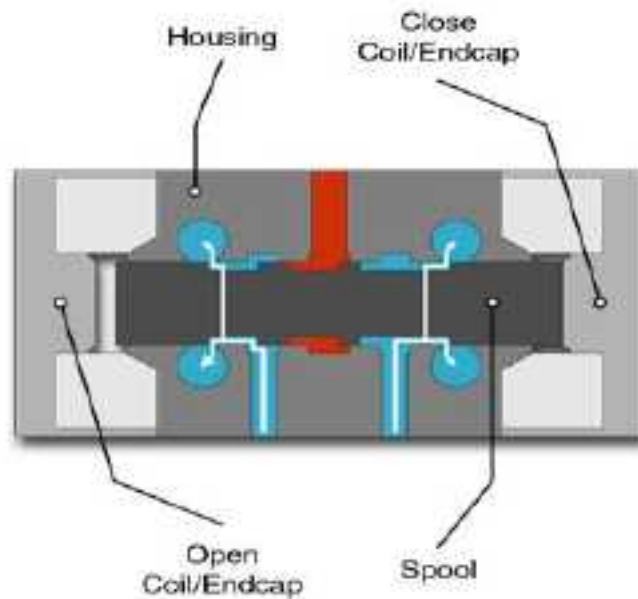


***Camless Air Control***  
***Camless Fuel Control***  
***Unique Engine Cycle***  
***Triple Hybrid (air, hydraulic, electric)***  
***Retrofittable***

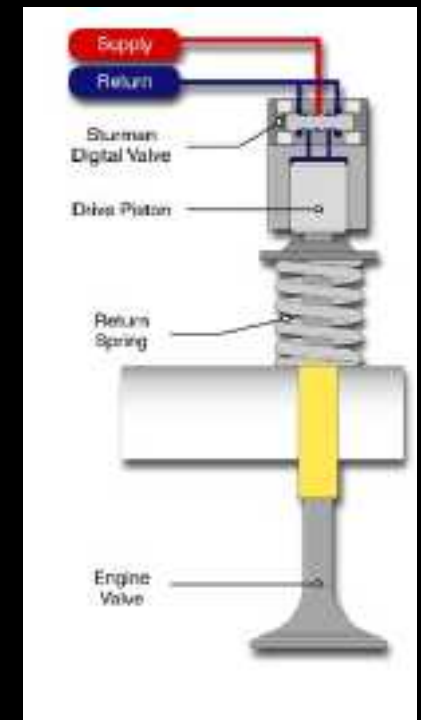
# The Digital Engine Running on Dynamometer



# Core Technology: the Sturman Digital Valve



**The Digital Valve controls**  
**injectors**  
**air valves**  
**hybrid systems**



# **The Digital Engine is *FLEXIBLE...***



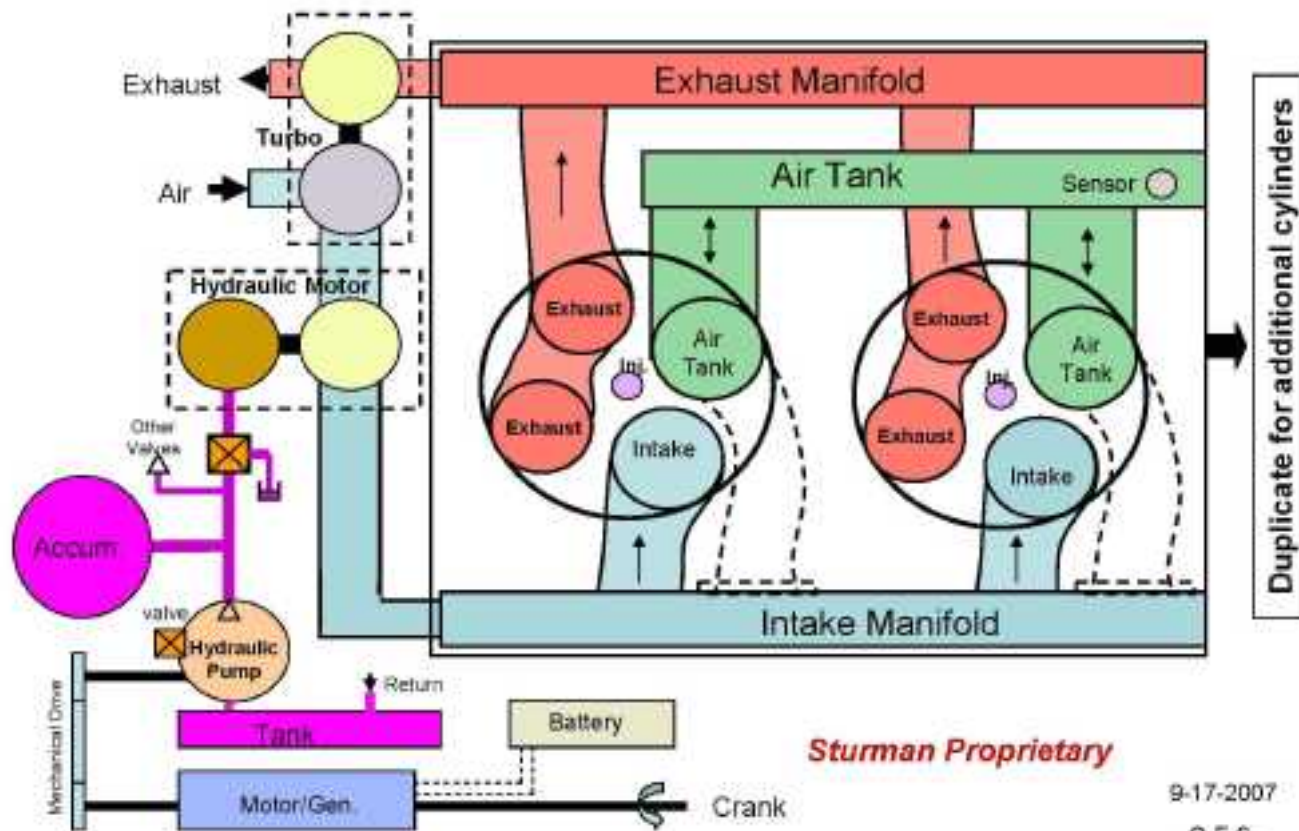
***You can play ...***

- many songs***
- at many speeds***
- and change songs at anytime !***

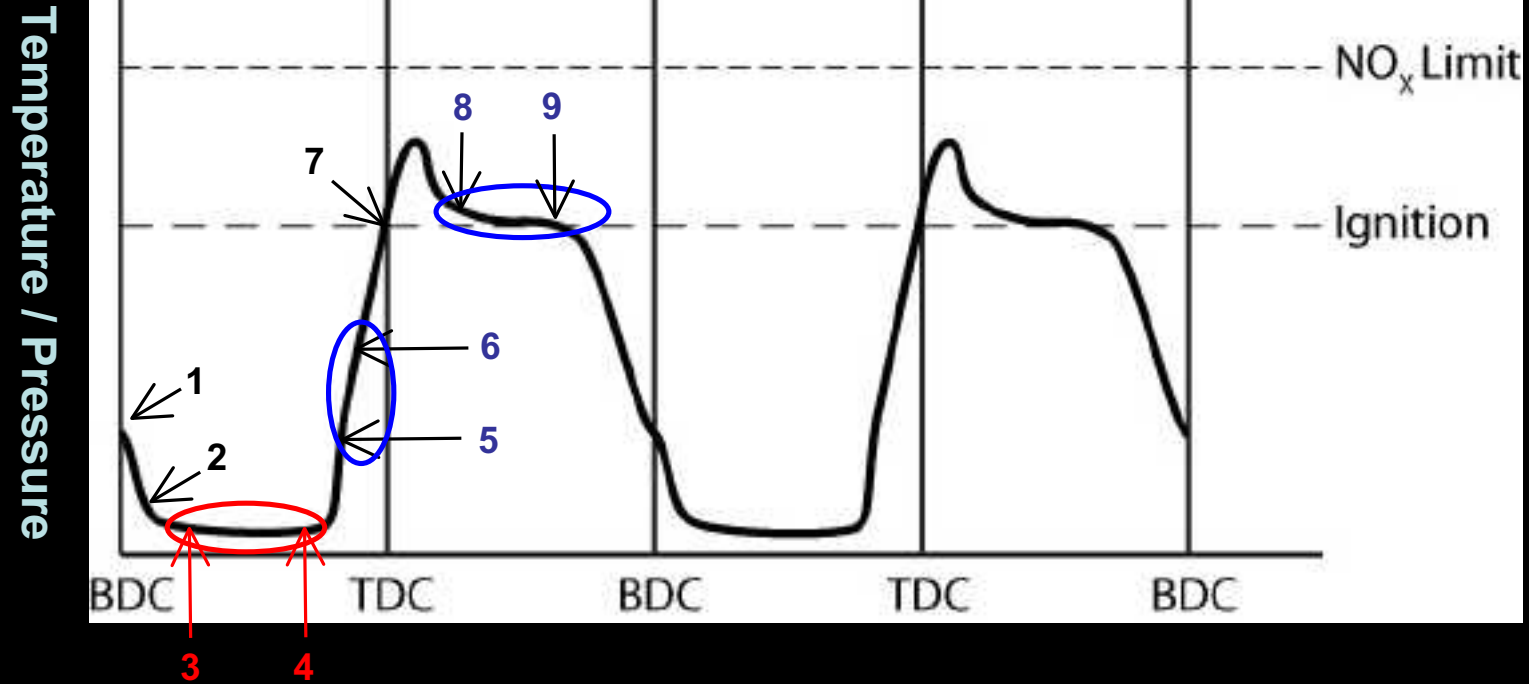


# Air/Hydraulic Hybrid

## Sturman TRI-BRID Retrofit





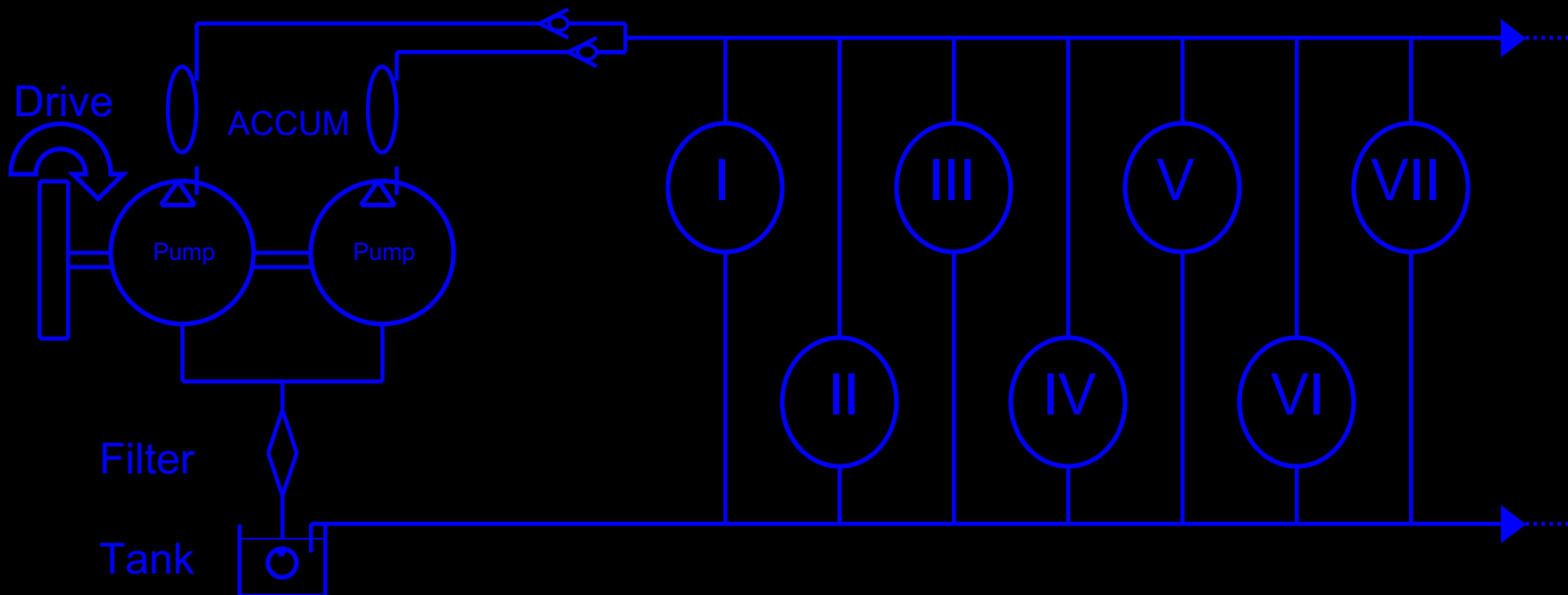


## *The Sturman Cycle*

- |                               |                         |
|-------------------------------|-------------------------|
| 1. Exhaust Valve Open (E.V.O) | 6. Air Injection Closes |
| 2. E.V.C.                     | 7. Ignition             |
| 3. Fuel Injection Starts      | 8. Air Injection Opens  |
| 4. Fuel Injection ends        | 9. Air Injection Closes |
| 5. Air Injection Opens        |                         |

# Efficient Hybridization

- I. DIGITAL ENGINE
- II. DIGITAL TRANSMISSION
- III. DIGITAL STEERING
- IV. DIGITAL SUSPENSION
- V. DIGITAL RIDE CONTROL
- VI. DIGITAL TURBO



# Applications:



**Thank you!**