

P-1

5 Oct. Propulsion & Power Div.

Reaction Control System C. Vaughan & B. Proli'ka

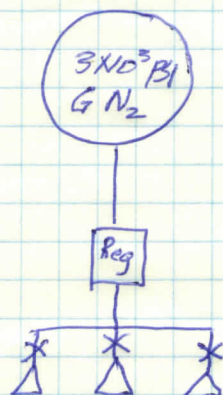
Function

1. Stabilization
2. Counteract Torques
3. Translation & Ullage
4. Rendezvous & Docking

Types

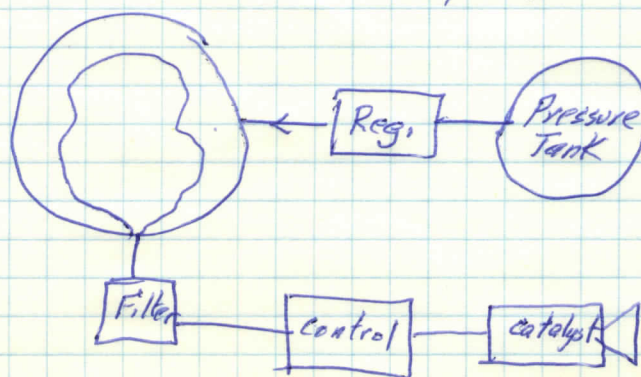
1. Passive (gravity grad.)
2. Momentum transfer (unused)
3. Mass Expulsion
 - a. pressurized gas
 - b. monopropellant
 - c. bipropellant

Cold Gas System 3a.



60-70 #/sec/#gas

Hot Gas Monopropellant



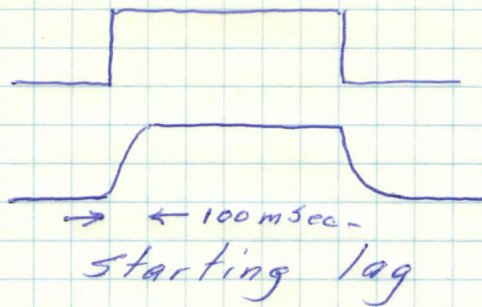
100-220 #/sec/#gas

P-2

5 Oct. Propulsion + Power Div

Reaction Control System

Hot Gas Monopropellant - Mercury program



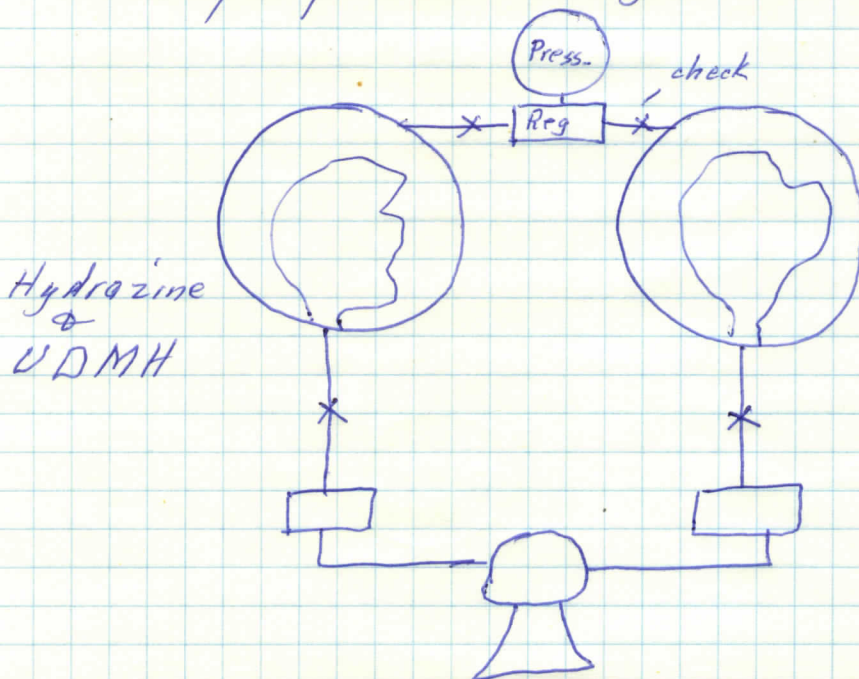
Gold gas sys-

Mono " "

Hydrogen Peroxide
silver Catalyst

Hydrazine
shell 405 catalyst

Bipropellant System



Gemini
React. sys-

280-300 #sec/#

Gemini RCS (on-off

Orbit Altitude
+ Maneuvering (OAMS)

Reentry

Apollo
Command Module

Service "

Lunar Module

Fuel Oxid Thrust

MMH N_2O_4 25,85 Ablative
100

" " 25 "

" " 95 "

" " 100 Radiation

same as service

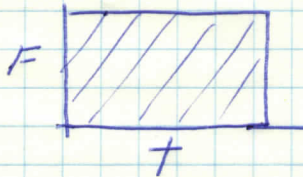
P-3 5 Oct, Propulsion + Power Dir.

Thrust

$\downarrow$ constant $\downarrow$ Press $\downarrow$ Throat Area
 $Force = C_f P_c A_t + \frac{1}{2} \dot{m} V^2$

Specific Impulse $I_{sp} = \frac{I_{mp\ total}}{Wt}$

Total Impulse

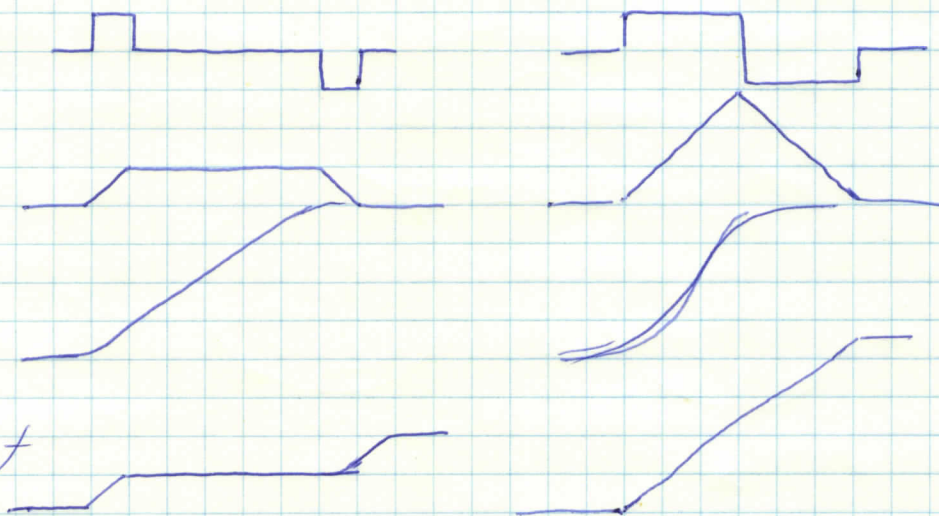


Economical vs Fast Maneuver
Minimum Time

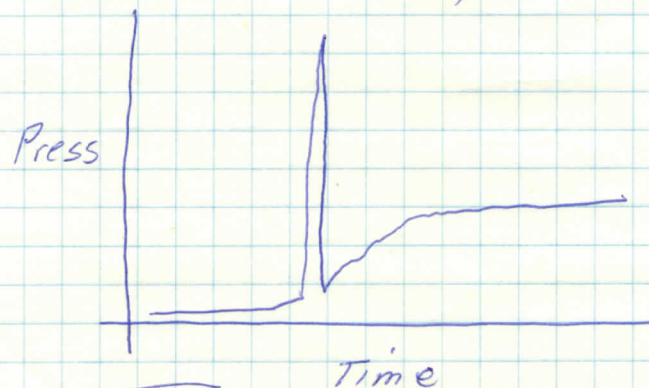
Thrust

$\dot{w}$

propellant



Ignition Press. Spike - caused by dribble vol.
vacoma etc.



Solved by small
chamber preignition

$V_e \frac{dm}{dt}$

$$F = V_e \frac{dm}{dt} = \dot{m} V_e$$

P-4 500t. Propulsion + Power

RCS Service module has 4x4 independent motors

LEM module has 2 systems of 4 ea - Ascent propellants may be used.

Command Module -

2 systems for redundancy - inter connected.