Continuous Space Safety Architecture that Fix exploration Exceptions through Technology (SAFETY)

Abstract

This invention describes several architectural improvements achieved through technology that either fix or mitigate exploration exceptions. This addresses several root causes that have not been addressed since the Space Shuttle Challenger and Space Shuttle Columbia accidents.

To ensure Continuous Space Safety, significant design enhancements (and hence resultant architectural changes) must be contemplated. This invention proposes several significant design enhancements that amount to architectural changes for (a) cryogenic liquid stages (b) solid rocket boosters (c) service modules used with crew exploration vehicles.

During the Challenger accident given the current SRB design and inadequate External Tank (ET) design, there was no way of mitigating the hot gasses escaping from the leak (plume impingement) in the booster and the cryogenic liquid (stage) external tank was not adequately protected from structural collapse and subsequent giant flame of escaped hydrogen. This resulted in the loss of crew and mission (LOCM).

During the Columbia accident, the foam covering from the cryogenic liquid (stage) external tank impacted the orbiter wings that destroyed the orbiter and lead to loss of crew (LOC) during return.

US Patent References

US Patent 6158693 - Recoverable booster stage and recovery method

US Patent 4878637 - Modular space station

US Patent 6726154 - Reusable space access launch vehicle system

US Patent 6113032 - Delivering liquid propellant in a reusable booster stage

US Patent 4557444 - Aerospace vehicle

US Patent 4880187 - Multipurpose modular spacecraft

US Patent 4452412 - Space shuttle with rail system and aft thrust structure securing solid rocket boosters to external tank

US Patent 4802639 - Horizontal-takeoff transatmospheric launch system

US Patent 4884770 - Earth-to-orbit vehicle providing a reusable orbital stage

US Patent 4265416 - Orbiter/launch system

Claims:

What is claimed is:

1. A Dual Hull cryogenic liquid rocket design/architecture is clamed. The inner hull is designed to be light just enough to carry the cryogenic liquid loads. It is supported by the outer hull that is designed to be strong yet light. Inert gas (with low specific conductivity) such as Argon is filled in the inter hull region. A thin layer of insulation (foam) covers just the internal tank just enough to prevent the inert gas from liquefying. A pressure gradient is maintained between the outer hull and the inner hull that will ensure a slight positive flow of inert gas from the outer hull towards the inner hull so that the outer hull remains at ambient temperature.
2. The safety of solid rocket booster is enhanced through redesign with pressurized tank(s) of inert gas (Argon) added to the solid rocket booster. Upon safety (emergency) activation, the inert gas will cascade through the booster reducing the impact of exhaust hot flames. In another embodiment of this invention, the tank may contain liquefied (cryogenic) inert gas. In other embodiments the design is enhanced to inject other extinguishers so as to tamp down or terminate the combustion process.
3. LOX/Methane throttle able engines are designed for use in service modules. In one embodiment, a single engine is used. In another embodiment multiple engines are used that provide engine out capability enhancing the safety of service module hence crews.
4. As per this claim, liquid engines based launch abort system augmented by solid booster invention integrated below the crew exploration vehicle is used. Current launch abort systems are not useful during exploration activities. The launch abort system that is situated just above the service module is meant to be used not only for ensuring crew safety through quick launch aborts, but also used during capsule returns to planets/moons to provide breaking maneuvers and enhance crew safety.

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

BACKGROUND

Field of the Invention

This invention relates to the field of space exploration.

Description of the Prior Art

The Apollo program was designed to land humans on the Moon and bring them safely back to Earth. Six of the missions (Apollo's 11, 12, 14, 15, 16, and 17) achieved this goal. In the Apollo program, the astronauts came back in the Apollo capsule. Rest of the Saturn vehicle used to launch the astronauts was expendable.

The Space Shuttle **Space Transportation System** (**STS**) is the first orbital spacecraft designed for partial reusability. It carries payloads to low Earth orbit (LEO), provides crew rotation for the International Space Station (ISS), and performs servicing missions. Each Space Shuttle is a partially reusable launch system that is composed of three main assemblies: the reusable Orbiter Vehicle (OV), the expendable external tank (ET), and the two partially reusable solid rocket boosters (SRBs).

The Shuttle external tank is covered with foam insulation on the outside that prevents formation of ice on the tank that has proven to be more of a headache than a useful feature. The solid rocket boosters do not have the safety systems being proposed in this invention.

The Saturn launch vehicle had a launch abort system that was separate from the Apollo capsule (crew module) based on solid motors place above the crew capsule and service module.

NOTE TO L&R

This document is enclosed as a reference to the parallel in process provisional patent application.