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CONCEPTUAL DESIGN OF A NUCLEAR RAM JET - ROCKET MISSILE

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TITLE: CONCEPTUAL DESIGN OF A NUCLEAR RAM JET - ROCKET MISSILE

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The conceptual design of a nuclear ram jet - rocket missile is presented. This missile is a modified, scaled-up AC-210 nuclear ram jet carrying ammonia in the space enclosed by the spike and inlet diffuser. The payload may be a 10,000 pound thermonuclear weapon or equivalent weight of reconnaissance equipment plus local shielding as in the AC-210 missile. The payload for a missile of body size equivalent to the AC-210 will be reduced by the weight of ammonia carried.

Atmospheric re-entry and guidance into a target or possible recovery is accomplished under power.

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AC-210-R

Conceptual Design: Nuclear Ram Jet - Rocket Missile

Concept

The conceptual design of a nuclear ram jet - rocket missile is presented. This missile, designated AC-210-R, is a modified, scaled-up AC-210 nuclear ram jet carrying ammonia in the space enclosed by the spike and inlet diffuser. This space also houses the guidance, control equipment, and payload. The payload may be a 10,000 pound thermonuclear weapon or equivalent weight of reconnaissance equipment plus local shielding as in the AC-210 missile. The payload for a missile of body size equivalent to the AC-210 will be reduced by the weight of ammonia carried.

This missile may possibly be designed to reach escape velocity or to yield velocity only sufficient to maintain a satellite orbit. Re-entry into the atmosphere and guidance into the target or for possible recovery is accomplished under power.

Design

The AC-210-R has the same general configuration as its precursor, the AC-210 nuclear ram jet missile. A comprehensive description on the technical design of the AC-210 missile is presented in document XDC 56-5-81. Figure 1 is a sketch of the AC-210 missile; Figure 2 depicts the AC-210 design modified into the nuclear ram jet - rocket AC-210-R. Dimensions are not included since modification and scaling up of the AC-210 is required. This is because parasitic structural weight fraction decreases with increasing size and, although the monopropellant rocket fuel mass increases, the energy is nuclear and is not tied up in mass (other than the reactor) as it is in a bipropellant chemical rocket.

Military Advantages

A nuclear ram jet-rocket would have all of the strategic advantages of a

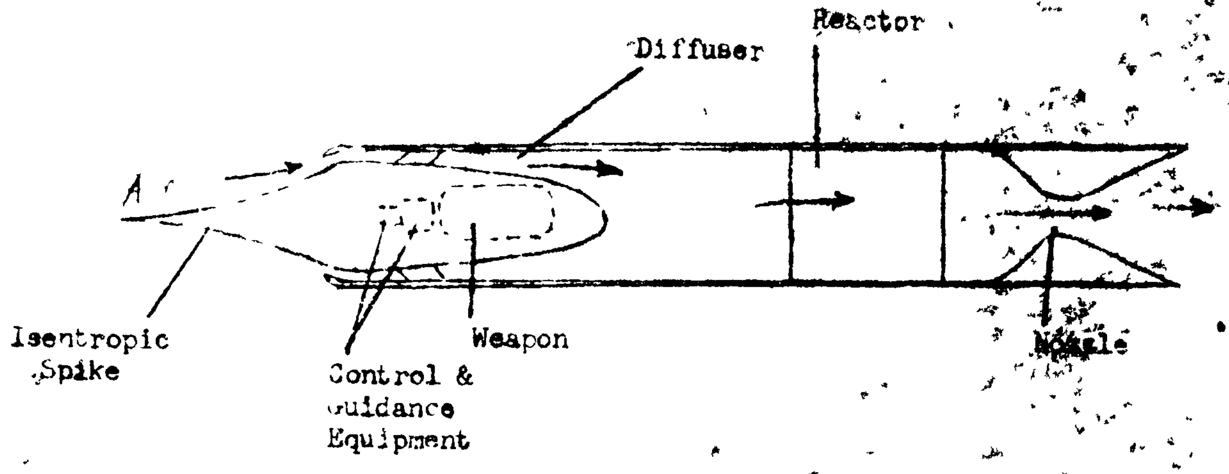

Figure 1 - AC-210 Nuclear Ram Jet Missile

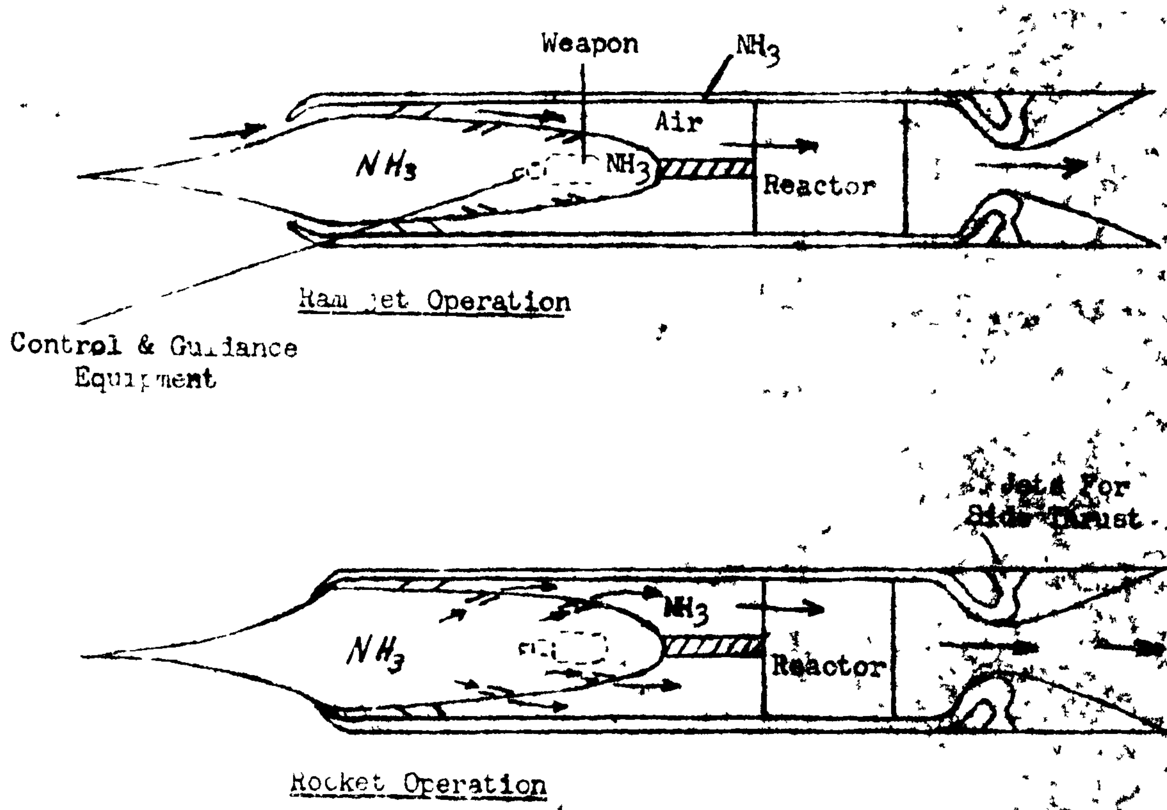

Figure 2 - Nuclear Ram Jet - Rocket Missile

chemical ICBM and would have the following additional advantages:

1. It could be launched into a satellite orbit or could possibly attain escape velocity
2. Its time-of-flight would be extended; the missile could be brought into the target or recovered at any reasonable time after launching; the mission can be altered after launching.
3. Because power is available throughout its mission remote guidance and missile accuracy problems are considerably relieved; with power available near the end of the mission the missile can be accurately guided into the target or onto an air strip for recovery.
4. Atmospheric re-entry is made at low flight speeds; rocket thrust is used to slow down the missile, and the problem of excessive skin temperatures is diminished.
5. After atmospheric re-entry, nuclear ram jet power enables the attainment of controlled high speed atmospheric flight.
6. Missile recovery may be possible since landing is achieved with rocket thrust; ram jet thrust is low at low flight speeds and high thrust at low flight speeds can be obtained by reverting to rocket operation (for application as a recoverable reconnaissance missile the warhead payload is reduced and sufficient ammonia is reserved in storage for this operation).

<u>Operation</u>

As with the AC-210 ram jet missile the ram jet - rocket would be launched with a booster, probably a solid propellant type.

The missile is then air-breathing and climbs to an altitude of about 100,000 feet as a nuclear ram jet. Then the inlet duct is closed by moving the isentropic spike forward. Ammonia from the forward tanks is released into the reactor and rocket thrust is developed to carry the missile above the atmosphere. The reactor temperature is maintained at a maximum design value and the ammonia is admitted at a flow rate to yield maximum specific impulse from the portion of ammonia to be used for ascent. Air drag becomes almost negligible during rocket ascent above an altitude of 100,000 feet.

Upon reaching orbital altitude side-wise jets would turn the missile onto a flight path tangent with an orbital ellipse. The reactor is then made sub-critical and ammonia flow is stopped. The missile is kept in its orbit, "in storage"; from time to time orbital flight path corrections would be made by turning on the power by remote control.

If escape velocity is attained guidance is achieved by operating side-wise jets with low flow conditions.

When it is desired to return the missile for recovery or to strike a target, the side-wise jets are used to turn the missile such that the jet nozzle is forward. Ammonia is then released through the reactor which is turned on full power and rocket thrust is thereby exerted to slow down the missile. As the missile re-enters the atmosphere at about 100,000 feet altitude and about Mach 1 the ammonia flow is stopped, the sidewise jets turn the missile so the jet nozzle is toward the rear and the isentropic spike is moved forward to open the inlet. The missile is again an air-breathing nuclear ram jet; the reactor power is increased and flight is attained as in the AC-210.

For landing and recovery, the isentropic spike is moved to close up the inlet and the final portion of ammonia is passed into the reactor under high flow conditions to produce a large value of specific impulse. Telescoping wings may be added to the design to increase the lift and to shift the center of flight; high thrust at low flight speed is achieved and landing is enhanced.

An abbreviated preliminary parametric study is required to determine payload, ammonia load and AC-210 scaling and modification requirements to establish practical feasibility and potential.

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