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An Investigation of Tandem-Row, High-Head Pump Inducers

The design and performance of tandem-row pump inducers were theoretically and experimentally investigated. A typical inducer consists of an axial-flow impeller with a small number of blades, each of which approximates a simple helix. Inducers are generally located immediately upstream of the main fuel pump and operate at the same rpm and on the same shaft as the main pump rotor. When the period of operation is relatively short (several minutes), the problems of low efficiency and cavitation damage to the impeller blades are not restrictive. However, for long-term operation, impeller and casing damage due to cavitation become important problems. Flow instabilities also present a significant limiting condition for acceptable inducer performance. Model tests and actual performance data have shown that, under certain operating conditions, the increase in discharge and pressure-head across an inducer may fluctuate violently, resulting in corresponding thrust fluctuations and concomitant unsteady motions and accelerations of the vehicle. In addition, low-frequency oscillations may occur at the structural natural frequency.

The results of the investigation indicate that the optimum design is a tandem inducer system using a supercavitating first stage and a subcavitating second stage operating over a wide range of suction specific speeds and flow coefficients. The theory for supercavitating cascades of cambered foils appears to agree well with the test data, provided that the flow is nearly two-dimensional and that supercavitating conditions exist. The complex three-dimensional flow field present in an actual inducer will require empirical modifications to the design.

Although this investigation was especially directed to the design and operation of pump inducers for liquid-fueled rocket engines, the theory and experimental results pertaining to fluid-flow cavitation effects should be applicable to the design of other fluid power systems.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:
NASA-CR-110790 (N70-42166), An Investigation of Tandem Row High Head Pump Inducers

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

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