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Gas-Bearing Blower
Manufactured by Socit Rateau
for the
Ultra High Temperature Reactor Experiment

by
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A helium blower operating on hydrodynamic gas bearings has been manufactured by Socit Rateau for the Los Alamos Scientific Laboratory

This type of blower was selected for use in the Ultra High Temperature Reactor Experiment (UHTREX) because of highly radioactive system contamination resulting from the investigation of unclad fuel elements.

This blower is designed for the gas cleanup loop through which about one percent of the primary loop coolant will be diverted for the removal of fission products and other impurities. With helium at 495 psi and 100F, the blower is designed to produce a pressure rise of 15 psi at a flow of 120 lb/hr. Figure 1 is a cross sectional drawing of the blower showing some of the major components. The electric motor armature, two centrifugal impellers, and the thrust runner are mounted on a common hollow shaft that also serves as the bearing journals. The three-phase, 2-pole, squirrel-cage induction motor drives the two staged 5⁷/₈-inch diameter centrifugal impellers at 19,200 rpm. Each of the hydrodynamic journal bearings consist of three 115 arc, tilting pads preloaded by means of a spring on one pad. The thrust bearing, which handles the major portion of the load, consists of three 60 arc tilting pads. Bearing surfaces are coated with "Glacier DU", a teflon sintered bronze. All pads are pivoted on tungsten carbide points. Helium in the motor compartment is circulated by means of holes bored in the hollow shaft above the upper bearing. The pressure containment vessel was designed in

*Work done under the auspices of the U. S. Atomic Energy Commission.

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accordance with the ASME pressure vessel code and its applicable nuclear cases. Material acceptance tests were in accordance to the rules of LLOYDS REGISTER OF SHIPPING. Possible contact between journals, runners, and pads is monitored by thermocouples in the pads. Design conditions were met at 19,200 rpm with the motor operating at 5 hp as shown in the performance curve of Fig. 2. The over-all performance curve, which is a plot of nondimensional flow coefficient versus head coefficient is shown in Fig. 3. Figure 4 shows the approximate efficiency of the blower with respect to the flow coefficient. Note that the over-all efficiency is about 6.5% at the design conditions.

Fig. 1 - Cross Sectional View of Centrifugal Blower

GAS, HELIUM

INLET TEMPERATURE, 80°F

INLET PRESSURE, 503 psia

DESIGN POINT

FLOW = 120 lb/hr

ΔP = 15 psig

SPEED = 19,200 rpm

● DATA POINT

Fig. 2 - Pressure Rise vs Flow Curve for UUTREX Gas Cleanup System Centrifugal Blower

H = HEAD, ft

U_t = TIP SPEED, ft/sec

$g = 32.2 \text{ ft/sec}^2$

Q = INLET FLOW, ft^3/sec

D = TIP DIAMETER = 0.4895 ft

○ DATA POINTS AT 15,000 rpm

● DATA POINTS AT 17,000 rpm

▽ DATA POINTS AT 19,000 rpm

▼ DATA POINTS AT 20,000 rpm

Fig. 3 - Over-all Performance Curve for UHTREX Gas Cleanup System Centrifugal Blower

η = OVER-ALL EFFICIENCY

$$= \frac{\text{ADIABATIC GAS HP}}{\text{INPUT HP TO MOTOR}}$$

INCLUDES:

1. BRG AND ROTOR WINDAGE POWER
2. INTERSTAGE LOSSES
3. MOTOR EFFICIENCY

Fig. 4 - Over-all Efficiency Curve for UHTREX Gas Cleanup System Centrifugal Blower