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CENTRIFUGAL SODIUM PUMP FOR THE PURIFICATION OF INERT ATMOSPHERES

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Abstract

A liquid sodium pump and contacting tray of new design are described and recommended for the removal of oxidizing gases from inert atmosphere working chambers. Long pump life is assured by preventing the hot alkali from contacting the bearings, and by low speed operation.

Introduction

The authors have described in an earlier report[1] three liquid sodium pumps which have been used to maintain inert atmospheres of very low oxygen and water-vapor content in a dry-box working chamber. The helical pump works satisfactorily for short periods. However, because of its high speed and submerged bearings, it develops an objectionable vibration after a few days of continuous operation and, in addition, liquid sodium rises through the worn upper bearing and is thrown off the rotating shaft. The pump herein described was designed to overcome these difficulties.

Description and Testing

The newly developed scavenging unit is shown in Figure 1. It consists of a vertically mounted 1/50 HP Bodine motor which draws its power from a 110 v. Variac. The drive-shaft passes down through the silicone lubricated bearings to the impeller. Just below the lower bearing, a downward-directing helical pump element is affixed to the shaft to direct the liquid metal away from the bearing. The shaft extends below the impeller, passes through an opening in the intake screen, and drives the wiper-disintegrator blade. The molten sodium at 150°C moves toward the intake screen, where the wiper-disintegrator blade breaks up any clumps of oxide, and passes through the screen into the pump. The sodium is pumped up the riser tube to the top of the contacting tray, where it discharges onto the downward sloping tray through a number of orifices. After running down the tray where it contacts the circulating atmosphere, the sodium drops into the reservoir.

The pump has now been tested for a month of intermittent operation, including several periods of continuous operation of 24 hours. The pump was quiet and vibrationless both before and after the testing operation, indicating that the bearings have not been damaged. In addition the pump was left inoperative for two weeks to determine whether the heavy oxide crust formed on the surface would prevent proper operation upon start-up. The only effect was that the discharge holes were slightly clogged, but were easily cleared by probing with a wire. The pump operates most efficiently at speeds below the normal motor RPM, and it was found that satis-

factory control was achieved by using the Variac. An additional Variac was used to adjust the temperature of the sodium reservoir.

Discussion

Spattering of small droplets of sodium occurs during the operation of this unit. At high discharge rates, the impact of the sodium streams on the vertical reservoir wall causes the formation of the droplets; at low rates, the streams tend to break up into large drops, and in the process, small drops are formed. Many of these small drops are carried in the gas stream and are deposited in the working area. One could prevent this at the higher discharge rates by sloping the reservoir wall to produce a smooth downward deflection in the discharged streams.

One finds that a significant amount of dust is blown about the dry-box when any of these pumps are used. This has been no more than a nuisance in the authors' work, although it might be quite undesirable for others. A solution might be found in locating the scavenging unit in an auxiliary chamber connected to the dry-box. The inert atmosphere could then be circulated past the pump and back through suitable filters to the working area.

A Note on Dry-Box Technique

It cannot be too strongly stressed that considerable care is required of those using an extremely uncreactive atmosphere. One should introduce tools and apparatus only after a thorough

"baking-out" in a drying oven. The use of wood or cellulose materials should be strictly limited, and when not actually in use, these materials should be kept in covered containers. A port system for the transfer of tools and samples is imperative. The port should be capable of being evacuated and flushed with an inert gas. Although a port when properly used does not prevent contamination of the working atmosphere, it greatly decreases the scavenging clean-up time required. It was fround that the clean-up time was reduced from 45 minutes to about 5 minutes by the use of such a port system on the dry-box in this laboratory. Finally, a positive gas pressure must be maintained inside the dry-box at all times to prevent contamination from leaks.

Summary

A centrifugal sodium pump, for use in producing and maintaining inert atmospheres in closed working chambers has been designed and operated. It is superior to previous models in that it is free from bearing failure, noise, and vibration, and is suggested as a reliable means of maintaining non-reactive atmospheres.

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Bibliography

(1) R. K. Edwards, R. L. McKisson, and L. A. Bromley, "Liquid Sodium Pump for the Purification of Inert Atmospheres". Unclassified U. S. Atomic Energy Commission Report, UCRL-687, Sept. 1950.

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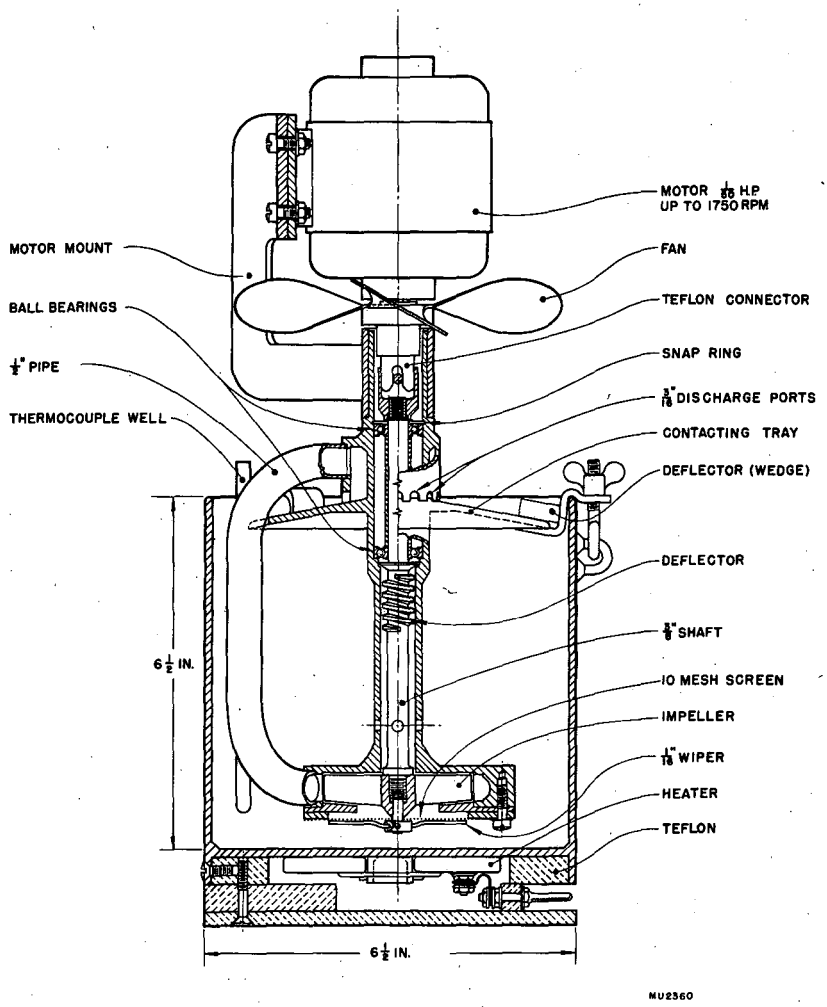

Fig. 1
Centrifuged Sodium Pump