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VACUUM-LOCK ACTUATOR AND
ION-SOURCE POSITIONER FOR
A SURFACE IONIZATION MASS SPECTROMETER

AUTHORS:

Olin H. Howard
Aubrey Langdon
Fred W. Taylor

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE GASEOUS DIFFUSION PLANT

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OAK RIDGE GASEOUS DIFFUSION PLANT
P. O. Box P
Oak Ridge, Tennessee 37830

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VACUUM-LOCK ACTUATOR AND ION-SOURCE POSITIONER
FOR A SURFACE IONIZATION MASS SPECTROMETER

Olin H. Howard
Aubrey Langdon
Laboratory Division

Fred W. Taylor
Engineering Division

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UNION CARBIDE CORPORATION
NUCLEAR DIVISION
Oak Ridge Gaseous Diffusion Plant
Oak Ridge, Tennessee

ABSTRACT

A vacuum-lock actuator and an ion-source positioner were designed, fabricated, and installed on a surface ionization mass spectrometer to eliminate stressing of the analyzer tube, which impairs its alignment. The electrically powered vacuum-lock actuator also eliminates the manual effort formerly required to operate the vacuum lock.

VACUUM-LOCK ACTUATOR AND ION-SOURCE POSITIONER
FOR A SURFACE IONIZATION MASS SPECTROMETER

INTRODUCTION

A surface ionization mass spectrometer is used at the Oak Ridge Gaseous Diffusion Plant for the isotopic analysis of uranium as well as other elements. It is a 12-in.-radius, 60° magnetic instrument supplied by Nuclide Analysis Associates as SU-1 (1). The ion source is the triple-filament type (2). A vacuum lock, shown in figures 1 and 2, enables changing samples without breaking the vacuum (3).

The vacuum lock, as supplied by the manufacturer, was operated manually. The 3-in.-dia piston of the lock is fitted closely to the cylinder wall. Operation of the lock required considerable manual effort, and subjected the mass spectrometer analyzer tube to stresses that might have eventually impaired its critical alignment. Consequently, the vacuum-lock actuator shown in figure 3 was designed, fabricated, and installed. The actuator is electrically powered, eliminating the manual-effort requirement; and it is mounted on the vacuum lock, eliminating stressing of the analyzer tube.

The ion source includes seven focusing lenses or plates. Four of these plates and the three filaments are mounted on the removable source carriage (lock piston) shown in figure 4. The remaining three plates are fixed in the source compartment. After the source carriage has been reinserted following a sample change and an ion beam is being generated, the beam must be centered in the slits of the fixed plates. As the mass spectrometer was supplied by the manufacturer, the ion beam was centered by rotating the source carriage with a spanner wrench applied to the perimeter of the carriage. This torsional force also subjected the mass spectrometer analyzer tube to stresses that might have eventually impaired its critical alignment. Consequently, the rotational source positioner shown in figure 5 was designed, fabricated, and installed. The positioner is mounted on the vacuum lock, eliminating stressing of the analyzer tube.

SUMMARY

A vacuum-lock actuator and an ion-source positioner have facilitated operation of the mass spectrometer vacuum lock by greatly reducing the manual effort required and providing a fine adjustment for rotational positioning. Repeated stressing of the spectrometer analyzer, which usually impairs its alignment and resolving power, is eliminated, and more effective ion-beam focusing can be employed.

VACUUM-LOCK ACTUATOR

The vacuum-lock actuator (figure 3) includes a motor-driven, ball-bearing

screw (5/8-5), the nut of which is attached to one end of a hollow shaft so the screw is concentric with the shaft. The shaft is an axial extension of the blank carriage of the vacuum lock (figure 1). Thus, when the screw is turned in the appropriate direction, it drives the blank carriage against the source carriage, ejecting the latter from the vacuum lock. During insertion of the source carriage, atmospheric pressure drives it against the blank carriage, after the space between the two carriages has been evacuated in the first pumping stage. The rate of insertion is limited by the rate of retraction of the blank carriage by the actuator.

The output torque and speed of the synchronous, reversible motor are 150 in.-oz and 72 rpm. Since the ball-bearing screw has five threads per inch, the drive rate of the actuator is approximately 15 in./min. The required travel in one direction is approximately 10 in., requiring 40 sec.

The actuator is adaptable to programmed, automatic ejection and insertion of the source carriage.

ION-SOURCE POSITIONER

The rotational ion-source positioner (figure 5) includes a hand-driven screw (1/2-40) mounted on the vacuum lock near the source-insertion end. The axis of the screw is perpendicular to the axis of the vacuum lock. A pin extends from a nut on the screw through a slot on the source-carriage base (figure 4). Turning the screw drives the pin against a side of the slot, causing the source carriage to rotate. The slot is located on the circumference of the source-carriage base with respect to the orientation of the source so that the ion beam is approximately centered when the pin is in the slot and the nut is at about the midpoint of the screw. Very little travel from this point is required to center the ion beam.

Since the screw has forty threads per inch, one turn rotates the source carriage approximately 0.025 in. on its 18-in. circumference. Hence, one turn of the screw rotates the source carriage approximately 0.5° . The carriage can now be positioned more precisely, enabling more of the spectrometer focusing to be done mechanically. Although the advantage of mechanical over electrical focusing is difficult to measure, it appears that instrument stability and accuracy may be improved by minimizing adjustments of the ion-source electrical potentials.

SOURCE IN

SOURCE OUT

Figure 1
SCHEMATIC DRAWING OF VACUUM LOCK

PHOTO NO. PH-68-425

Figure 2
VACUUM LOCK

PHOTO NO. PH-68-274

SOURCE IN

PHOTO NO. PH-68-275

SOURCE OUT

Figure 3

POWERED VACUUM-LOCK ACTUATOR

Figure 4
SOURCE CARRIAGE

Figure 5
ROTATIONAL SOURCE POSITIONER

REFERENCES

1. Warren, V. L. and Horton, J. C., *Uranium Isotope Measurements with a Model SU-1 Surface Ionization Mass Spectrometer*, Union Carbide Corporation, Nuclear Division, Oak Ridge Gaseous Diffusion Plant, March 22, 1962 (K-1463).
2. Inghram, M. G. and Chupka, W. A., "Surface Ionization Source Using Multiple Filaments," *Review of Scientific Instruments*, 24, 518 (1953).
3. Stevens, C. M., "A Vacuum Lock for Routine Solid Analyses with a Mass Spectrometer," *Review of Scientific Instruments*, 24, 148 (1953).