BNL-41171
Informal Report

BNL--41171

DE88 012133

A Manually-operated Ultra-high-vacuum Water-cooled Slit Mechanism for the U13U Wiggler/Undulator Spectroscopy Branch Line at the National Synchrotron Light Source

S.L. Hulbert, E. Rotela and M. Shleifer

April 1988

Research Supported by the
OFFICE OF BASIC ENERGY SCIENCES
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

NATIONAL SYNCHROTRON LIGHT SOURCE
BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.

Under Contract No. DE-AC02-76CH00016

A Manually-operated Ultra-high-vacuum Water-cooled Slit Mechanism for the U13U Wiggler/Undulator Spectroscopy Branch Line at the NSLS

Steven L. Hulbert, Elbio Rotela, and Mark Shleifer

National Synchrotron Light Source
Brookhaven National Laboratory

Abstract

We describe a manually-operated ultra-high-vacuum (UHV) water-cooled slit mechanism. The design, which is based on the use of rigid parallelograms, provides a continuously adjustable bilateral slit opening. The entire mechanism is mounted on an eight-inch Conflat flange with two bellows for cooling water tubes and a linear feedthrough to control the size of the slit opening.

Introduction

The U13 transverse optical klystron (TOK) wiggler/undulator insertion device produces a total radiated power of nearly 300W when it is operated at maximum magnetic strength (K = 8) and the NSLS VUV ring (750 MeV) has a stored current of 500mA.[1] The first two optical elements of the U13U spectroscopy branch line on this insertion device are gold coated mirrors which absorb approximately 50% (3° angle of incidence) and 40% (2° angle of incidence) of the power load incident upon them.[1] Therefore the entrance slit, which is downstream of these two mirrors, will experience a worst case power load of 90W [300W x (1-0.5) x (1-0.4)]. Water cooling of this slit mechanism is required in order to avoid thermally-induced changes in the width of the slit opening and, possibly, gross mechanical distortion of the component parts.

Design Criteria

The following constraints were imposed upon the design of this slit mechanism:

1. The blades of the slit should be directly water cooled, i.e. by cooling water tubing *brazed* to the slit blades rather than by indirect attachment of the blades to cooling blocks via screws or thermally conducting straps.
2. The width of the slit opening should be continuously variable from 1μm to 1mm via manual control.
3. Reproducibility of the slit opening should be ±0.5μm.
4. The entire mechanism should be ultra-high vacuum compatible.

Engineering Design

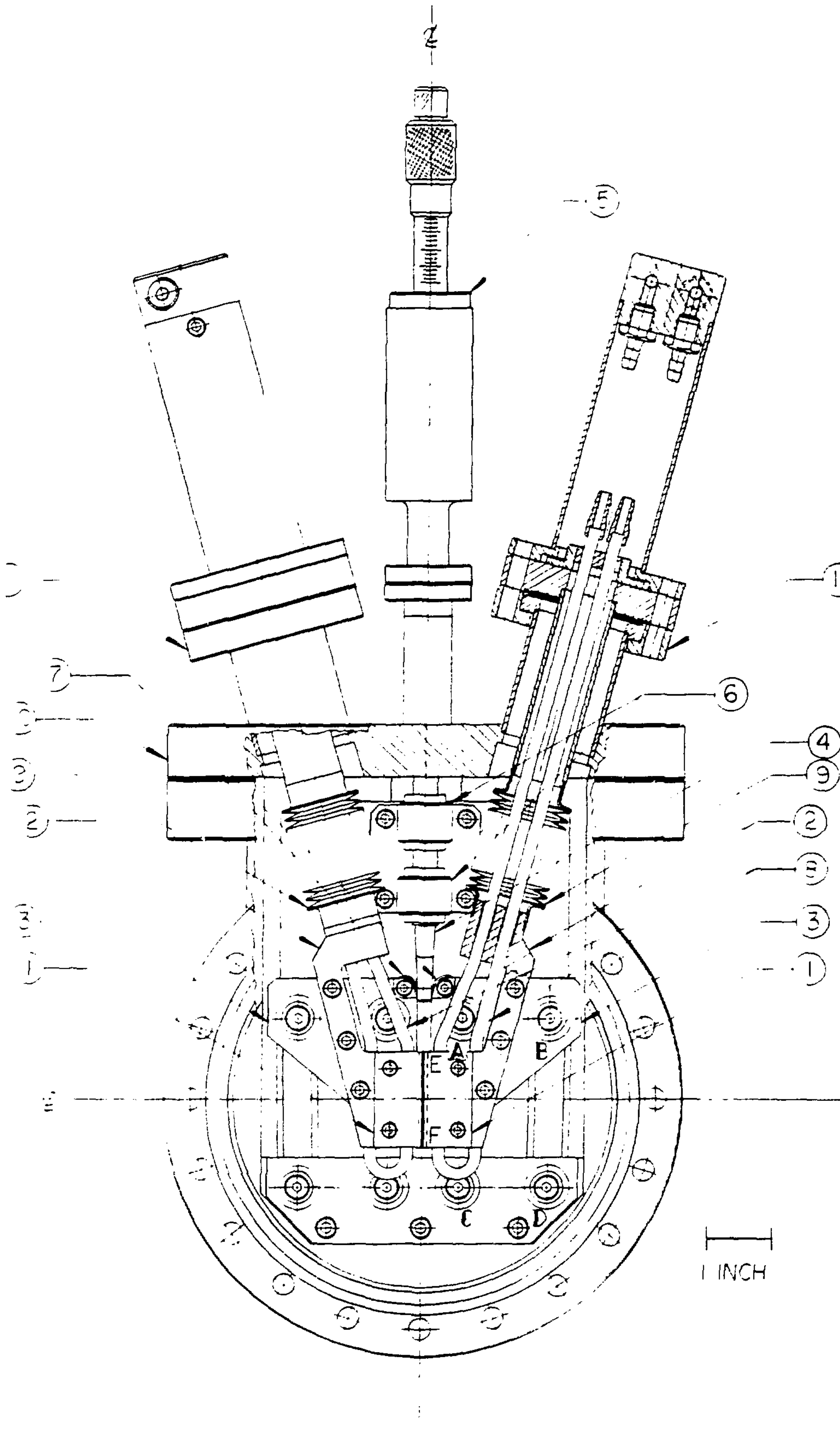
Design criterion (1) is required by the magnitude of the heat load expected on these slits, as described in the Introduction. The major design problem to be solved arises from the fact that the now-standard bilateral slit mechanism based on a parallelogram with vertices provided by flexural hinges (usually machined from a single aluminum plate) cannot function properly if it is mechanically loaded, as by the spring- and vacuum-loading forces associated with external cooling water tubes brazed to the slit blades. The slit design described in this report solves this problem by using a parallelogram with rigid vertices provided by precision rotary bearings.

The parallelogram design principle of the water-cooled slit mechanism is shown in the figure. Parallelogram ABCD has a fixed rigid side CD and a movable side AB always parallel to CD. The slit blade (1) is rigidly fixed through the blade holder (2) to the link AB (3) in such a way that the blade edge EF is positioned perpendicular to the axis of the link AB and always moves parallel to itself. Control of the width of the slit opening is provided by a precision linear feedthrough (5) and a specially-profiled rod (4) which pushes the blades apart symmetrically via a bearing (7) mounted on the link AB (3). The slit blade (1) and the cooling water tubes (8) are brazed to the blade holder (2). The blade holder (2) and bellows (9) are small enough to permit insertion and extraction through the 2¾-inch port (11) for assembly and repair. Both blade holder mechanisms and the linear feedthrough (5) are mounted on an eight-inch Conflat flange (10), so the opportunity to adjust the whole mechanism outside of vacuum exists even after assembly. The blade holders (2) are spring-loaded via the bearings (7) against the push rod (4) (spring not shown). Linearity of the push rod motion is provided by two ball bushings (6).

This work was supported by the Division of Material Sciences U. S. Department of Energy under Contract No. DE-AC02-76CH00016.

References

1. Steven L. Hulbert and Sushil Sharma, Nucl. Instrum. Methods *A266* , 491 (1988), and in proceedings of the 5th National Conference on Synchrotron Radiation Instrumentation, Madison, WI, June 1987. See also Steven L. Hulbert and Sushil Sharma, Optical Engineering, to be published June 1988.


5
11
7
6
4
9
2
3
1
A
B
E
F
C
D
1 INCH