

August 7-10, 1989

BNL--43318

DE90 001550

STEPPING MOTOR ADAPTOR ACTUATOR
FOR A COMMERCIAL U.H.V. LINEAR MOTION FEEDTHROUGH*

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An adaptor coupling has been developed that will allow the attachment of a standard stepping motor to a precision commercial (Varian) U.H.V. linear motion feedthrough. The assembly, consisting of the motor, motor adaptor, limit switches, etc. is clamped to the feedthrough body which can be done under vacuum conditions if necessary. With a 500 step/rev. stepping motor the resolution is 1.27 μ m per step. We presently use this assembly in a remote location for the precise positioning of a beam sensing monitor.

*Work supported by the United States Department of Energy under contract

#DE-AC02-76CH00016

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CONF-890802-7

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Introduction

X-ray beamlines, at synchrotron radiation facilities, frequently use U.H.V. linear motion feedthroughs for the actuation of various devices. For our application, we commonly use a Varian model 954-5150[1] linear motion feedthrough which incorporates a 0.025 inch thread pitch and a manual thumbwheel for position control.

A recently developed photoelectron x-ray beam position monitor [2], requiring accurate and repeatable remote positioning (See Fig. 3) along a vertical axis, was attached to a Varian feedthrough and installed in an x-ray front end. This installation prompted the design of the stepping motor adaptor actuator (See Figs. 1 & 2) allowing micrometer-type, remote position control.

The actuator assembly (See Fig.1) consists of nine parts: 1) Varian linear motion feedthrough, 2) stepping motor, 3) coupling, 4) hand knob, 5) limit switch, 6) electrical connector, 7) switch actuator, 8) shaft, and 9) the motor adaptor. These items will be described in the next section under the heading Construction Details and will be followed by a brief discussion on assembly.

Construction Details

The Varian linear motion feedthrough is compact and is constructed primarily of stainless steel. Shown in Fig. 1, item number 1, this feedthrough has an overall extended length of approximately 200 mm, a 38 mm diameter, a stroke of 25 mm, a 40-thread/inch lead screw with thumbwheel adjustment, and a 23-Kg load capacity. The unit is U.H.V. compatible and bakeable to 300° C - detailed information may be obtained through Varian's data sheet VAC2050.

The stepping motor, shown in Fig. 1, item number 2, is a five phase motor manufactured by the Berger Lahr Corporation and operates at 500 steps/rev. in the full step mode. When used in conjunction with the 40-thread/inch lead screw, we attain a nominal linear resolution of 1.27 μm per step. The motor is mounted approximately 80 mm away from the linear actuator's thumb knob, with the shafts collinear, and has its own hand knob

(Fig. 1, item number 4) on its free-end to give manual control to the actuator when needed. The motor's shaft is coupled to the actuator via a helical coupling (Fig. 1, item number 3) which provides high torsional rigidity, zero backlash, and allows for minor angular and/or parallel misalignment.

The shaft, shown in Fig. 1, item number 8, provides a connection between the actuator's thumbscrew and the flexible coupling, therefore permitting the rotation of the thumbscrew via the stepping motor. The unique feature of the shaft is that it has external threads of the same pitch as the actuator's shaft, so that the fitted switch actuator (Fig. 1, item number 7), when held from rotating, will move at the same rate and, therefore, at the same distance as the actuator shaft. Reiterating, the switch actuator moves the same distance as the linear actuator's shaft. The switch actuator is used to actuate limit switches (Fig. 1, item number 5) that can restrict the travel in the extended and retracted directions. These switches are adjustable and can limit the travel from 12 to 25 mm.

The electrical connector, Fig. 1, item number 6, allows easy attachment of motor control wiring.

The last component, for discussion, is the motor adaptor. It has a general cylindrical shape and positions and holds the stepping motor and the brackets for the limit switches and electrical connector. It has been designed with enough clearance to slip easily over the linear motion feedthrough's body and is then secured in place by two screws that apply clamping force on the feedthrough's body. The adaptor is slotted longitudinally approximately three quarters of the way up from the bottom. This forms two beams that are "C" in cross section which have been designed to operate within their elastic limit, and, therefore act as springs for easy installation and removal.

Assembly

The motor adaptor assembly is easily attached and can be incorporated to a U.H.V. feedthrough that is unmounted or in mounted position and under vacuum condition.

The assembly procedure is as follows: 1) attach the shaft to the U.H.V. feedthrough's thumbwheel; 2) install the switch actuator (note the position of the U.H.V. feedthrough); 3) slide the motor adaptor, with stepping motor and flex coupling attached, over the U.H.V. feedthrough, and tighten the motor adaptor's clamping screws and the flex coupling clamping screws; 4) install the brackets for the limit switches and electrical connector; 5) wire the switches and the motor to the connector; 6) adjust the position of the limit switches.

Acknowledgement

We would like to express our gratitude to Walter Stoeber for his excellent design work incorporated in this instrument.

Conclusion

The stepping motor adaptor actuator offers a means of achieving, with micrometer-type precision, linear motion in a U.H.V. environment. Important features are its adaptability to a popular U.H.V. feedthrough and the convenience of in-situ installation, if required. Further, with some minor modification, the adaptor actuator could be used in a similar way for a rotary actuator.

References

- [1] Varian Vacuum Products Division, 121 Hartwell Avenue, Lexington, Massachusetts 02173; catalogue VAC 4025.
- [2] Erik D. Johnson and Tom Oversluizen, UHV Photoelectron X-ray Beam Position Monitor. These proceedings.....

Figure Captions

Fig.1 Assembly drawing of the stepping motor adaptor actuator on a Varian linear motion U.H.V. feedthrough. 1) Varian linear motion feedthrough, 2) stepping motor, 3) coupling, 4) hand knob, 5) limit switch, 6) electrical connector, 7) switch actuator, 8) shaft, and 9) the motor adaptor.

Fig.2 Photograph of stepping motor adaptor actuator.

Fig.3 Assembly drawing of the photoelectron beam position monitor with Beryllium Oxide (BeO) power absorbing disc. 1) stepping motor, 2) adaptor actuator assembly, 3) Varian U.H.V. linear feedthrough, 4) base flange, 5) BeO disc holder, 6) BeO power absorbing disc, 7) photon beam, 8) blade support, and 9) blade.

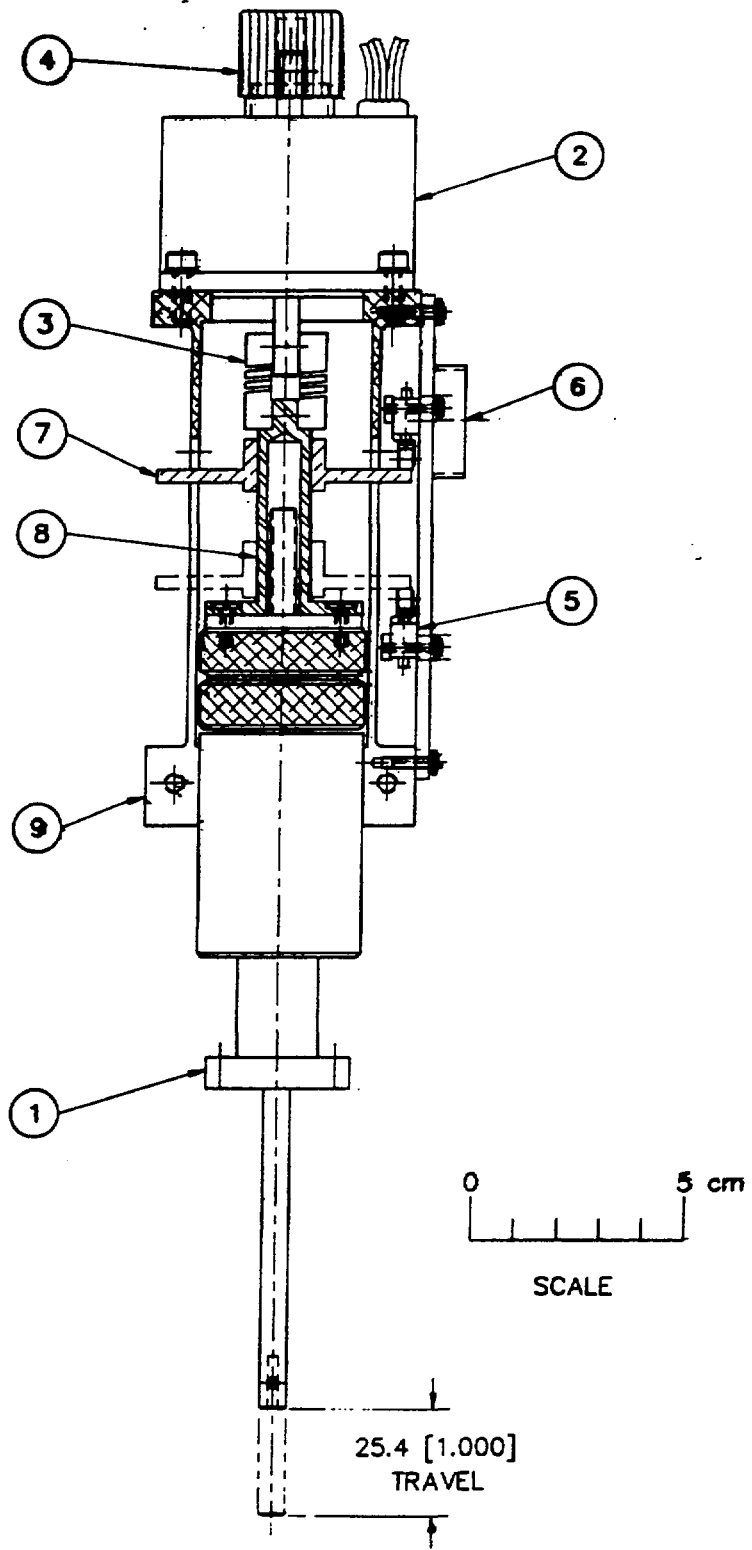


Fig. 1

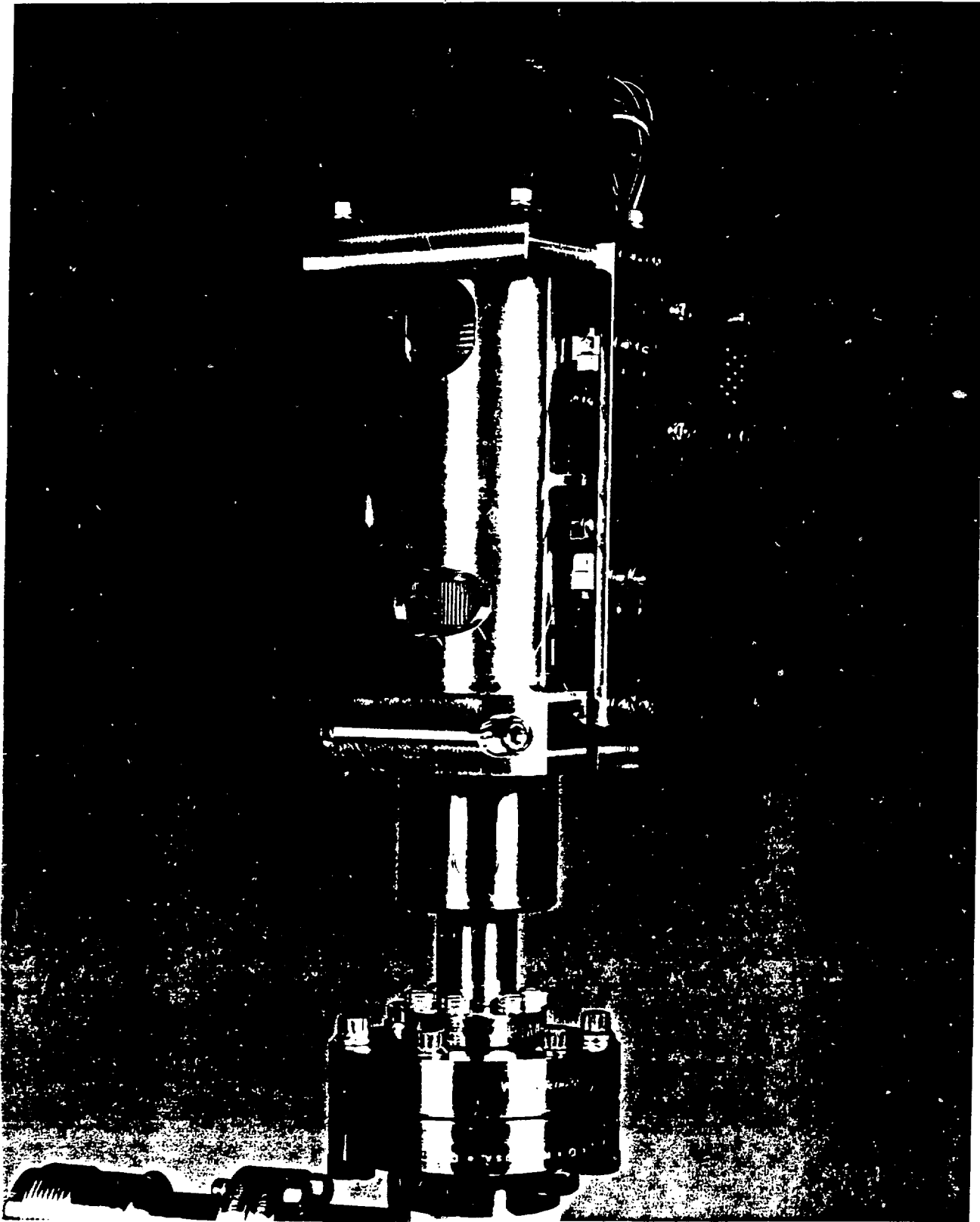


Fig. 2

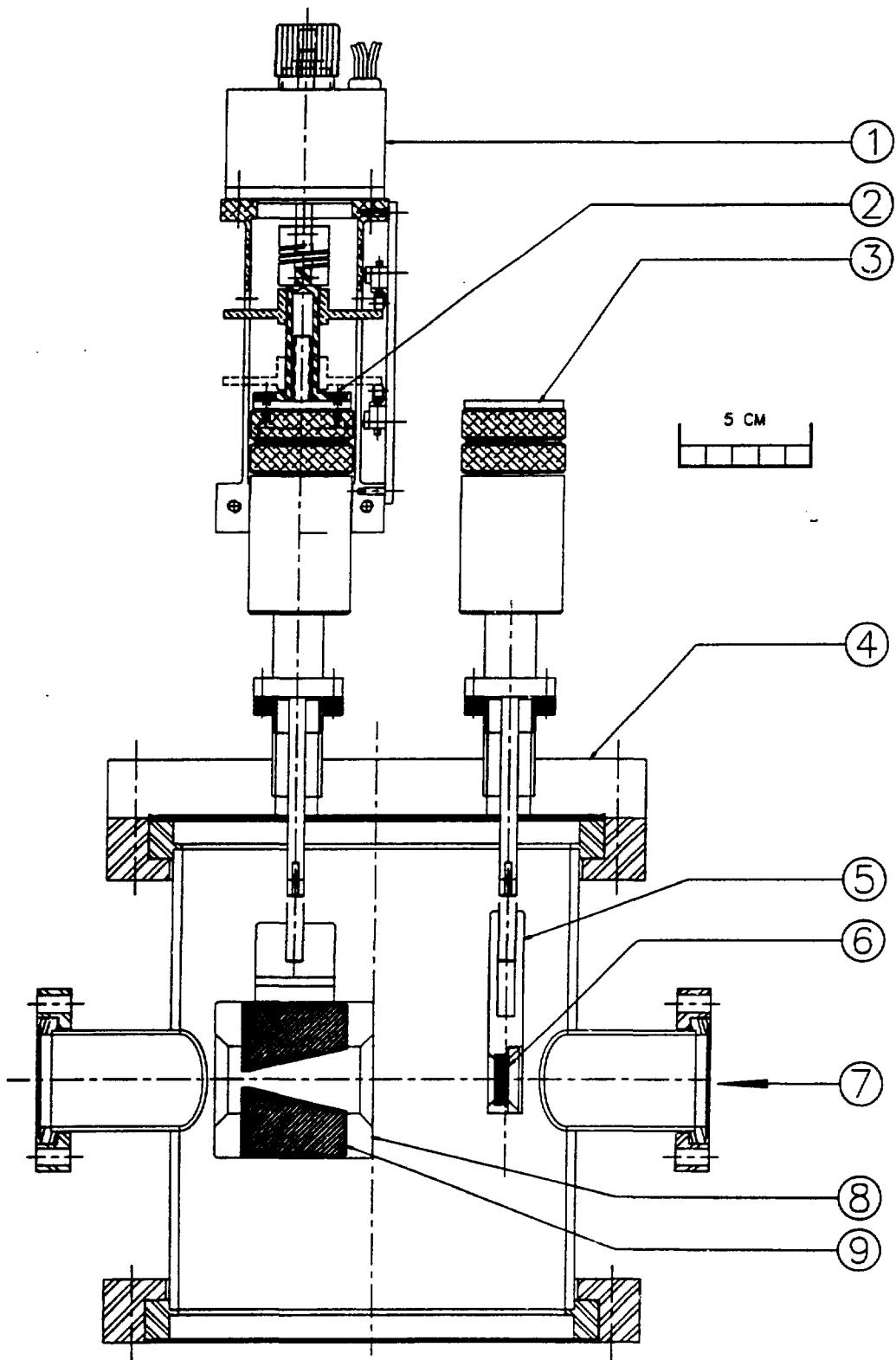


Fig. 3