

# BTeV Pixel Detector Positioning System

# Specifications

Travel: 2Cm X&Y

Position feedback away from operating point:  
+ - 0.1 mm

Position feedback near operating point: <  
0.001 mm

Repeatability: 0.001 mm

Must operate in  $> 1$  T magnetic field

Connection to detector must be kinematically correct to avoid straining detector

# X Axis Actuator

Preloaded crossed roller slide.

Preloaded roller screw with 1 mm lead.

Driven by pneumatic indexer with step sizes of 0.001 mm and 0.010 mm.

Coarse position feedback using linear potentiometer.

# Y Axis Actuator

Preloaded ball bushing guide element.

Preloaded roller screw with 1 mm lead.

Driven by pneumatic indexer with step sizes of 0.001 mm and 0.010 mm.

Coarse position feedback using linear potentiometer.

# Attachment To Detector

Kinematic mounting using preloaded spherical bearings and one ball bushing to provide correct constraints without stressing detector.

Actuators and mounting provide 5 degrees of freedom to detector, no freedom in z axis

# Feedback

Coarse position feedback is provided by linear potentiometers mounted on the actuators.

Fine position feedback near the operating point is provided by capacitive sensors mounted on the detector, sensing distance to a fixed target mounted on the vacuum vessel.

# Prototype

A prototype Y axis actuator system was constructed to verify compliance with design goals. Performance results follow:

1. Step size: 0.001mm & 0.010 mm, with or without load.
2. Load capacity: 200 lb. nominal.
3. Stiffness: X & Z directions, measured at end of actuator shaft at full extension, 116 lb. Force = 0.050 mm deflection.
4. Stiffness: Axial, measured in compression, 211 lb., force = 0.024 mm deflection.

# Prototype

Cont.

Note: Deflections due to load do not affect position accuracy since the fine position feedback is obtained at the detector.

High speed: With pneumatic oscillator, may change with the final valve configuration, 5 mm per minute, 4 min. = 2 Cm full travel.

# Future Development Plans

Changes to Y- actuator prototype:

- change oil to light grease,
- employ re-designed pneumatic indexer

Changes to X- actuator design:

- shorten assembly to provide more room for detector cables.

- employ re-designed pneumatic indexer.

Changes to pneumatic indexer:

- better brake design
- easier adjustment means
- make backlash adjustable

Overall design:

- devise control system and valving
- re-design to employ “o” ring seals

# Illustrations

- Fig. 1 Y – Axis Actuator
- Fig. 2 X & Y Axis Actuators mounted on vessel (looking in z direction)
- Fig. 3 X - Axis Actuator (without Y-Axis Actuator) & cross-section thru base
- Fig. 4 X & Y Axis actuators mounted on vessel (looking in x direction)
- Fig. 5 Primary actuator connection to detector
- Fig. 6 Secondary actuator connection to detector
- Fig. 7 Tertiary actuator connection to detector
- Fig. 8 Detector constraint diagram

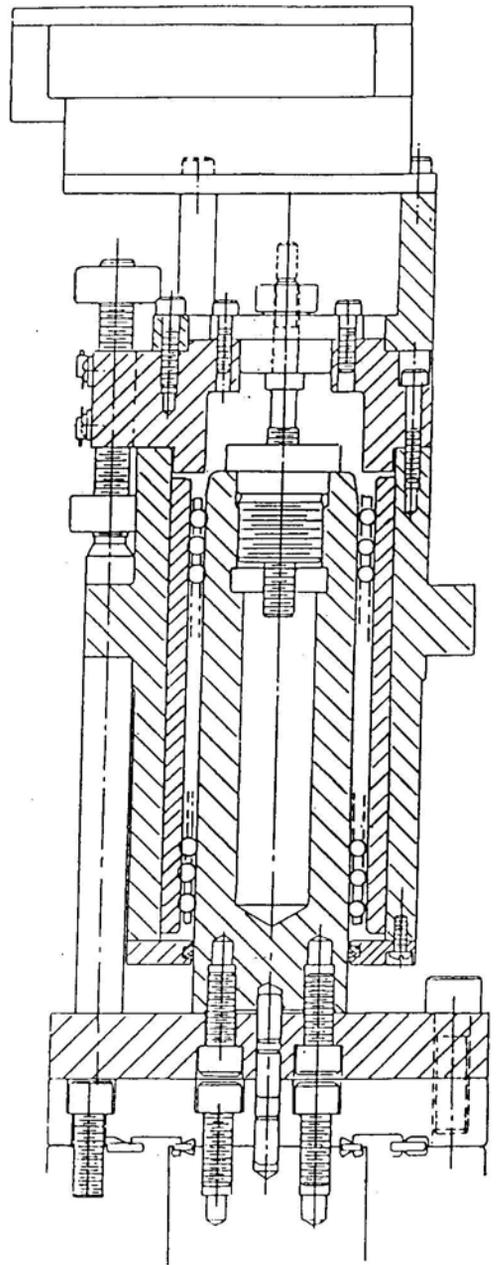
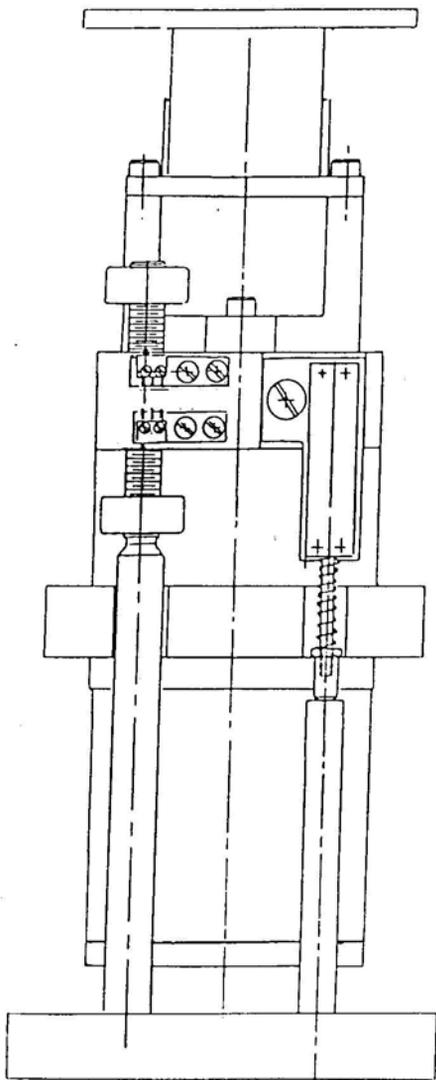


Fig. 1

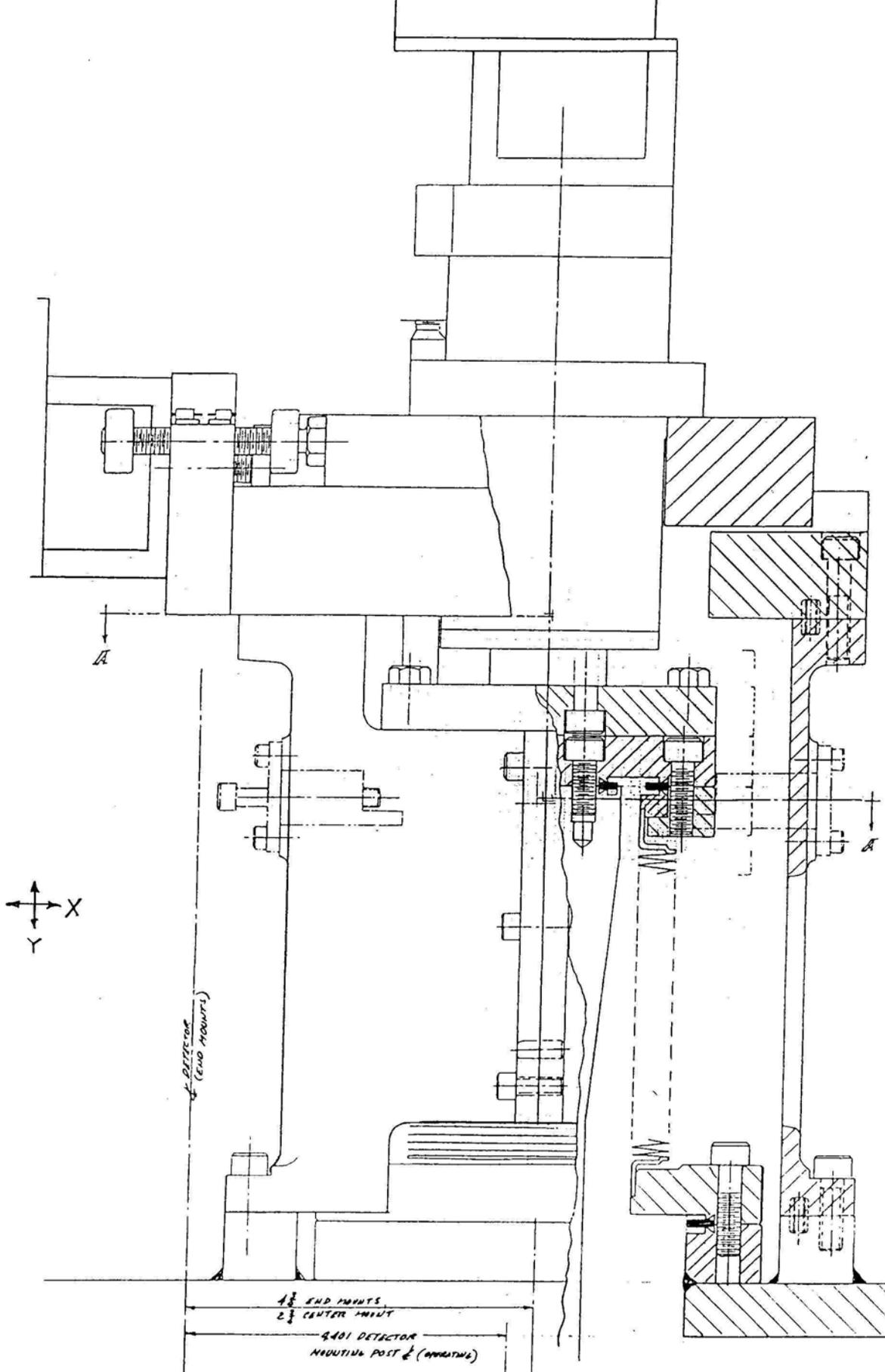


Fig. 2

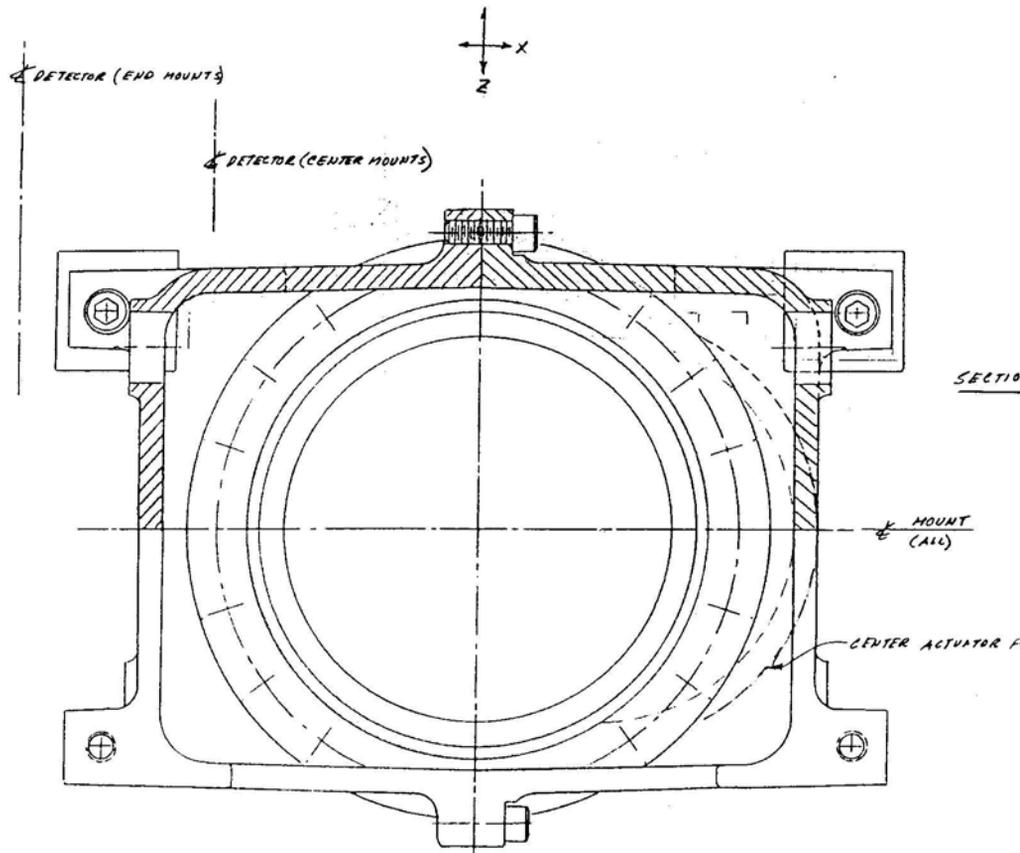
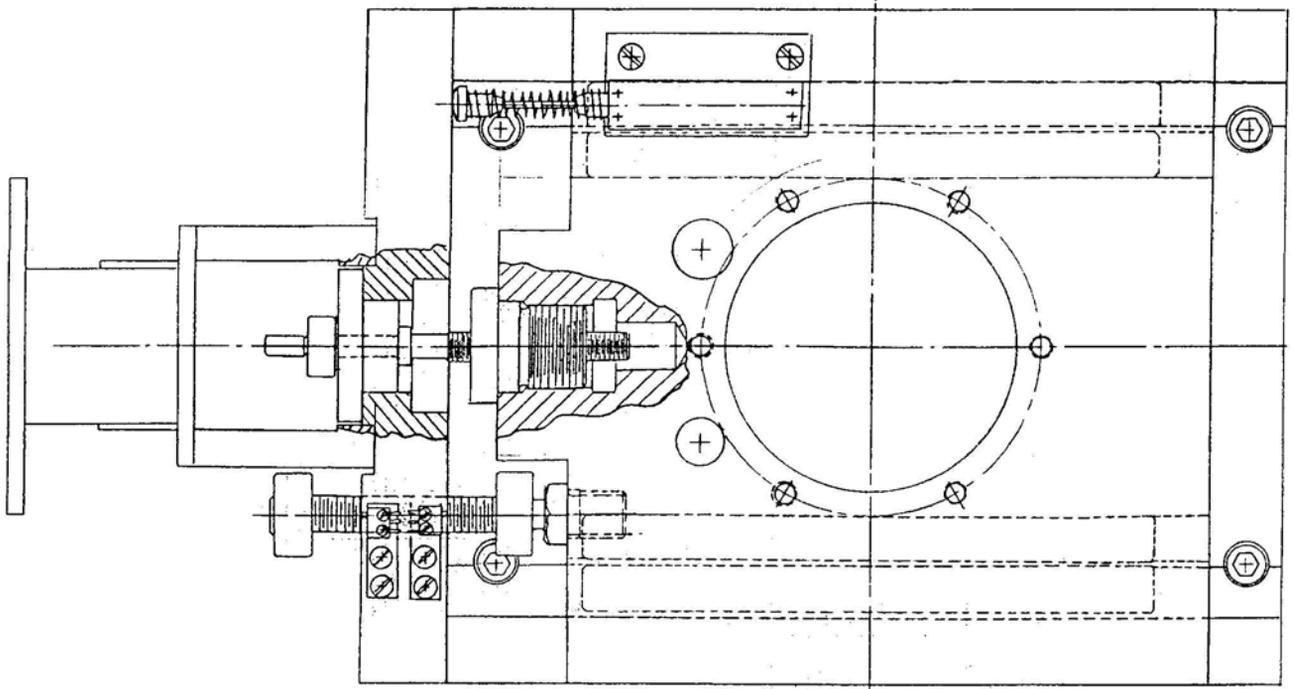


Fig. 3

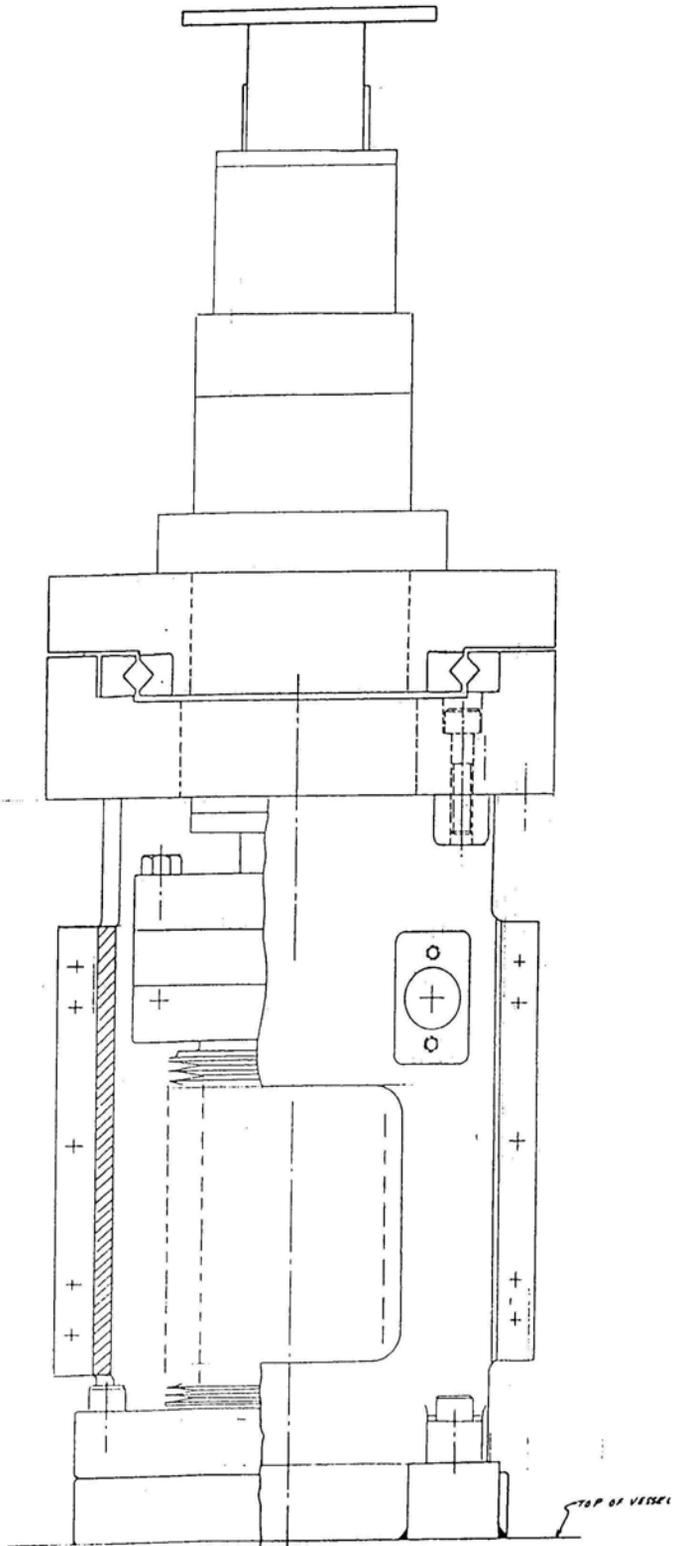
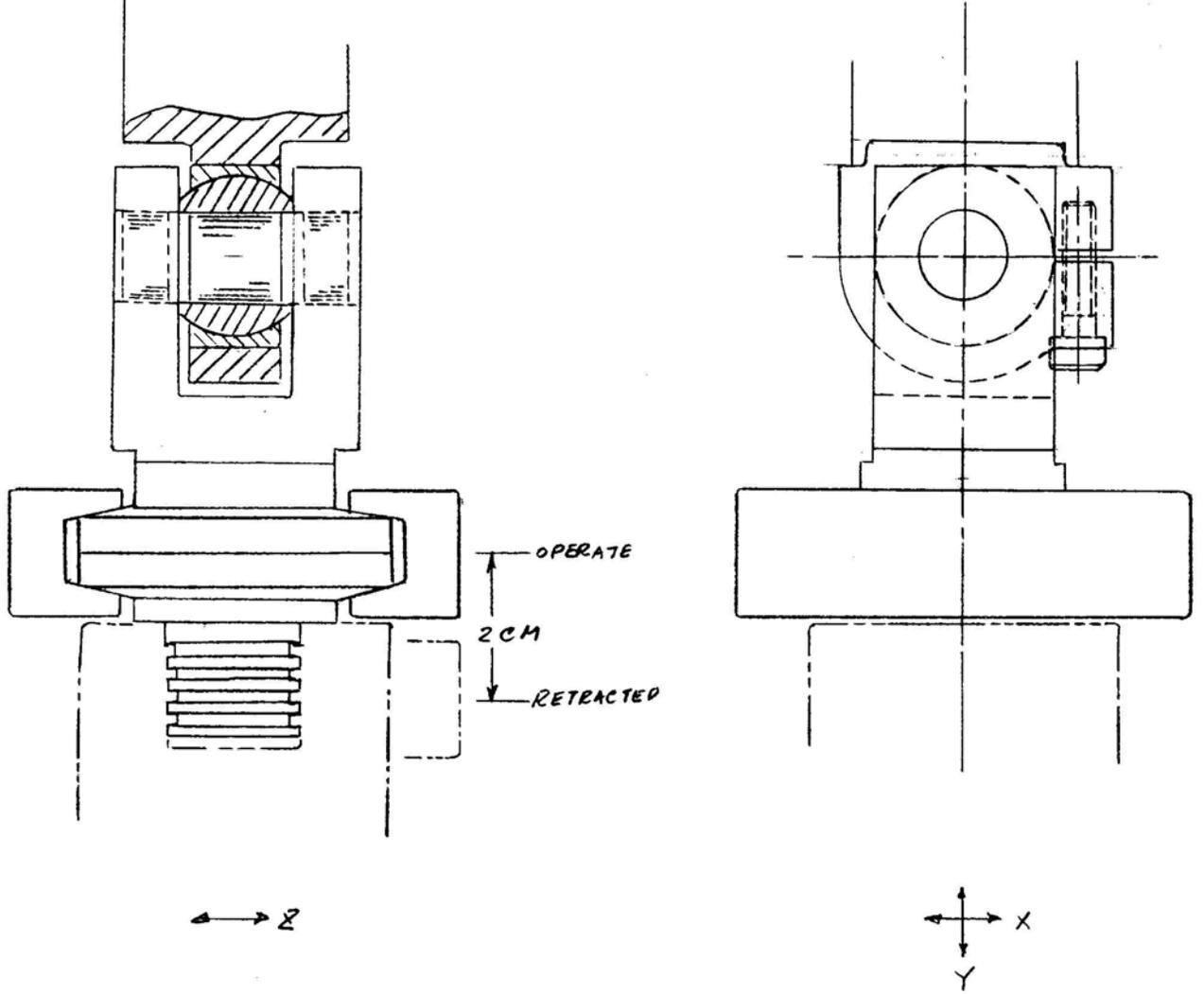


Fig. 4

VIEW LOOKING IN X DIRECTION

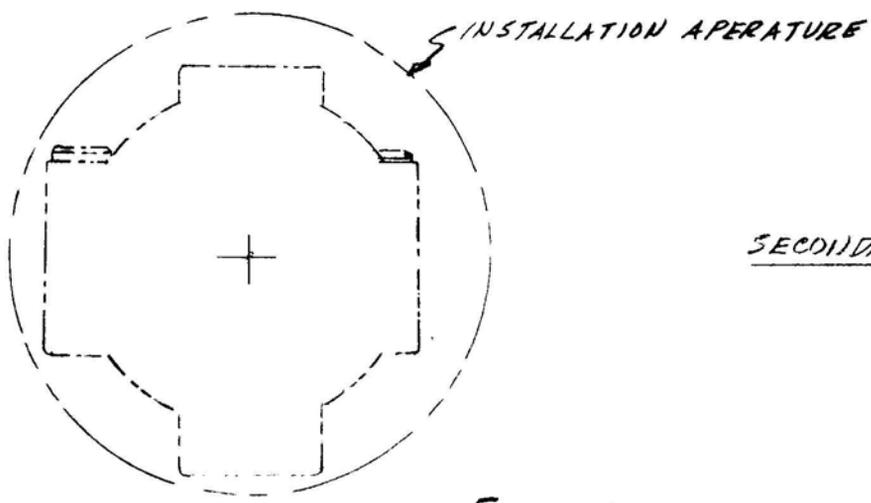
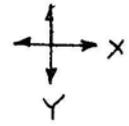
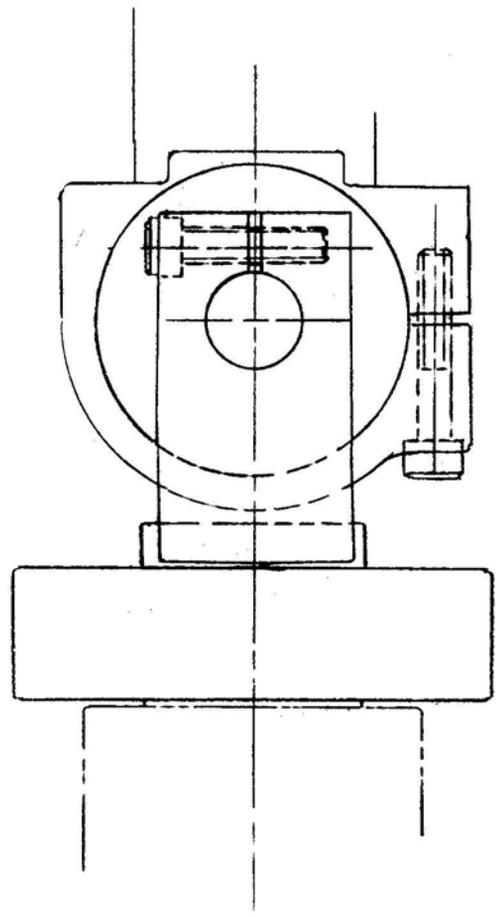
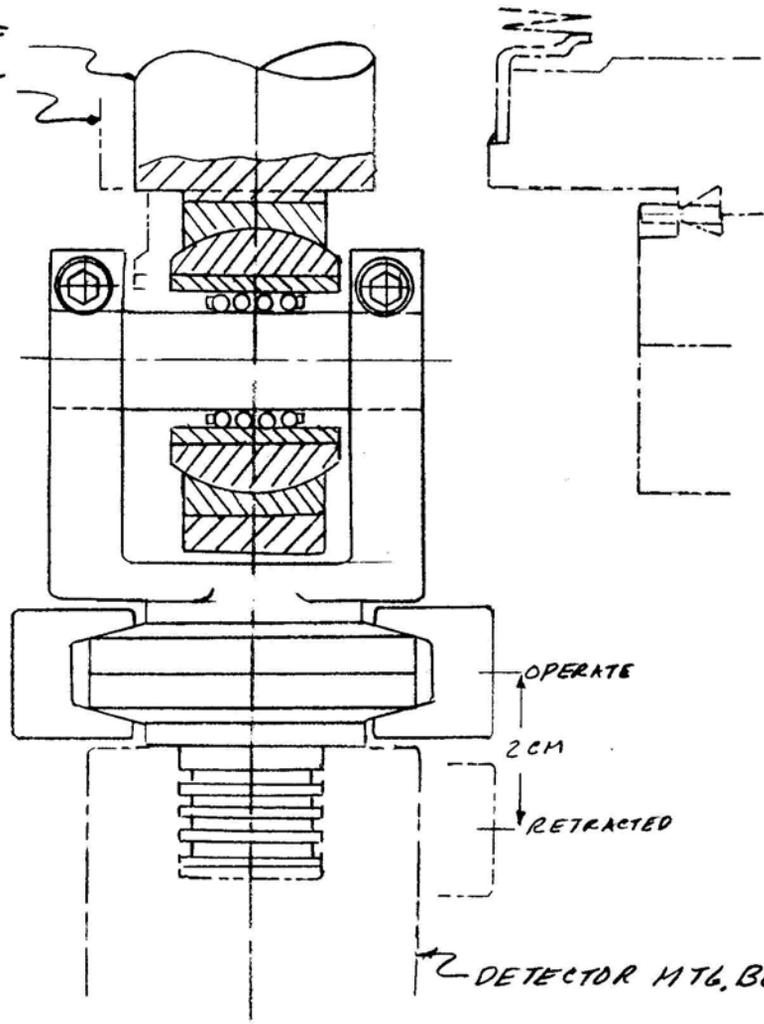


PRIMARY ACTUATOR CONNECTION

Fig. 5

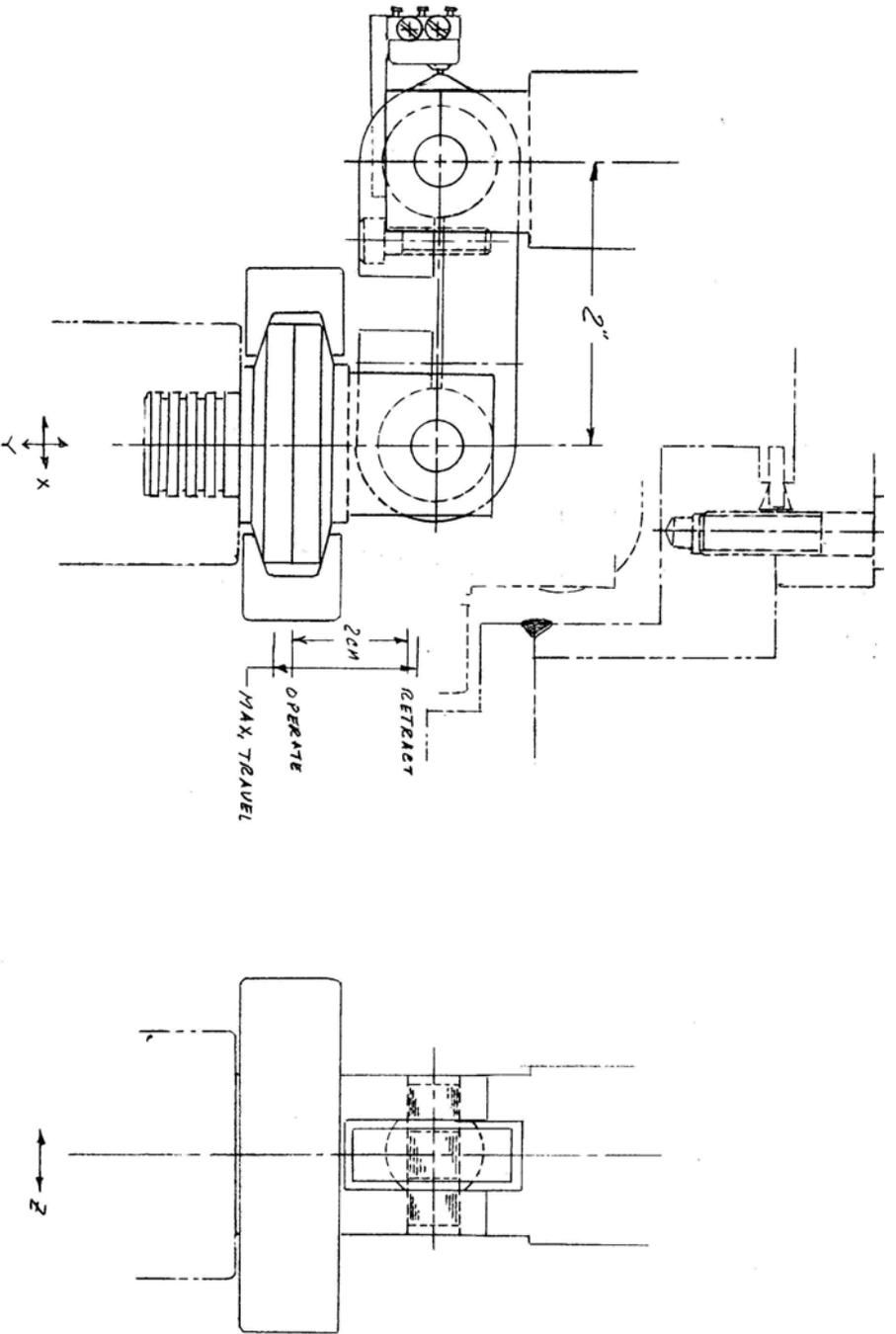
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OPERATE  
RETRACT



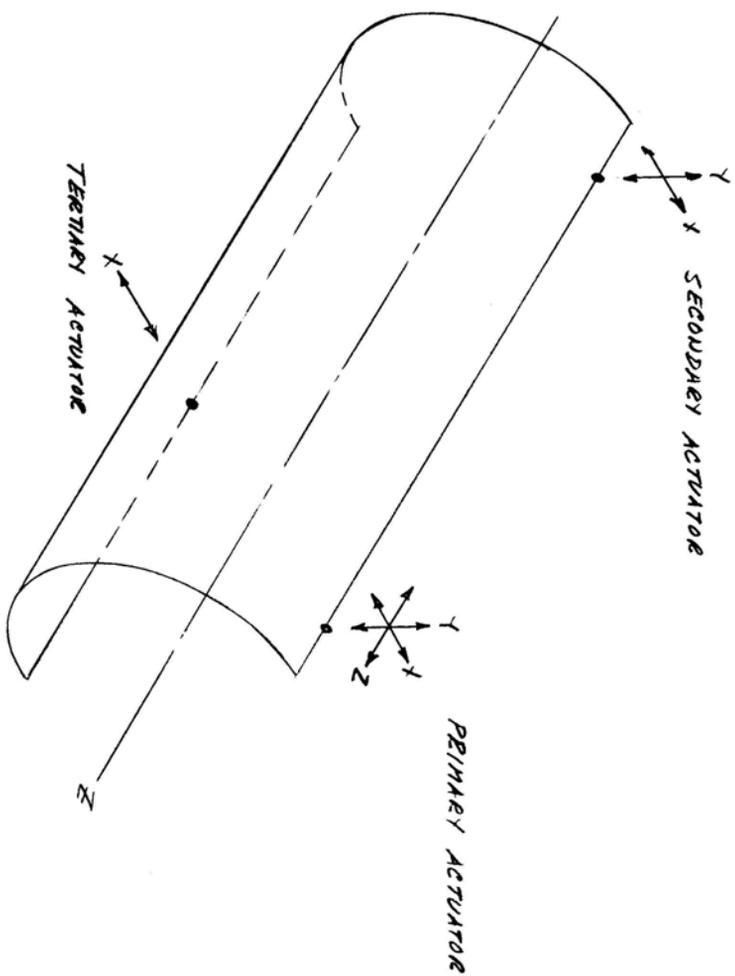
SECONDARY ACTUATOR CONNECTION

Fig. 6



TERTIARY ACTUATOR CONNECTION

Fig. 7



DIRECTIONS OF CONSTRAINT  
ALL OTHER AXES AND ALL ROTATIONS FLEXIBLE

Fig. 8