HEDL-SA-1723

CONF-790602--89

AUTOMATED INSPECTION OF NUCLEAR FUEL PELLETS

D. R. McLemore

R. S. Wilks*

D. H. Nyman

R. M. Brady*

April 1979

American Nuclear Society

June 1979

Atlanta, Georgia

HANFORD ENGINEERING DEVELOPMENT LABORATORY
Operated by Westinghouse Hanford Company, a subsidiary of Westinghouse Electric Corporation, under the Department of Energy Contract No. EY-76-C-14-2170

* Westinghouse-Mechanical Technology Division, Pittsburgh, PA

DISCLAIMER

HEDL-SA-1723
Poster Session

AUTOMATED INSPECTION OF NUCLEAR FUEL PELLETS

Introduction

The development and evaluation of automated equipment for the fabrication and inspection of nuclear fuel is being conducted. This equipment is being developed as part of the Breeder Fuel Fabrication Development Program conducted at the Hanford Engineering Development Laboratory (HEDL).

A major inspection operation in the process is the gaging of fuel pellets for dimensions (length and diameter), surface flaws and weight. The system is modularly designed for ease in maintenance to allow for the replacement of entire inspection stations without loss of production. The pellet inspection system is divided into two parts: (1) mechanical and (2) process control and data processing.

The mechanical portion consists of a pellet handling system; inspection stations for measuring length, diameter, weight and surface flaws; and a glovebox-like containment.

The control and data processing portion of the gage consists of a process control system, a small dedicated minicomputer and a supervisory computer system which will be located in a centralized control center and be shared with other development activities in the Fuels and Materials Evaluation Laboratory (FMEL).

Discussion

The length, diameter, and surface flaw inspections utilize laser optical systems with solid-state detection devices. Both the diameter and length measurement stations use linear diode array sensors while the surface flaw station uses a single element detector to distinguish between flawed and unflawed areas. A standard commercially available weight scale is

used to statistically sample pellets for weight in order to determine pellet densities.

Fuel pellets are placed in a vibratory feed system for orientation and delivery to the handling system. Pellets are transported through the various inspection stations with a reciprocating overhead gripper mechanism.

The transport system utilizes a pick-and-place operating principal (zero velocity at each end of the handling cycle) to minimize wear of the gaging components and damage to the pellets.

The pellet gaging system is controlled by a dedicated minicomputer system. The control system can be operated either through a local teletype or via the supervisory computer in the centralized process control room. The dedicated computer system is used to control the operation of the mechanical handling system, synchronize data inputs and outputs with the handling cycle, and sort the fuel pellets.

Attribute data are transmitted to the supervisory computer for trend analysis and process control information.

The system is designed to minimize the amount of hardware actually in containment. The laser, rotating prism, and optical detector for the length, diameter, and surface flaw inspections are mounted in individual "suitcases" outside the alpha containment barrier.

Pellet Inspection

Pellets are delivered to the automated gaging systems and placed in a vibratory feeding system. The gage is then activated through remote console commands.

The vibratory feed system delivers the pellets one at a time to an escapement mechanism which presents the pellets to the overhead pick-and-place grippers. The gripper mechanisms then transport the individual pellets through the various inspection stations. At each of the three optical

inspection stations, the pellets are placed on parallel rollers which rotate the pellet during the inspection. This inspection data is analyzed to determine the acceptability of the fuel pellet. The fuel pellets can then be segregated into one of three categories: (1) acceptable; (2) rejectable; and (3) hold for centerless grinding. Weight data is taken statistically for estimating the mass per unit length value for the fuel lot.

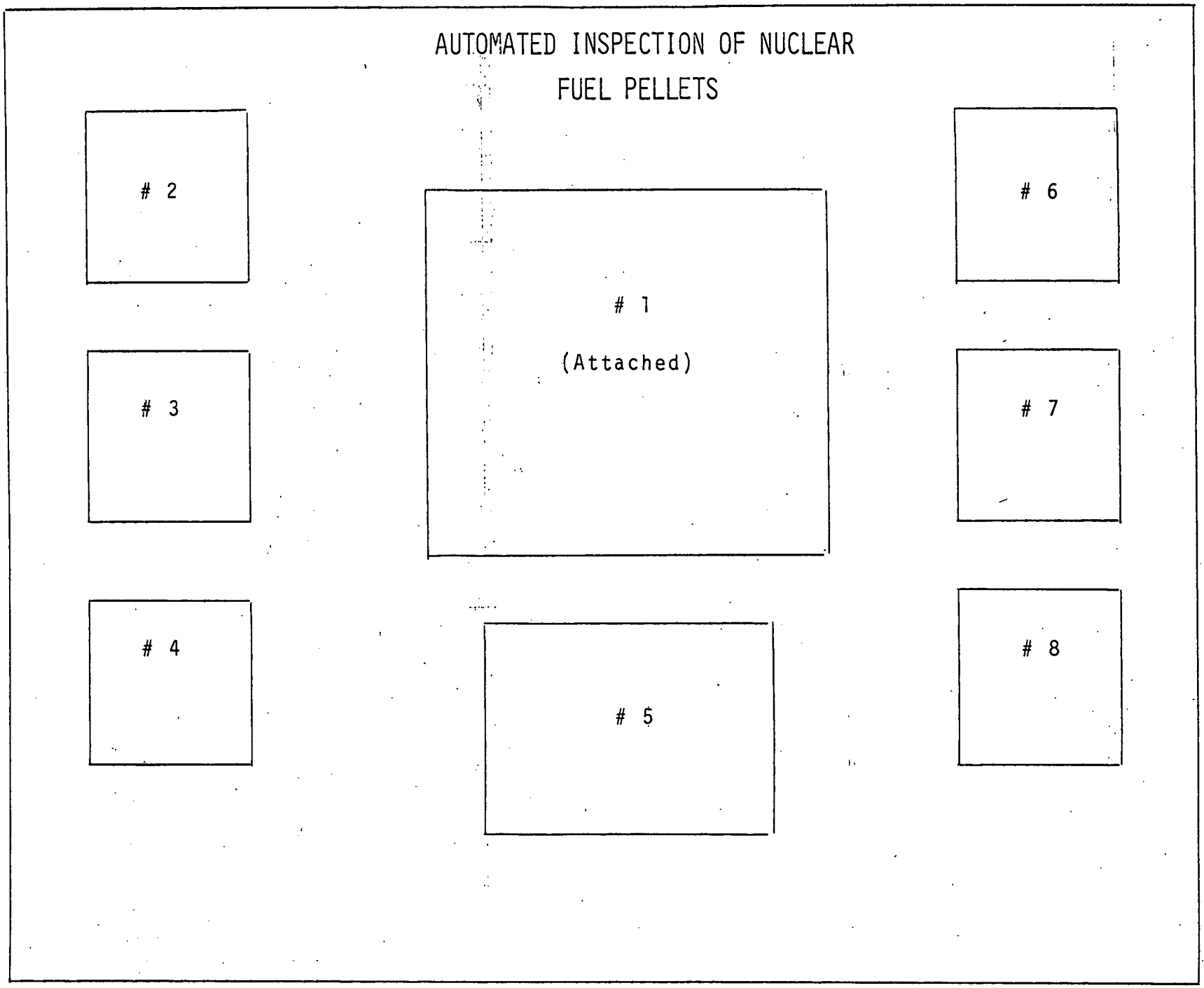
This inspection equipment was designed for operation at a rate of three pellets per second. The gage has successfully operated at a rate of two per second. New gripper designs are presently being evaluated which should allow for reliable operation at design speed.

Summary

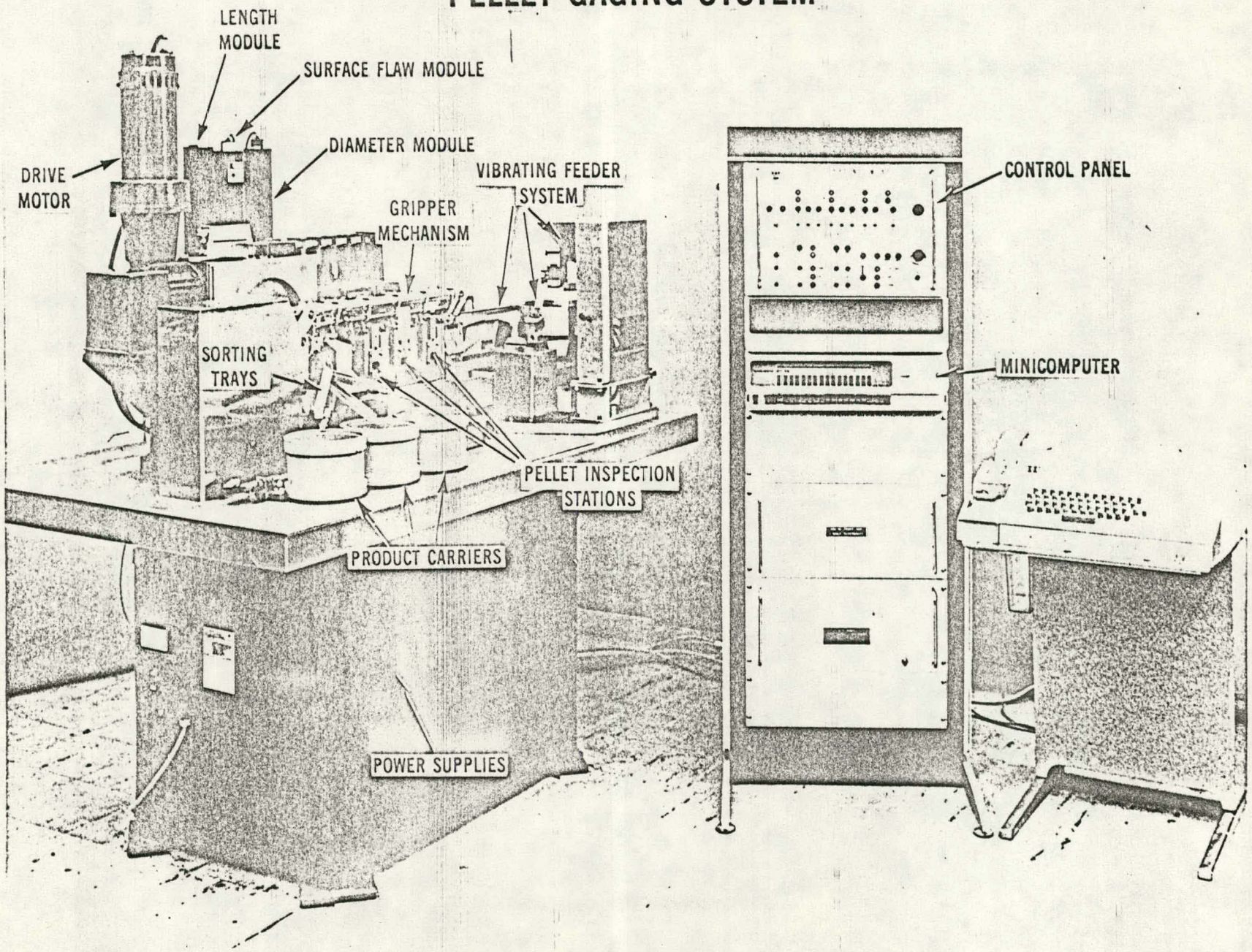
The evolutionary development of the automated fuel pellet inspection system has involved several man years of effort and the testing of five different engineering prototypes.

The experience gained from the process testing of this latest generation of the automated fuel pellet gaging system will be used to design and build a production unit which is completely automated and can be maintained remotely.

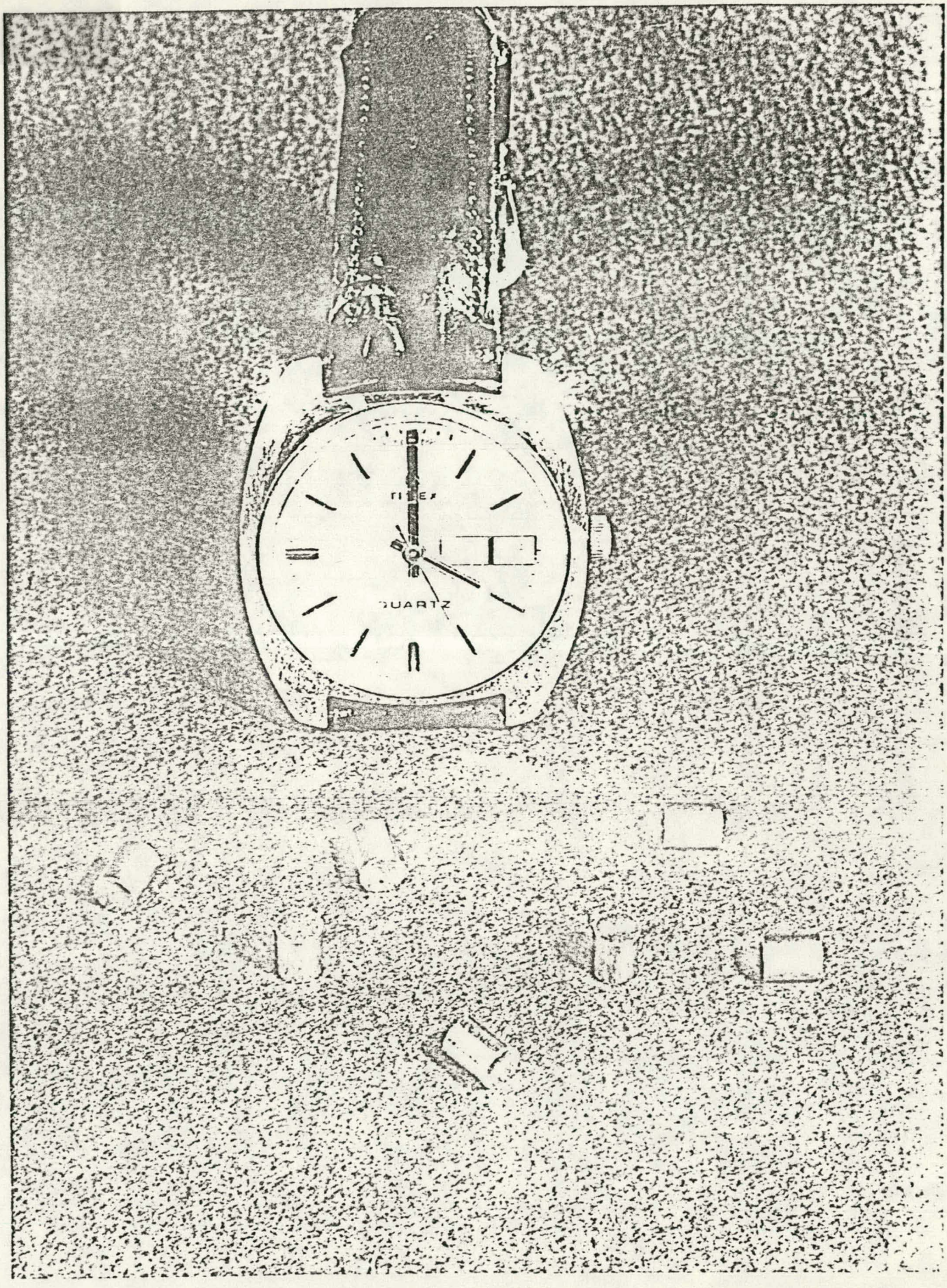
Poster Board Example: (Photos Attached)



PELLET GAGING SYSTEM

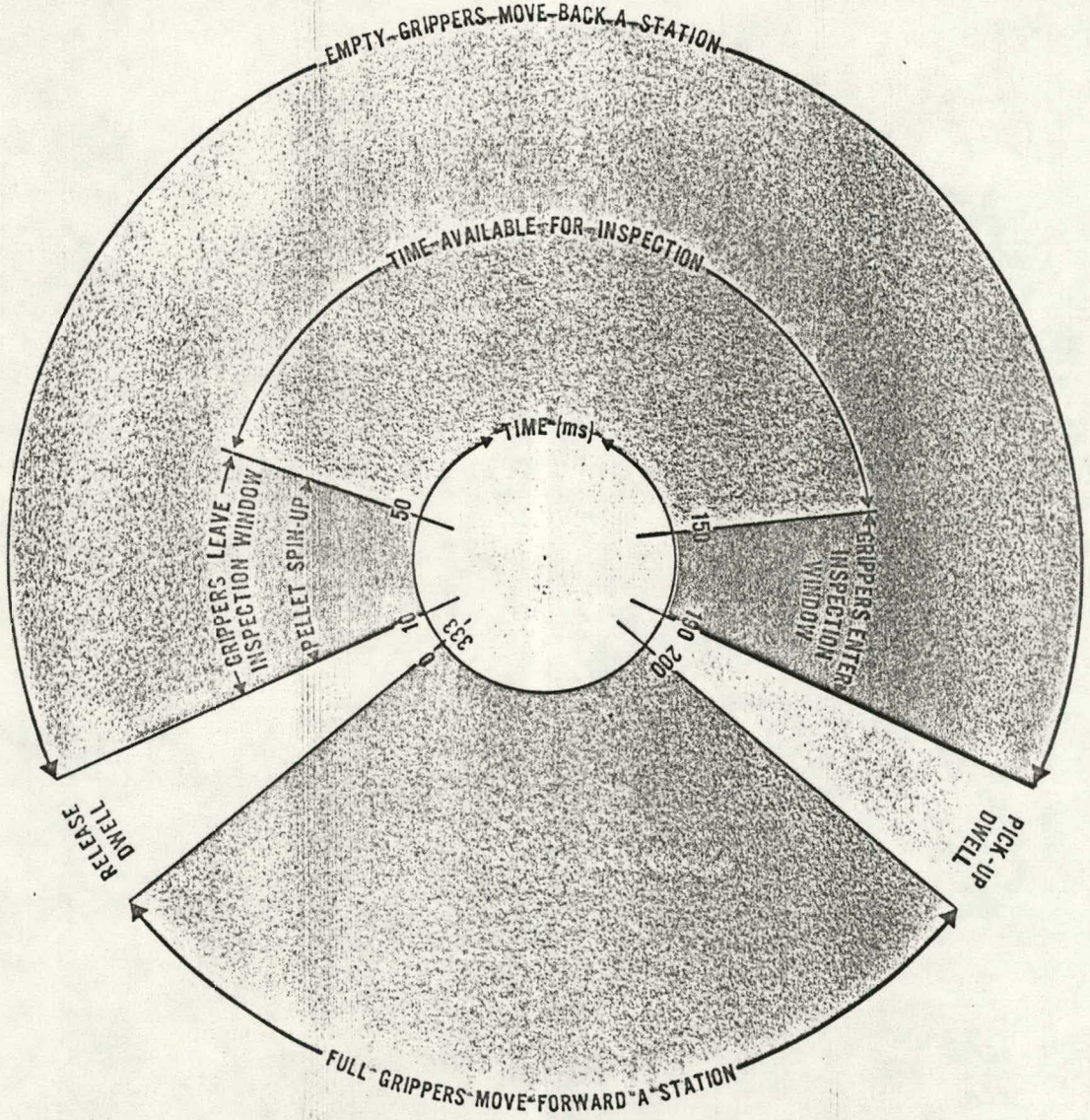


HEDL 7903-209.2

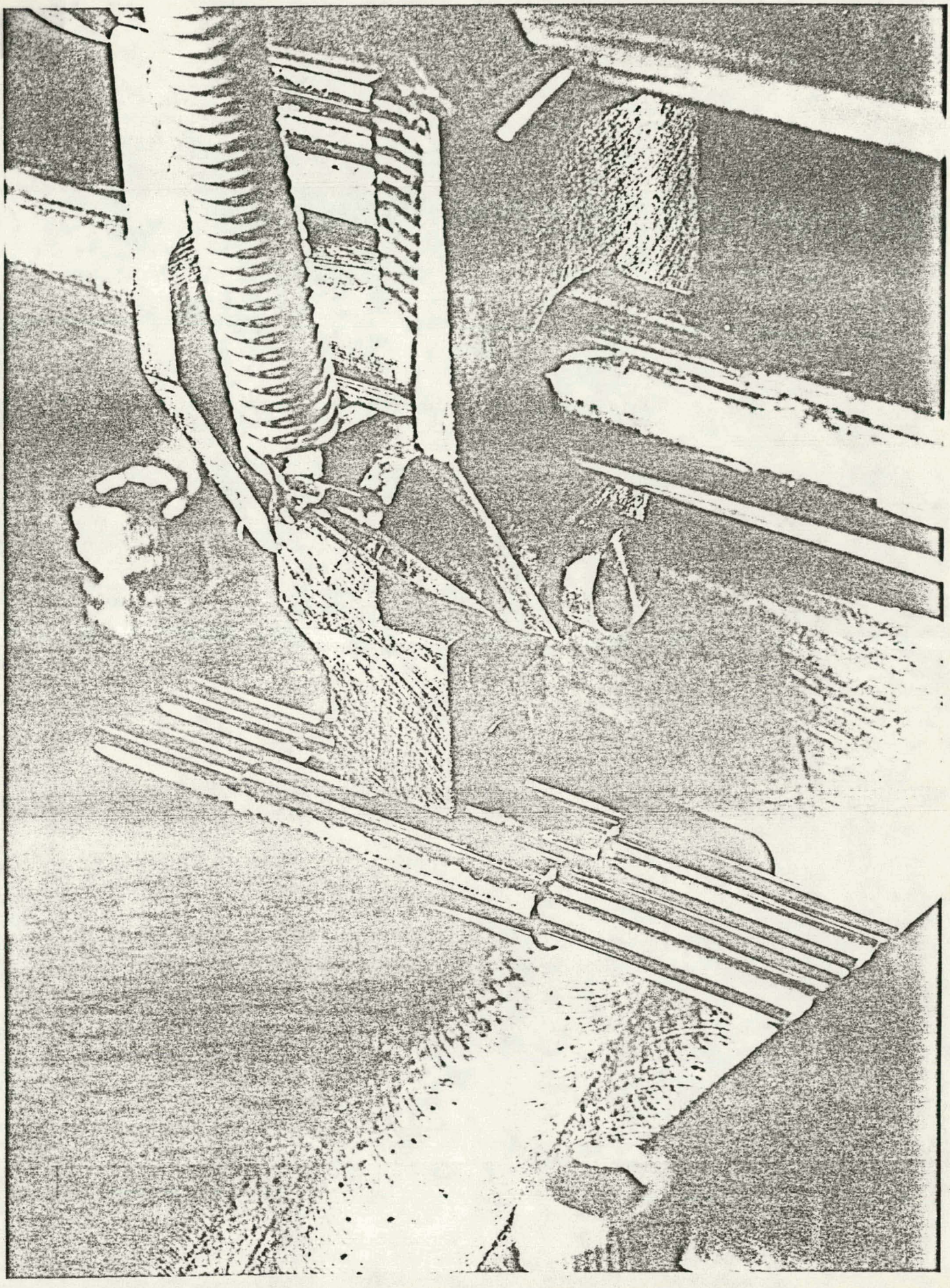


#2

PELLET GAGE HANDLING CYCLE

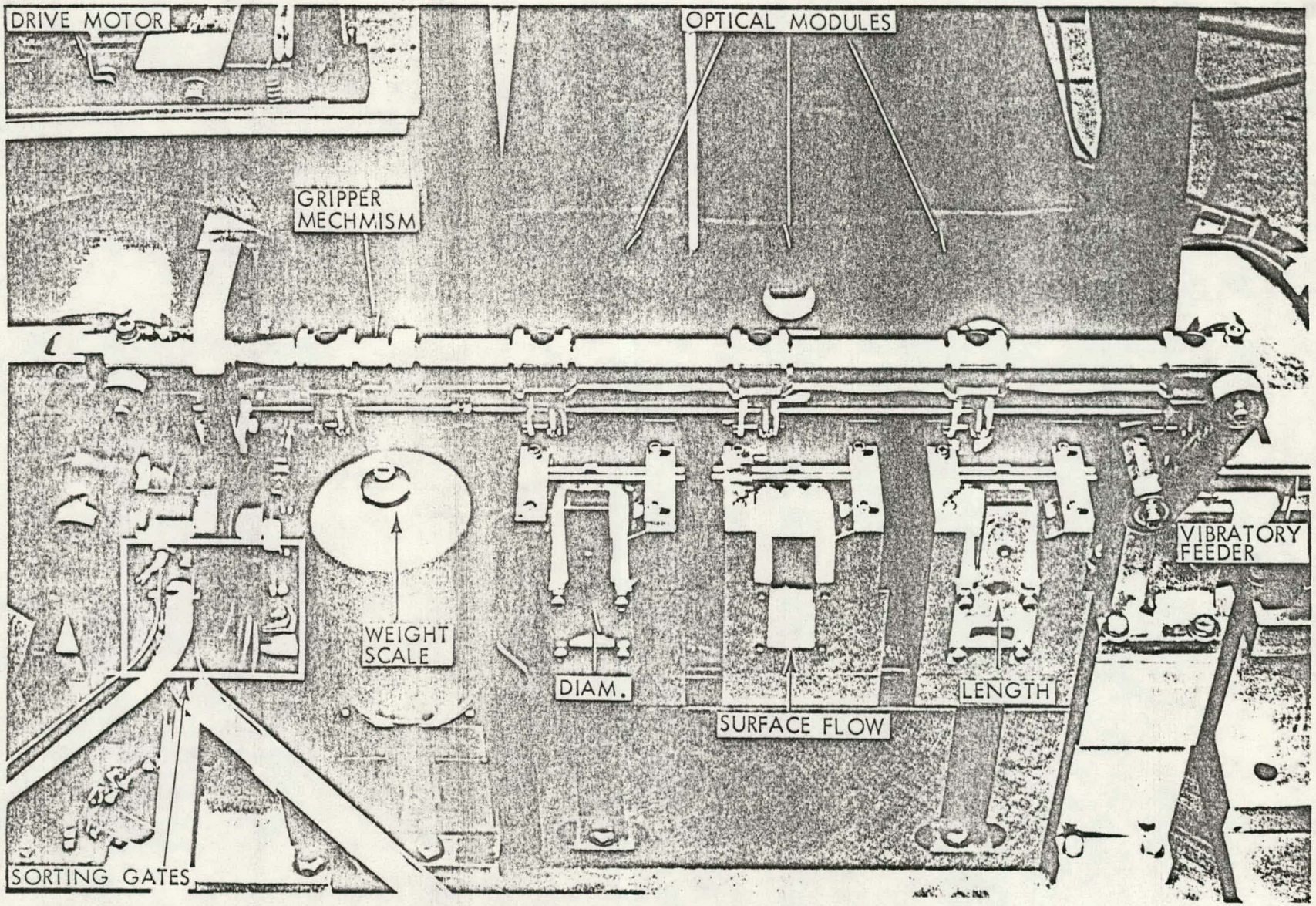


#3



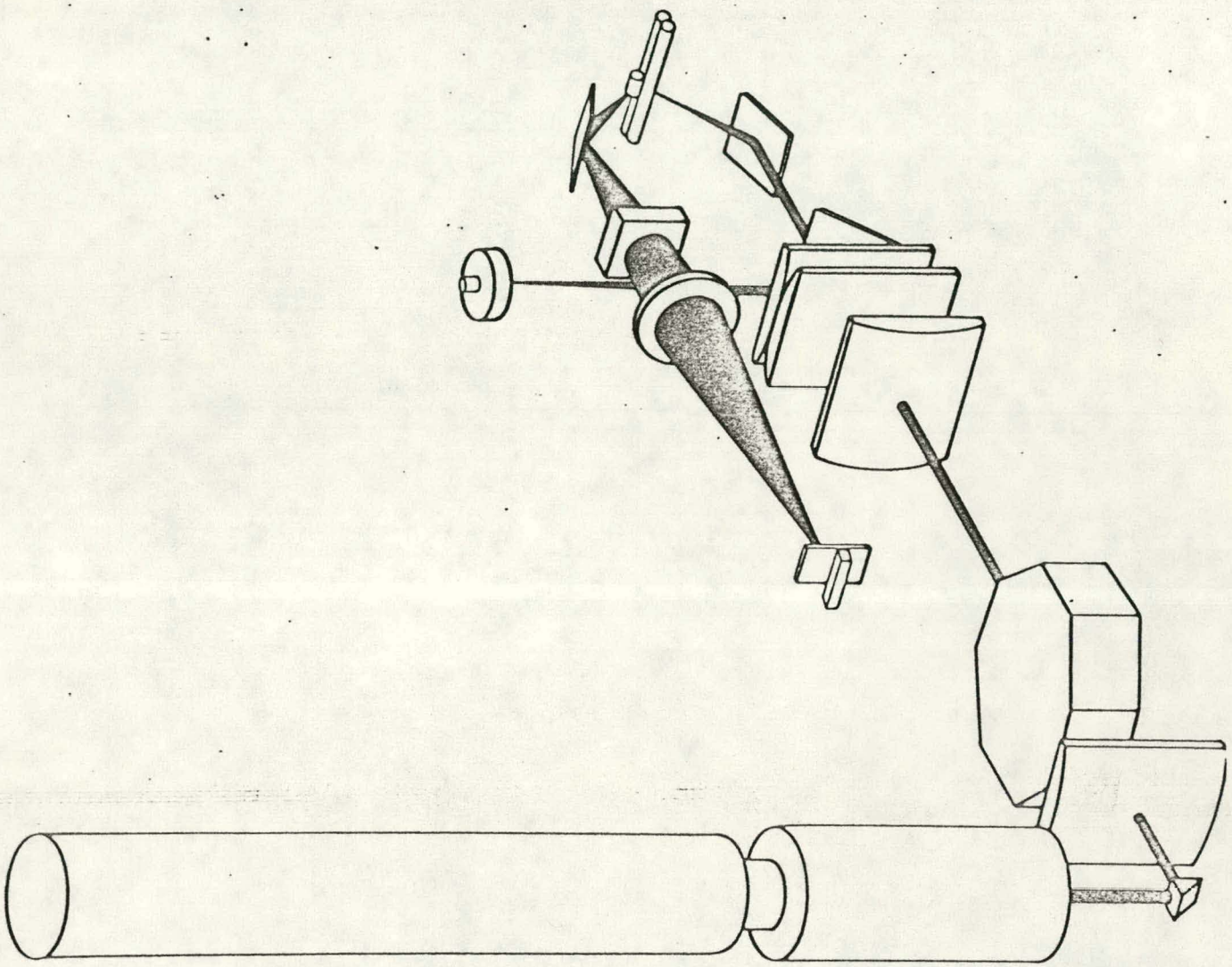
4

MECHANIZED FUEL PELLET INSPECTION SYSTEM

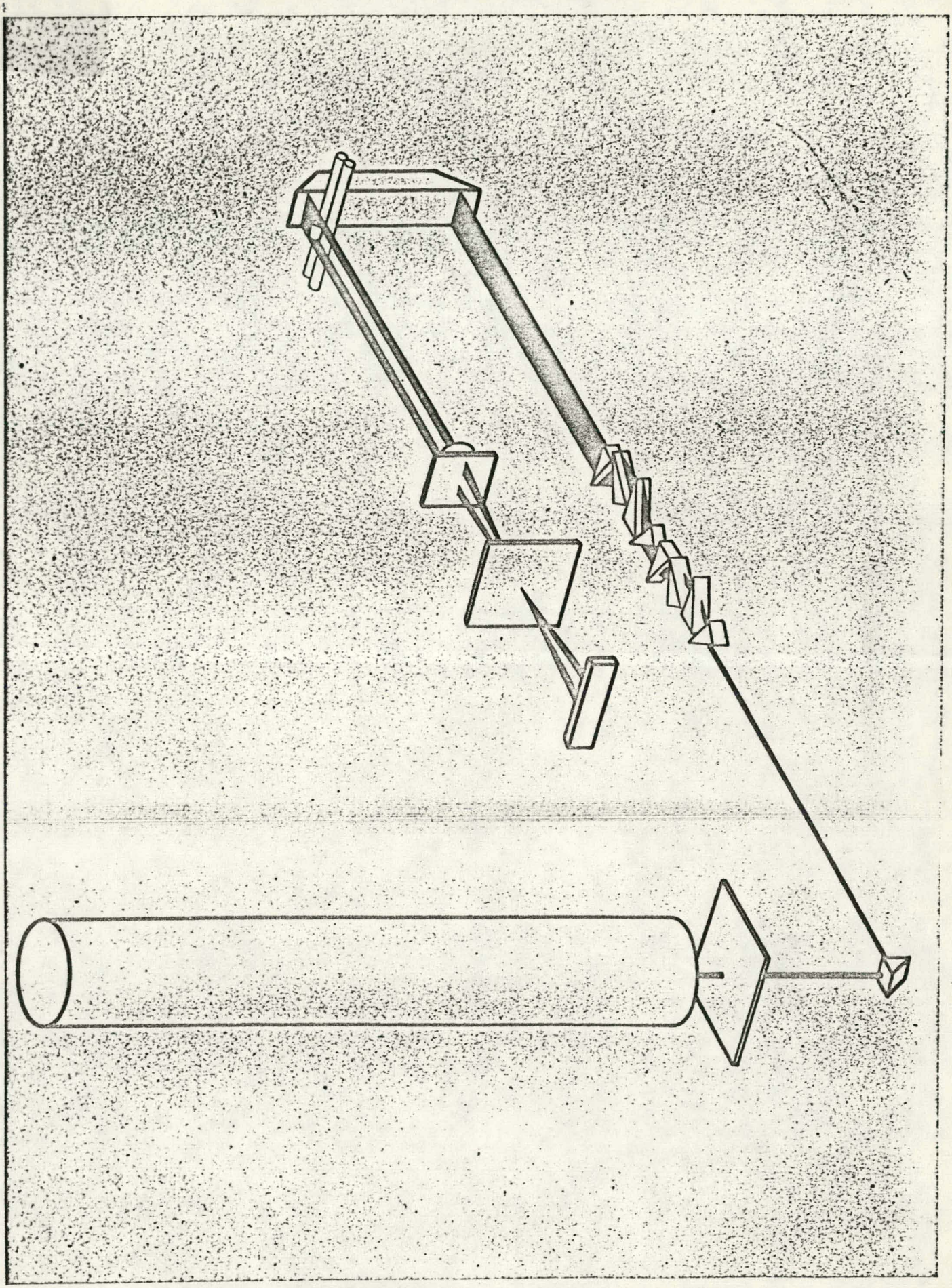


#5

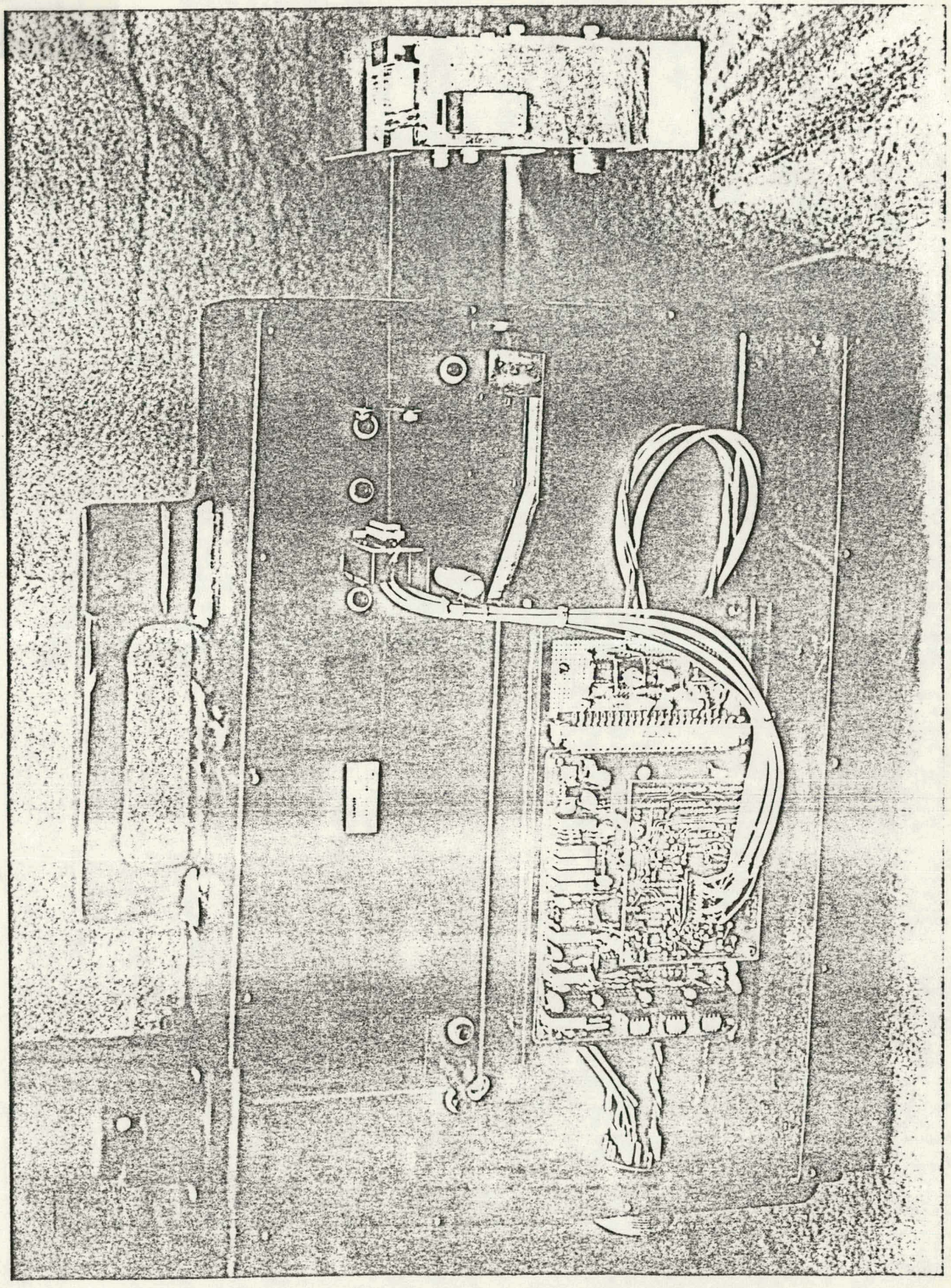
HEDL 7907-043.12



#6



#7



#8