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WINDSCALE

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Transporter System for Remotely Operated Manipulators.

by Dr. J.R. Wakefield.

Transporter system for remotely operated manipulators

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Introduction

This system is intended for installation in irradiated fuel examination cells or plutonium fuel fabrication cells in which a continuous line of workstations is located in horizontal mode (Figure 1). It is usual for a pair of manipulators to be committed to each workstation and the operators to move from one to another as the workpiece progresses. Thus at any time several pairs of manipulators are lying idle representing a considerable capital investment. Also when a manipulator requires maintenance, it is usual for it to be withdrawn into the operating area at the expense of extensive tenting and interruption to adjacent workstations. This operation breaks the sealed containment concept and could lead to contamination of equipment and operators. The present proposal aims to eliminate this aspect and offers the possibility of savings in capital investment on manipulators and material transport systems.

Description and operation

In essence, pairs of remotely operated manipulators are carried on transporter trolleys along the length of the line cells and are moved from station to station as the work progresses (Figure 2). Thus, in a line of ten workstations with say two operators, two such transporters would be installed with one spare in reserve. The operating console for each pair is plugged in at each station and has sufficient leads to permit overlap. The movements of the transporters are also controlled from these consoles and offer an additional degree of freedom to the manipulators. In addition, a flat loading platform on the transporter is used for conveying materials and components from one workstation to another (Figure 3).

Maintenance and repair of the manipulators would be carried out in an end cell in which the spare set is normally parked. Following decontamination, modular components may be passed out to an attached glove-box for hands-on maintenance and the fitting of new parts. The transfer of parts and materials in and out of the glove-box is by sealed posting techniques. The transporter unit will operate from the floor or walls of the cell or may be suspended from the roof.

Design of the system

The drive to the transporter trolley is by magnetic linkage with a compact master unit travelling outside the containment envelope. The master unit is propelled by a geared induction motor via steel cables. These cables also carry the low voltage DC current to the propulsion electromagnet mounted on the master unit. The drives to the articulated arm manipulators mounted on the slave trolley are via rotary permanent magnetic couplings from the master unit. These drives are picked up at the base of the manipulators and are transmitted by gears and lead screws to the arm and jaw functions (Figure 4). Power to the magnet motors is supplied via a supported multicore flat cable system running within the master unit track. The design permits a total air gap (stainless steel membrane plus clearances) of up to 10mm although the preferred arrangement is for 3mm of steel and clearances of 2mm each side.

Possible breakdown consequences

It is important in any proposal concening active equipment that full consideration be given to all breakdown and rectification procedures.

1. Transport system

(a) Master Unit. This can be driven out after disconnection from the slave unit by de-energising the electromagnet. If the driving motor has failed this can be repaired conventionally as the whole of this system is clean. If the electromagnet has failed, this can be replaced and then driven back to pick up control of the slave trolley.

(b) Slave unit. This is entirely passive and the only moving parts are the wheel bearings. If driveable, it would be driven to the end of the cell line for cleaning and subsequent replacement or maintenance. If not driveable it could be pulled or pushed by other units to the maintenance area.

2. Manipulators

Each manipulator, on command, will revert to the folded transportable position. If this fails, then the adjacent manipualtor would be used to effect this. Alternatively, each manipulator could be detached from the slave unit for better access and approach either by its partner or another master/slave unit.

Present state-of-the-art

The magnetically linked master/slave transport system has been designed, developed and is in manufacture(1). A prototype system has performed all the required tests and is sufficiently developed for installation (Figures 5 and 6). The magnetic base drives for the manipualtors have been designed (Figure 7) but require some development(2,3). The development of the 5kg articulated robot arm suitable for adaption to this concept is in progress(4). Development work on the control system and man-machine interfaces is also planned(5).

References

1. J R Wakefield. Windscale Nuclear Laboratories. (To be published).

2. J W Finch. 'Permanent magnet synchronous doubly-salient couplers'. Proc. IEE Conference on Special Machines. September 1981. London.

3. Private communication. K J Hill, A Dumbreck. AERE Harwell.

4. 5.Private communication. J Phillpott. AERE Harwell.

MULTI-MANIPULATOR

CELL LAYOUT

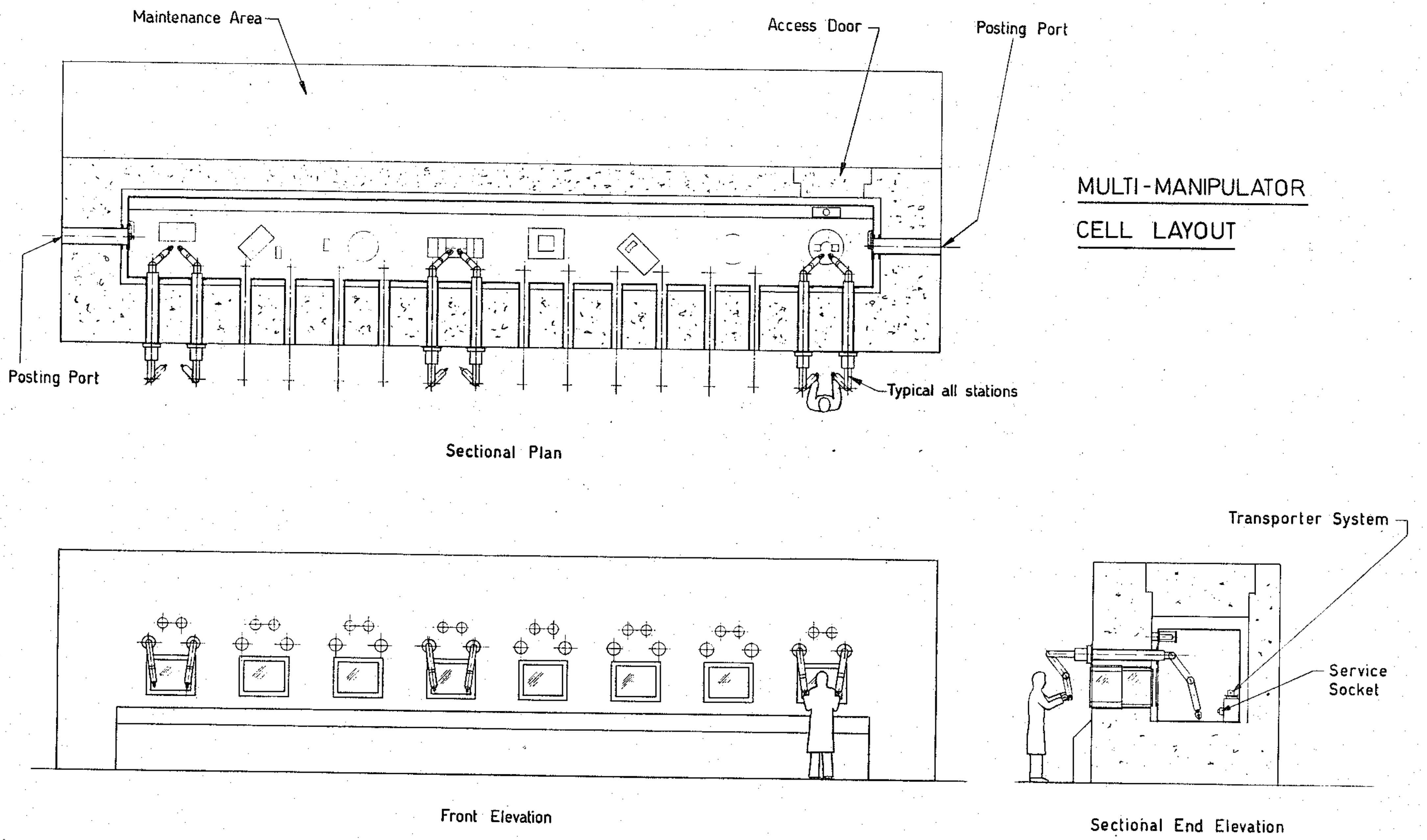


FIG. I.

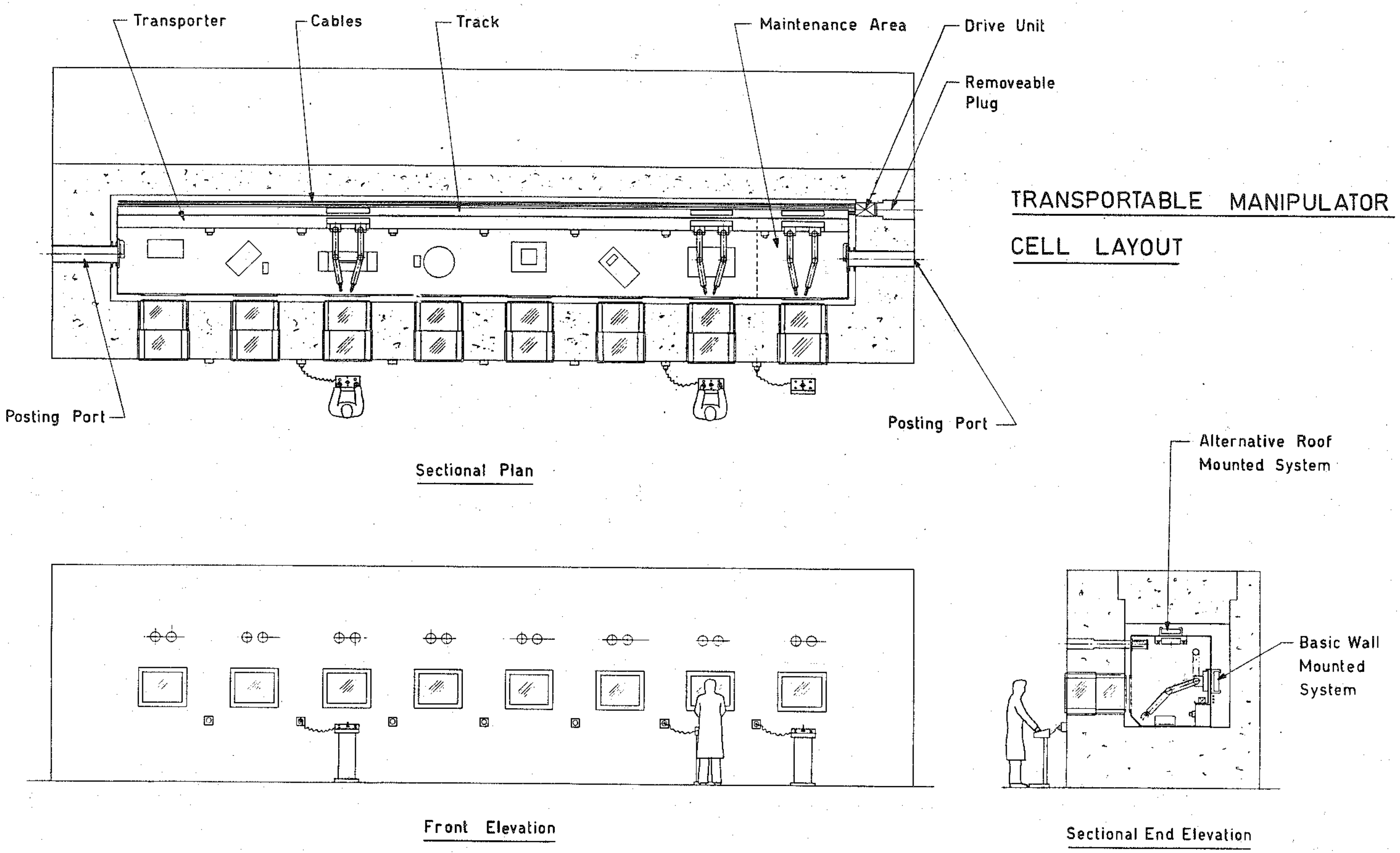

TRANSPORTABLE MANIPULATOR
CELL LAYOUT
Transporter
Cables
Track
Maintenance Area
Drive Unit
Removeable
Plug
Posting Port
Posting Port
Sectional Plan
Front Elevation
Alternative Roof
Mounted System
Basic Wall
Mounted
System
Sectional End Elevation

FIG. 2.

TRANSPORTABLE MANIPULATOR

CELL LAYOUT

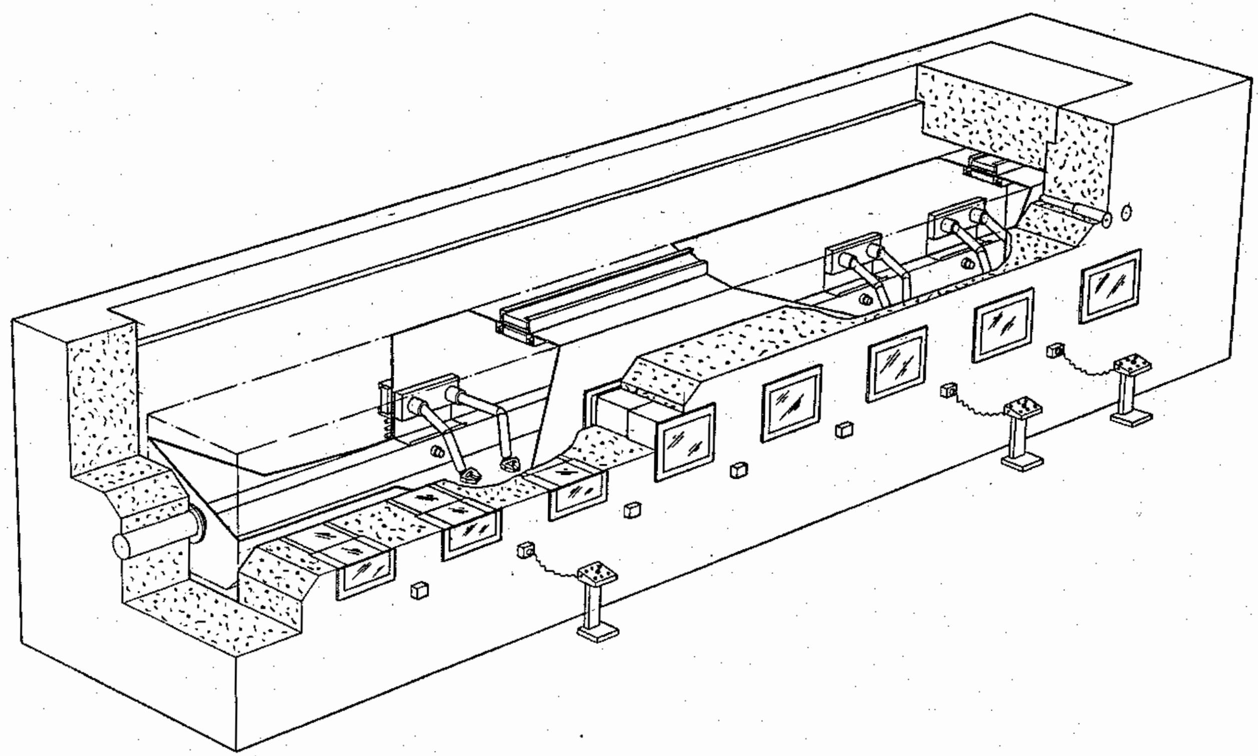
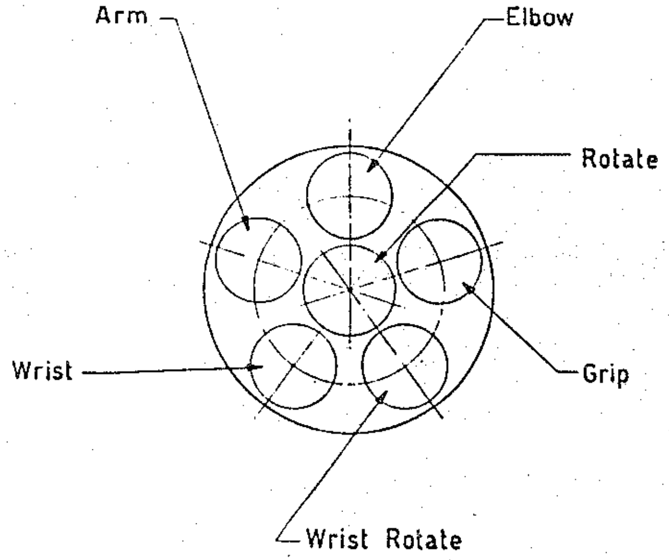
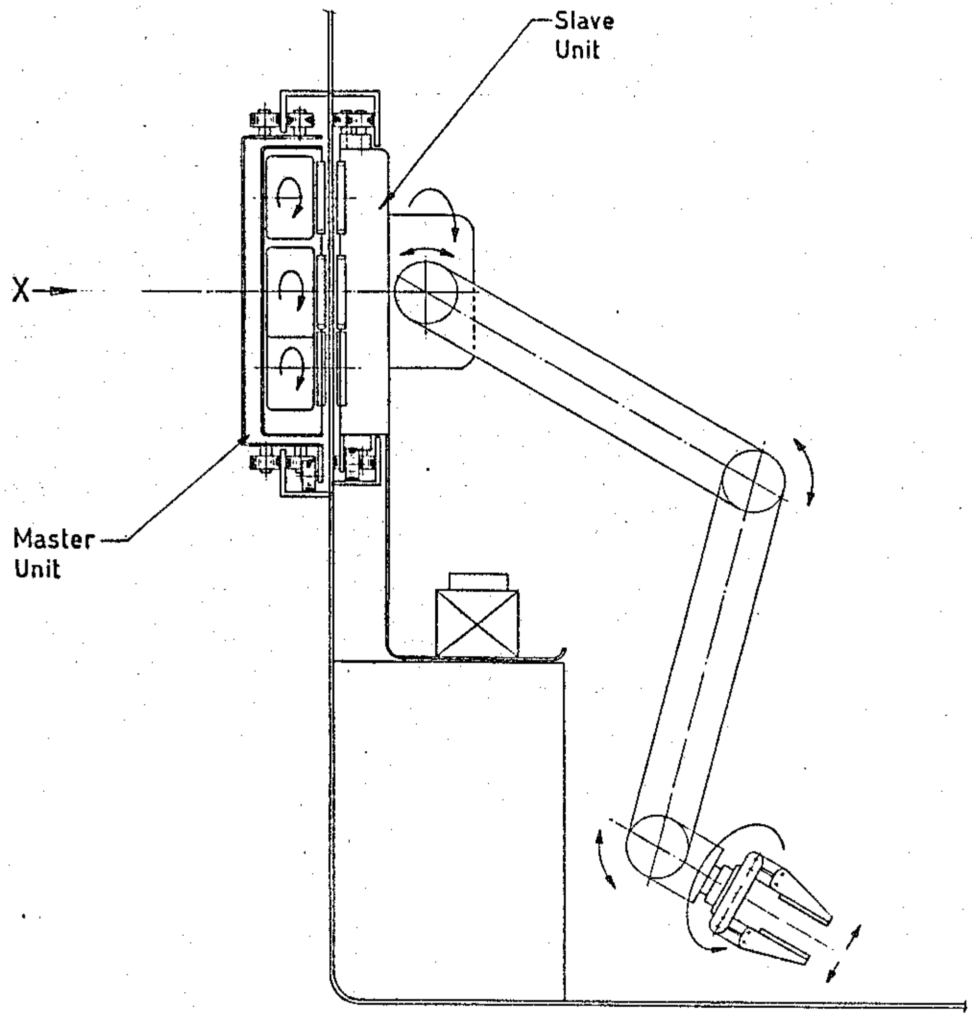


FIG 3.



VIEW ON X



SECTION ON ℄ OF MANIPULATOR

- TRANSPORTABLE MANIPULATOR -

SECTIONS THROUGH

DRIVE MECHANISMS

FIG. 4.

FIG. 5

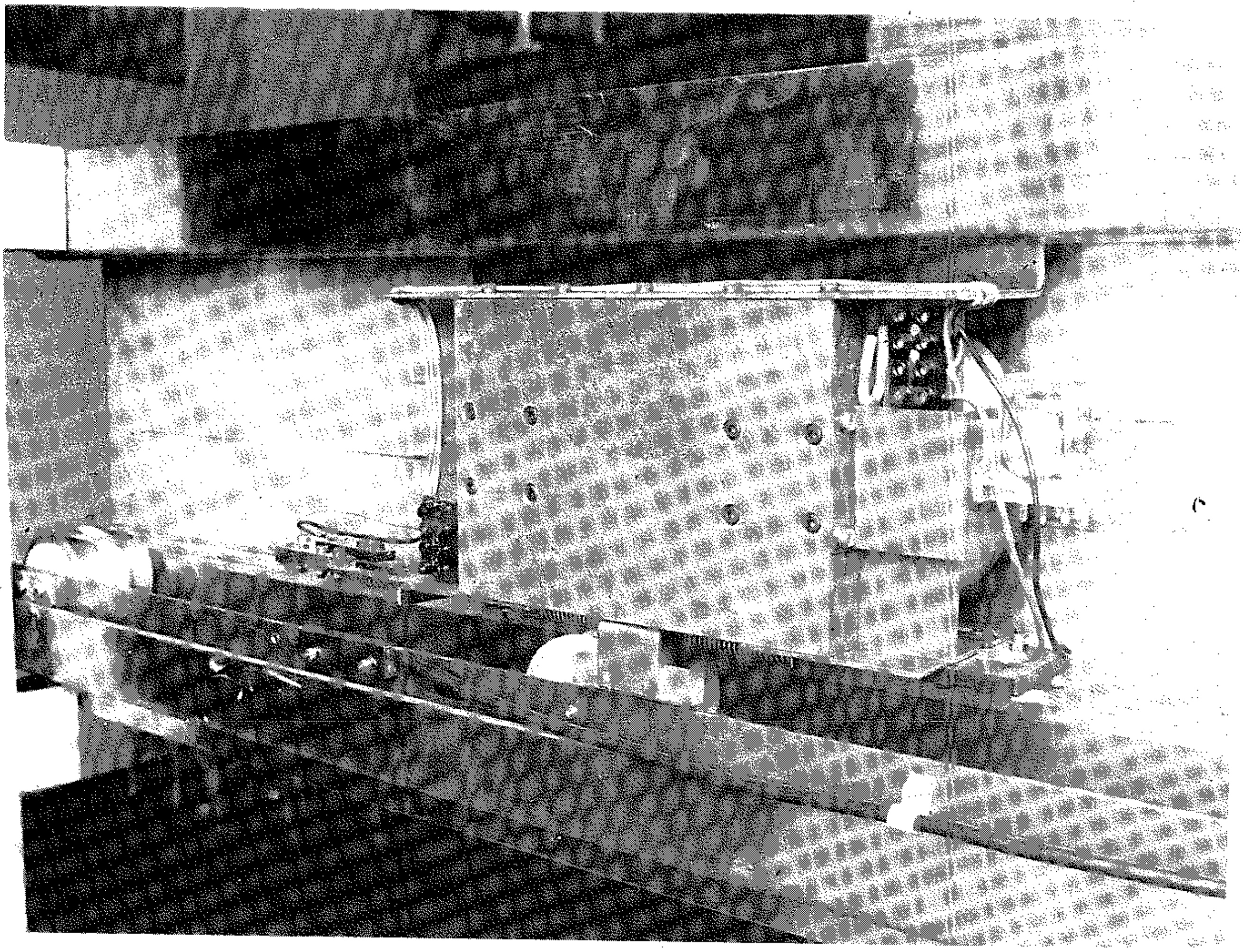
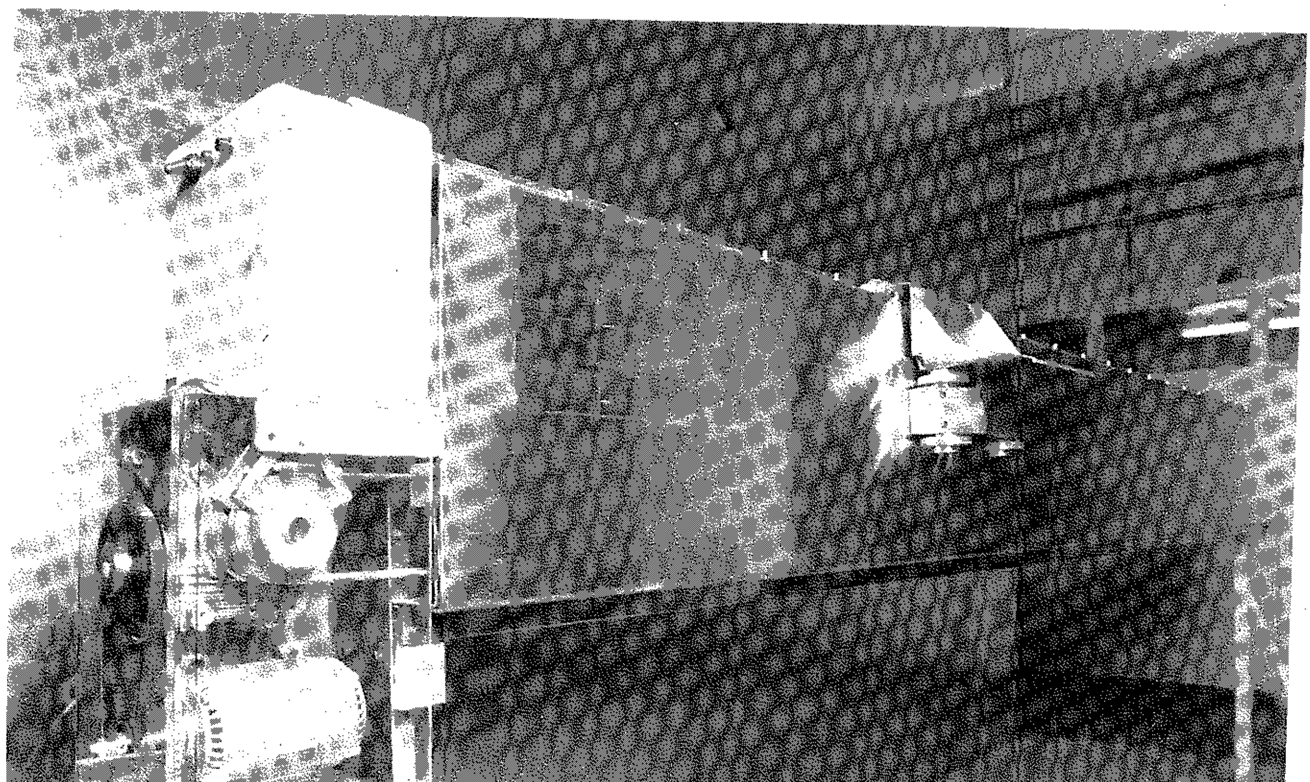


FIG. 6



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