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REMOTE MAINTENANCE TESTING

JULY 1, 1978 - JUNE 30, 1979

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ABSTRACT

The results of the remote handling and remote maintenance testing at the Remote Maintenance Test Facility (RMTF) from July 1, 1978, through June 30, 1979, are presented. Specific test arrangements and test results from the RMTF of such items as high-efficiency particulate air (HEPA) filter disposal, solids removal equipment, and sample transfer container capper/decapper in support of several projects are discussed.

SUMMARY

For approximately 5 years, the RMTF has maintained a program at the Idaho Chemical Processing Plant (ICPP) for evaluating and testing remote handling techniques and equipment for the remote maintenance of designated plant equipment in new plant expansion and upgrading the existing plant. This report covers the fifth year of this effort. Equipment tested and evaluated during this period included a HEPA filter burial cover, a remotely replaceable in-cell light fixture, solids removal equipment, a dissolver closure, underwater handling tools, and a sample transfer container capper/decapper.

CONTENTS

FIGURES

FIGURES (contd.)

REMOTE MAINTENANCE TESTING
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I. INTRODUCTION

With the introduction of the "as-low-as-reasonably-achievable" (ALARA) personnel exposure philosophy, the development and use of plant equipment specifically designed for remote maintenance and the development of the associated remote handling techniques have become increasingly important. The predicted reduction in the personnel exposure limits in the near future will further emphasize remote maintenance as a viable approach to the resulting problems. This report covers the fifth year's effort in testing this type of equipment[a] and handling techniques. Previous annual reports on this testing were as follows: ICP-1081[1] (1974-1975), ICP-1113[2] (1975-1976), ICP-1143[3] (1976-1977), and ICP-1170[4] (1977-1978).

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[a] The use of a commercial name for equipment or material used or the appearance of equipment or material in one of the illustrations in this report is not to be construed as an endorsement of that brand, nor is it implied that this is the only equipment or material of its kind that is available.

II. OBJECTIVES

The primary objective of the remote maintenance testing effort is to test and evaluate equipment and techniques to reduce personnel radiation exposures to ALARA levels during the maintenance of failed plant equipment. Most of the failed equipment will be remotely replaced rather than repaired. The removed equipment item will be decontaminated remotely in a decontamination cell or corresponding shielded area to a low level of residual contamination and then repaired by direct maintenance.

In many instances, the remote replacement of the failed equipment will greatly reduce the plant "downtime", since extensive plant decontamination to satisfactory levels for personnel access will not be required. However, the present philosophy is to provide for the remote replacement of only the more failure-prone equipment items based on past operating experience with comparable equipment. Marginal failure items, by comparison, would be installed with quick-release connectors for direct maintenance. Extensive decontamination and plant downtime would be required in some of these cases before the connectors could be opened manually and the item repaired or replaced.

Remote maintenance testing is aimed at verifying the remote handling aspects of mocked-up equipment relative to the final installation and also review of similar system designs. However, several of the mockups that have been fabricated and tested were of sufficient detail and accuracy to also confirm the final design.

III. TEST FACILITIES

The RMTF, which is located in the Materials Testing Reactor Building, was used for all the mockup and testing of remote maintenance items during the fifth year. The facility consists of a master-slave area and a wall-mounted manipulator area.

The master-slave area (Figure 1), which is designed to simulate a process hot cell, is about 4.6 m (15 ft) long by 6.1 m (20 ft) wide by 4.6 m (15 ft) high. Associated with it are three mocked-up wall sections, each containing a pair of manipulators and a mock viewing window. These wall sections are mounted on heavy-duty casters for flexibility of equipment arrangements. One of the mocked-up wall sections is shown on the left side of Figure 1. Also shown in Figure 1 are the overhead bridge crane and bridge-mounted manipulator that are provided as part of the facility. This area is used to simulate all process cells where remote handling is done by master-slave manipulators or manipulation from above (through a cell hatch opening) by the bridge crane and bridge-mounted manipulator.

The wall-mounted manipulator area (Figure 2) is designed to simulate a process cell arrangement where many valves can be located on one wall and where remote operations are performed with a single wall-mounted manipulator and a 907-kg (1-ton) bridge crane. The structure comprising this area (Figure 2) is approximately 12.2 m (40 ft) high, 3.1 m (10 ft) wide, and 18.3 m (60 ft) long. The valves, which are located on the wall opposite the wall-mounted manipulator, are readily accessible for remote changeout studies and development. Large airlifts, process off-gas filter units, and remotely replaceable pump units have also been mounted on this wall for changeout studies using the single wall-mounted manipulator. Two portable simulated viewing windows are located on the manipulator side of the corridor for viewing studies. Television (TV) units, including both normal and three-dimensional units, are also used

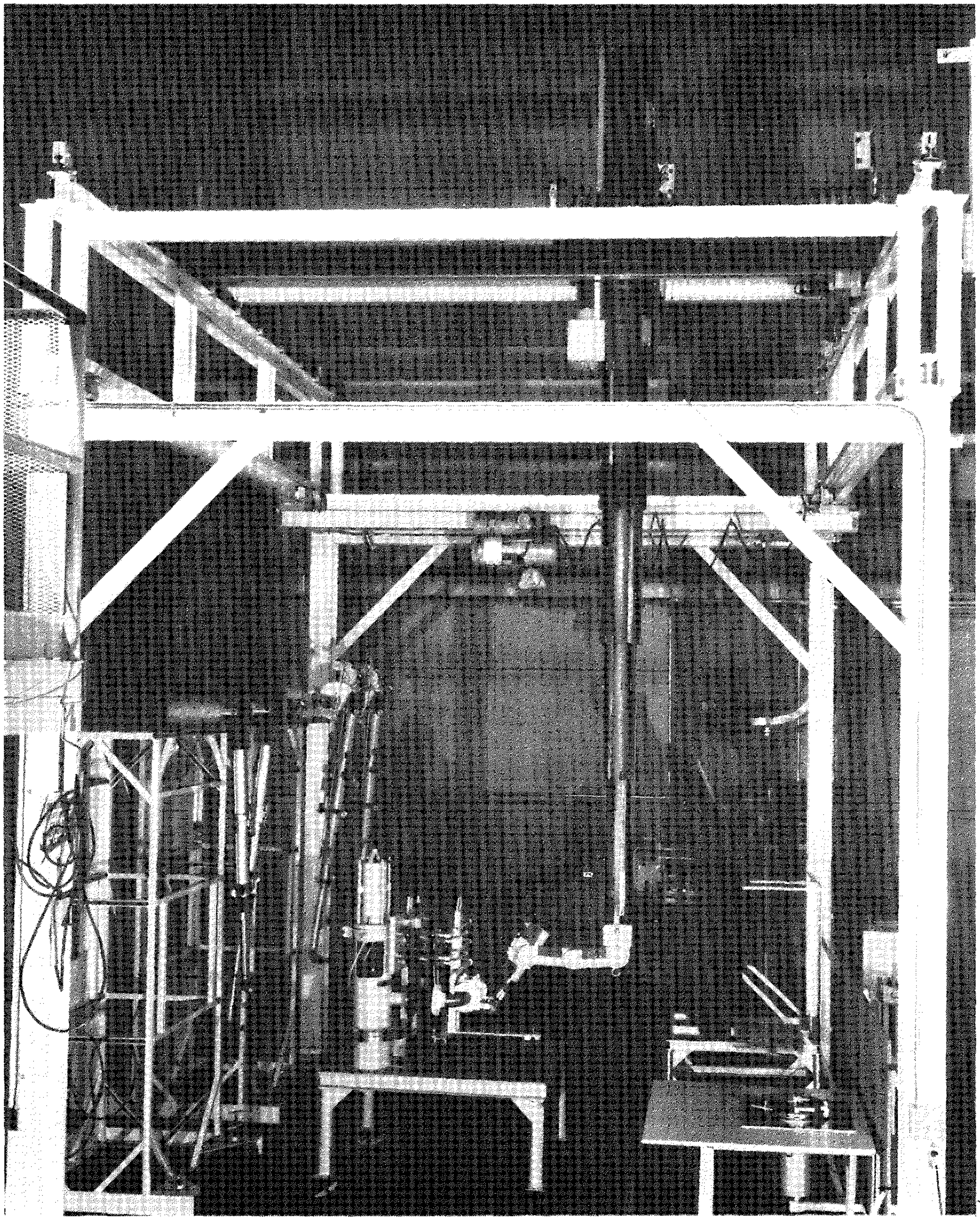

Fig. 1. Master-slave area.

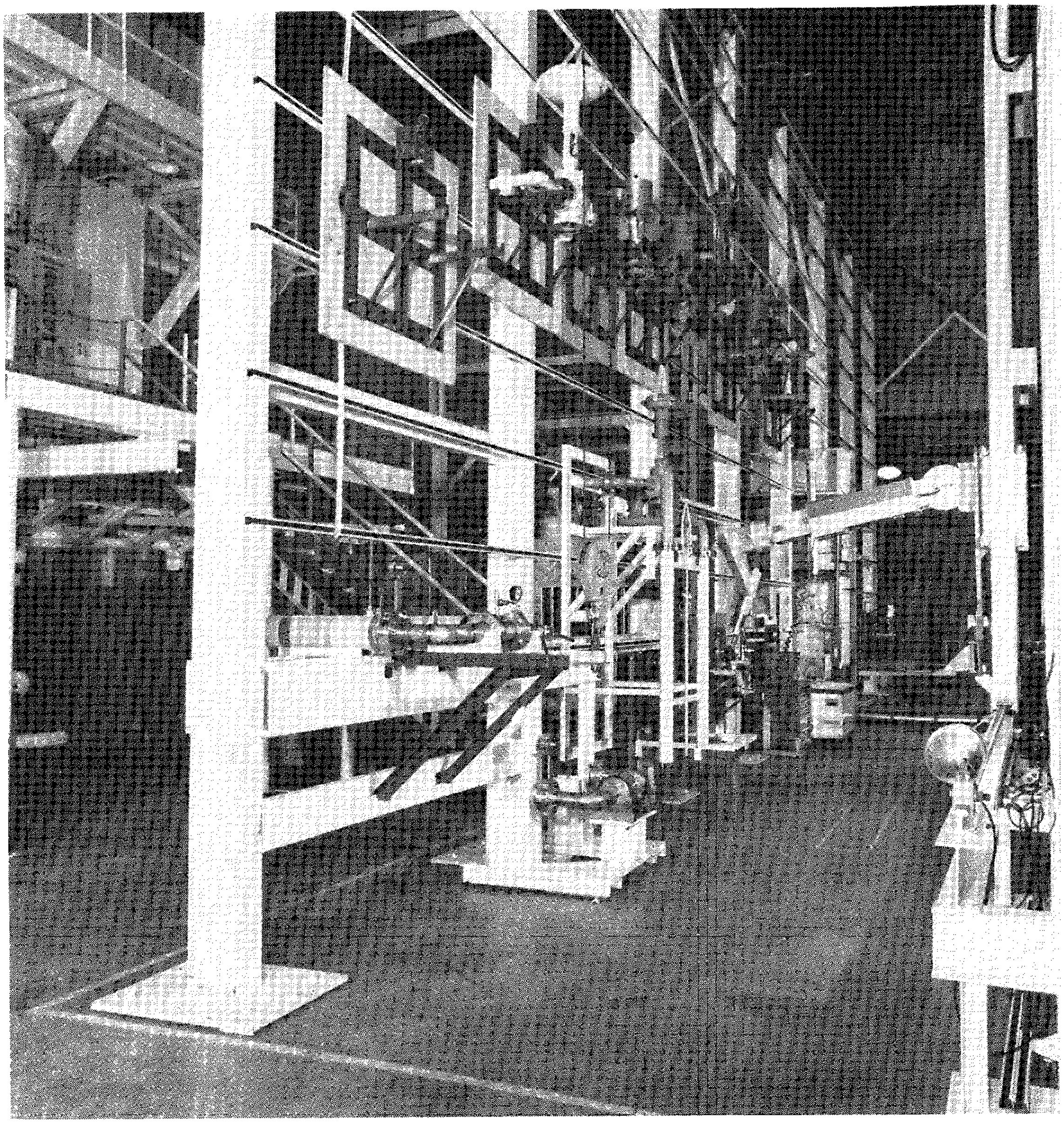

Fig. 2. Valve cubicle area.

as a part of the viewing and changeout studies. A video tape unit included with one of the TV monitors has been used extensively for taping complete remote handling operations for playback for operator training and other purposes.

IV. REMOTE HANDLING DESIGN

Testing effort continued on two items that had been started earlier--the HEPA filter cover and the pneumatic transfer capsule capper/decapper.

1. NWCF FILTER BURIAL COVER

A filter handling fixture was previously described (ICP-1113[5]) to remove, replace, and transport the NWCF process off-gas filter units between the valve cubicle and filter handling cell. The fixture is an ice-tong arrangement with two handles. When one handle is vertical, the fixture is released from the filter; when the other handle is vertical, the fixture is positively latched to the filter housing. The solid base plate of the fixture also serves as a cover for the top surface of the contaminated filters during transfer to the filter handling cell.

Self-sealing covers have also been provided for each filter to prevent the spread of contamination during transfer from the filter handling cell to the Radioactive Waste Management Complex (RWMC) and during processing at the RWMC. Figure 3 shows one of the covers being lowered onto a filter with the guide-on skirts of the cover providing the alignment. The sealing channel in the top of the used filter will still contain the silicone sealing grease after the filter is removed from the process. The self-sealing cover contains a continuous peripheral knife edge which will penetrate the silicone as the cover is lowered to complete the seal. Figure 4 is a bottom view of the cover showing the guide-on skirts and also the spring steel latches that lock the cover permanently to the filter by engaging beneath the silicone seal channels on four sides.

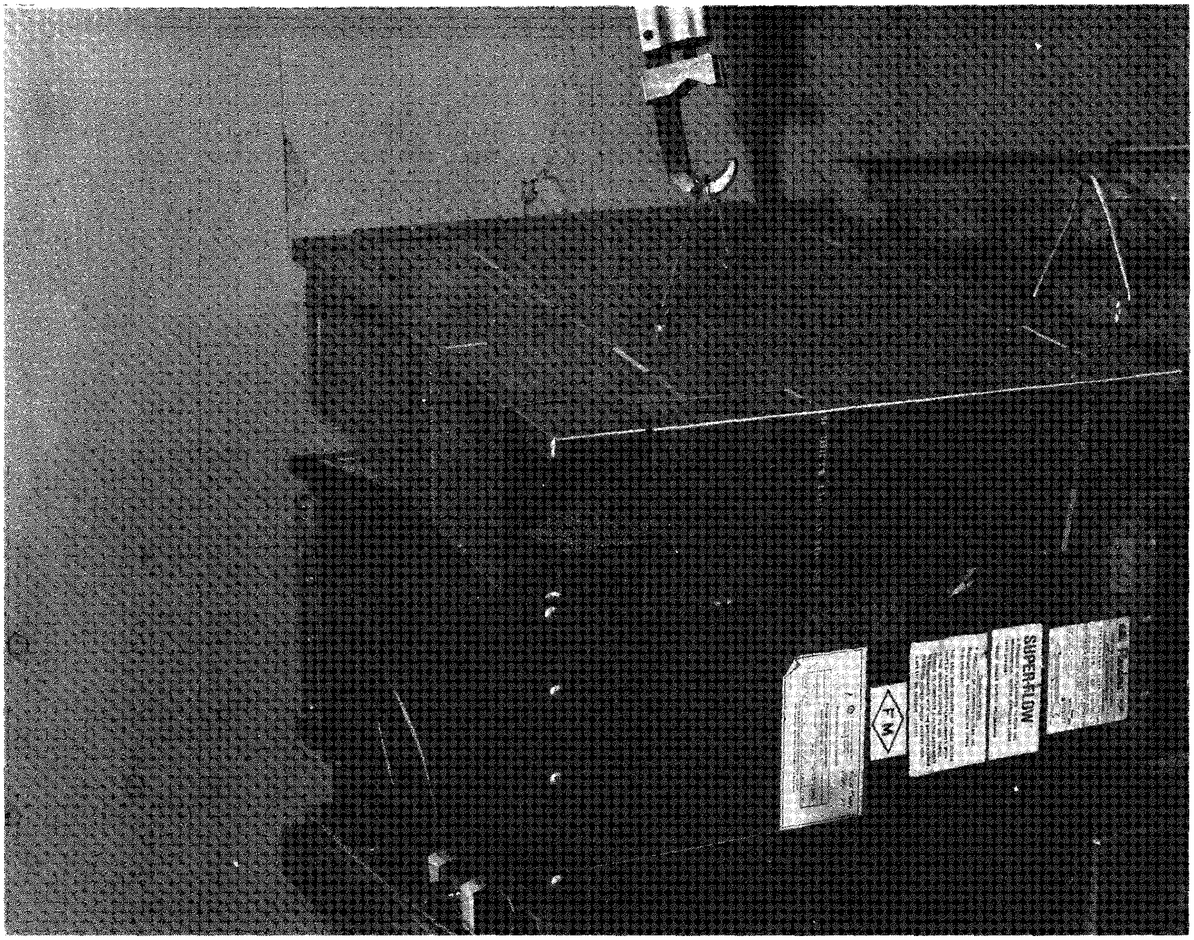

Fig. 3. Filter burial cover being installed.

2. NWCF SAMPLE TRANSFER CAPPER/DECAPPER

A sample transfer capper/decapper was previously described (ICP-1170[6]) to cap and decap a plastic pneumatic transfer capsule using the master-slave manipulators. The new model is designed for easy removal of the entire unit for any required maintenance. In Figure 5 it is being removed from the wall support bracket using the manipulator. The capper/decapper is small enough to be transferred into and from the sampling cell through the double-door sample transfer system described in ICP-1143.[7]

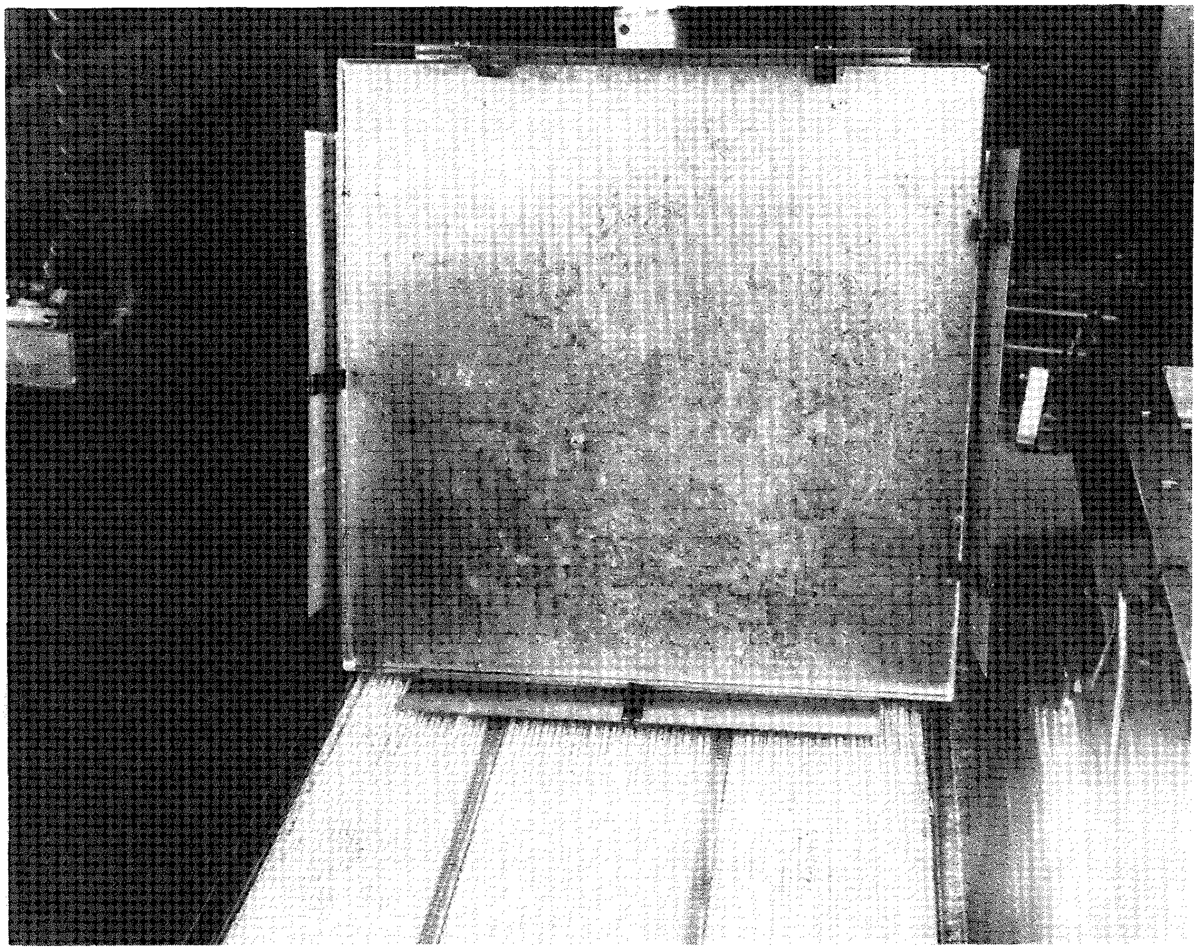

Fig. 4. HEPA filter burial lid (bottom view)

3. NWCF TV CAMERA SUPPORT SYSTEM

Several remote maintenance operations in the NWCF will be performed in cell locations not visible through the existing cell viewing window or in cells which have not been provided with viewing windows. In both cases TV viewing must be provided in the cells by portable TV units. To assure a clear stable picture of each maintenance operation, the TV unit will be placed on a support stand that has been located to give the best possible view. Some cases may require two TV units for adequate visibility.

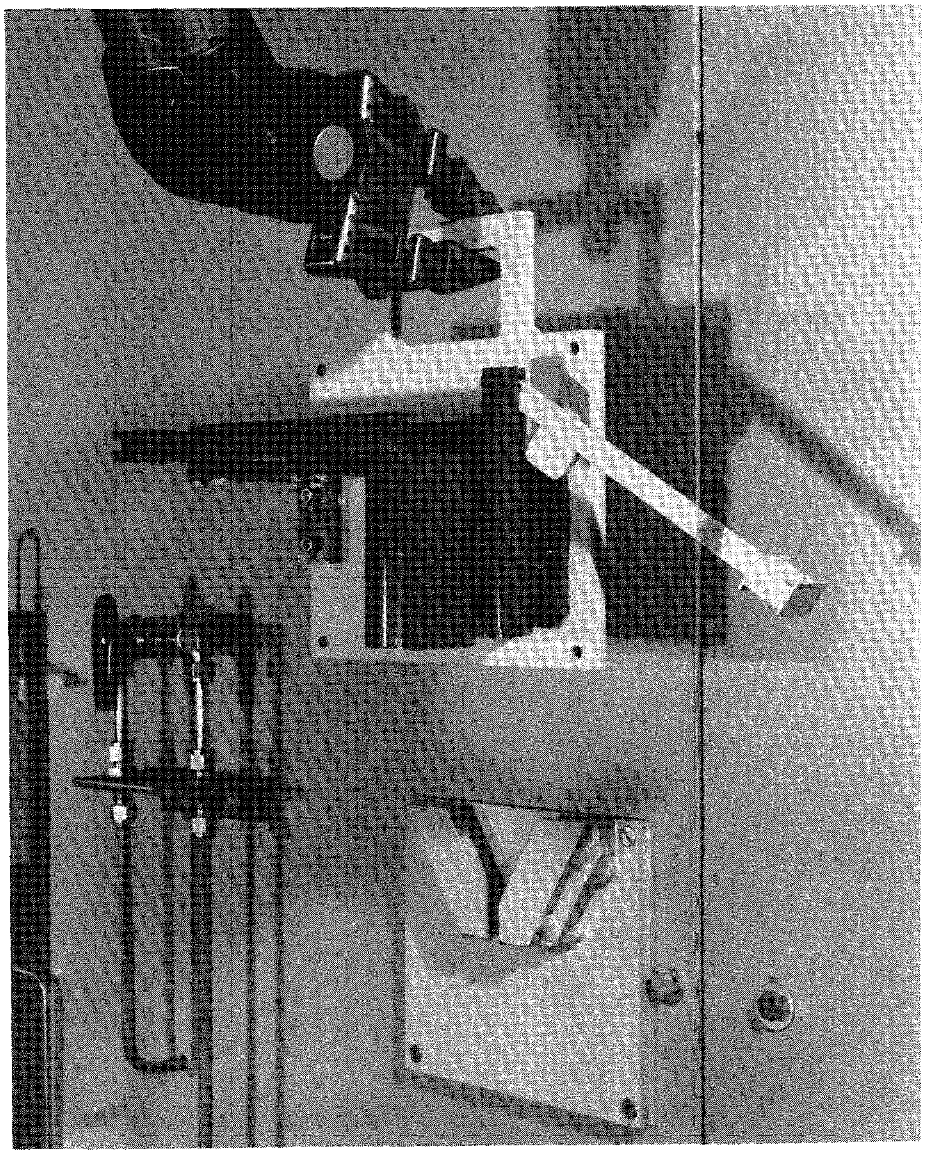

Fig. 5. Capper/decapper removal.

The TV camera may be plugged into TV service stations that have been provided in the plant cells for in-cell connections, or the camera cord may be lowered with the camera through the opened cell hatch from above. Two camera supports were designed for these two approaches, although only one unit (Figure 6) was fabricated for testing. This unit is composed of three parts; viz., (1) the remotely removable TV camera assembly, (2) the remotely removable TV cable assembly, and (3) the

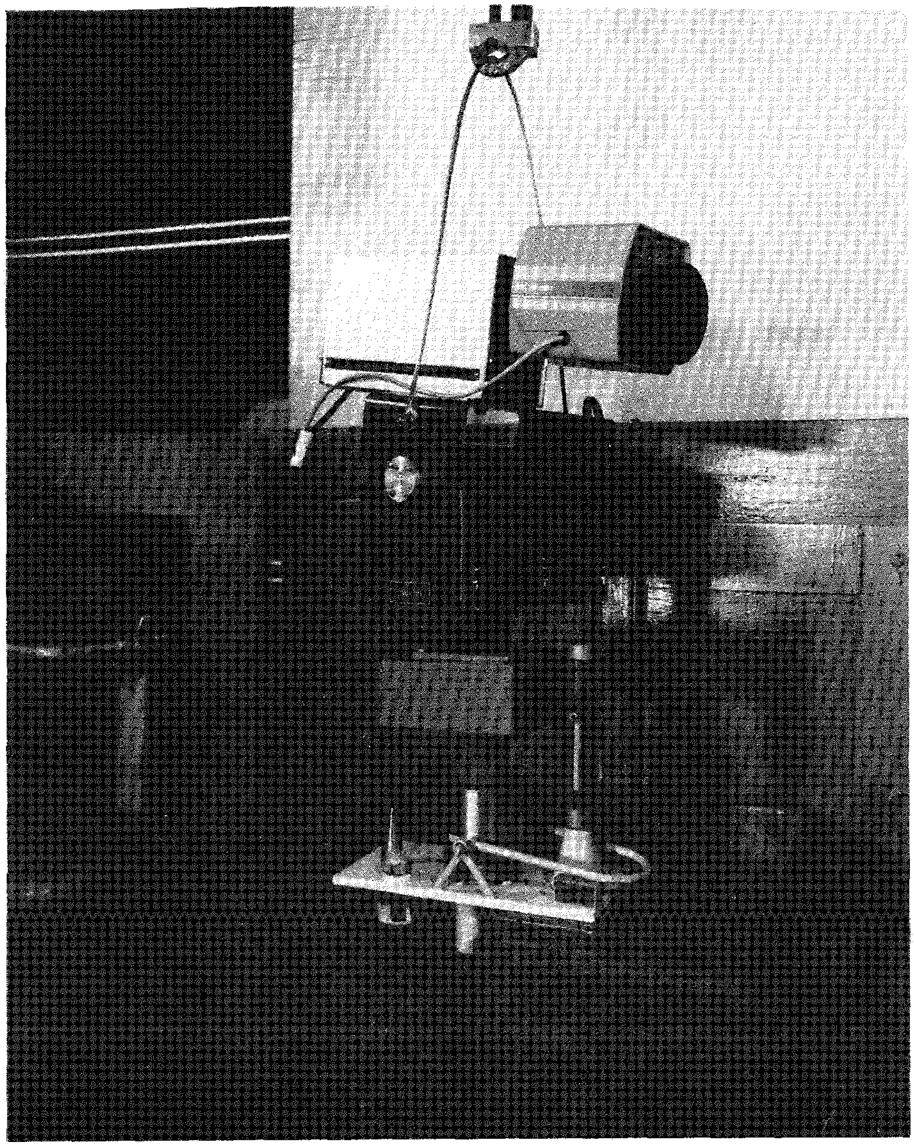

Fig. 6. TV camera support assembly.

permanently mounted TV camera support stand. A remote electrical TV connector is provided between the camera assembly and the cable assembly which allows camera control and picture transmission to be connected to the plant TV system without lowering and removing contaminated cables from the cell. Figure 7 shows the three parts being separated. Testing of this unit is continuing.

The other camera support design has the TV cable attached directly to the removable TV camera assembly. This arrangement would be used

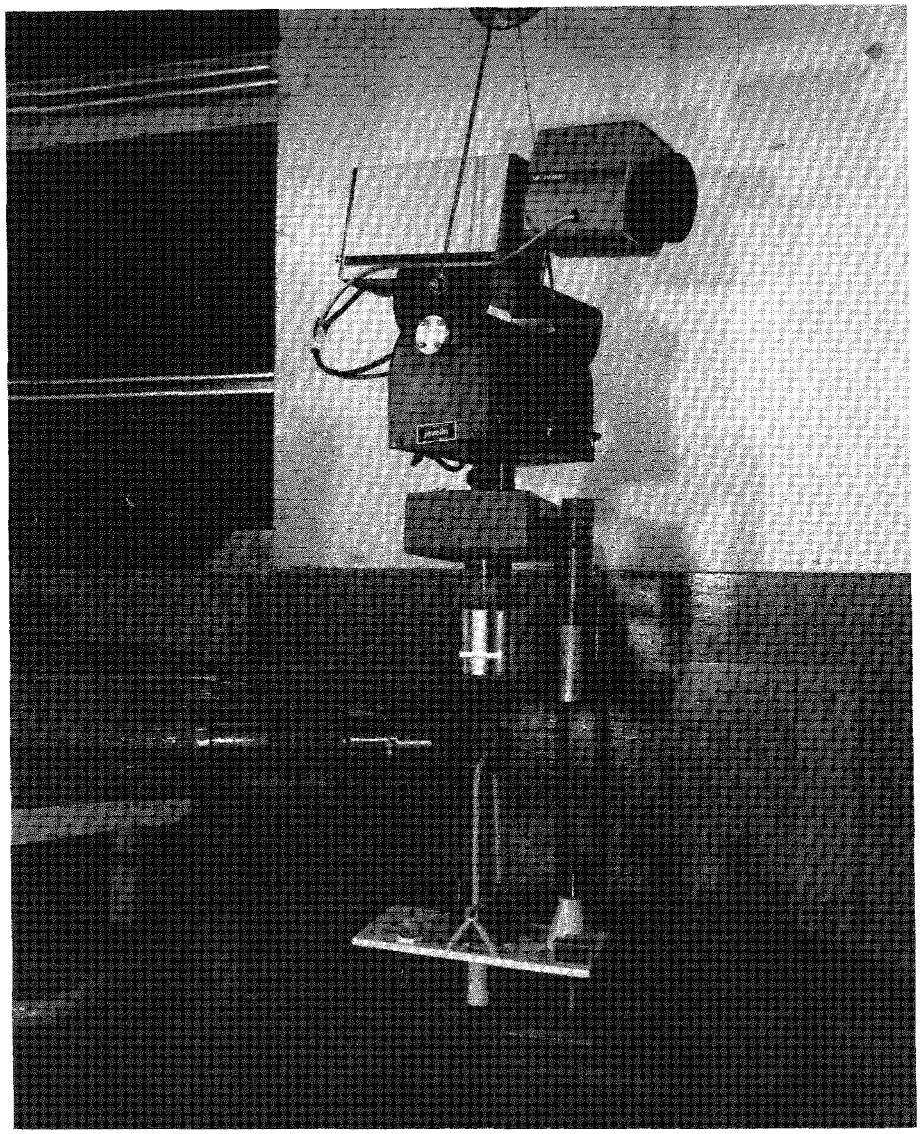

Fig. 7. TV camera support components.

primarily for lowering the TV camera through the open cell hatch and viewing at the TV monitor adjacent to the hatch opening.

V. REMOTE HANDLING TEST RESULTS

Remote handling tests carried out in the master-slave manipulator area of the RMTF required extensive use of the bridge-mounted PaR manipulator located on the top of the structure. Tests included evaluating the manipulating and viewing capabilities for both individual components and assemblies to ensure functional performance.

1. NWCF FILTER BURIAL COVER

The mockup of the filter burial cover described in Section IV.1 was tested for remote operability with the bridge-mounted PaR manipulator and performed satisfactorily. Figure 8 shows the cover installed on a filter unit which is being lifted by the PaR manipulator. In Figure 9 the filter and cover are being lowered into a filter transfer container. The transfer containers have a capacity of three sealed filters.

2. NWCF SAMPLE TRANSFER CAPPER/DECAPPER

Design and testing were completed on the NWCF pneumatic sample transfer capsule capper/decapper. The new decapper consists of a thin, flat plate with a U-shaped opening in one end to fit under the sample transfer capsule cap. In Figure 10 the decapper plate has been moved into the full forward position with the U-shaped opening fully under the cap. The decapper plate has been raised by the master-slave, removing the cap. The decapping operation requires less than 1 min to perform.

To cap a capsule, the cap is placed on top using the master-slave manipulator as shown in Figure 11, and the capping lever is moved to the left directly over the cap (Figure 12). The cap is sealed to the capsule by pushing down on the capping lever with the master-slave. The capping operation also requires less than 1 min to perform.

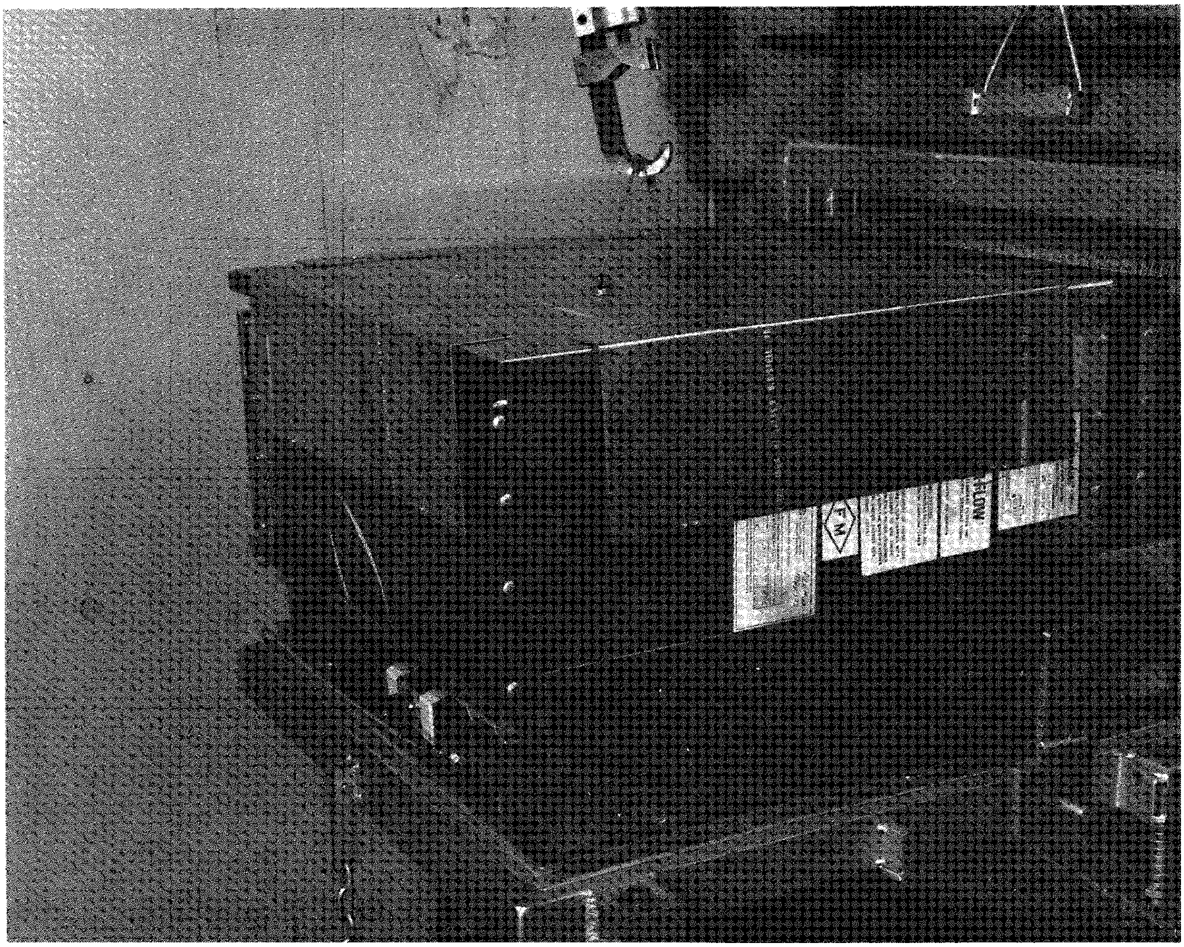

Fig. 8. Filter burial cover on filter.

The complete capper/decapper may be removed remotely for maintenance or replacement as shown previously in Figure 5. The unit is lifted out of the V-grooved wall bracket by the master-slave. The time required for this operation was less than 1 min.

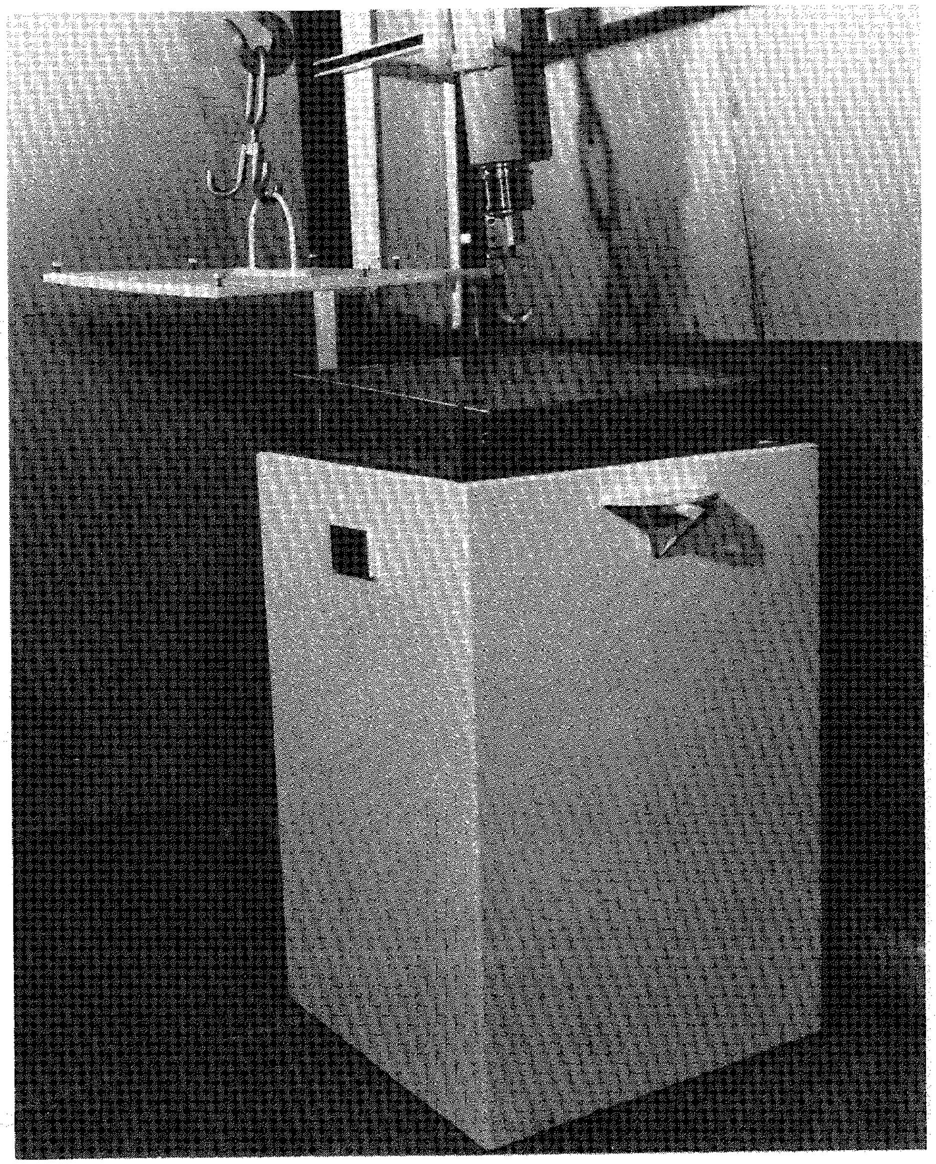

Fig. 9. Burial cover on filter in filter transfer container.

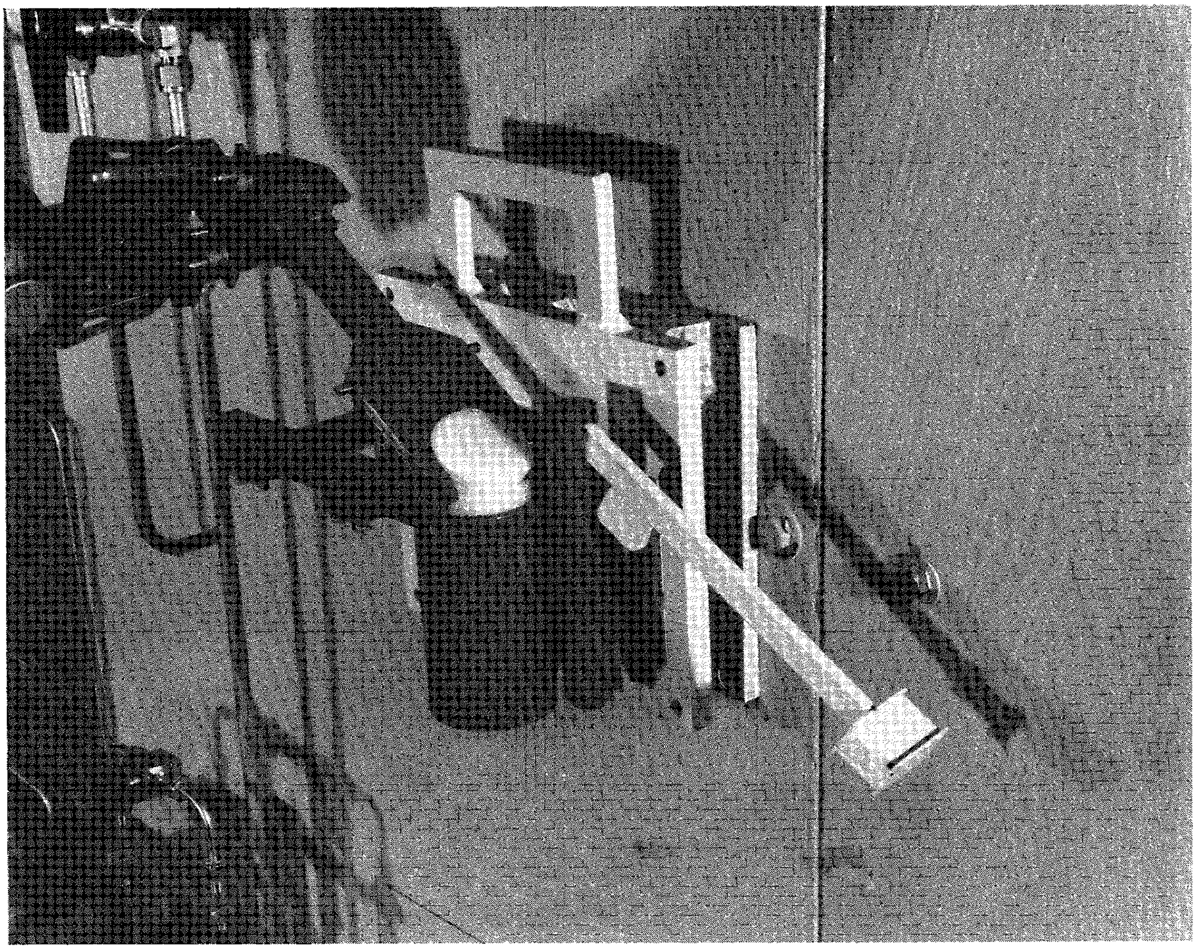

Fig. 10. Decapping sample transfer capsule.

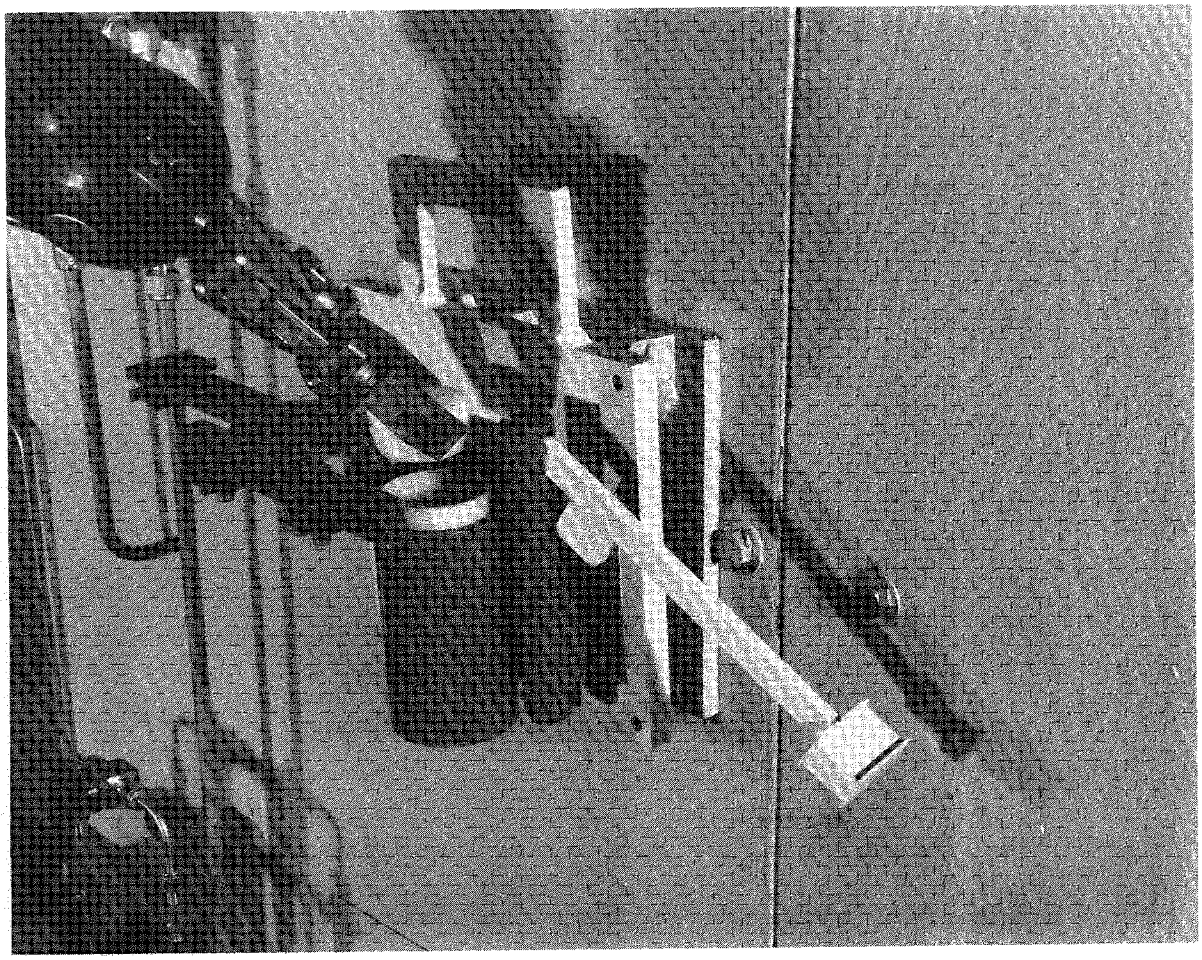

Fig. 11. Cap being placed on transfer capsule.

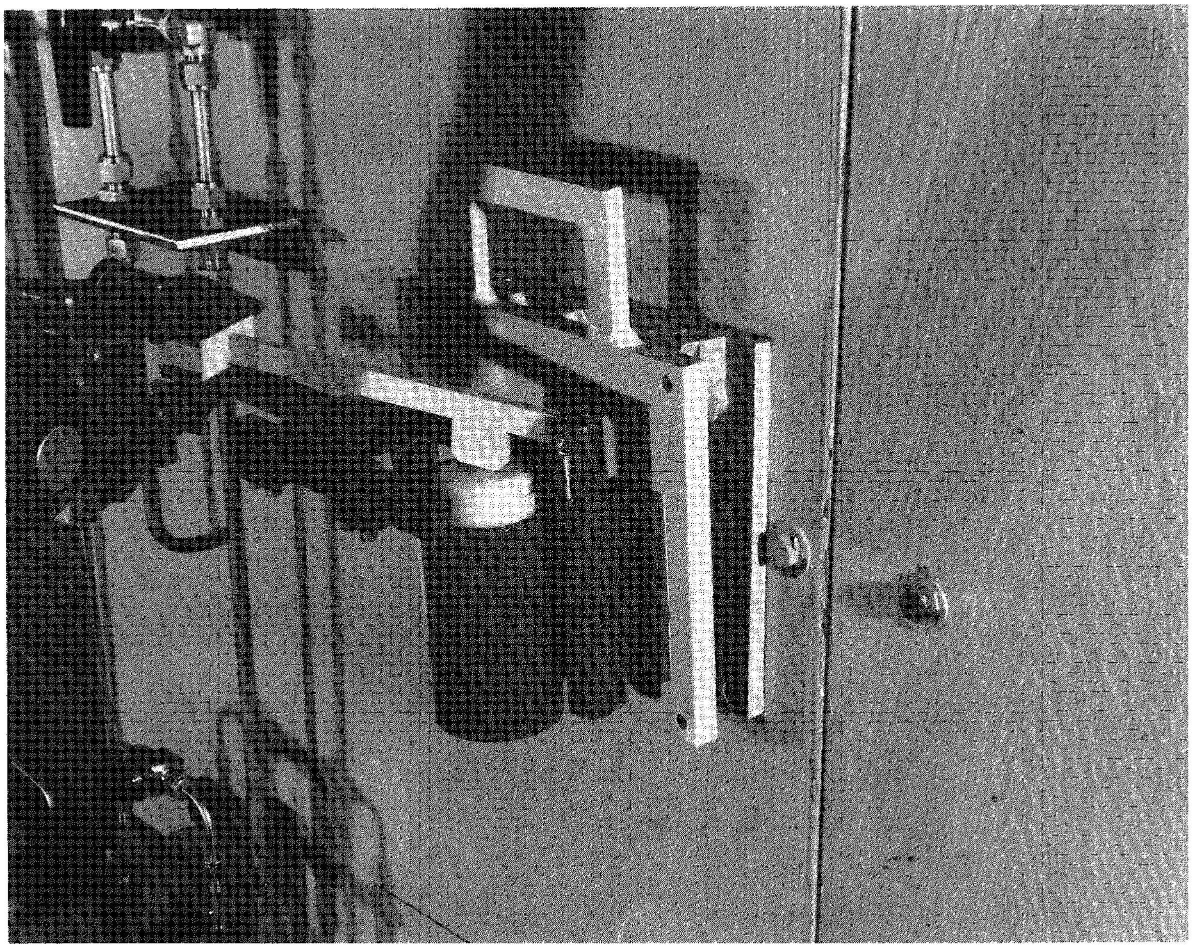

Fig. 12. Capping lever in capping position.

3. FAST IN-CELL LIGHT FIXTURE

A prototype in-cell light fixture for the Fluorinel Dissolution Process and Fuel Storage (FAST) Project was fabricated and tested to verify the remote replaceability of the unit. Figure 13 shows the light fixture being lifted by the manipulator for installation. In Figure 14 the light fixture has been lowered into the V-guide-in support and pushed sideways with the manipulator to engage the electrical connector at the left end. The manipulator is securing the seismic locking pin.

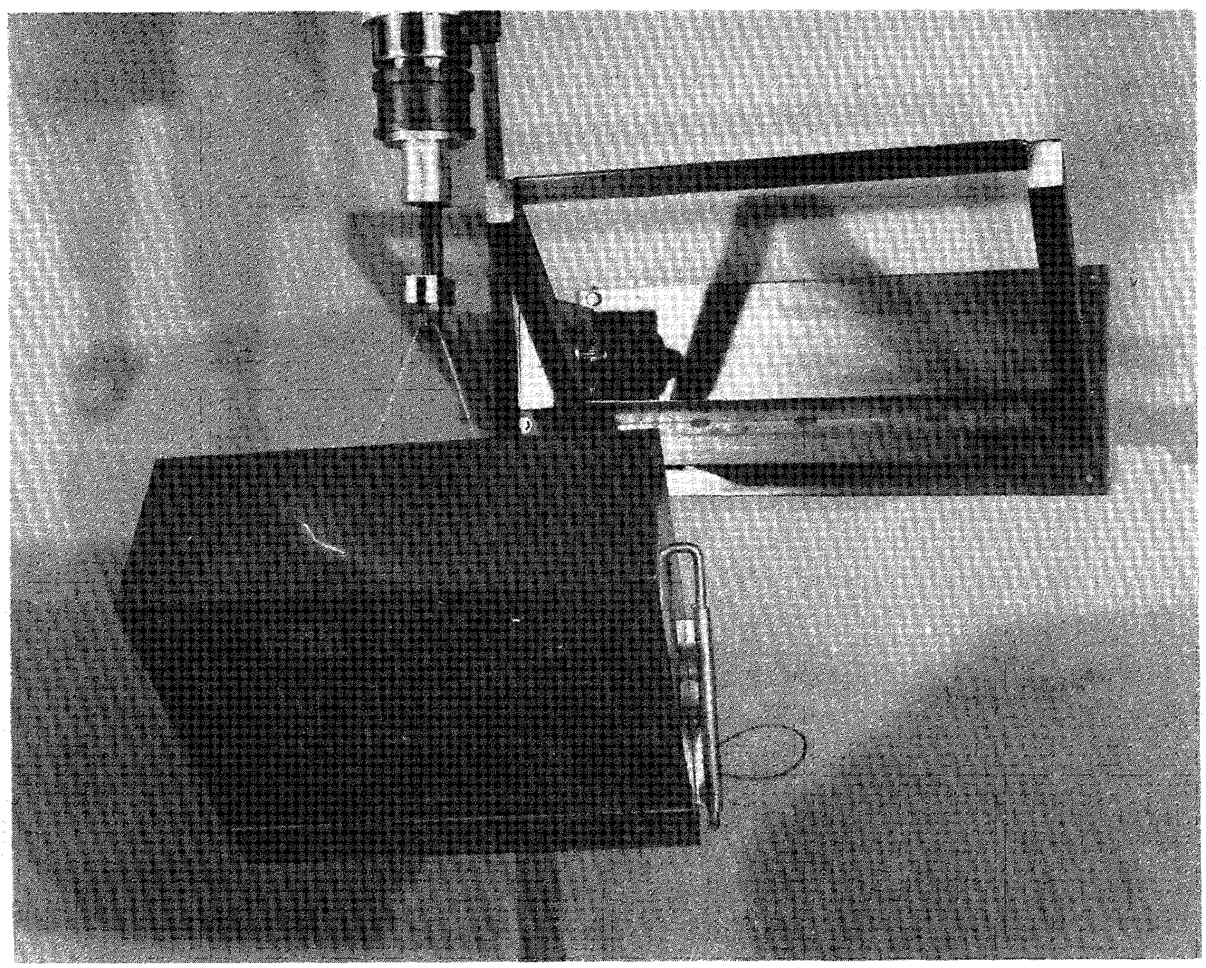

Fig. 13. Light fixture being installed by manipulator.

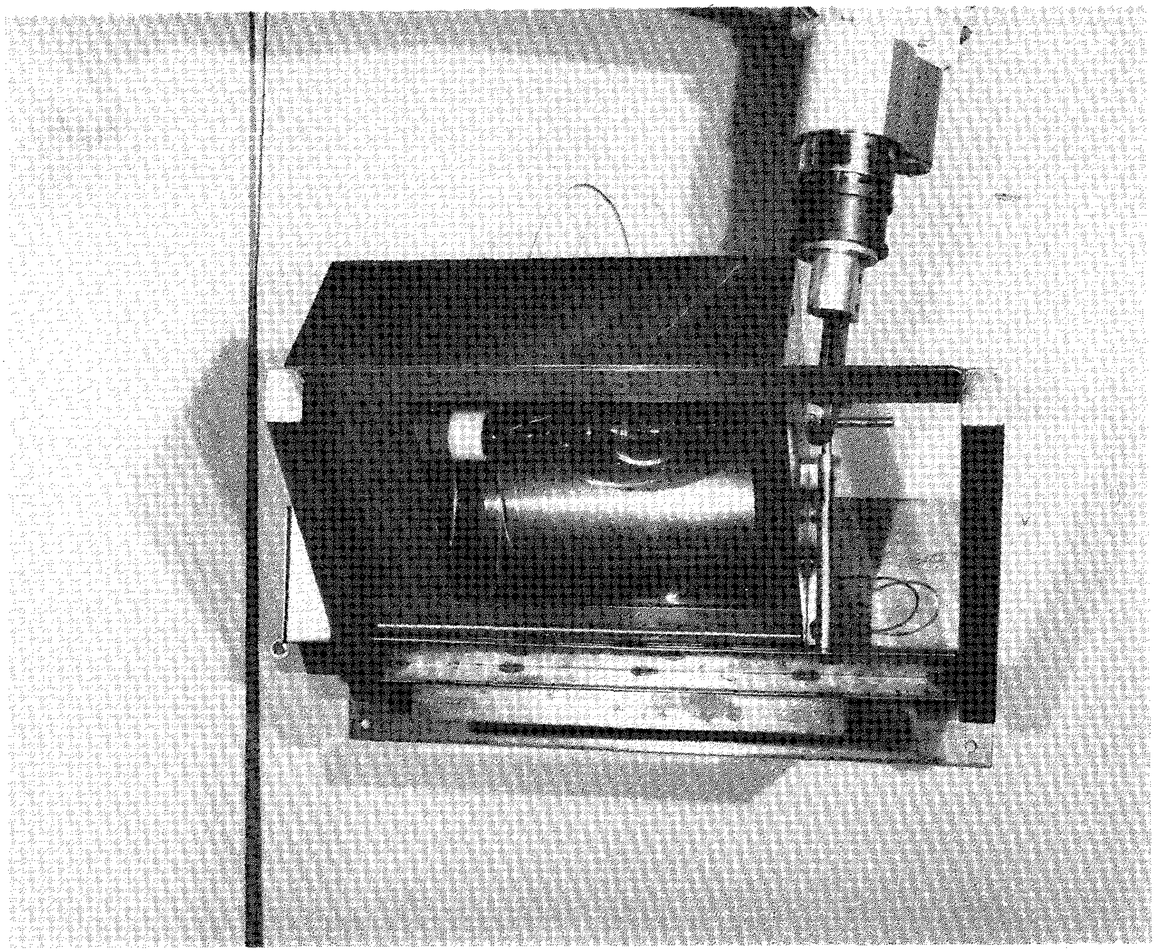

Fig. 14. Manipulator securing seismic locking pin.

4. FAST UNDERWATER HANDLING TOOLS

Two FAST underwater handling tools were functionally tested using an overhead crane to carry the weight (similar to the flotation tank on each tool during underwater operation). The handling tools were operated from a work platform approximately 25 ft above the floor.

The first tool tested was a 23-ft-long J-hook tool designed to lift a fuel element out of a fuel storage rack. The fuel element was simulated by a 2-by-4-by-44-in. wood member with a 6-in. flexible lifting loop on top and the fuel element storage rack by an 8-in. vertical pipe 10-1/2 ft long. After being lowered 6-1/2 ft into the pipe, the J-hook engaged the fuel element lifting bail with no difficulty.

The second tool tested was a 27-ft-long retrieval tool for recovering objects dropped on the canal floor. The crane and work platform were also used for this test, and the mock fuel element was successfully picked up when lying on its side on the floor.

5. FAST CLARIFICATION FILTER

The FAST process stream will contain an appreciable quantity of undissolved solids which will be removed by a stainless steel filter. A full-size mockup of the filter container and associated pipe jumpers and valves was completed and tested for remote replacement of the various components. Figure 15 shows the pipe jumpers, filter container, etc., bolted as they will be in operation.

In Figure 16 the pipe jumpers in the lower left side have been unbolted and removed, and the jumper in the lower right side has been unbolted and moved back on the guide-in platform. Removal and replacement of the jumpers presented no difficulties. A counterweight has been attached to the filter outlet valve directly below the remote connector to compensate for the valve air actuator weight during valve removal. The impact wrench is opening the remote connector to release the valve. As a result of this test, supplemental TV viewing was recommended for remote connector alignment during the valve replacement. The filter vessel top closure (upper left in Figure 16), which has the filter attached, was also removed and replaced satisfactorily, but pointed up the need for some minor changes in the bolt-nut engagement

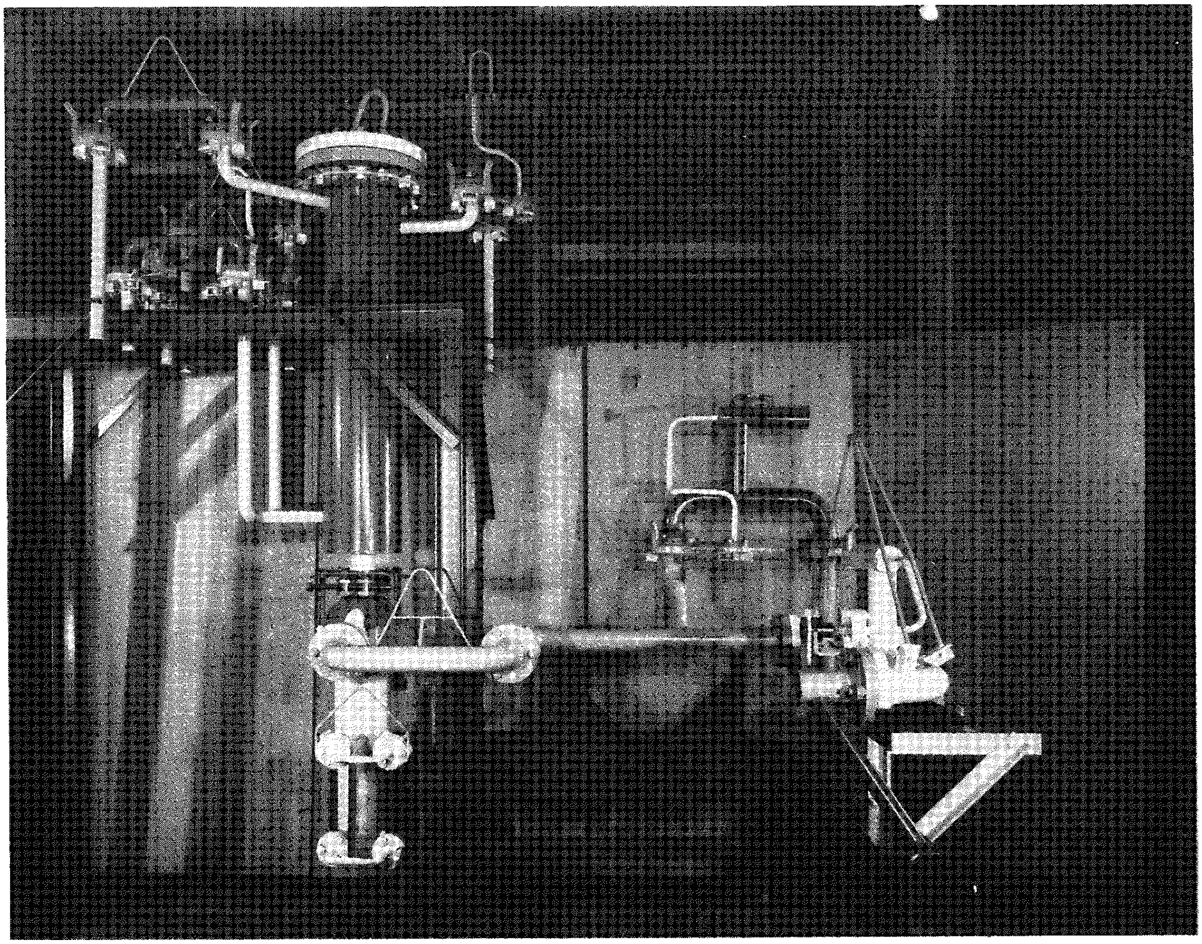

Fig. 15. FAST clarification filter components assembled.

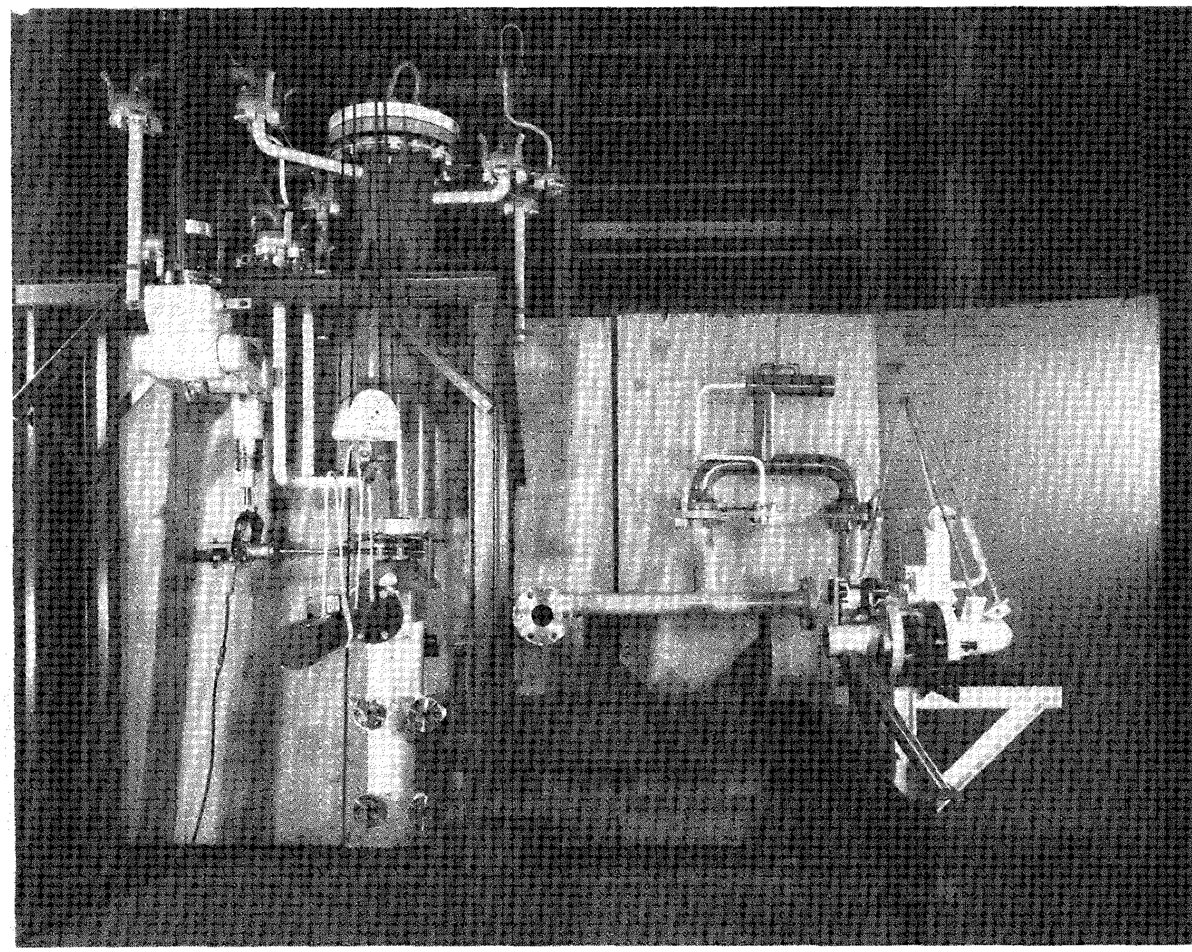

Fig. 16. FAST clarification filter components unbolted.

6. FAST DISSOLVER CLOSURE

The FAST Project dissolvers are designed with power-operated closures that have been mocked up as shown in Figure 17. Testing of the mockup included both functional and remote handling evaluations. The functional tests included operation of the dissolver closure assembly through 550 open and close cycles. The first 500 cycles were completed to verify the functional operation of the closure mechanism. The additional 50 cycles were completed to verify proper closure with both top closure O-ring seals in place. Figure 18 shows the closure in the closed position (chain guard removed); in Figure 19 the closure is fully opened.

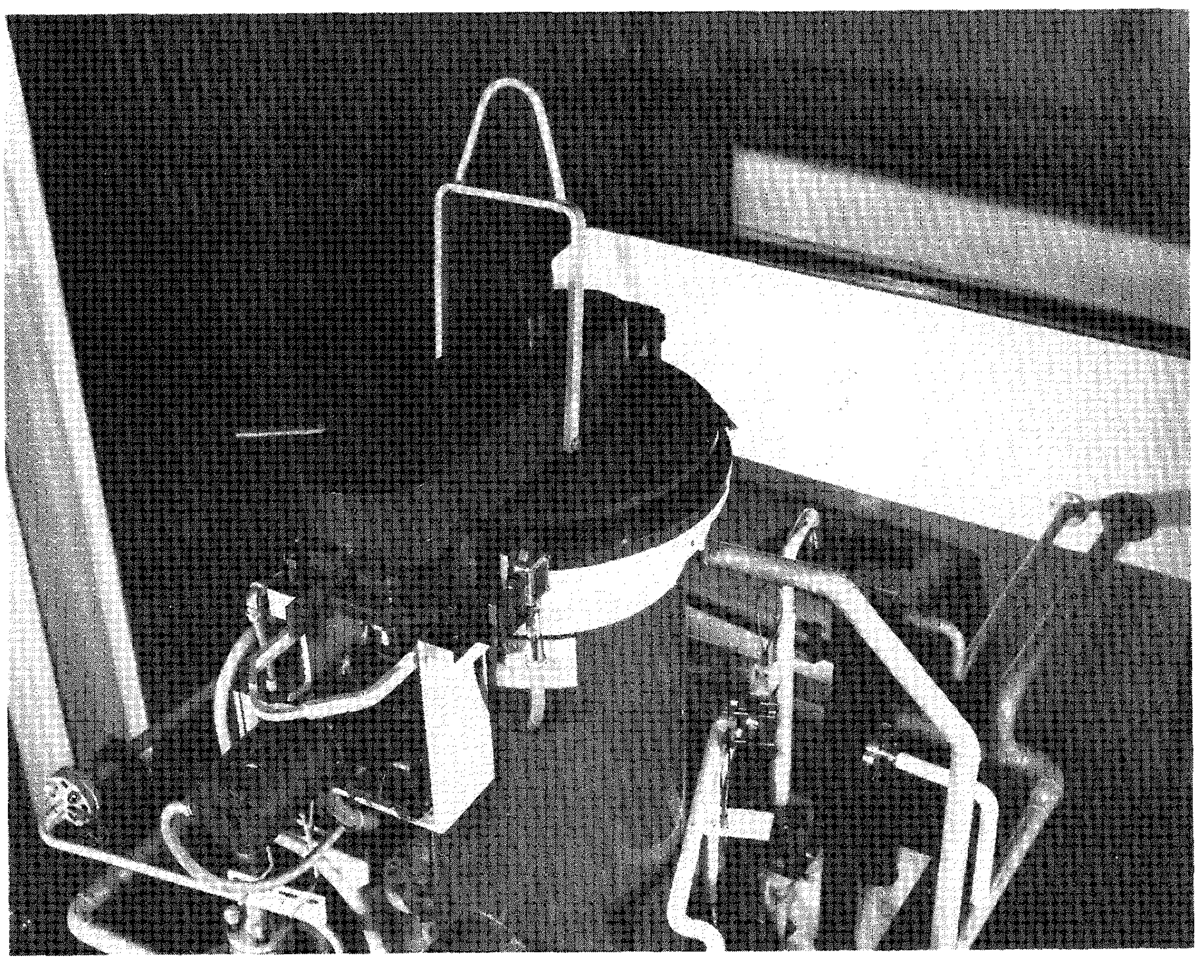

Fig. 17. FAST dissolver closure.

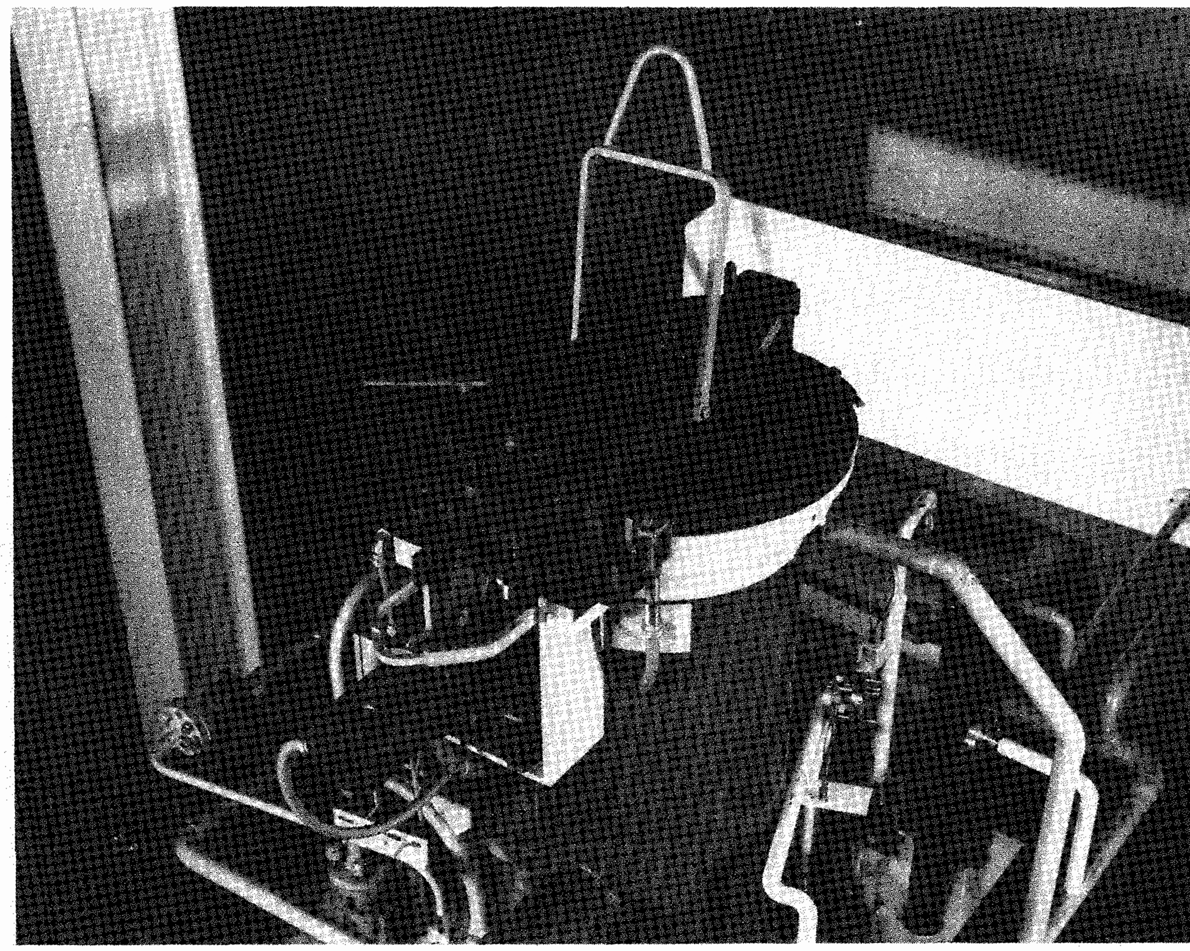

Fig. 18. FAST dissolver closure closed.

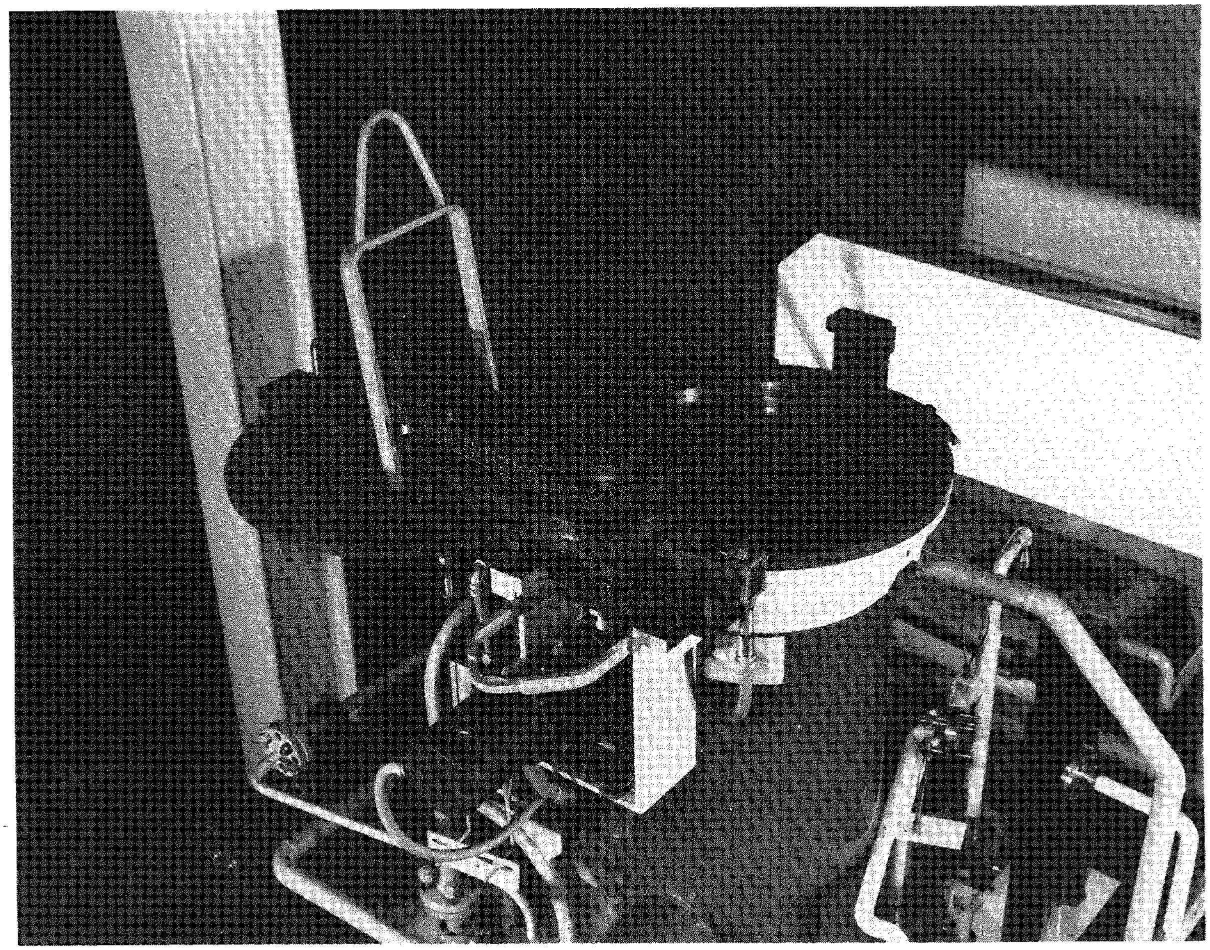

Fig. 19. FAST dissolver fully opened.

The 550 cycles were completed satisfactorily. The remote handling tests included (1) loosening the closure mechanism and drive motor mounting bolts with the manipulator-held impact wrench, (2) removing the closure mechanism from the drive motor assembly using the crane and manipulator, (3) removing the drive motor assembly with the manipulator, and (4) reinstalling all items. In Figure 20 the closure mechanism is being removed using the crane. The manipulator is providing guidance to reduce the possibility of binding with the drive motor spline. The complete drive motor assembly was removed with the manipulator as shown in Figure 21. All items were reinstalled successfully using the crane and manipulator for lifting and the impact wrench for bolt tightening.

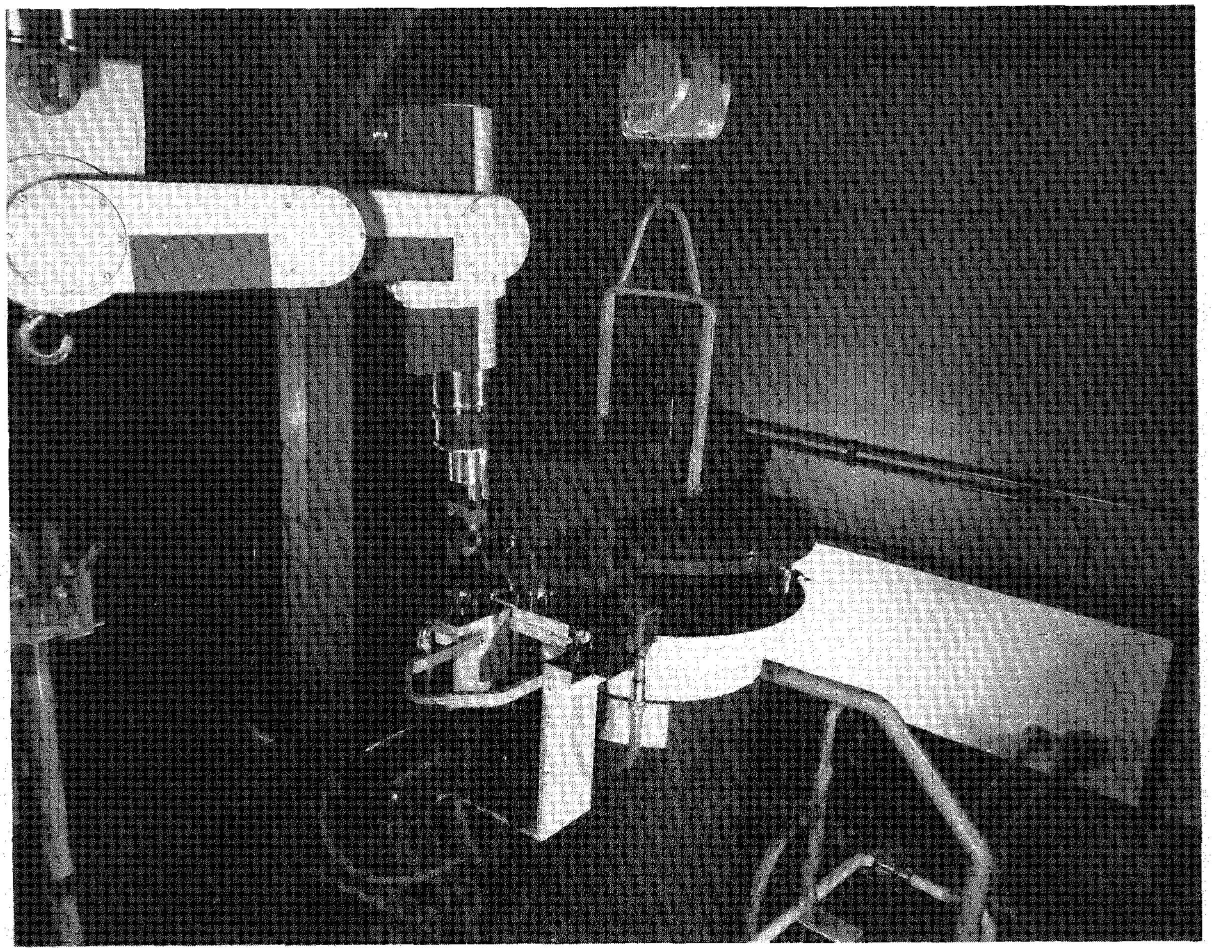

Fig. 20. FAST dissolver closure mechanism being removed.

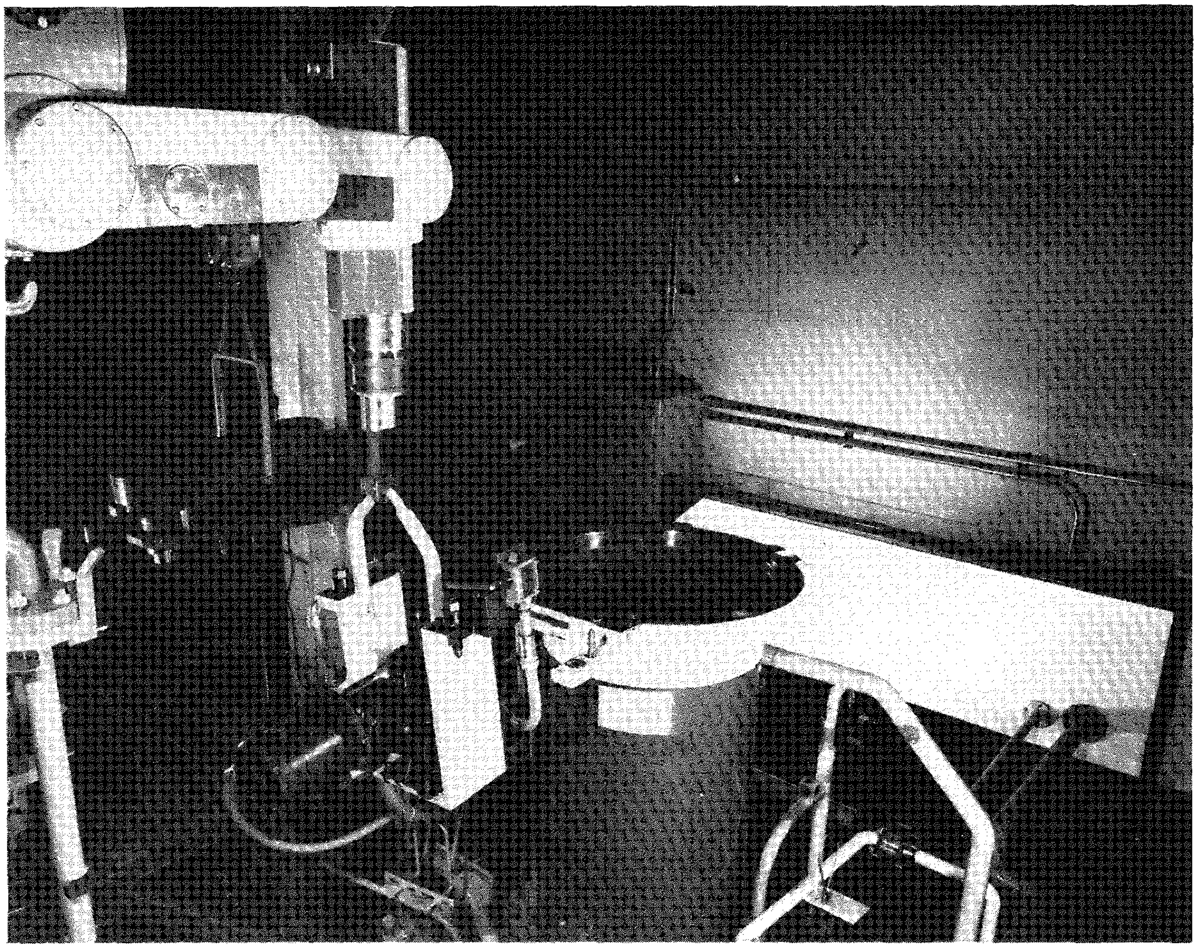

Fig. 21. Drive motor being removed.

7. FAST CLARIFICATION CANISTER AND PUMP

The undissolved solids in the FAST process stream that are collected on the stainless steel filter described in Section V.5 are removed from the filter by a blowback system. The damp solids are blown off the filter into a mocked-up blowback receiver vessel shown in the upper right side of Figure 22. The solids slurry flows from the receiver vessel into the solids canister for removal. In Figure 22 the canister lid is being

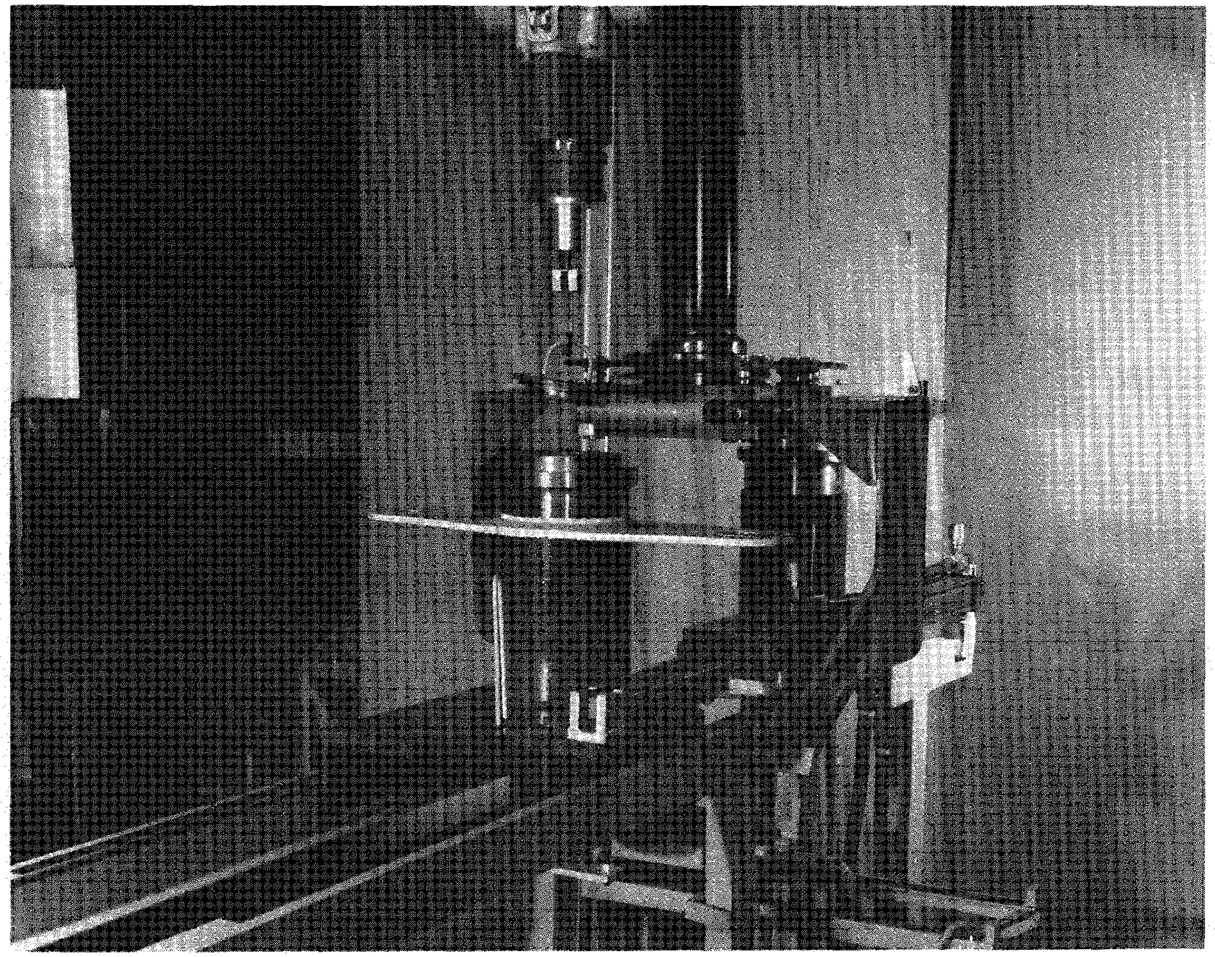

Fig. 22. Canister handling assembly.

removed from the canister, which is inside the canister holder in the foreground. The canister holder in the background contains a shortened canister which serves as a plug at the bottom of the blowback receiver vessel when solids are collecting on the stainless steel filter. The shortened canister has sufficient internal depth for two solids-level-measuring diptubes that project down from inside the blowback receiver.

After the plug canister is lowered from the bottom of the blowback receiver vessel, the canister holder with a full-size empty canister is moved into position and sealed to the bottom of the blowback vessel with the impact-wrench-actuated remote connector shown in Figure 23. The seal

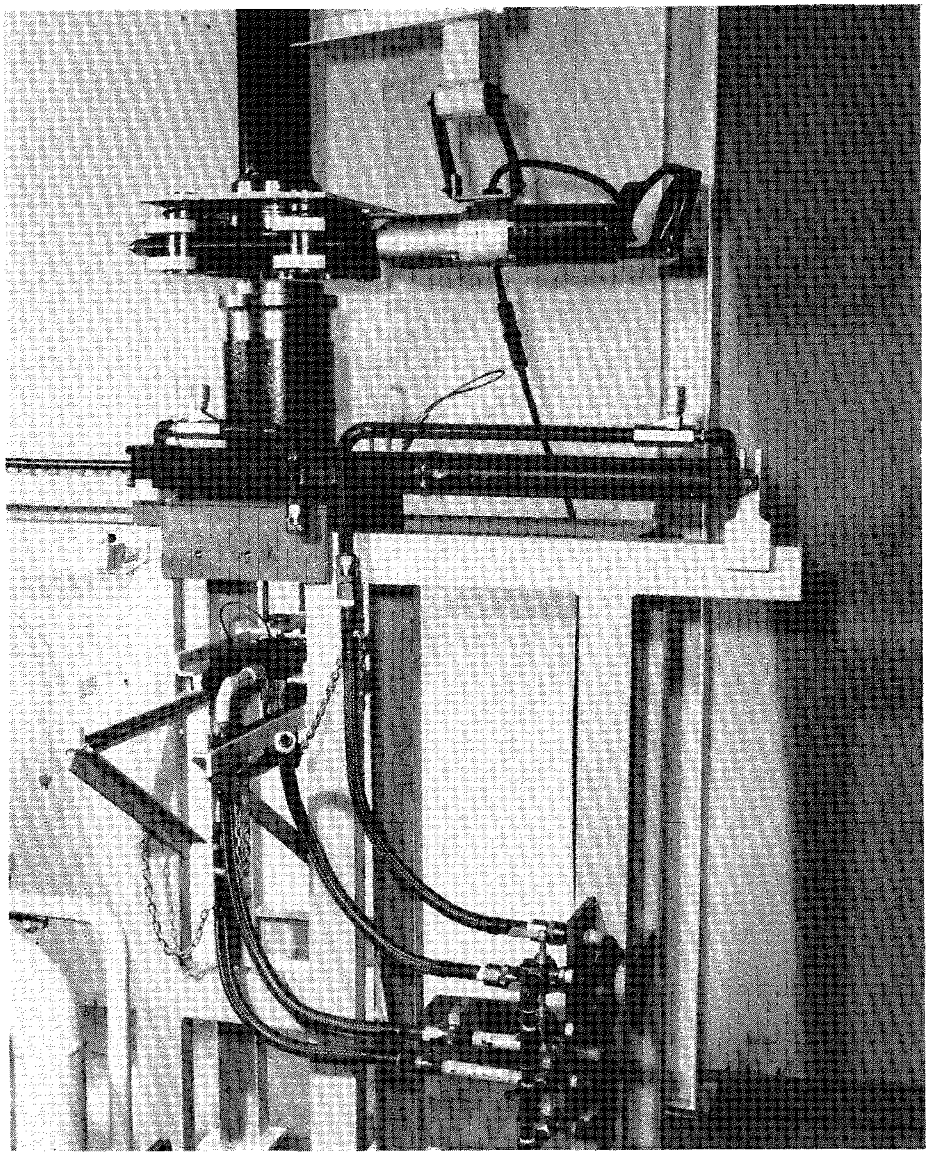

Fig. 23. Canister elevating mechanism.

is made simultaneously for both the canister and canister holder by an O-ring in the canister and the remote connector for the canister holder. Although the mockup shown in Figures 22 and 23 functioned satisfactorily, several minor changes were recommended. They included changing the air cylinders to water-actuated cylinders for smoother operation, providing two guide rings on the rounded lifting bail of the canister cover to center the manipulator finger, replacing the quick-disconnects to the air cylinders with a type that can be operated with one hand (the ones shown require two hands), and lowering the collar on the canister elevating mechanism 1/4 in. so the elevating mechanisms could be used for removal and replacement of the remote connector if required.

Figure 24 shows the overall mockup, which included a pump and motor unit in the foreground for pumping the complexed process solution. The pump unit was included to evaluate both the difficulties of remote pump and motor replacement and also any visual interference with the canister replacement described above.

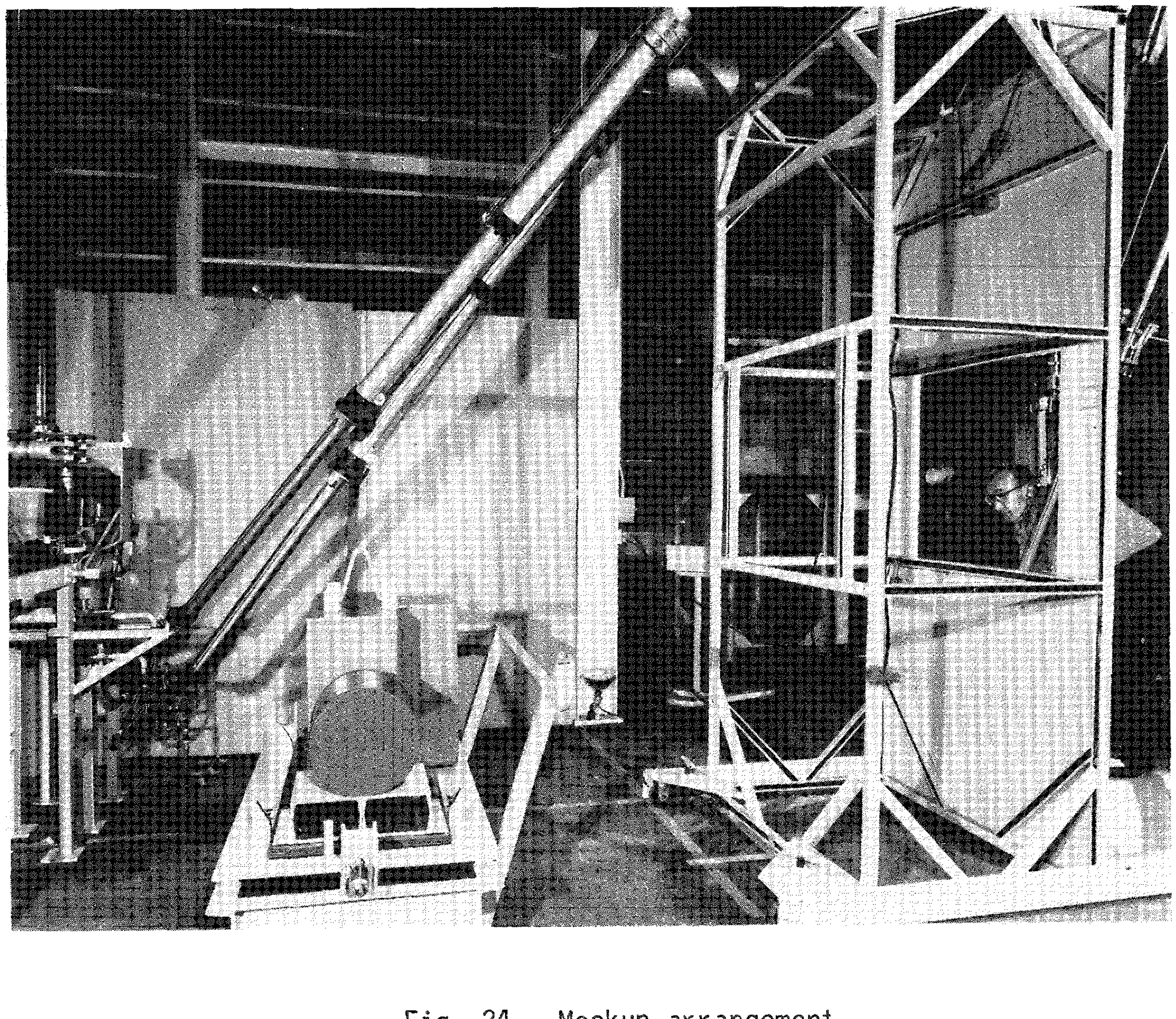

Fig. 24. Mockup arrangement.

In Figure 25 the manipulator operator's viewing capability of the canister replacement operation is not impaired. However, this figure does indicate restricted viewing of the three-bolt flanges at the right end of the pump unit. Supplemental viewing with a TV camera at right angles to the window view was recommended to help locate the flange boltheads.

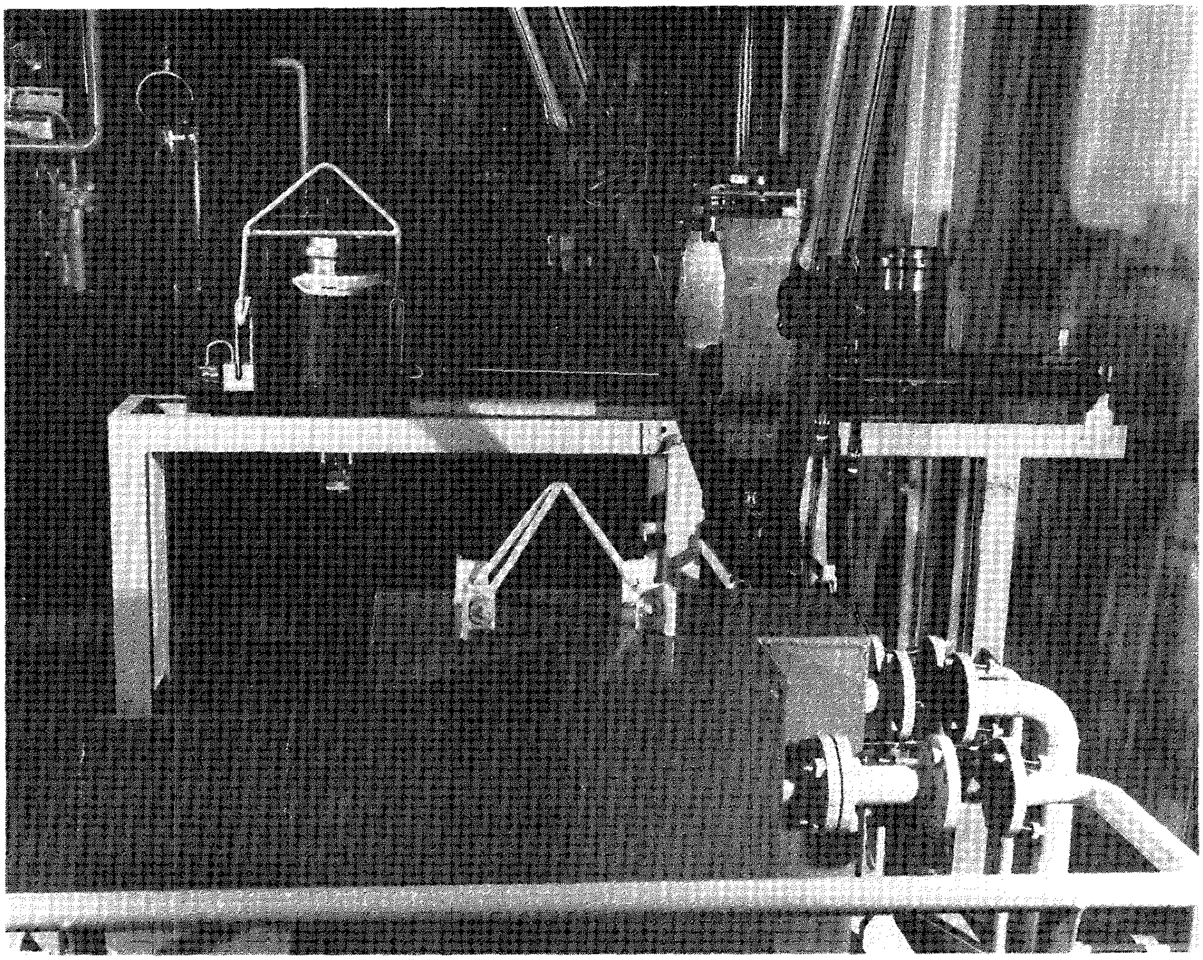

Fig. 25. Manipulator operator's view of mockup.

8. FAST SPENT RESIN TRANSFER

The water treatment resin for the FAST fuel storage pool water will require replacement every 3 to 5 years. During those years it is anticipated that sufficient contamination will be removed from the water to require handling the resin remotely. Two mockups of the resin handling system were fabricated and tested. Each mockup simulated a portion of the resin handling as it will be viewed through adjacent viewing windows. Viewing, access, and reach tests were performed.

Figure 26 shows the first mockup arrangement with a transfer canister in the lower center, the heater-condenser above and left of center, and the remote connector left of the heater-condenser. The line above the remote connector will contain two valves (not included in the mockup) which are separated sufficiently for the line between the valves to contain a volume of the slurried resin slightly less than the capacity of a transfer canister. This volume is dropped into a transfer canister, which has been attached to the remote connector, by closing the upper valve and opening the lower valve. The canister is then moved to the heater-condenser and raised into the unit by a hydraulic cylinder, and the water in the resin is boiled off. The canister is then lowered and a cover is placed on it. The canister is moved to a 30-gal transfer drum that will hold five transfer canisters.

Testing with this mockup indicated that the impact wrench that operates the remote connector would be difficult to replace with the master-slave manipulators. A redesign of the wrench support corrected this deficiency. Replacement of the drive motor for the canister removal system transfer table would also be difficult because it is too close to the wall below the window and cannot be seen by the operator. An in-cell mirror (Figure 27) was used to improve the visibility. A similar problem occurred on the 30-gal drum transfer table, which was the second mockup arrangement (Figure 28). The table drive motor is located at the left end of the transfer table and cannot be seen directly through the viewing window. An in-cell mirror was added to rectify this problem. The recommendation was also made that the drive motor for the drum transfer table be moved to the opposite end of the transfer table for better accessibility and that both drive motors be mounted vertically. Vertical mounting would simplify remote alignment and would also bring the lifting bail for each motor into view through the window. This would eliminate the need for in-cell mirrors.

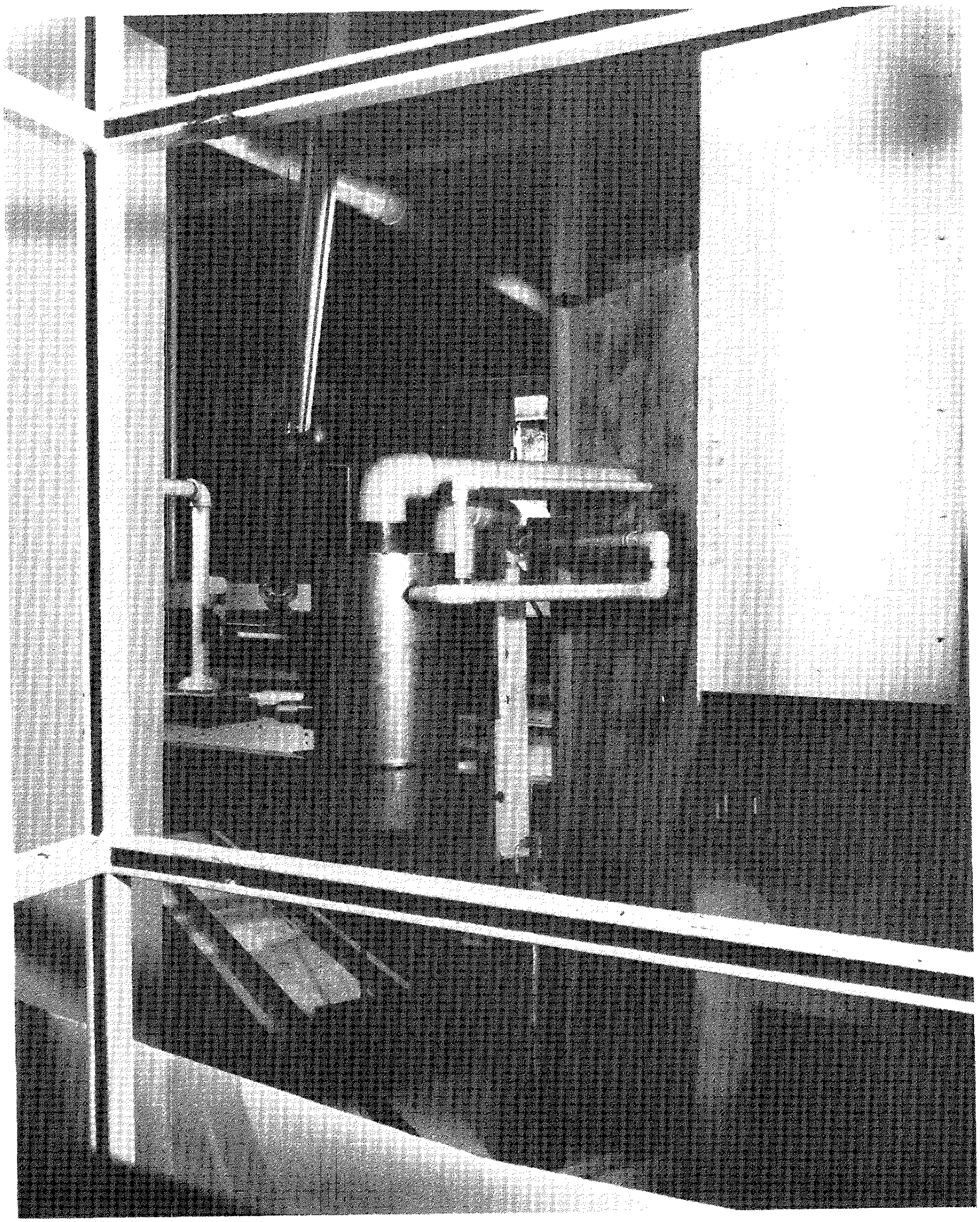

Fig. 26. First mockup arrangement.

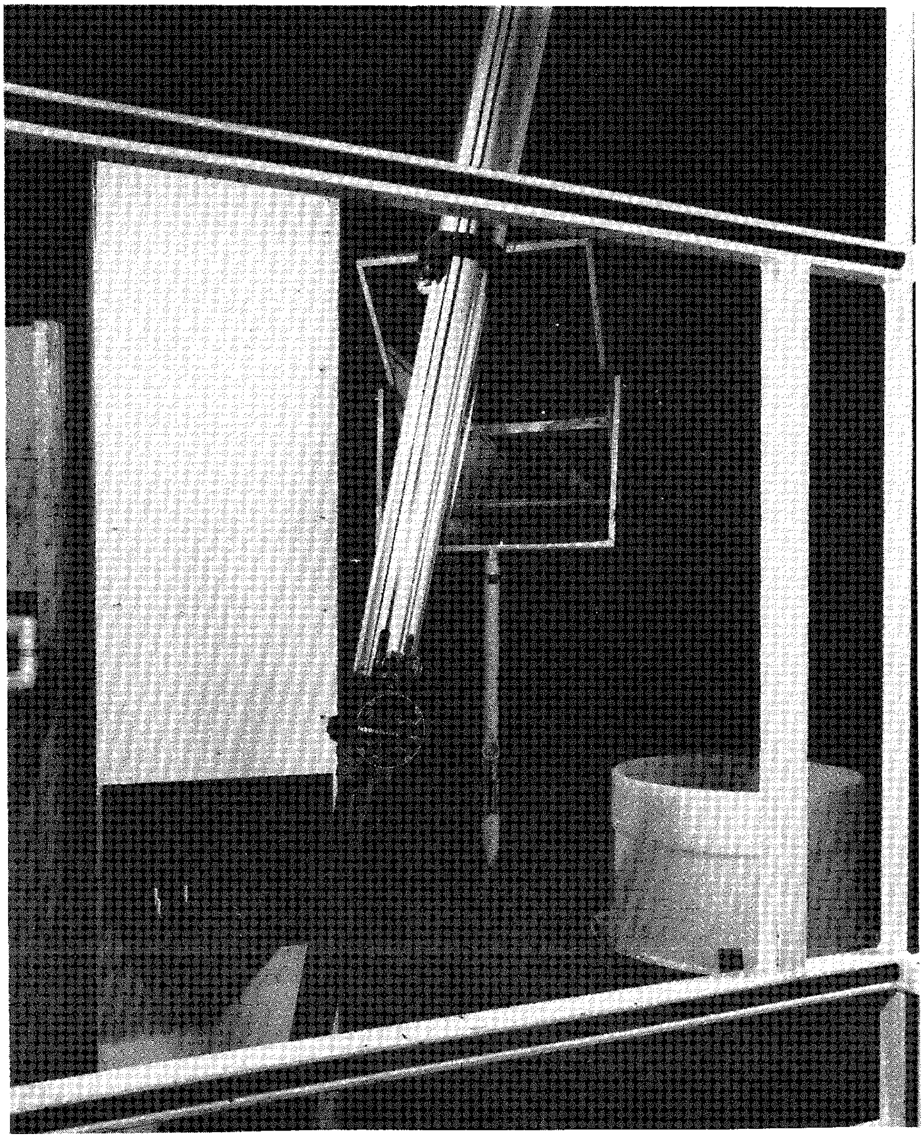

Fig. 27. In-cell mirror arrangement.

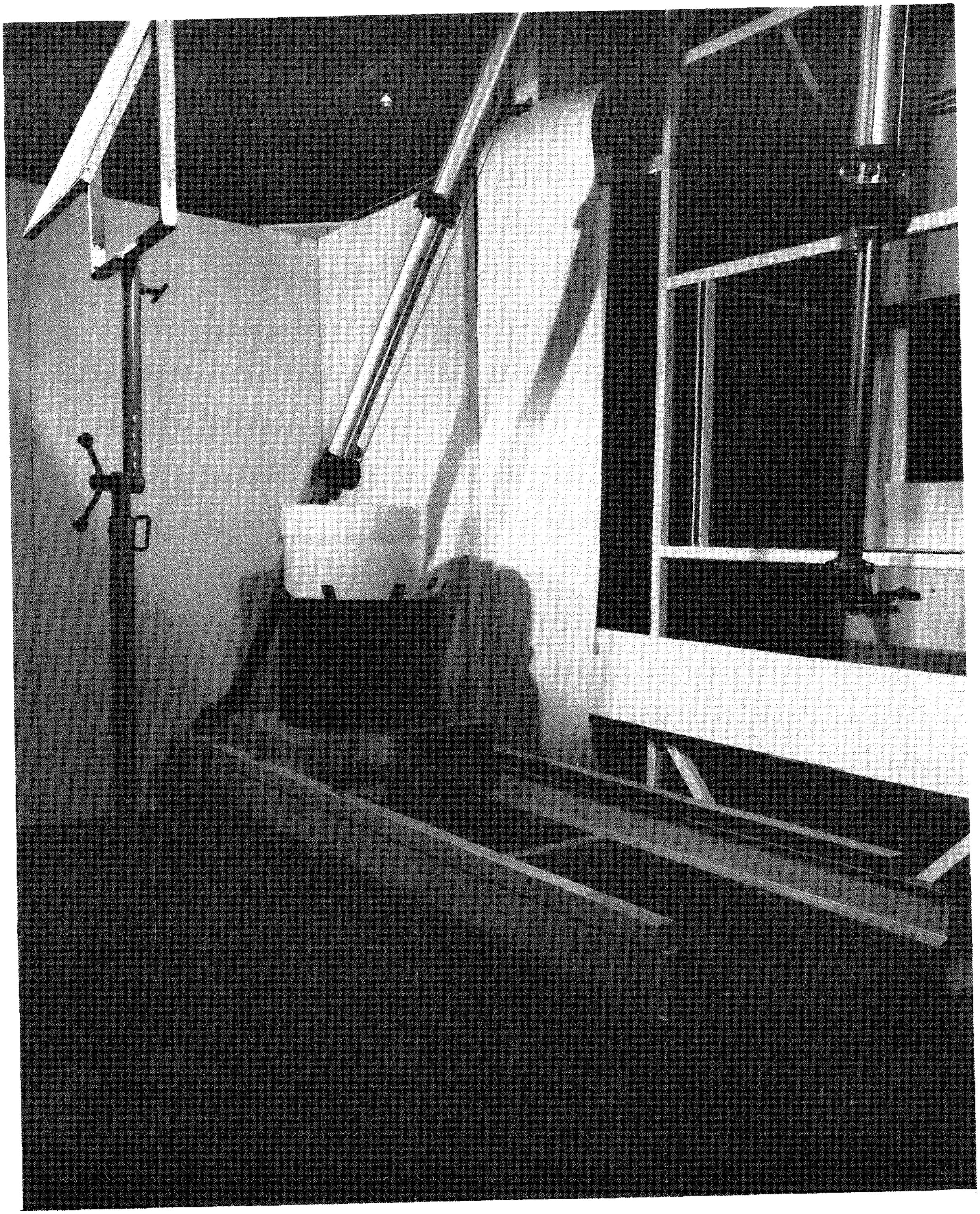

Fig. 28. Second mockup arrangement.

9. FAST FILTER HOUSING

The FAST filter units consist of six banks of four HEPA filters per bank and are designed to handle all the ventilation from the Fluorinel Dissolution Process (FDP) cell. A mockup of one-half of a bank containing two HEPA filters is shown in Figure 29. The two filters are located in the bottom half and the dioctyl phthalate (DOP) introduction and

Fig. 29. Filter housing mockup.

sampling components in the top half. The DOP particulates are introduced immediately above each filter and sampled immediately below to check for leaks through the filter or around the filter seal. Replacement of the filters and operation of the DOP components were tested using master-slave manipulators, an impact wrench, and a 1-ton crane.

Figure 30 is a top view of the DOP components including the particulate introduction units (square plate with five holes) and the particulate diffuser ("crab traps") immediately below the DOP introduction units. The crab traps would be used for particulate and air mixing and sampling of a filter located in the housing above this filter unit, and the introduction units would provide DOP particulates for the filter immediately below the crab trap. When the crab traps are not being used for DOP testing, they are rotated out of the airstream by the impact-wrench-actuated unit shown in Figure 31. The unit functioned satisfactorily. Figure 32 shows the crab traps rotated to the side and the particulate sample collection tubes which are located below the crab traps.

Replacement of the two filters requires unbolting the four corner bolts shown in Figure 29 and lowering the door to the horizontal position shown in Figure 33. In Figures 33 and 34 the impact wrench is actuating the filter elevator to disengage the knife edge seal at the top (Figure 34). The master-slave manipulator then slides out the elevator and the two filters (Figure 35) for removal of the filters as shown in Figure 36. If the filter elevator requires replacement, it can be removed as shown in Figure 37.

As a result of these tests, the RMTF recommended that (1) the push plate in the center of the filter door be lowered to about the center of the support-pivot pins on the sides of the door for better operation and (2) the Kynar slides on the bottom of the filter elevator be replaced with rollers. The elevator, with two filters, was difficult to slide with the master-slave manipulator because of friction.

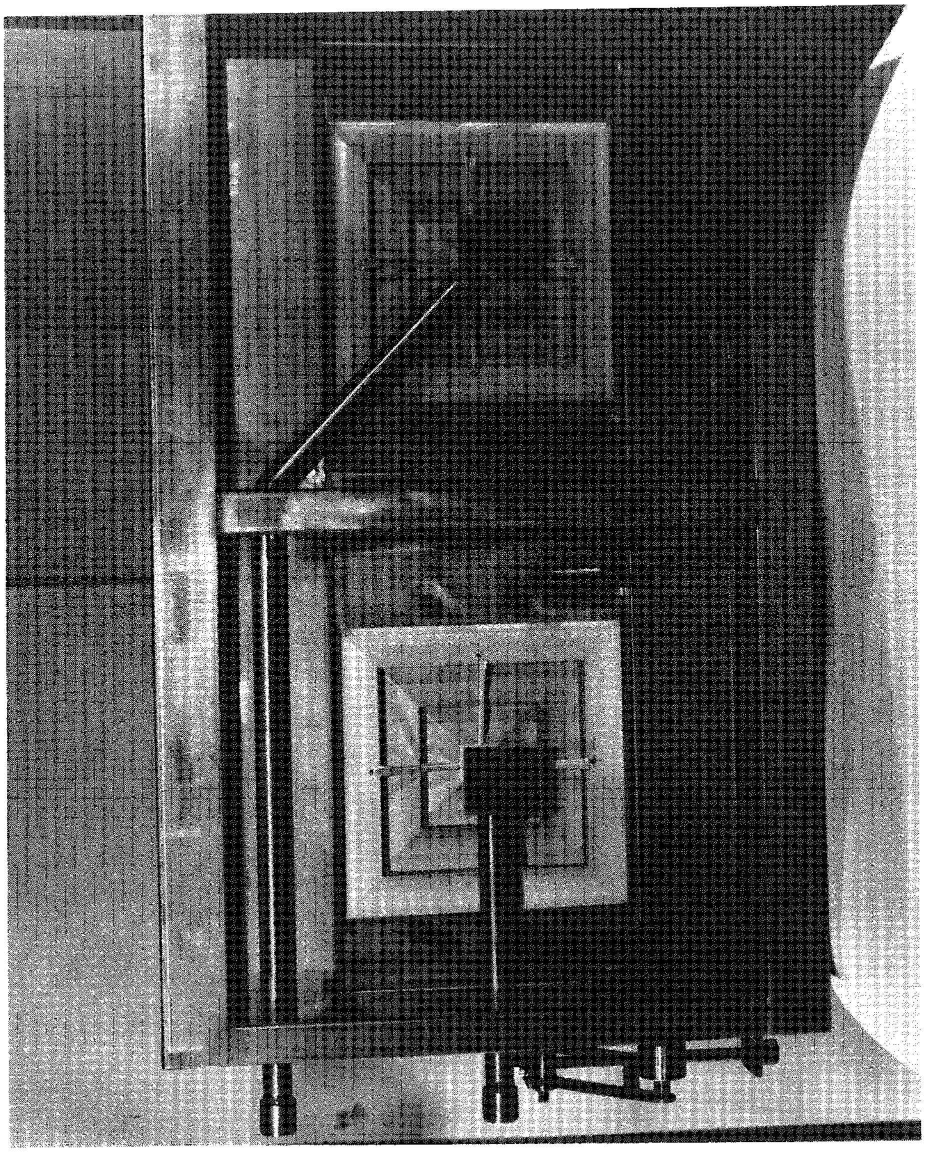

Fig. 30. DOP components.

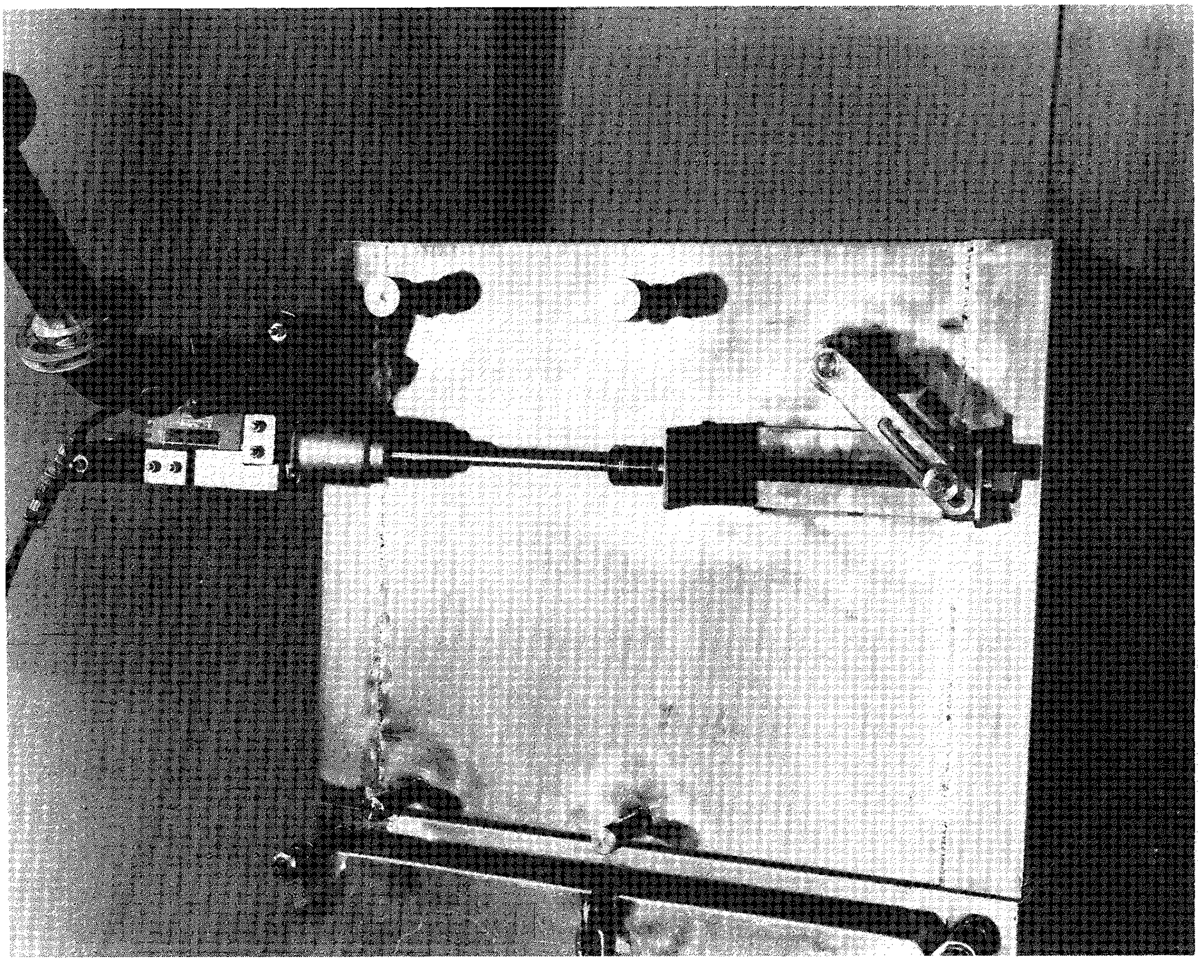

Fig. 31. Crab trap actuator.

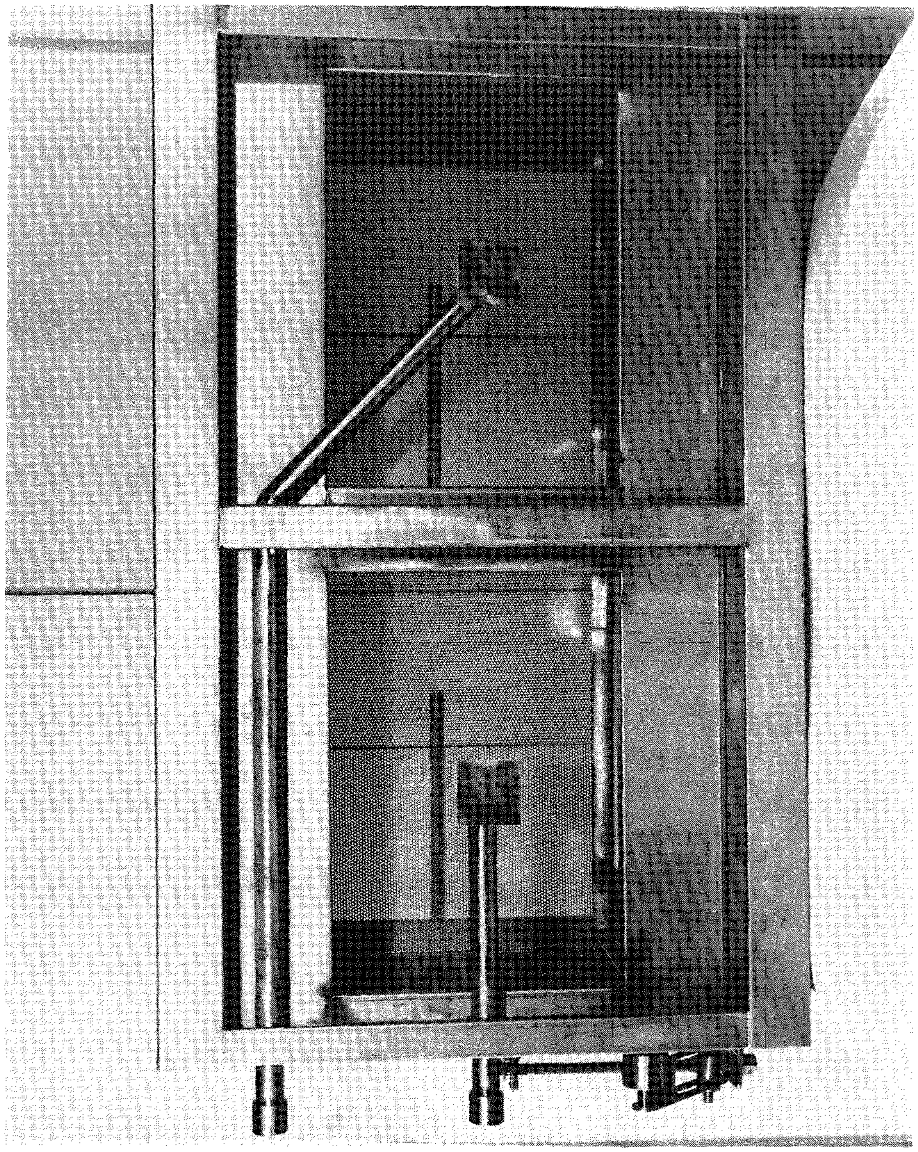

Fig. 32. Particulate sample collection tubes.

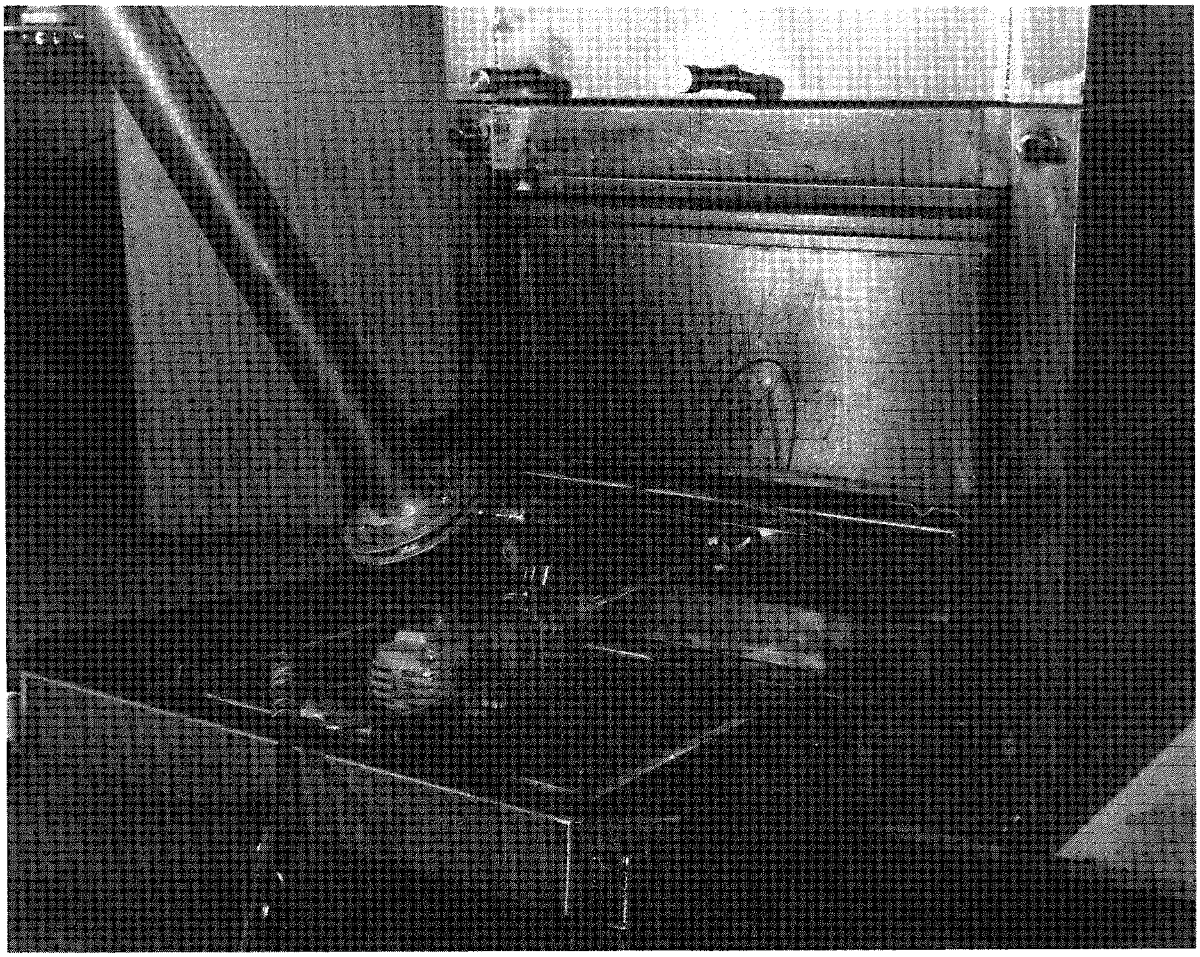

Fig. 33. Housing door in lowered position.

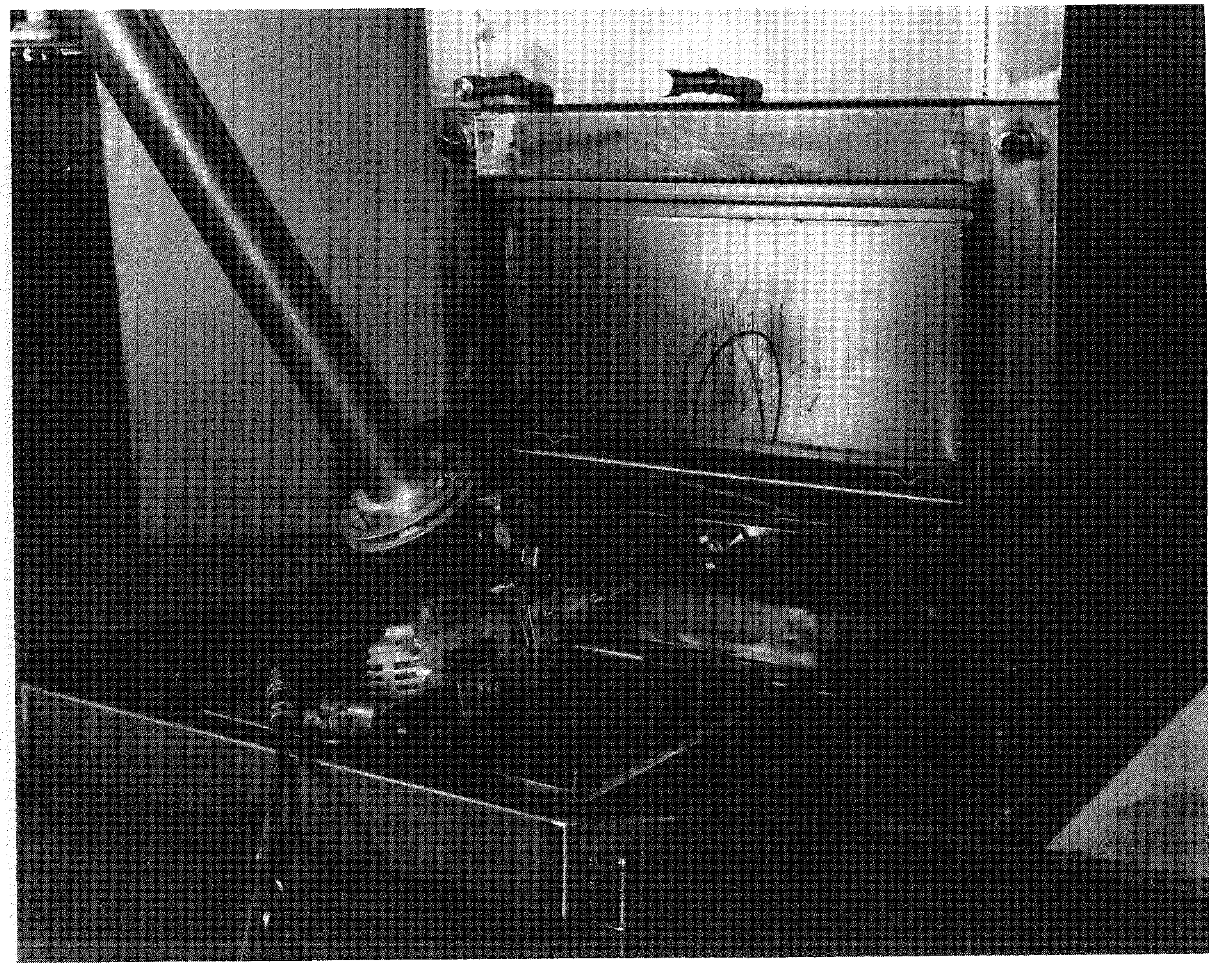

Fig. 34. Filter disengaged from seal knife edge.

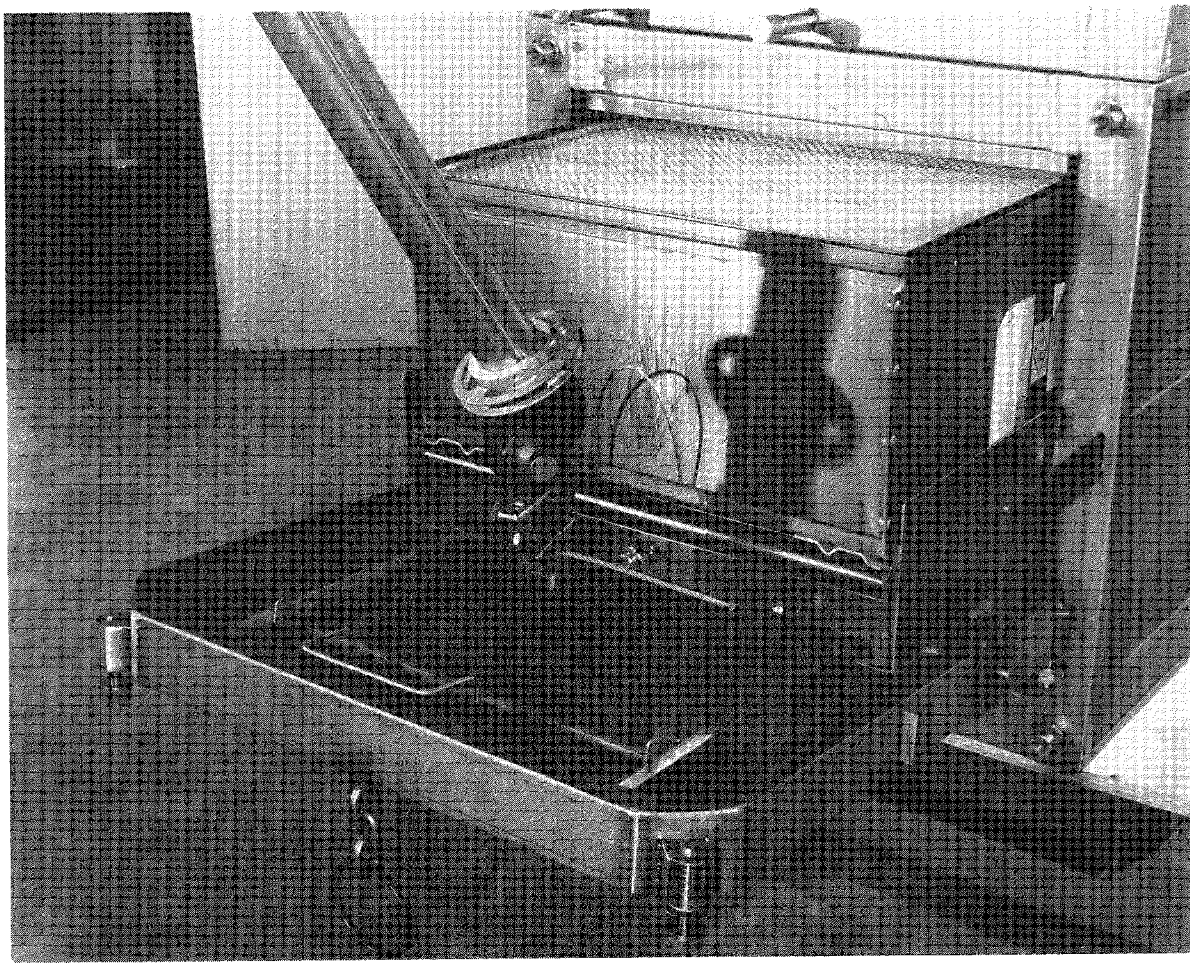

Fig. 35. Filters and elevator being removed from housing.

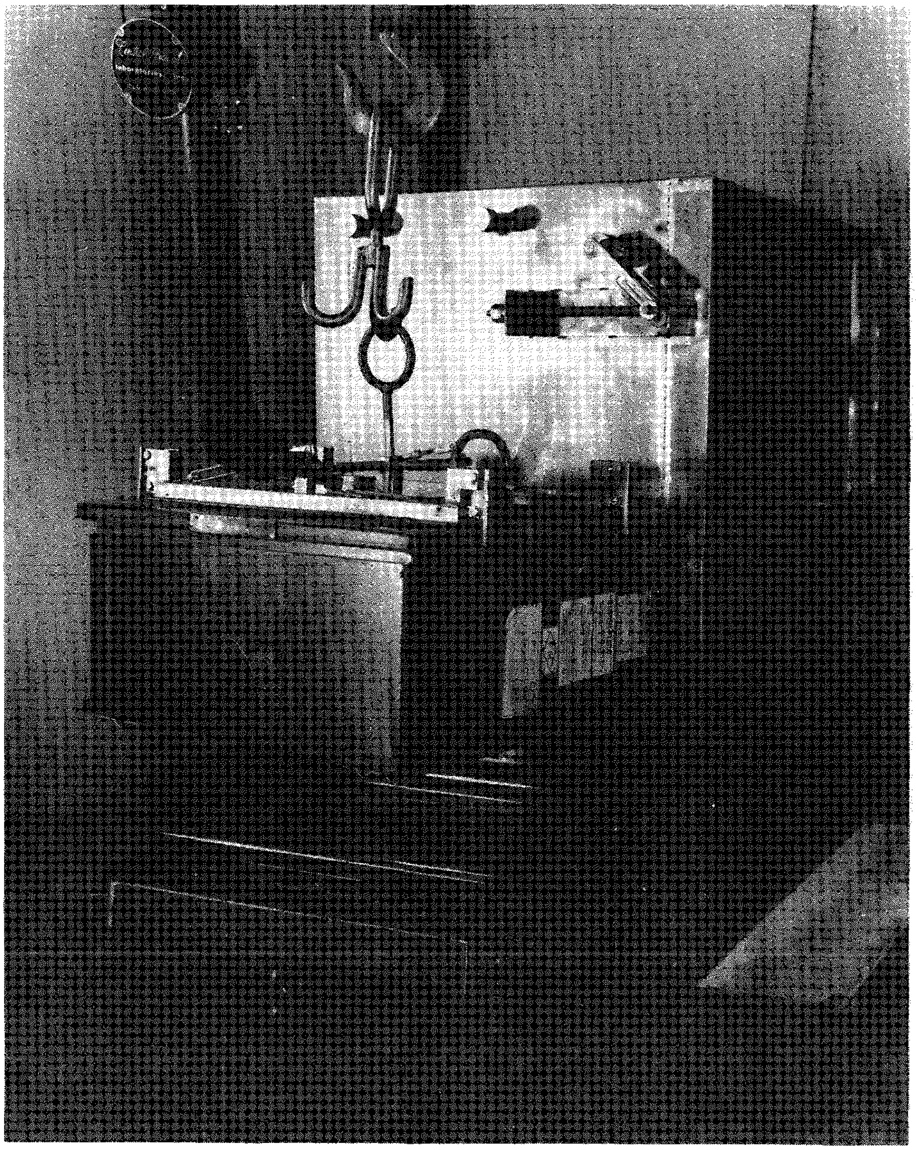

Fig. 36. Filter being removed from elevator.

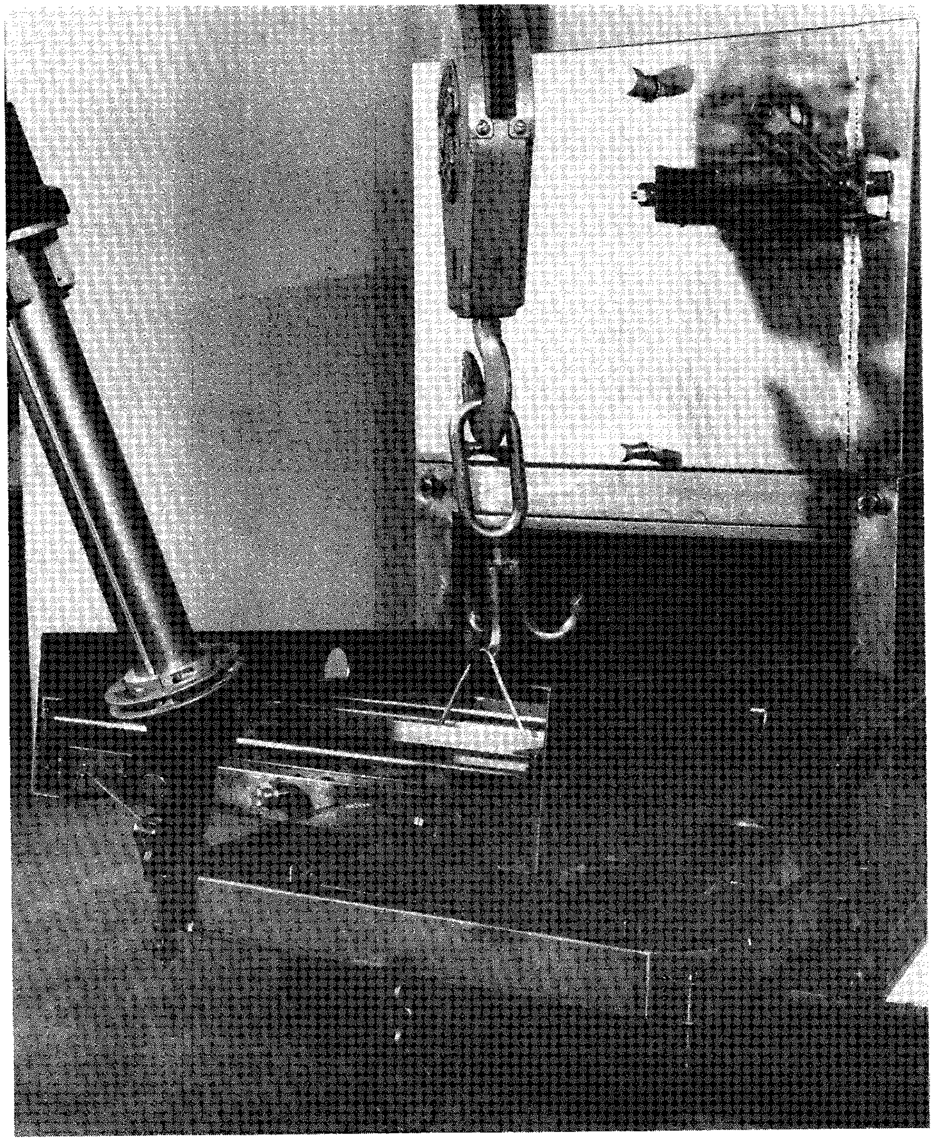

Fig. 37. Elevator replacement.

10. FAST CLOSED-CIRCUIT TV SYSTEM

The FDP cell closed-circuit TV system will have three cameras for use during operations and remote maintenance. One camera will be portable with wall support brackets and plug-ins to provide overall cell coverage. The second camera will be mounted on the crane trolley to scan the crane operating area. Both of these cameras will be radiation-resistant and have zoom lenses. Their signals will be fed to plug-ins at the viewing windows for monitors. The third camera will be mounted on the trolley of the overhead electromechanical manipulator and will be raised and lowered by a powered reel. The camera will also be radiation-resistant but will not have a zoom lens. It will have two replaceable lenses. One lens will point straight down; the second lens is at 90^0 to the vertical with the capability to rotate 360^0. This is the camera that was tested. It is 1-5/8 in. in diameter, is sealed so that it can be submerged if necessary, and has its own light source.

The first test consisted of lowering the camera inside the FAST dissolver mockup described in Section V.6 and observing a vertical weld with the 90^0 lens. Figure 38 shows a picture taken from the TV monitor. The magnification is approximately 4X and the "width of weld" is 1/16 in. In actual use, the weld picture would be recorded prior to use of the vessel and filed for later comparison. Although welds in the actual dissolver will probably not be initially distinguishable from the parent metal because of the grind and polish finish, later corrosion should be apparent in the weld area. Figure 39 shows a 1-in. pipe nozzle welded into the side wall at the tangent.

To simulate looking for undissolved material, the straight-down lens was used in the second test. Figure 40 shows a 1/2-in.-diameter machine bolt on the bottom of the mockup.

Further TV recordings were made successfully inside a water-filled full-scale plastic dissolver in which the bottom was partly covered with

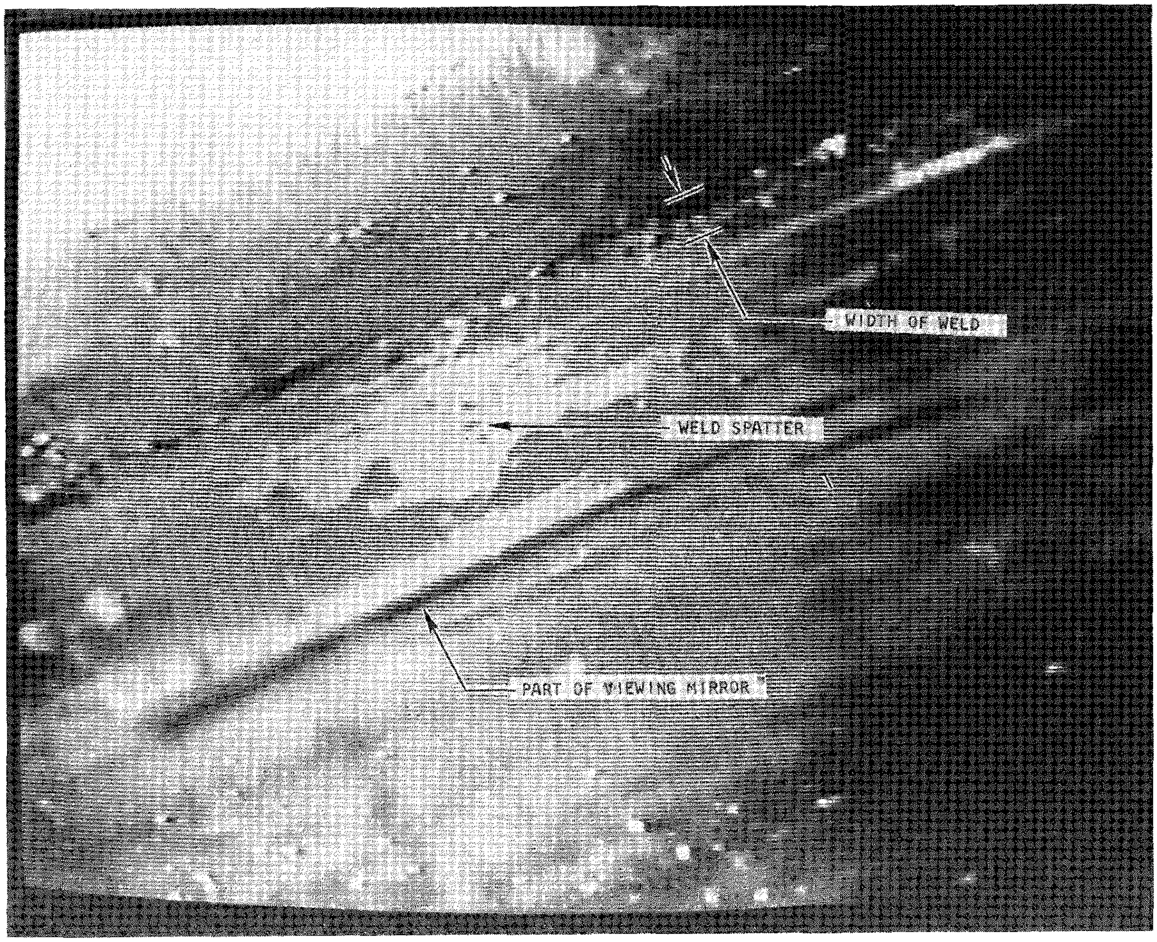

Fig. 38. Vertical weld viewed with 90° lens.

short stainless steel pins and fine lead oxide powder. The materials were readily identified. The tests also indicated that it is possible to read print as small as 1 mm high.

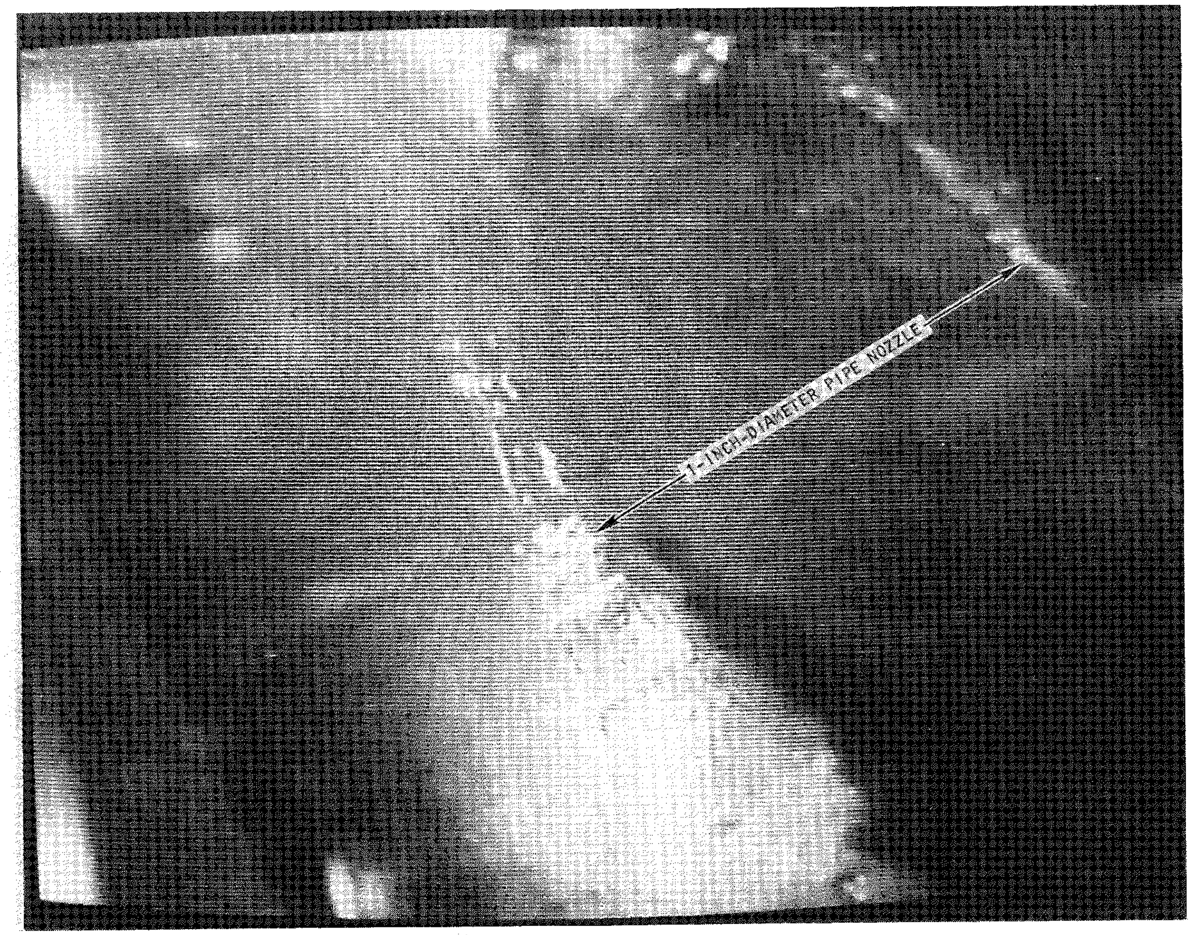

Fig. 39. 1-in.-diameter pipe nozzle in vessel wall.

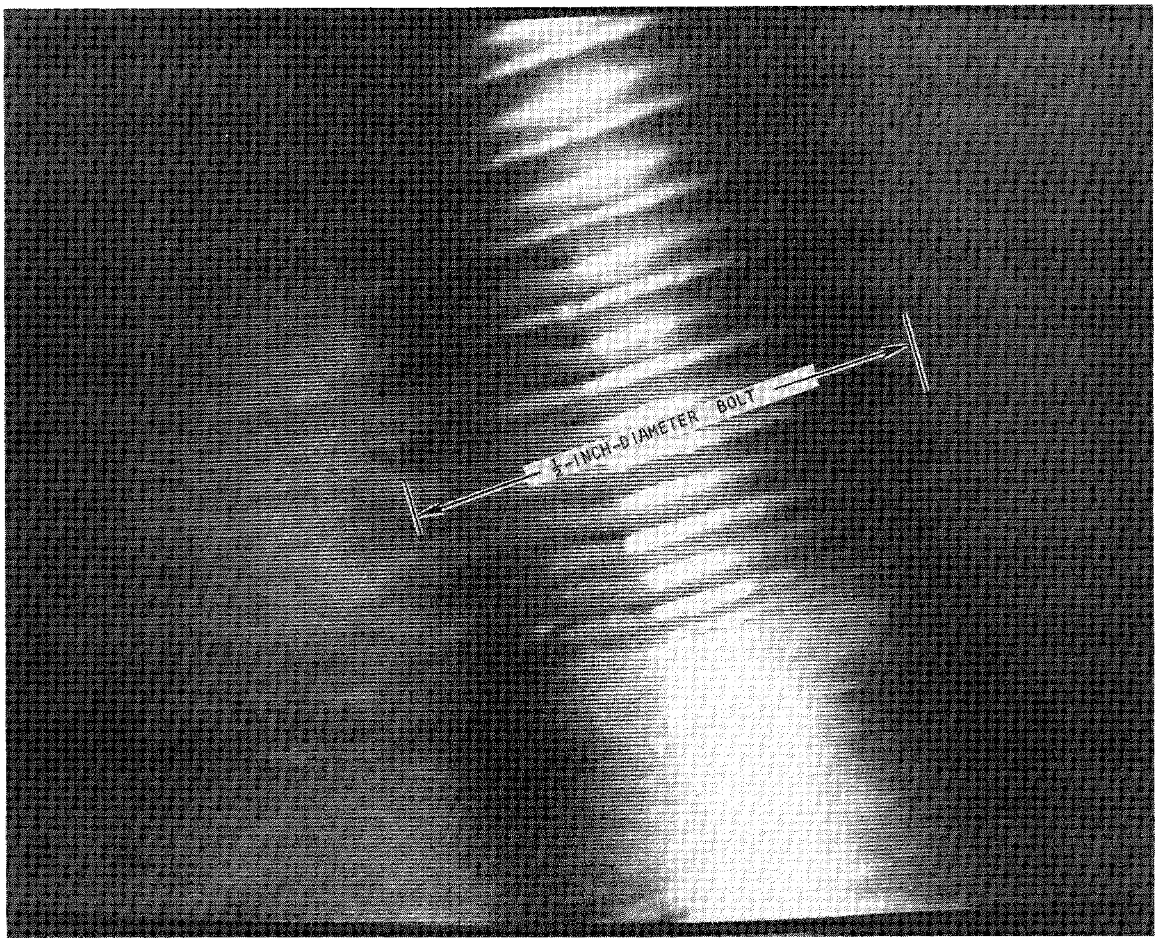

Fig. 40. 1/2-in.-diameter bolt on mockup floor.

VI. FUTURE PLANS

Mockup and testing efforts of remote handling equipment have continued in support of two major projects during this year. The continuing effort in the RMTF will include evaluating new detailed designs and additional remote maintenance equipment and techniques. Specifically, these will include the following:

(1) Continue work on in-cell TV equipment handling, support, alignment, and inspection techniques.

(2) Assemble and test NWCF sample transfer cart.

(3) Provide mockup and checkout support for FAST remote handling design.

(4) Complete preparation of NWCF remote equipment checkout system operation tests.

(5) Initiate study of current remote cutting and welding techniques.

(6) Conduct hands-on training sessions for NWCF operators.

(7) Investigate a method for calciner bubble cap replacement.

VII. REFERENCES

1. R. T. Jacobs, Remote Maintenance Development, June 1974 - July 1975, ICP-1081 (October 1975).

2. R. D. Fletcher, ed., Remote Maintenance Development, July 1975 - July 1976, ICPP-1113 (April 1977).

3. Idem, Remote Maintenance Development, July 1, 1976 - July 30, 1977, ICPP-1143 (May 1978).

4. Idem, Remote Maintenance Development, July 1, 1977 - June 30, 1978, ICP-1170 (October 1978).

5. R. D. Fletcher, ed., ICP-1113, pp 22-23.

6. Idem, ICP-1170, p 21.

7. Idem, ICP-1143, pp 37-38.

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