



Radiation Effects on Materials

AEC Research and Development Report

**SHEARING IRRADIATED URANIUM PLATES
PART II**

by

R. B. Olcott

Pile Engineering Division

July 1957

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RADIATION EFFECTS ON MATERIALS
(M-3679, 19th Ed. incl. Suppl. 1)

SHEARING IRRADIATED URANIUM PLATES - PART II*

by

Roland B. Olcott
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July 1957

Classification Cancelled ~~or~~ Changed
TO *Declassified*
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Name	Title	Date
<i>TID-1231</i>		<i>6-30-60</i>
<i>BAH of/18</i>		<i>hh 8/10/60</i>

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Printed for
The United States Atomic Energy Commission
Contract AT(07-2)-1

* Part I was issued as DP-185, Shearing Irradiated Uranium Plates,
by W. S. Delicate, E. J. Osterman, and C. W. Zeh, November 1956
(Confidential).

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ABSTRACT

Radioactive contamination was confined and controlled in an isolation tank when irradiated plates of natural uranium were cut under water.

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SHEARING IRRADIATED URANIUM PLATES - PART II

INTRODUCTION

Experimental aluminum-clad plates of natural uranium that were irradiated in one of the Savannah River reactors are too long to be handled with existing transfer and separations facilities. This report describes the equipment used to shear the plates into short pieces and the method used to prevent spreading of the radioactive contamination that was released during the shearing operation.

SUMMARY

Radioactive contamination from the shearing of irradiated plates of natural uranium was controlled by performing the operation in an open tank in a disassembly basin. The radioactivity in the tank was kept at a low level by recirculating the water in the tank through a filter and an ion exchange column. During the shearing operation, the highest activity of water in the tank was 8×10^{-3} $\mu\text{c/cc}$; which was only a factor of 20 above background activity of the water in the basin. Activity of air above the tank did not increase, and the radiation level in the working area, four feet above the water, was only three mrad/hr. Contamination of the shearing equipment was low enough, 25 mrad/hr at three feet, to allow the equipment to be removed from the tank and worked upon directly.

The ten plates that were cut had been irradiated to either 480 or 940 MWD/T average exposure and had cooled from twelve to sixteen months. Each plate was about 3 inches wide by 0.2 inch thick and (14) feet long. The plates were sheared into seven-inch sections with forces of 8,000 to 33,000 pounds. Force varied inversely as the amount of pile exposure.

DISCUSSION

EQUIPMENT

Radiation and Contamination Control

Isolation Tank

To prevent spread of radioactive contamination, the shear and associated equipment were contained in a 2000-gallon open tank as shown in Figure 1. To provide radiation shielding, the tank was suspended in a basin so that the shearing operation took place nine feet under water. A canvas shroud, that was fastened to the top of the tank and extended above the water surface, provided complete isolation during cutting, yet could be lowered to allow underwater access to the tank. Plates were supported by a feed table hinged to one end of the tank; they were moved into the tank through a porthole fitted with a rubber gasket.

Filtration System

To collect contamination in the isolation tank, a submerged pump maintained a water flow of approximately 15 gpm through filters and deionizers. Intake for this system was through two openings in the bottom of a chute, one directly below the shear blades and the other near the open shipping can. Filtered water was discharged into the top of the tank. The filters and resin columns were supported by a frame inside the isolation tank and were remotely replaceable.

Shipping Containers

Aluminum cans, shown in Figure 2, were used to ship seven-inch sections of plate to separations facilities. The cans were dumped into the dissolvers intact; consequently, no gasket material could be used to seal the covers. The maximum water leakage observed during testing of shipping cans was four or five drops per minute.

The cans were shipped in a standard slug bucket with partitions added to maintain can orientation as shown in Figure 3. It was necessary to maintain this arrangement in order to prevent cans from jamming in the dissolver charging chute.

Shearing Apparatus

A portable hydraulic shear was used with the blade modified to provide a vertical shearing action. This modification is described in Part I of this work (see Page 1). The shear was provided with a hydraulic hold-down cylinder and mounted on a table as shown in Figure 4.

The shear and table rested in a frame inside of the isolation tank. A chute leading from the shear to the shipping container guided cut sections and any particles into the can and directed water flow over the cut sections to the filtration system. A picture of the tank with equipment installed is shown in Figure 5.

Monitoring Equipment

Radiation levels were measured with "Cutie Pies" and air contamination was measured with a Kanne chamber and an "impactor" (a device for measuring particulate contamination of air).

OPERATION

Shearing

To prove that the equipment was adequate, a short plate, (Figure 6), with relatively low burnup was cut first. This plate had been irradiated in the MTR to 300 MWD/T and had cooled for 22 months. Water activity in the tank increased by a factor of 20 to a maximum of 8×10^{-3} $\mu\text{c/cc}$. The cut sections were sealed in a can provided with a pressure gage. There was no increase in pressure inside of the can during an eleven-day period.

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Ten aluminum clad plates of natural uranium were easily sheared into seven-inch lengths. The plates were 14 feet long and of three different types as shown in Figures 6 through 9. Five of these plates had 480 MWD/T average exposure and 505 days of cooling; the other five had 940 MWD/T average exposure and 370 days of cooling. Force required to shear the plates varied inversely as pile exposure and ranged from 8,000 to 33,000 pounds. The uranium core broke under the shear blade as observed in Part I of this work (see Page 1). The few small fragments that were formed either slid down the chute into the can or were swept into the filtration system. Pictures of the cut edges are shown in Figures 10 and 11.

Contamination and Radiation

Water contamination was effectively contained and controlled by the isolation tank and filtration system. The highest activity of water in the isolation tank was 3×10^{-3} $\mu\text{c/cc}$ and occurred only in the tank sump. The activity of water at the top of the tank did not increase above basin water background of about 3×10^{-4} $\mu\text{c/cc}$. The activity of basin effluent water did not increase above background during the cutting operation or when isolation tank water was mixed with basin water after the cutting was complete.

The maximum radiation level in the working area (approximately four feet above the water surface over the tank) was three mrad/hr and did not increase during the shearing operation. The radiation level three inches above the water surface over the tank was eight mrad/hr.

Air activity did not increase above background during the cutting operation.

Shipping

The canned plate sections were stacked in the modified slug bucket under water, shipped to separations facilities, and dumped into the dissolver intact. Figure 3 shows the cans stacked in the bucket before shipment and plate sections in a can are shown in Figure 11.

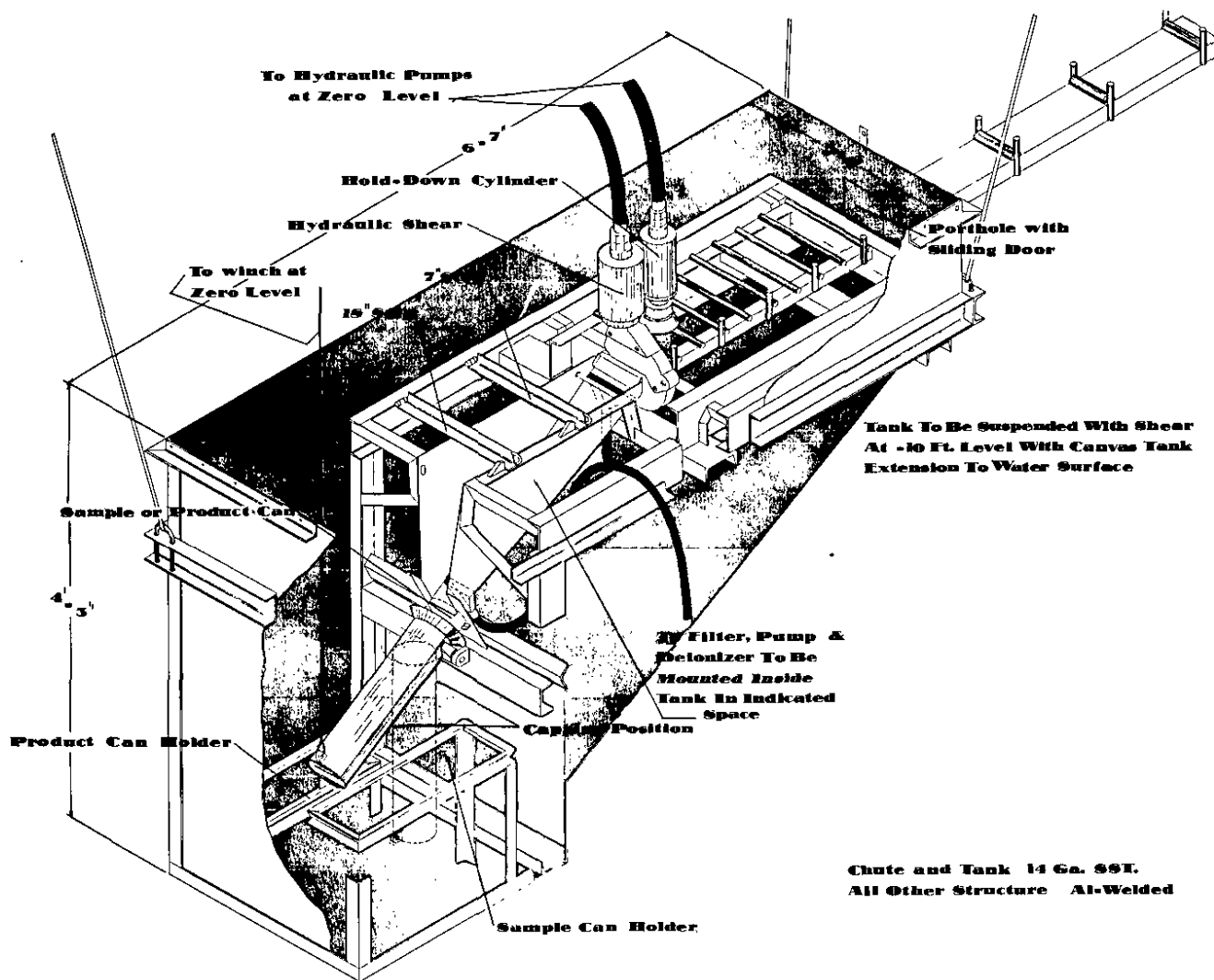
Equipment Contamination

The activity of the shear and table assembly after ten plates were sheared was low enough to allow the assembly to be removed from the basin without difficulty. The shear and table were rinsed with clean water before being removed from the basin. The radiation level three feet from the shear was 25 mrad/hr and three inches from the shear blade the level was 400 mrad/hr. These levels were low enough to allow direct maintenance work to be done on the equipment.

R. B. Olcott

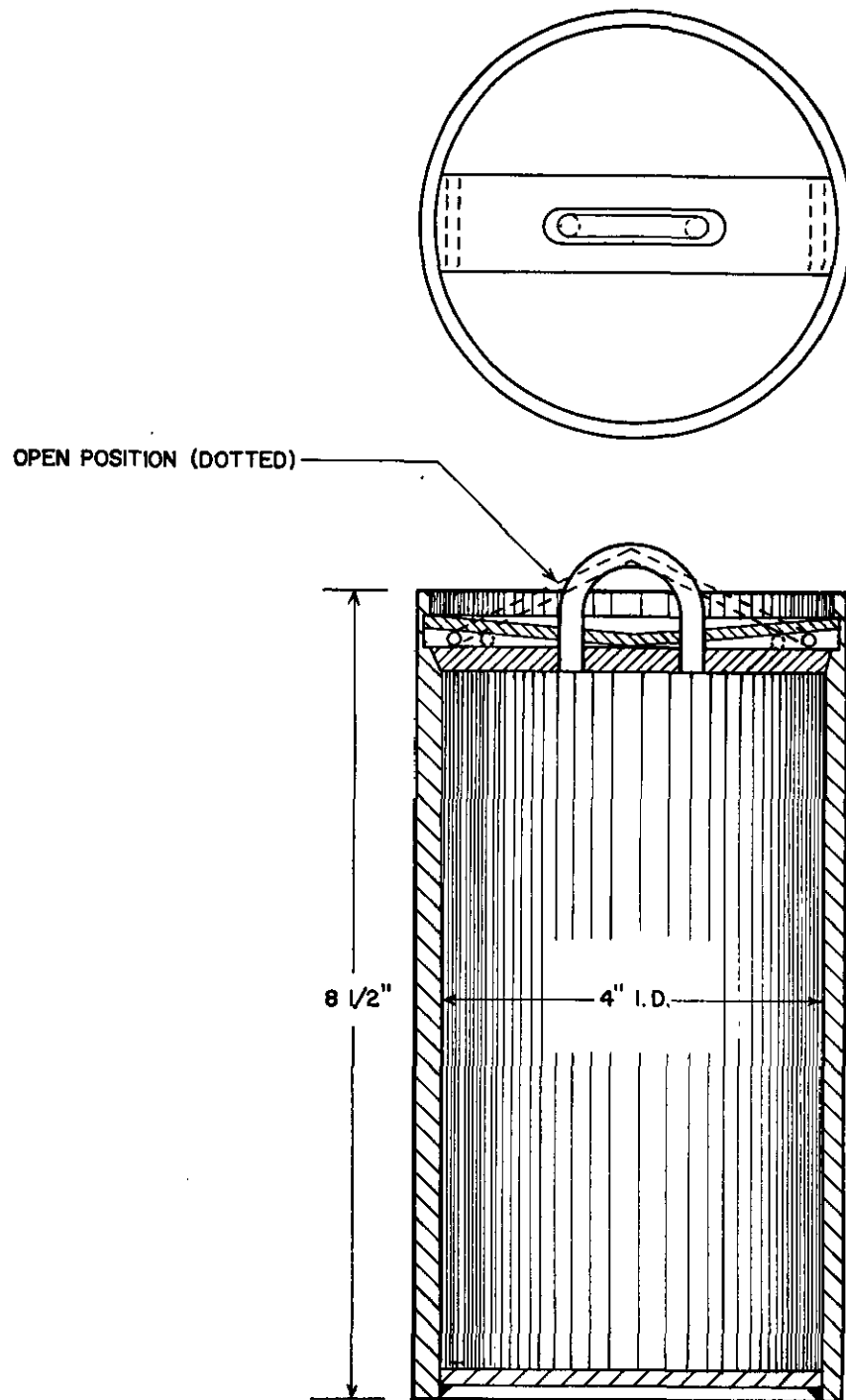
R. B. Olcott
Pile Engineering Division

FIGURE 1



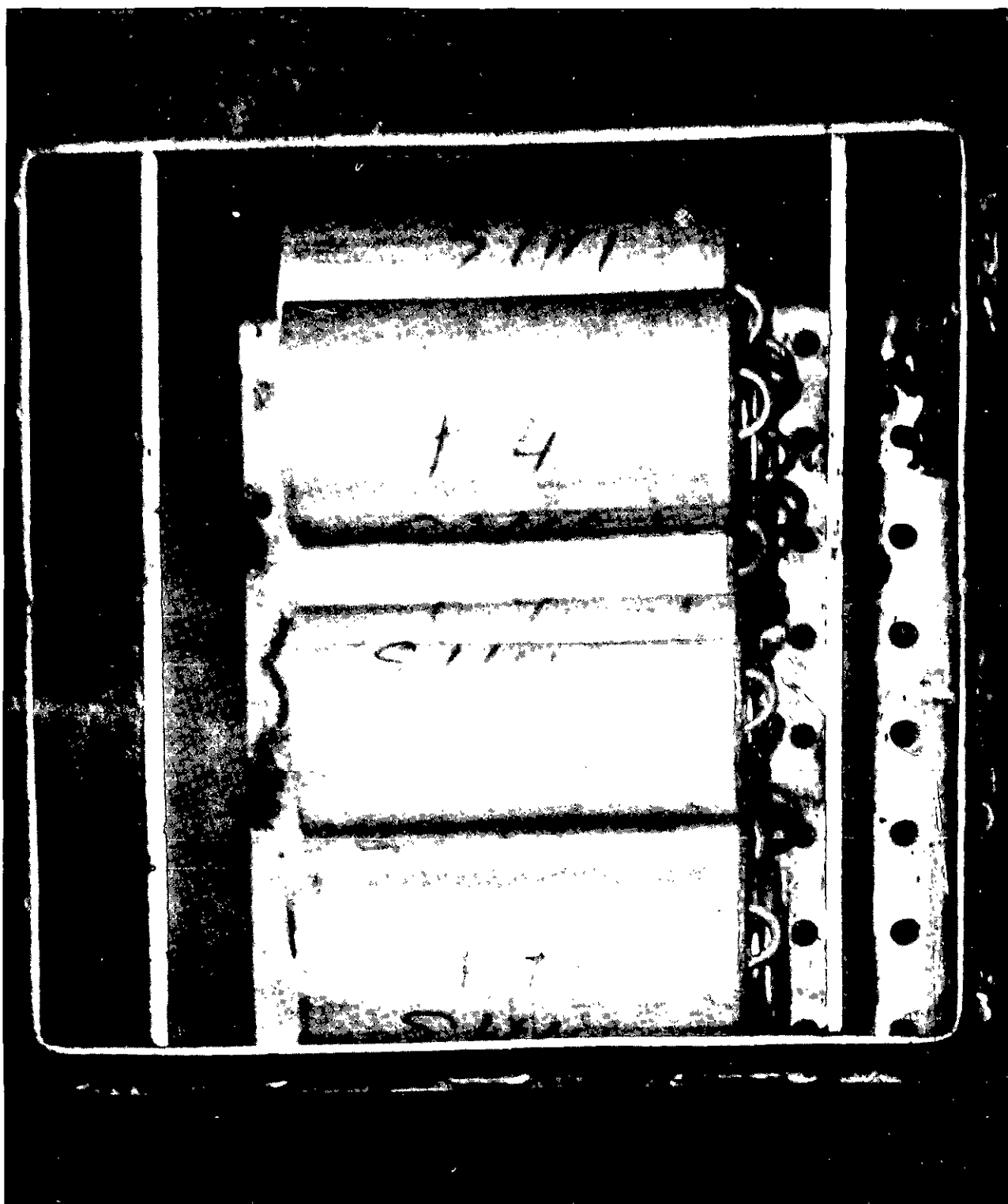
ARRANGEMENT OF EQUIPMENT IN THE ISOLATION TANK

FIGURE 2



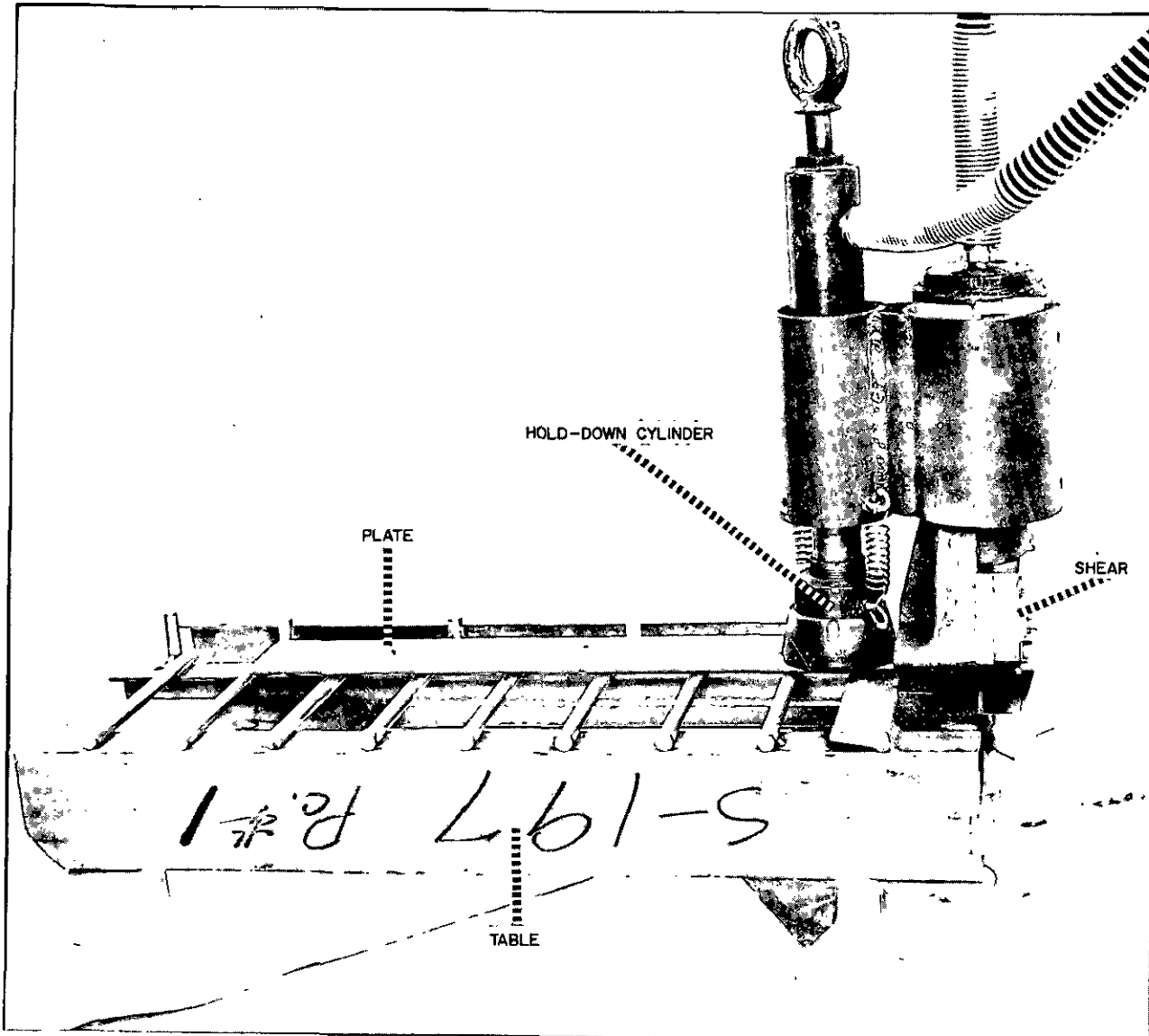
SHIPPING CAN

FIGURE 3



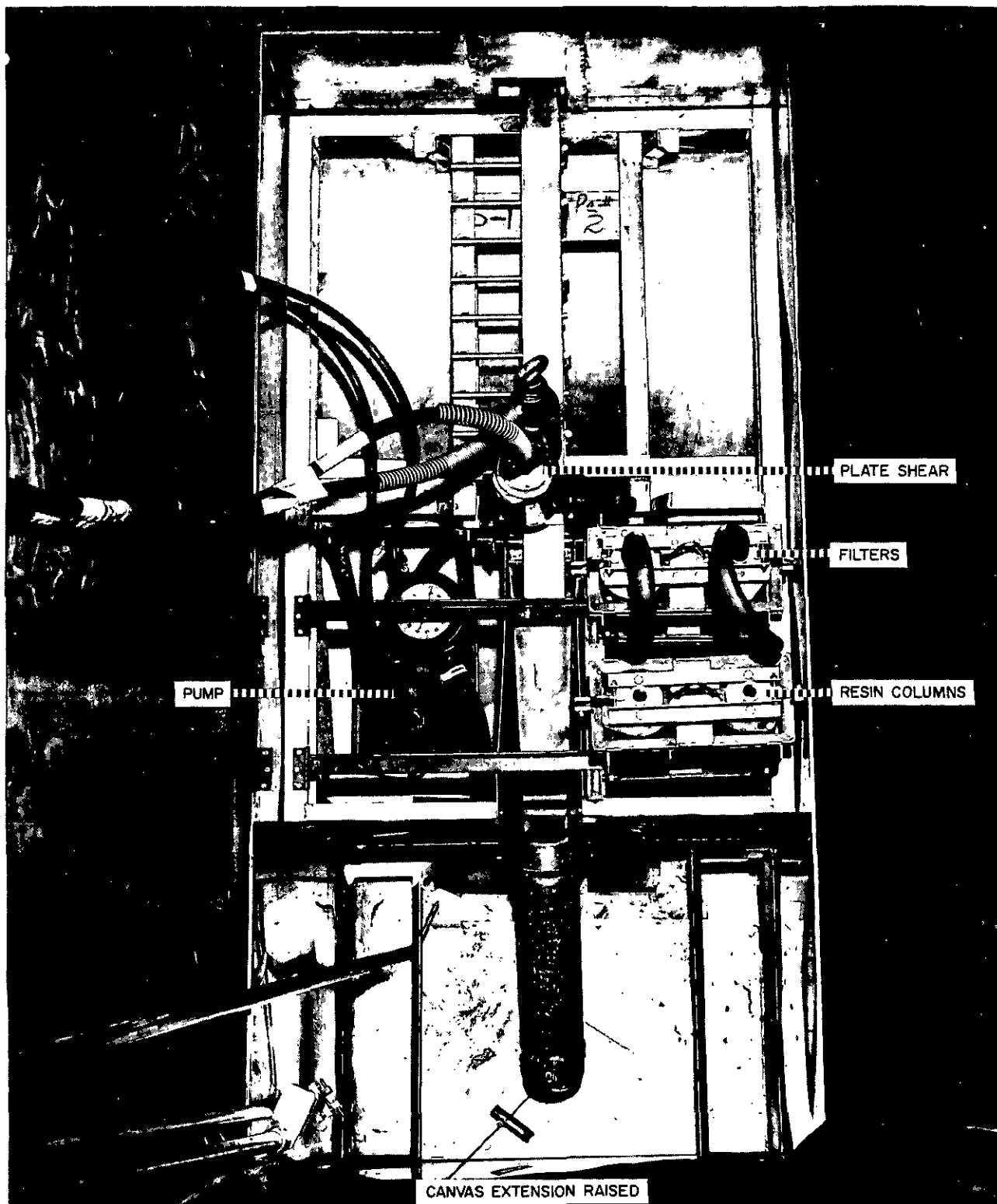
SHIPPING BUCKET CONTAINING CANS

FIGURE 4



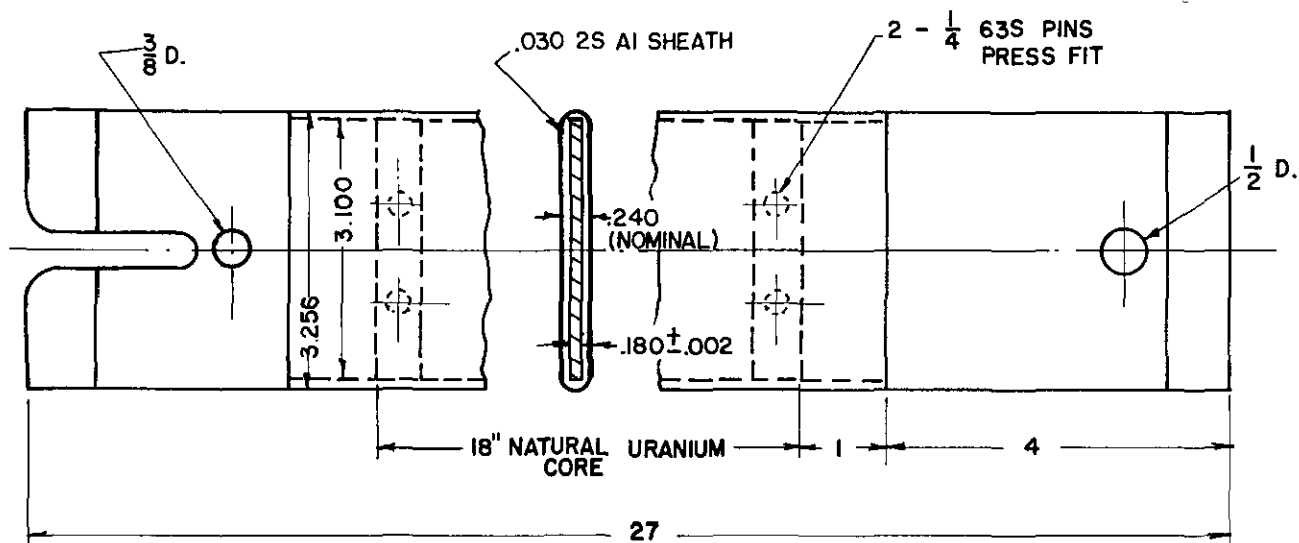
SHEAR AND TABLE

FIGURE 5



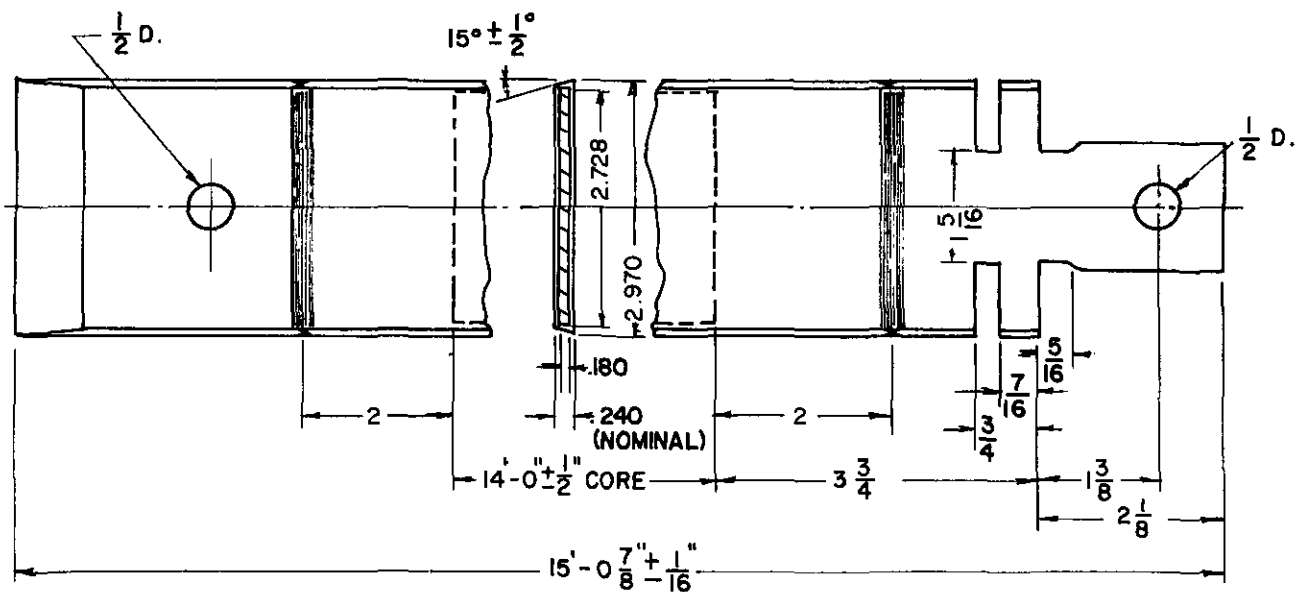
SHEARING EQUIPMENT INSTALLED IN ISOLATION TANK

FIGURE 6



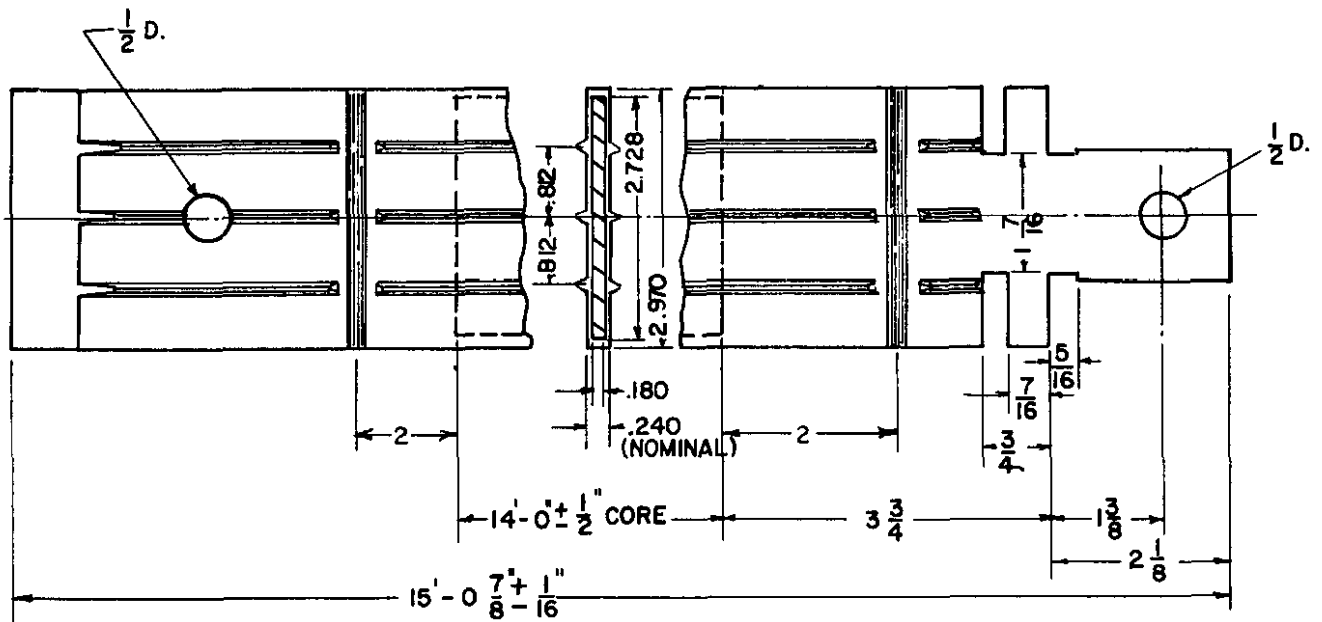
MTR PLATE

FIGURE 7



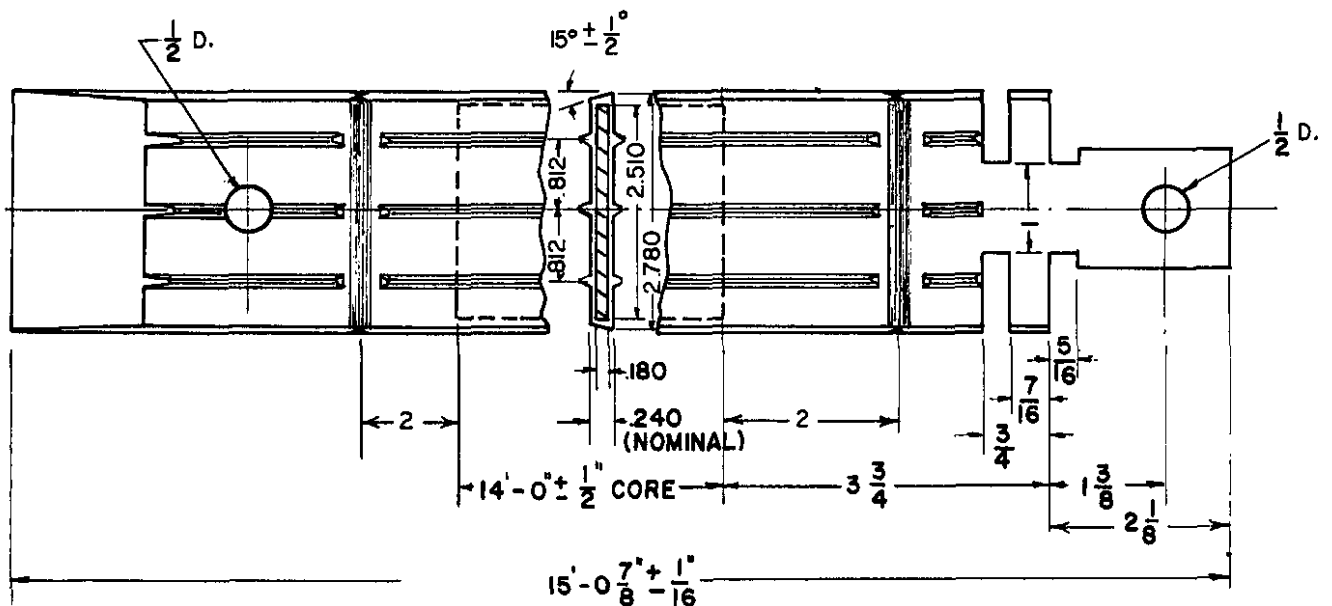
UNRIBBED PLATE

FIGURE 8



CENTER PLATE

FIGURE 9



NOTE ALL DIMENSIONS IN INCHES
OR AS SHOWN

OUTSIDE PLATE

FIGURE 10



CUT EDGE OF MTR PLATE

UNCLASSIFIED

FIGURE 11

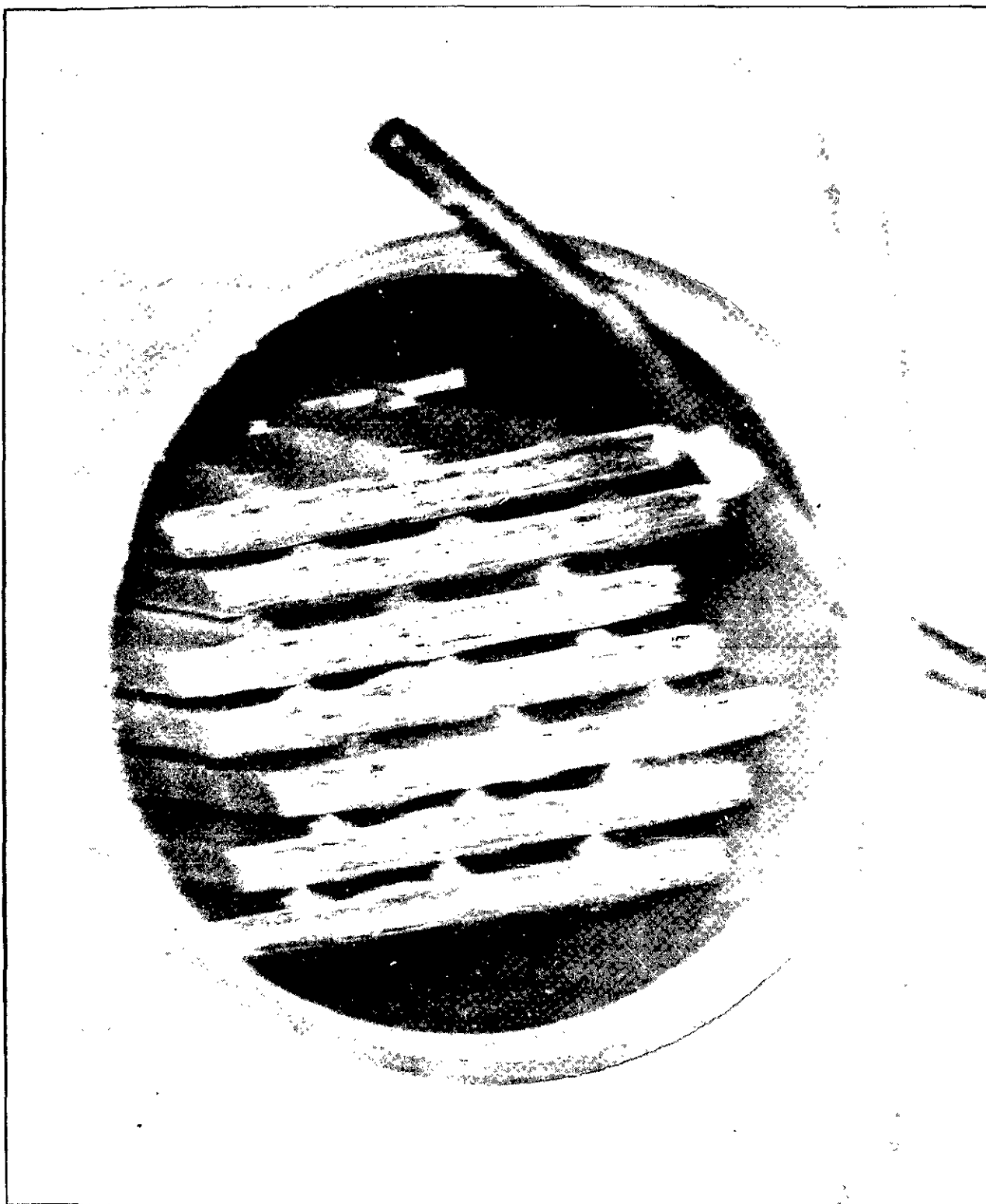


PLATE SECTIONS IN SHIPPING CAN