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WATER FLOW PATTERNS ON A TOWED CYLINDER.(U)
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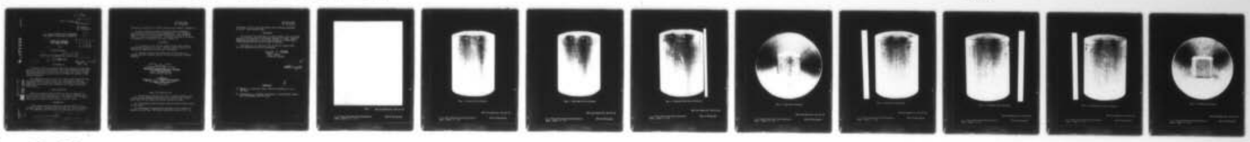

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U. S. NAVY UNDERWATER SOUND LABORATORY
FORT TRUMBULL, NEW LONDON, CONNECTICUT

WATER FLOW PATTERNS ON A TOWED CYLINDER.

By

Kirk T. Patton

USL Technical Memorandum No. 933-361-64

10 November 1964

INTRODUCTION

A series of tests were recently conducted to measure lift and drag forces on a towed circular cylinder, with towing attachment at one end. The studies are aimed at determining the minimal size of tail and body structure that might possibly be used for a dense fish having a cylindrical transducer.

This memorandum does not cover the initial tests, results of which will be included in a report after other investigations have been completed; it does discuss an interesting phenomenon in the nature of water flow pattern traces that occurred on the cylinder during the towing tests.

TOWING CONDITIONS

During the towing by USL's 83-foot test boat at speeds up to 11 knots, the cylinder was immersed in salt water an estimated three hours a day for three successive days. Upon completion of the tests, the cylinder was removed from the strut on the test boat.

OBSERVATIONS

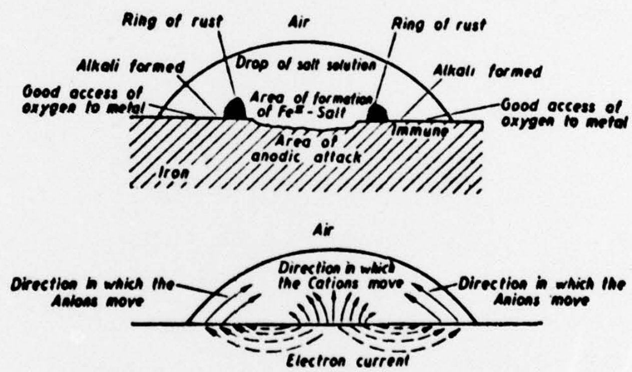
It was noted, from close inspection, that the surface of the cylinder displayed a regular pattern of water flow traces (see figure 1). The stagnation point and points of separation can be readily observed by inspecting the corrosion products (see figures 2 through 5).

In order to make the patterns more discernible, streamlines were plotted on the body by constructing tangents to the streaks by means of a french curve (see figures 6 through 9). Areas in which there is no flow are cross-hatched. The angular position of the lines of separation on the cylinder are shown in Figure 10.

DEDUCTIONS

1. The surface of the cylinder becomes covered with a more or less uniform distribution of pits. (Certain localized areas of the aluminum are cathodic to the main mass of aluminum).

2. Corrosion products form around the pits as shown on the diagram below for a similar process involving a sodium salt solution and iron.



(Taken from Reference (a))

3. The corrosion products in the form of sodium aluminate, tend to become streak formations (directly aft of the pits) due to water motion past the pits during the time the cylinder is towed.

4. The deposited sodium aluminate induces further corrosion along the flow lines.

The flow appears to separate and then return to the surface to separate a second time. The initial separation occurs at 102°. The theoretical solution using the Blasius series indicates separation at 108.8°. (See reference (b)).

CONCLUSIONS

The phenomenon described may be a useful research tool in investigations of flow patterns in the laminar sublayer of a body. Areas of stagnation and separation of water flow patterns on a faired object can be delineated if the object is made of aluminum.

The reason for the occurrence of a second flow pattern after the first separation should be investigated.

Kirk T. Patton
KIRK T. PATTON
Mechanical Engineer

References

(a) Rabald, R., "Corrosion Guide," Elsevier Publishing Co., Inc., New York,

(b) Schlichting, H., "Boundary Layer Theory," Fourth Edition, McGraw-Hill Book Company, New York, 1960

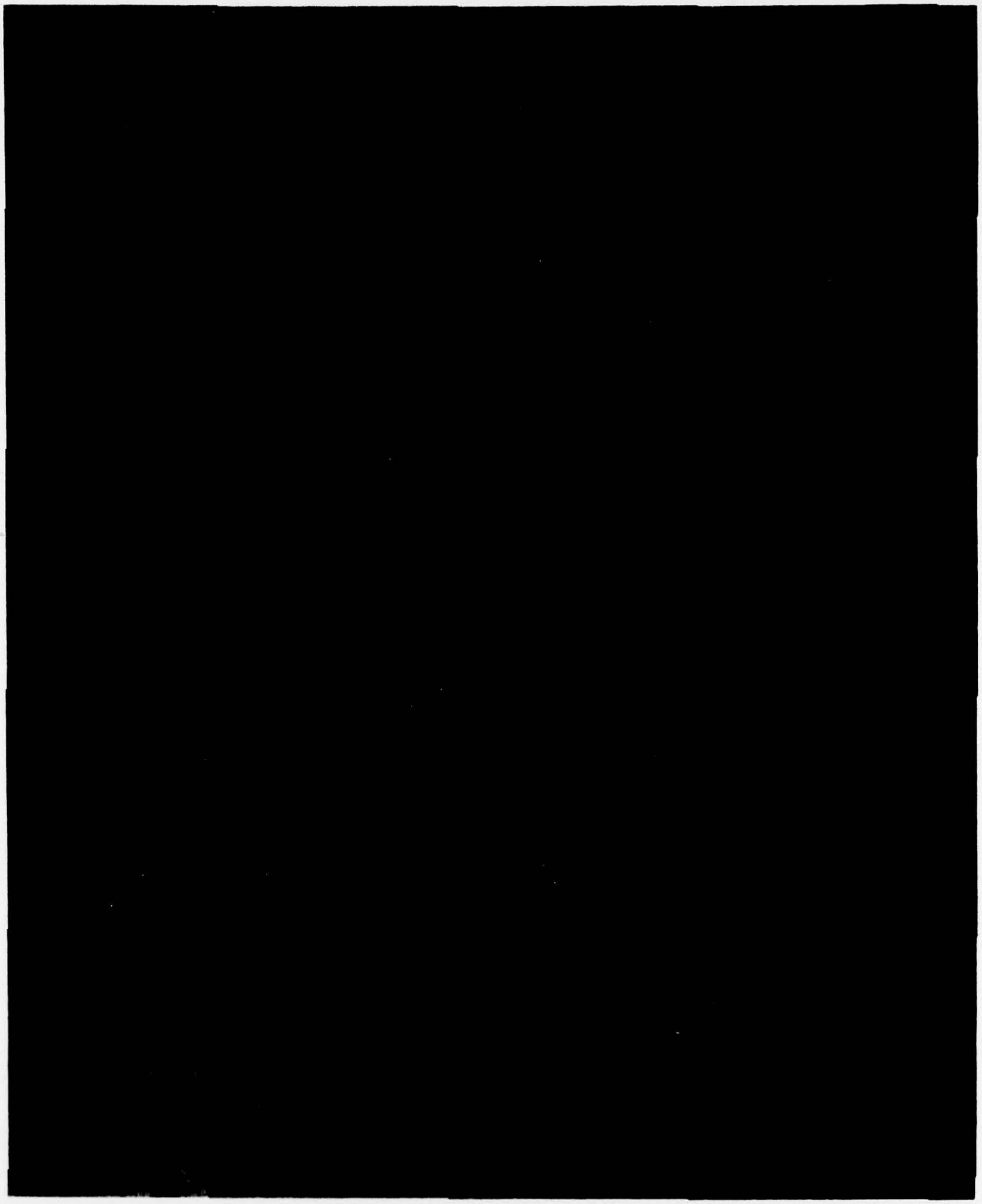


Fig. 1 **USL Tech Memo No. 933-361-64**

U. S. Navy Underwater Sound Laboratory **Official Photograph**
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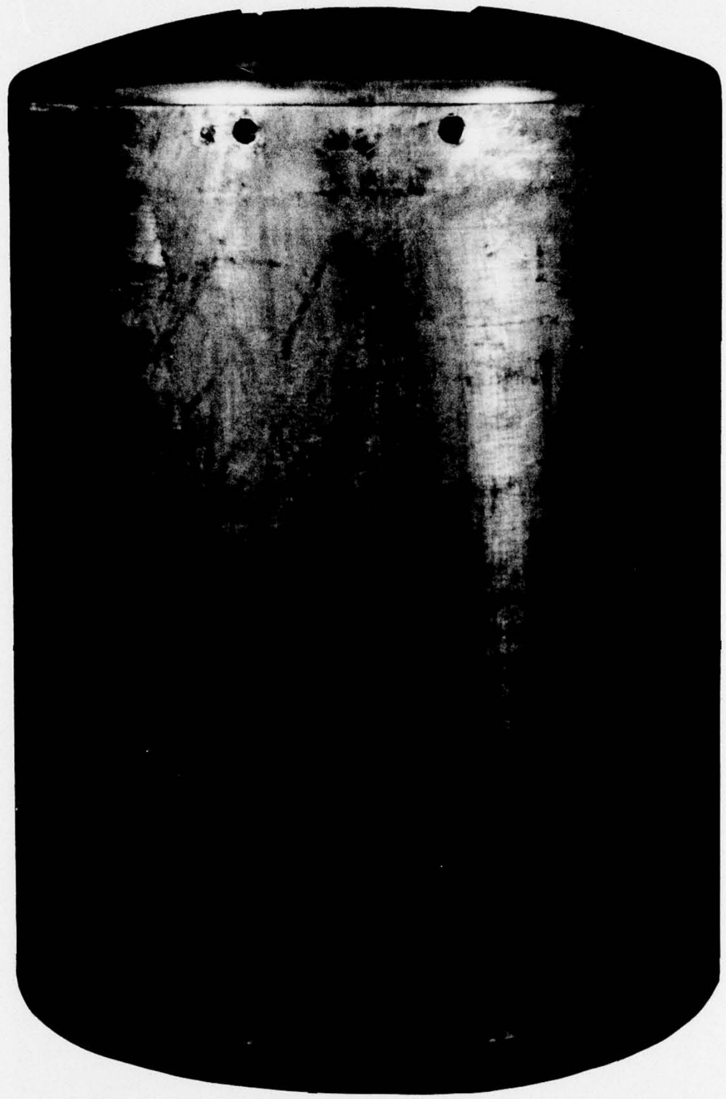

Fig. 2 - Front View of Cylinder

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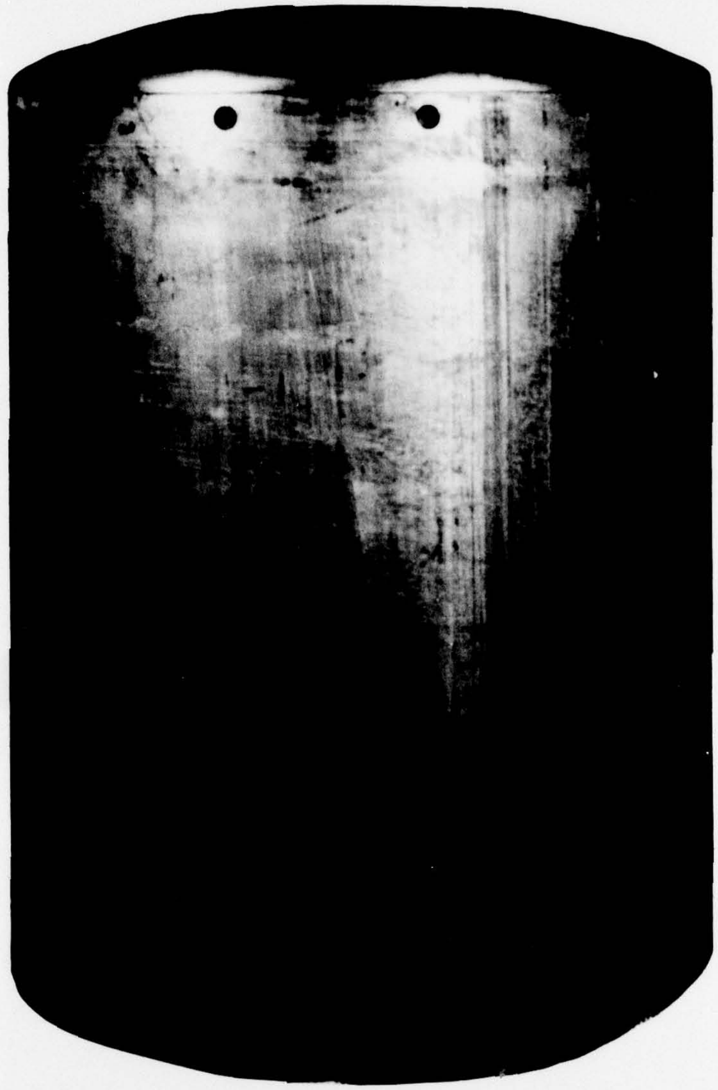

Fig. 3 - Port Side View of Cylinder

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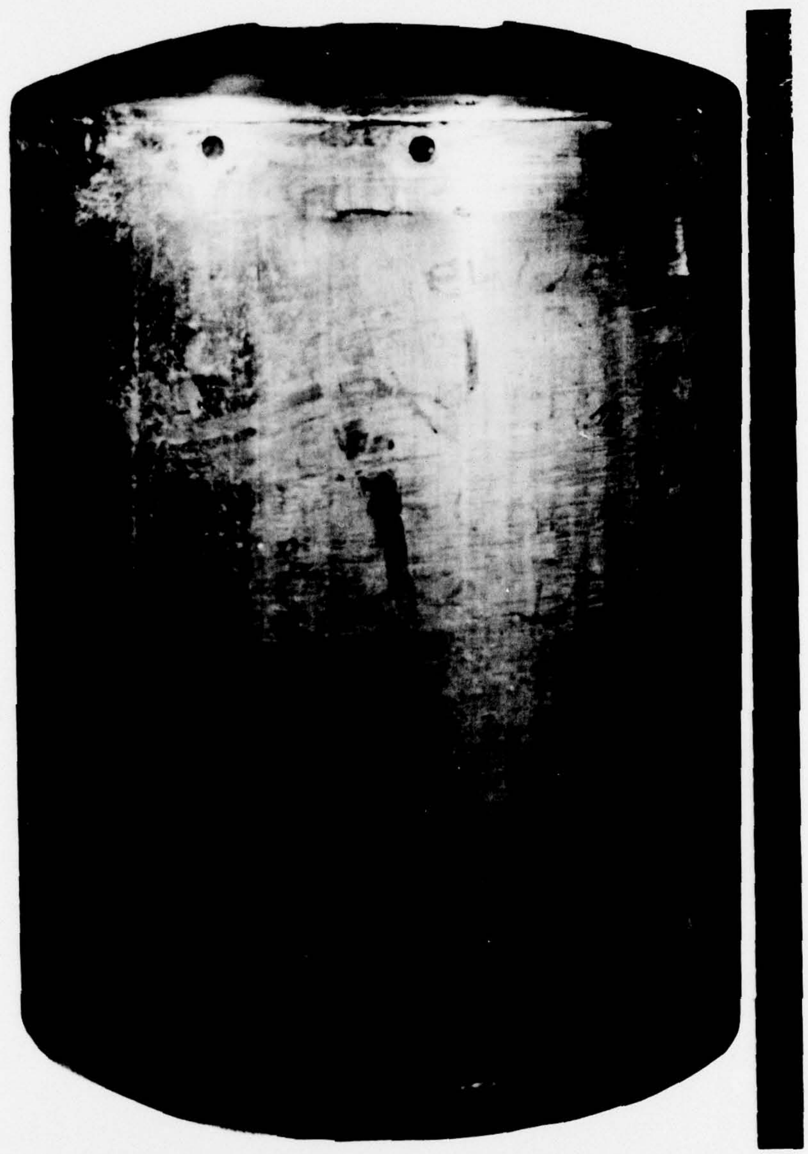

Fig. 4 - Starboard Side View of Cylinder

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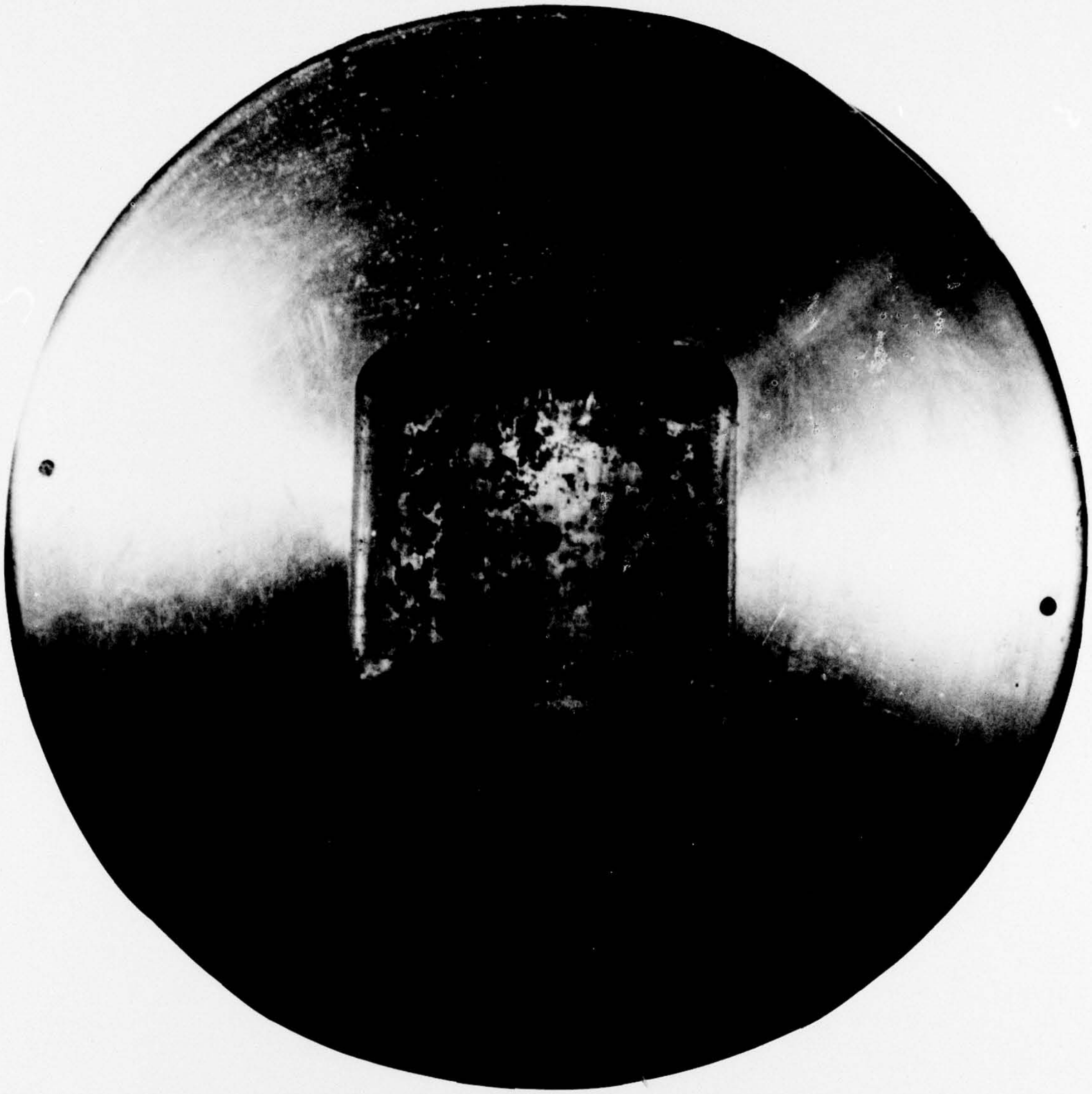

Fig. 5 - Top View of Cylinder

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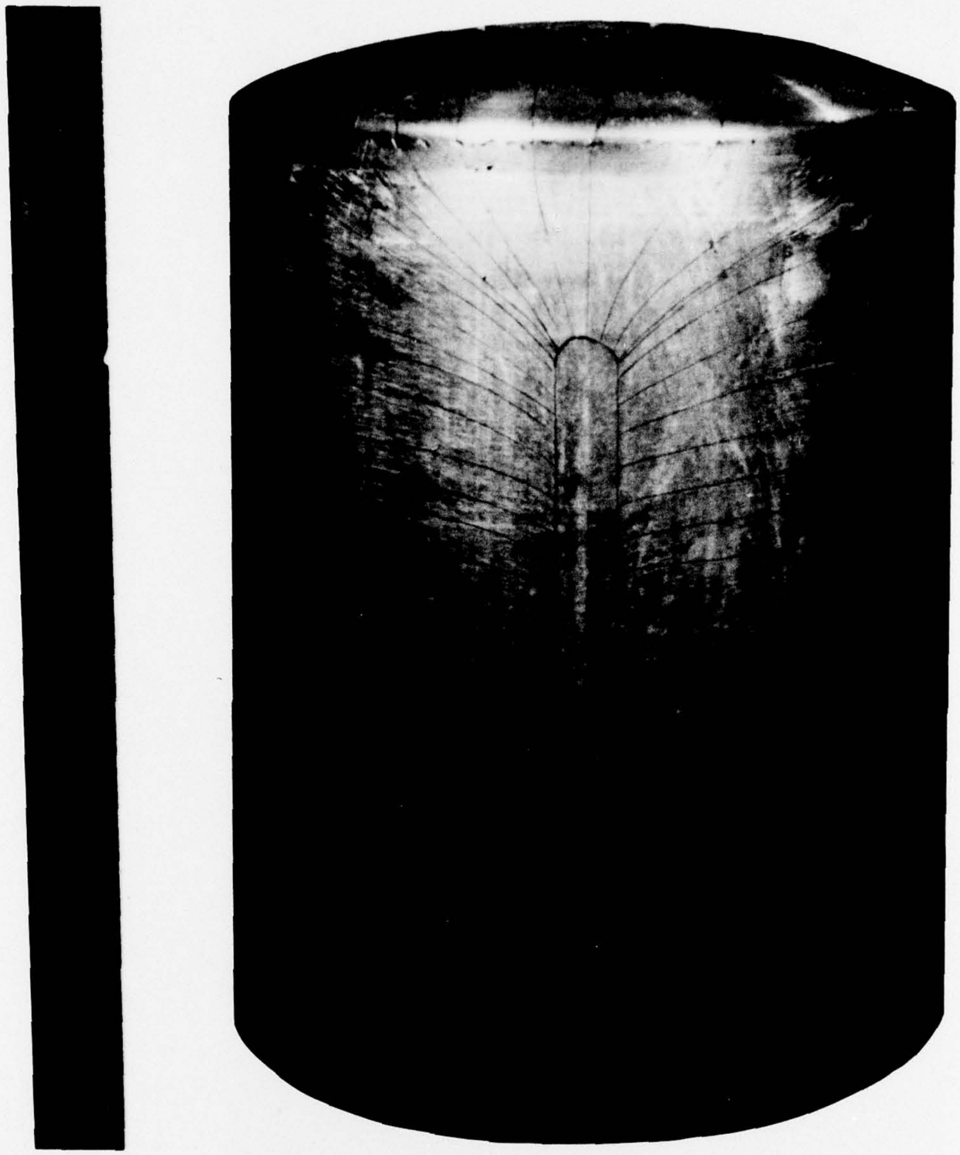

Fig. 6 - Front View of Cylinder

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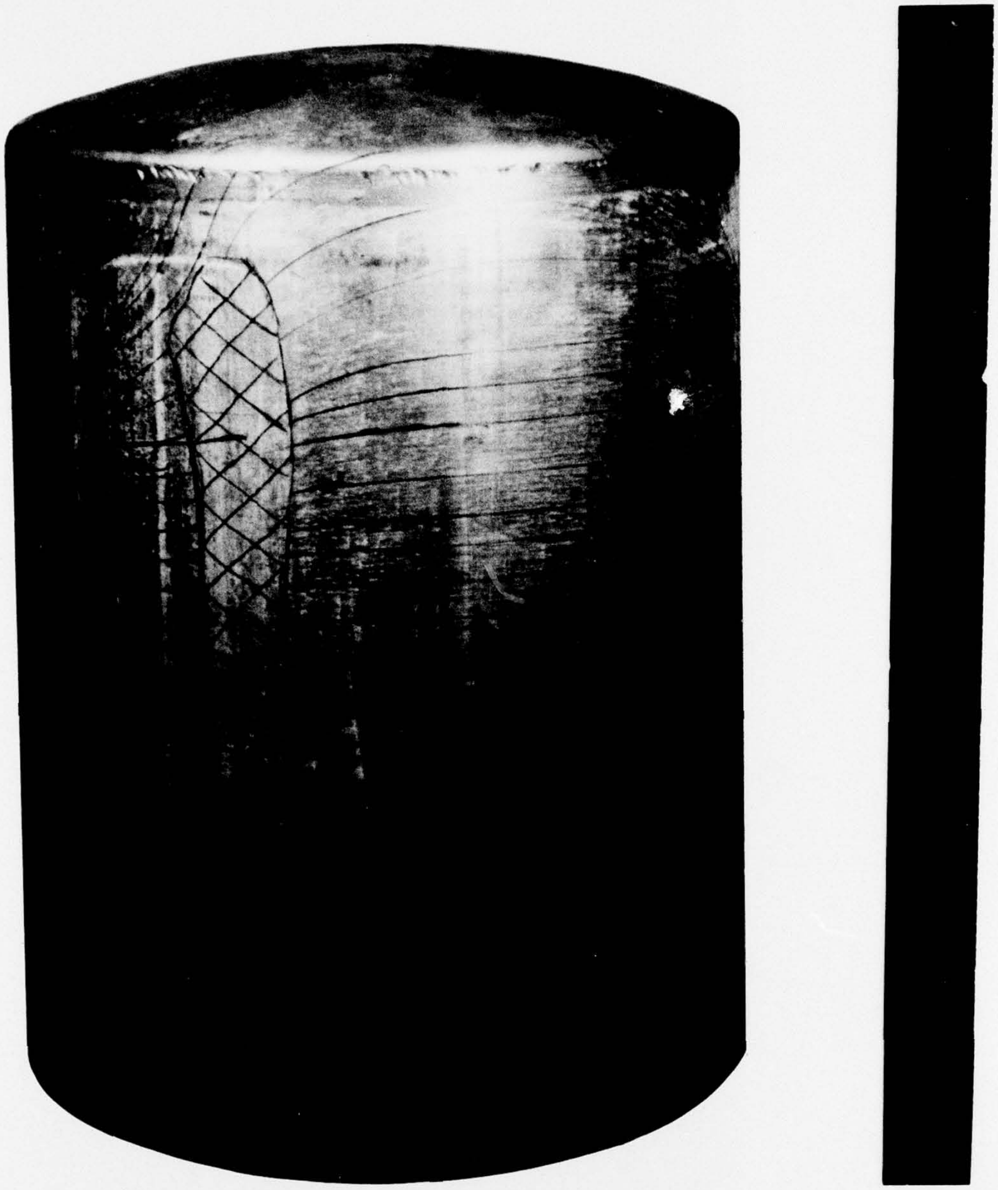

Fig. 7 - Port Side View of Cylinder

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Fig. 8 - Starboard Side View of Cylinder

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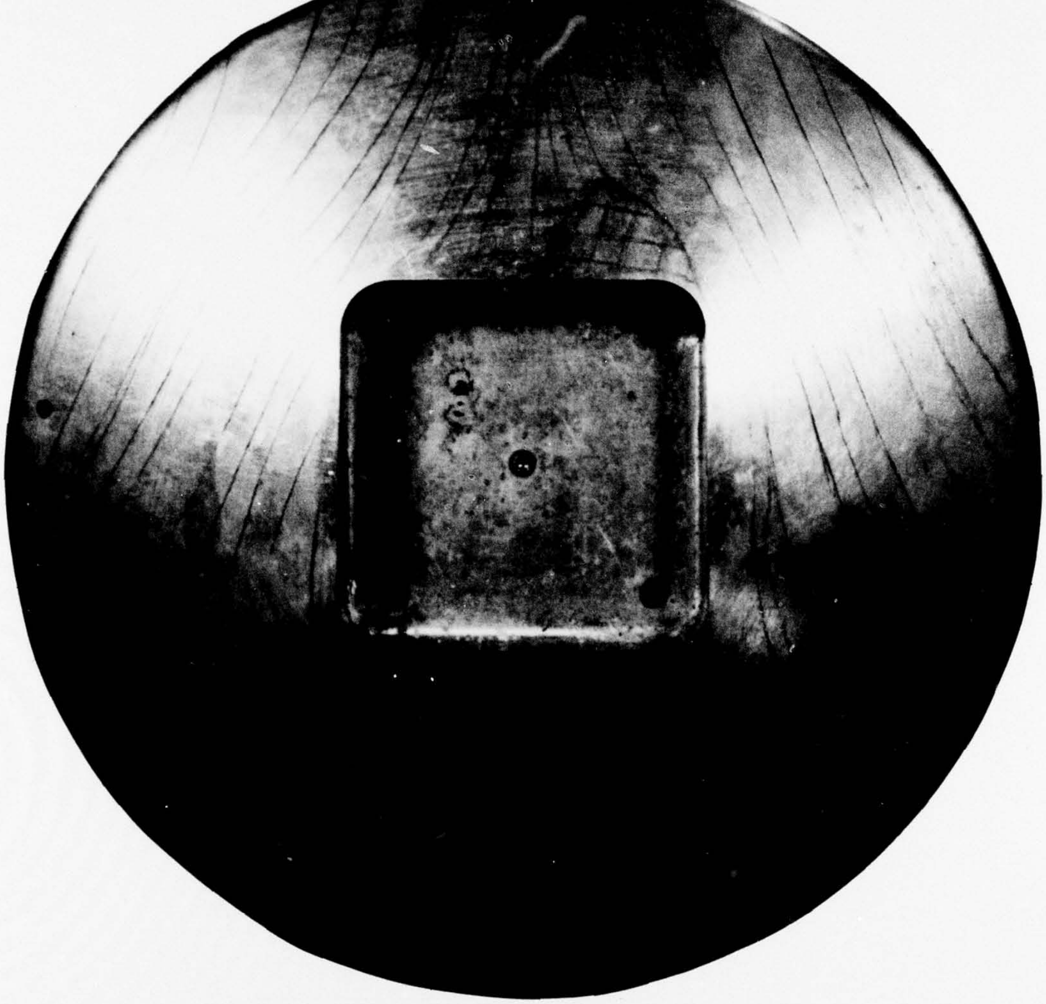

Fig. 9 - Top View of Cylinder

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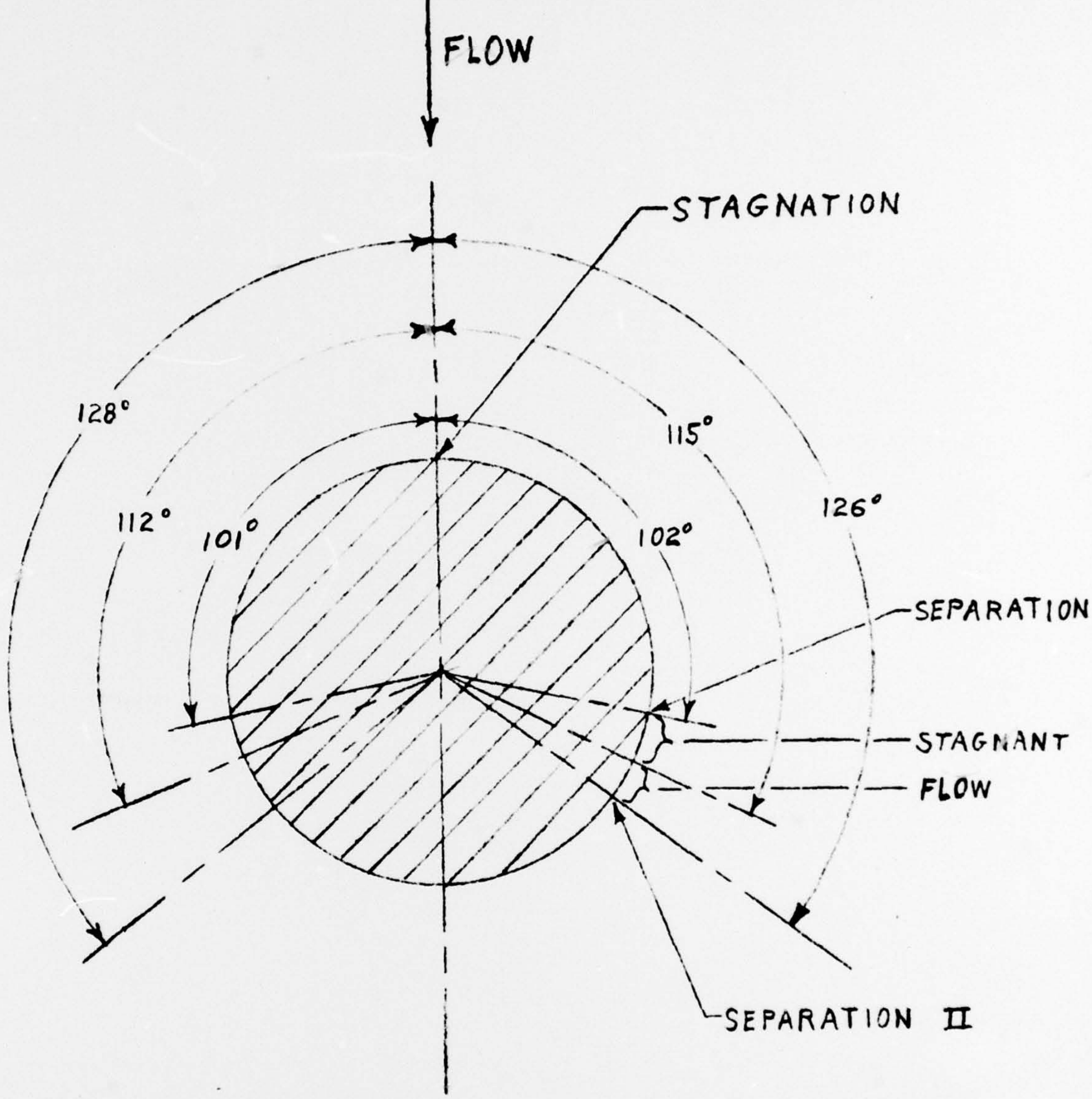

BOTTOM VIEW OF 16" DIA.
CYLINDER SECTION

FIG. № 10 TO USL TECH MEMO 933-361-64

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