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GAS REMOVAL SYSTEM ASSOCIATED
WITH DREDGE PUMP: PHASE C

Status Report No. 15

Prepared by
Robert E. Miller
Stephen C. Ko
and
John R. Adams

FRITZ ENGINEERING
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Prepared for
U. S. Army Engineers District, Philadelphia
Corps of Engineers
Philadelphia, Pennsylvania

April, 1967

Bethlehem, Pennsylvania

Fritz Engineering Laboratory Report No. 310.19

RESEARCH INSTITUTE OF LEHIGH UNIVERSITY

310.19

CIVIL ENGINEERING DEPARTMENT
FRITZ ENGINEERING LABORATORY
HYDRAULIC AND SANITARY ENGINEERING DIVISION

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PREFACE

The following status report summarizes the progress made under Phase C of the project during the period December 1, 1966 to March 31, 1967, at the Hydraulic and Sanitary Engineering Division of the Fritz Engineering Laboratory, under the terms of contract No. DA-36-109-CIVENG-64-72. The progress on the study was reported in fourteen status reports dated February 1964, April 1964, October 1964, December 1964, January 1965, June 1965, August 1965, October 1965, December 1965, February 1966, June 1966, August 1966, October 1966 and December 1966. (Fritz Engineering Laboratory Report No. 310.1^{(1)*}, No. 310.2⁽²⁾, No. 310.4⁽³⁾, No. 310.5⁽⁴⁾, No. 310.6⁽⁵⁾, No. 310.8⁽⁶⁾, No. 310.9⁽⁷⁾, No. 310.10⁽¹⁰⁾, No. 310.11⁽¹¹⁾, No. 310.13⁽¹³⁾, No. 310.14⁽¹⁴⁾, No. 310.15⁽¹⁵⁾, No. 310.16⁽¹⁶⁾, No. 310.18⁽¹⁷⁾). In addition, a translation (Fritz Engineering Laboratory Report No. 310.17) was prepared of an article entitled, "Wear Phenomena in Centrifugal Dredge Pumps" by A. Welte.

Phase A and Phase B of the project were completed and summarized in Fritz Engineering Laboratory Report No. 310.3⁽⁸⁾ (June 1964), and No. 310.7⁽⁹⁾ (February 1965) respectively.

Dr. John R. Adams is the project director. He is assisted by Mr. S. Ko and Mr. R. Miller, Research Assistants. Dr. L. S. Beedle is Acting Chairman of the Department of Civil Engineering.

* Numbers in parenthesis refer to references on pages 8 and 9 .

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I. Experimental Investigation

A test series was run with the gas removal system operating. The level in the accumulator was not controlled during the tests. A dimensionless plot of head versus water discharge is included in this report. Comparison with curves from an earlier test series (Status Report No. 14) indicates no change in pump performance. In an attempt to look at only the suction side of the pump a plot of net positive suction head (NPSH) versus water discharge was prepared. This also shows no change other than the expected variation between two given tests.

The flow meter in the removal system did not register any air flow from the accumulator. This is in agreement with visual observation of the flow in the accumulator. Two high-speed movies were taken of the accumulator, and again it did not appear that any significant upward air flow was occurring.

Tests were performed to see if the vacuum pressure on top of the accumulator was important. The vacuum on top of the accumulator was varied from zero to almost thirty inches of mercury. At a flow of 1000 gpm air was sucked into the accumulator from the regulating valve on the vacuum pump. If the vacuum was less than 5 inches H_G . Between 5 and 10 inches H_G vacuum no air was sucked into the accumulator, and an air pocket remained on top of the accumulator. However, no upward air flow could be measured. At vacuum pressures greater than 10 inches H_G water was sucked up into the hose connecting the accumulator with the scrubber tank.

It appears that the fundamental problem is that not enough air is entering the accumulator. Thus the vacuum system can only draw off water from the accumulator. The accumulator has been rotated 45° in an attempt to get the bottom of the accumulator closer to the main air stream in the suction pipe. However, it still appears that the air stream is carried past the accumulator.

II Comments on Letter of January 18, 1967 from U. S. Army Engineer District, Philadelphia

Paragraph a

It was decided at an earlier date (Reference your letter of March 31, 1965) to refer air flow to standard conditions. Obviously the pressure can only be measured at a limited number of locations. The pump face seems to be the most important place to measure the pressure. Our visual observations and movies do not indicate any abrupt pressure changes along the suction pipe. We could locate pressure taps at any point on suction line at which you were interested in the exact air flow.

Paragraph b

The only parameter of suction side performance which is available is NPSH. We have included several curves of NPSH versus water discharge. The variation in NPSH prevents the construction of a family of NPSH curves for different air flows.

Paragraph c

A schematic of the vacuum system is enclosed. A 3/4 inch diameter hose has been raised 30 feet above the accumulator. This hose

should serve a purpose similar to the riser pipe above the prototype accumulator.

Paragraph d

The behavior of the air flow in the suction line has been recorded with movies. There is a main air stream but the whole flow cross-section has some air suspended in it. Aside from photographs there is no way to quantitatively measure the cross section of the air flow. The air is suspended in the water and does not travel as a separate phase.

III. Experimental Data - Test Series II

1. Figure 1 Dimensionless Head as a Function of Dimensionless Discharge. Air Content 0 - 10%.

2. Figure 2 Net Positive Suction Head versus Water Discharge at a Discharge of 1000 gpm - with no vacuum and with a vacuum of 15 inches H_G .

3. Figure 3 Same as Figure 2 except at a discharge of 850 gpm.

NOTE: Curves for Figures 2 and 3 were obtained by starting at 0% air with the given discharge. As the percent air was increased the discharge decreases. All tests were run at 1440 rpm.

$H_{DIM} \times 10^2$

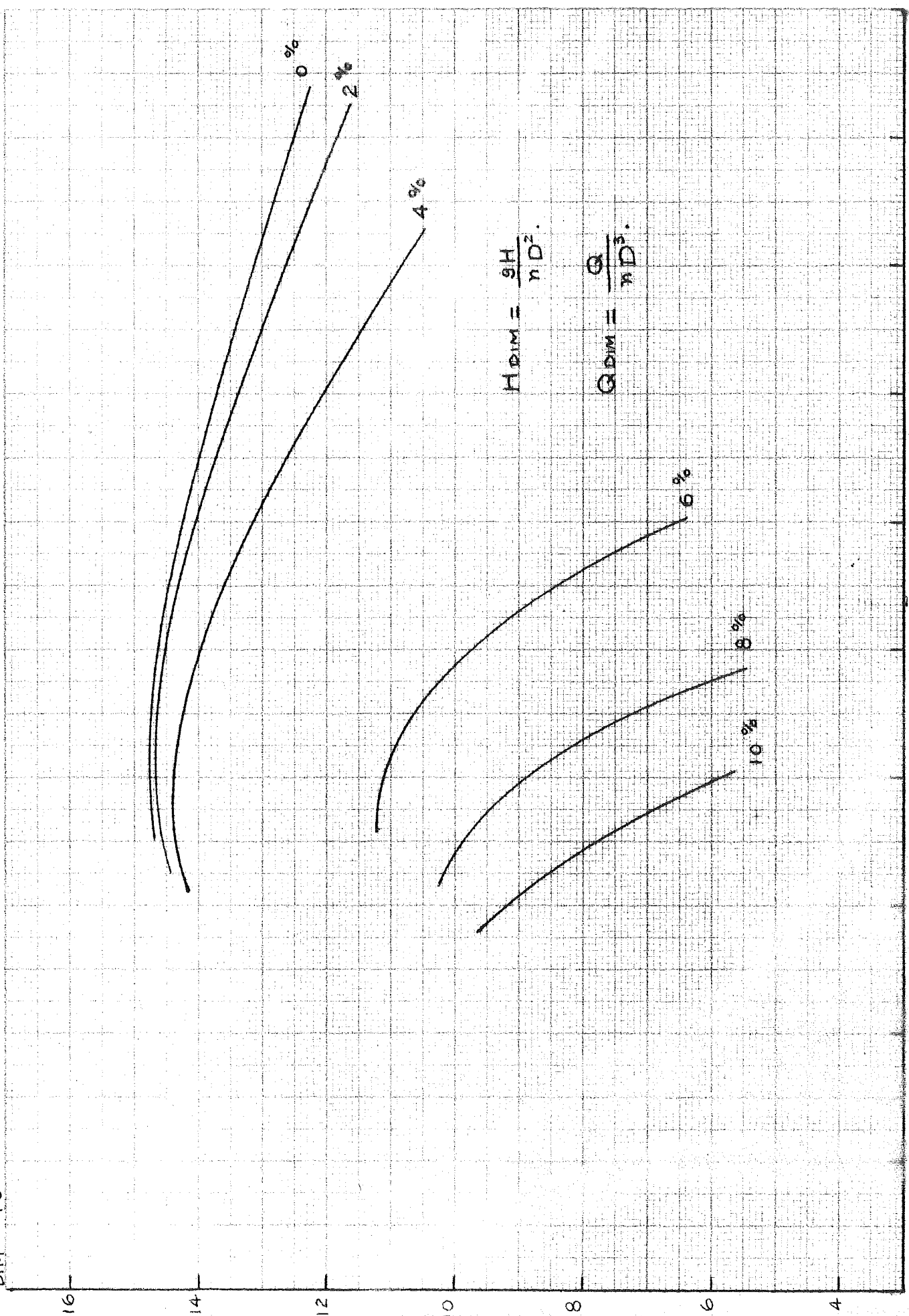
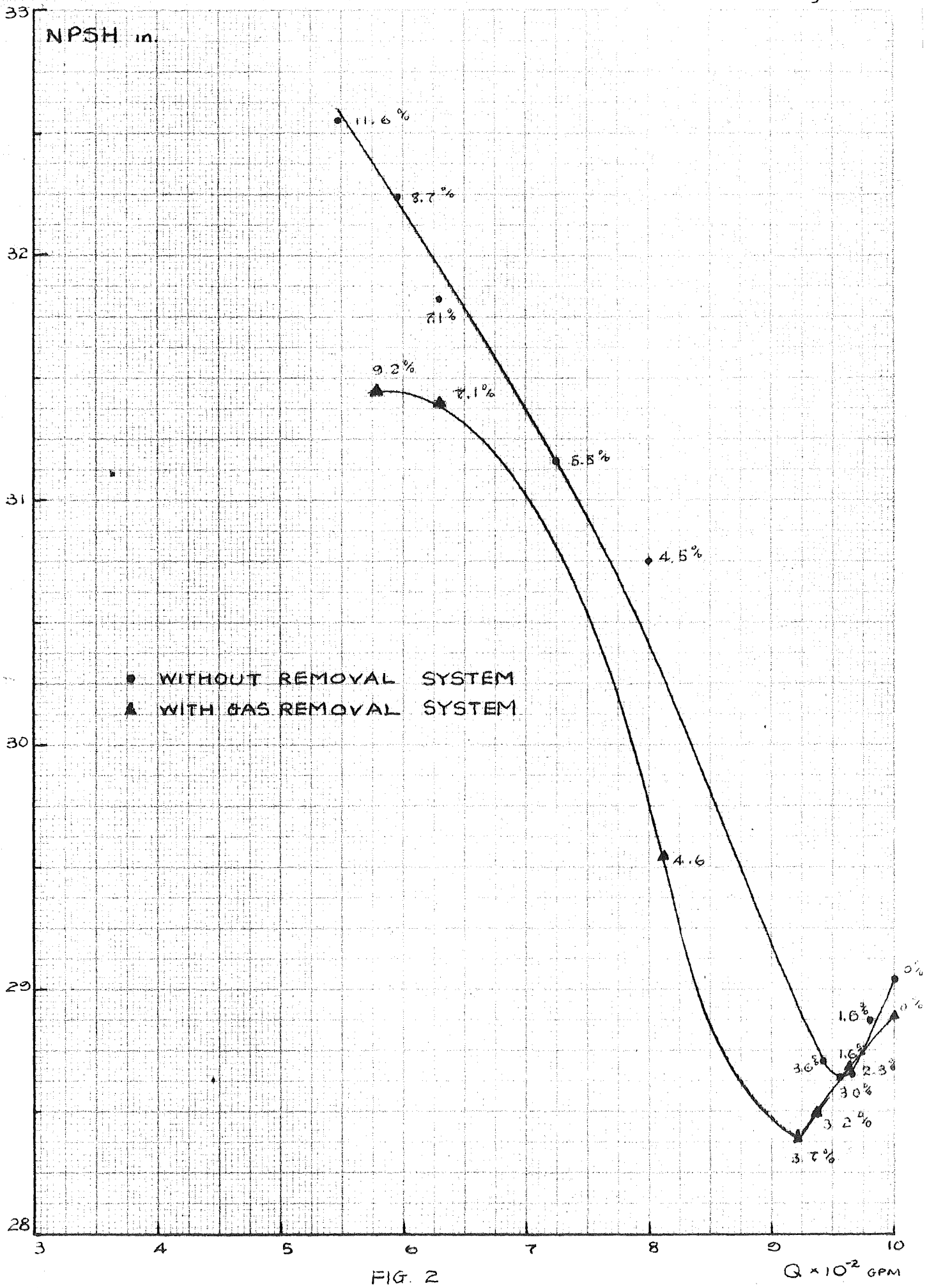


FIG. 1

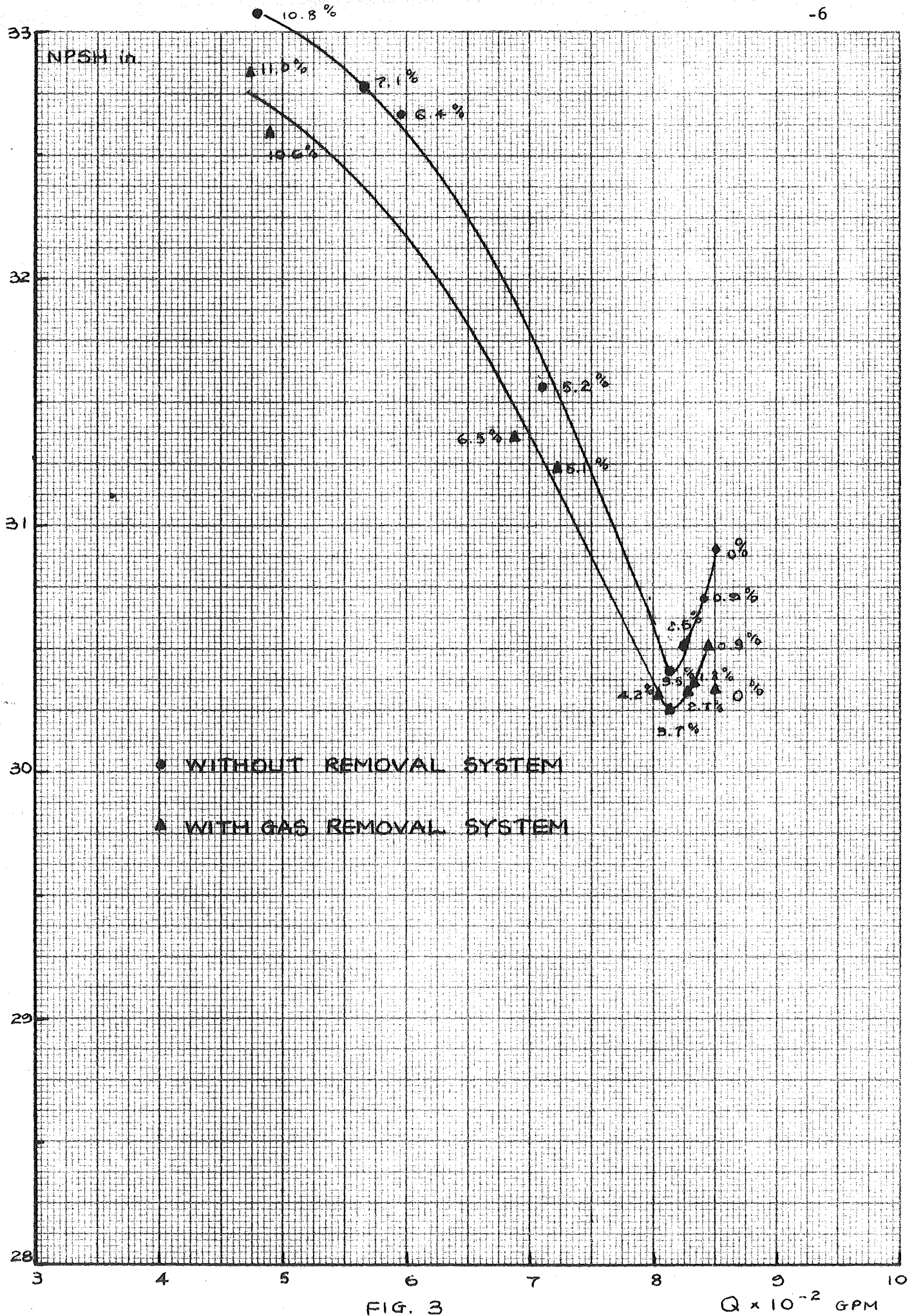
$Q_{DIM} \times 10^3$



MS 10 X 10 TO THE 1 INCH 259-11
REPRODUCED FROM

FIG. 2

$Q \times 10^{-2}$ GPM

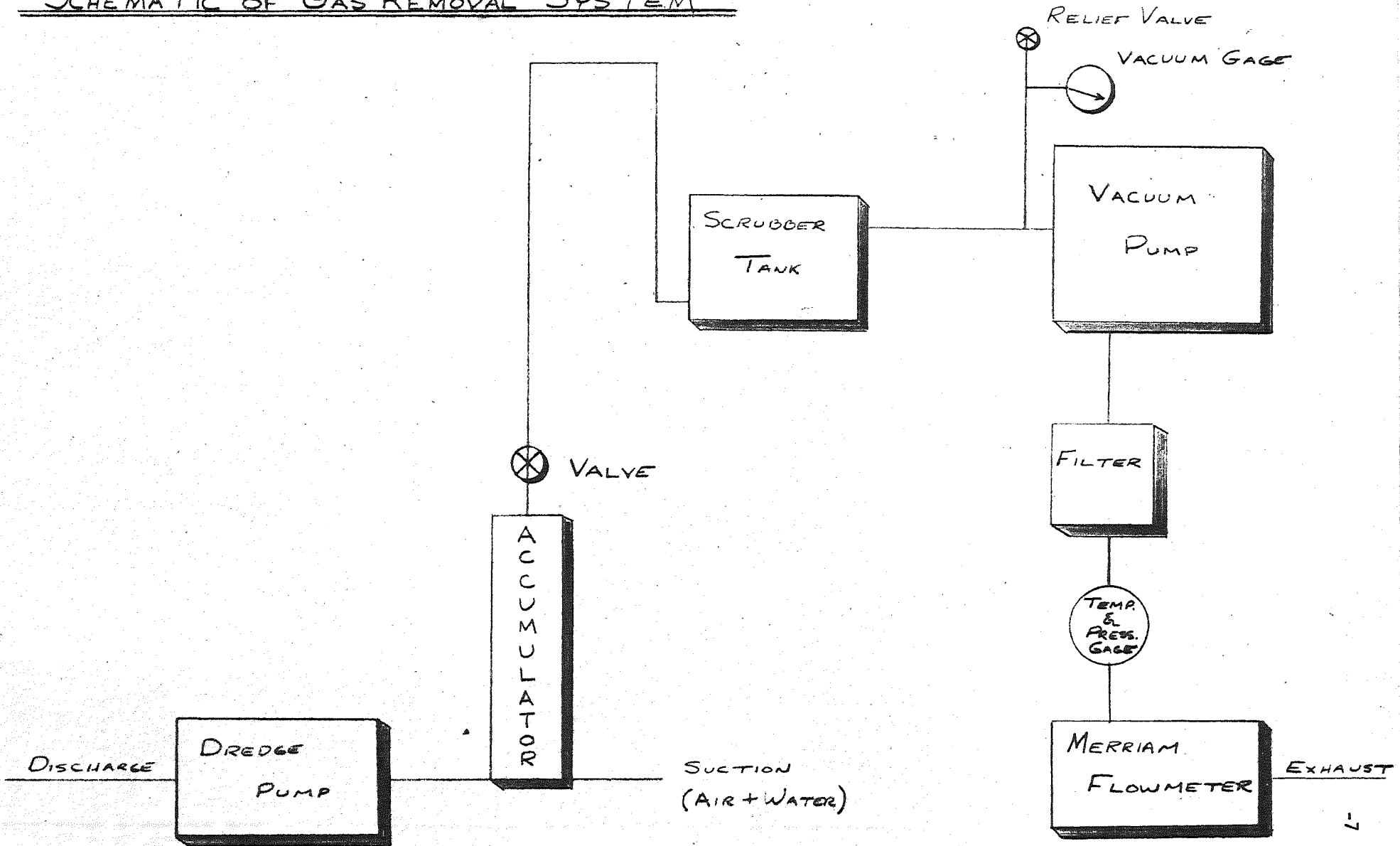


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FIG. 3

$Q \times 10^{-2}$ GPM

SCHEMATIC OF GAS REMOVAL SYSTEM



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