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Gas removal systems associated with dredge pump, Phase B, December 1965

A. Amatangelo

J. B. Herbich

GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B

Status Report No. 9

Prepared by
Alfred Amatangelo
and
John B. Herbich

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

December, 1965

Bethlehem, Pennsylvania

Fritz Engineering Laboratory Report No. 310.11

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 October 1, 1965 to November 30, 1965, 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 eight status reports dated February 1964, April 1964, October 1964, December 1964, January 1965, June 1965, August 1965, and October 1965, (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], and No. 310.10[10].

Phase A and Phase B of the project were completed and summarized in Fritz Engineering Laboratory Report No. 310.3[8], and No. 310.7[9] respectively.

Dr. John B. Herbich is the project director, Mr. A. Amatangelo is the project supervisor and are assisted by Mr. G. Bagge, and Mr. Robert E. Miller, Research Assistants. Professor W. J. Eney is Head of the Department of Civil Engineering and Fritz Laboratory and Dr. L. S. Beedle is the Director of Fritz Engineering Laboratory.

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*Numbers in parenthesis refer to references on pages 9 and 10.

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I. Description of Test Facilities

The installation of test facilities is near completion, only the small problems (leaks, etc.) must be eliminated.

The test facility basically consists of two large tanks which are connected by a line to the model pumps and a line between each other. This is shown in Figure 1 and 2. Also photographs are included to show the actual equipment and location on Figures 4, 5, and 6. More specifically, the test model facility is designed to simulate the prototype conditions as closely as possible. The drag head will not be used and will be replaced by a set of orifice plates having a range in size and secured at the entrance to the suction pipe. Air will be injected at a point directly downstream from the orifice plate. The suction pressure as well as the flow of water (gpm) will then be controlled by the size of the orifice and the rate of gas injection. The discharge (gpm) will be measured by the orifice at the entrance to the suction line whereas the air content will be measured by a flowmeter. A magnetic flowmeter at the discharge side of the dredge pump is used to measure the combined air-water flow.

The water is dredged from an open volumetric tank and is discharged into a closed volumetric tank (Figure 1). In order to insure continuous flow, the pressure in the discharge tank will be maintained at one pound per square inch above the atmospheric pressure. The discharge and suction tanks are connected by a 12-inch pipe equipped with a gate valve to maintain proper dredging depth. The pressure at the discharge tank, approximately 50 psia, will be reduced to about 15.7 psia in order to simulate the actual dredging conditions. The excess free air, not removed by the accumulator, will be collected in

the discharge tank from where it will be evacuated and passed through an air flowmeter. The two-tank arrangement is selected because it will allow monitoring the amount of air that will go in or out of solution in the suction line by means of the following mass balance: amount of air introduced into the suction line = amount of air removed by the accumulator + the amount of air removed from the discharge tank, $\pm$ amount of air going into or out of solution.

II. Progress on Installation

1. All accessories for the air compressor have been received. The unloading valve for the compressor was not received from Fisher Governor Co. until November 29, 1965.

2. All the associated air piping and water piping for the compressor have been installed except for the unloading valve mentioned in (1) above.

3. The electrical connections for the sensing units and the starter switch were installed.

4. The plexiglass-bronze impeller No. TD7 was repaired and returned by the Industrial Models Company. The bronze core was very poorly assembled and had to be reworked in our machine shop before installations.

5. The repaired impeller and the plexiglass suction piping were installed.

6. The completed system was filled in order to perform a leak check. The sides of Tank B bulged excessively so six-inch channel bracing was installed.

7. The manometers for measuring suction line pressure, suction head, and discharge head were installed.

8. Calibration runs on the pump were made on November 24, 1965 but leaks in the discharge head manometer invalidated the data. Also excessive leaks occurred through the external joints of Tank A. The external joints of Tank A have been welded as best as possible, but it is not yet certain if this will control the leakage.

III. Experimental Investigation

The preliminary calibration tests have been made on the test facility without air injection in order to obtain the basic characteristics of the model dredge pump and measuring devices. As expected, the calibration test revealed minor adjustments which must be made in order to obtain meaningful test data. These minor adjustments are presently being made and another calibration of the test equipment will be made shortly. In Part II of this report a complete listing of minor adjustments and problems that were encountered may be found.

As soon as the compressor installation is complete and the above adjustments are made a more complete calibration test will be accomplished. This will include testing with and without air injection.

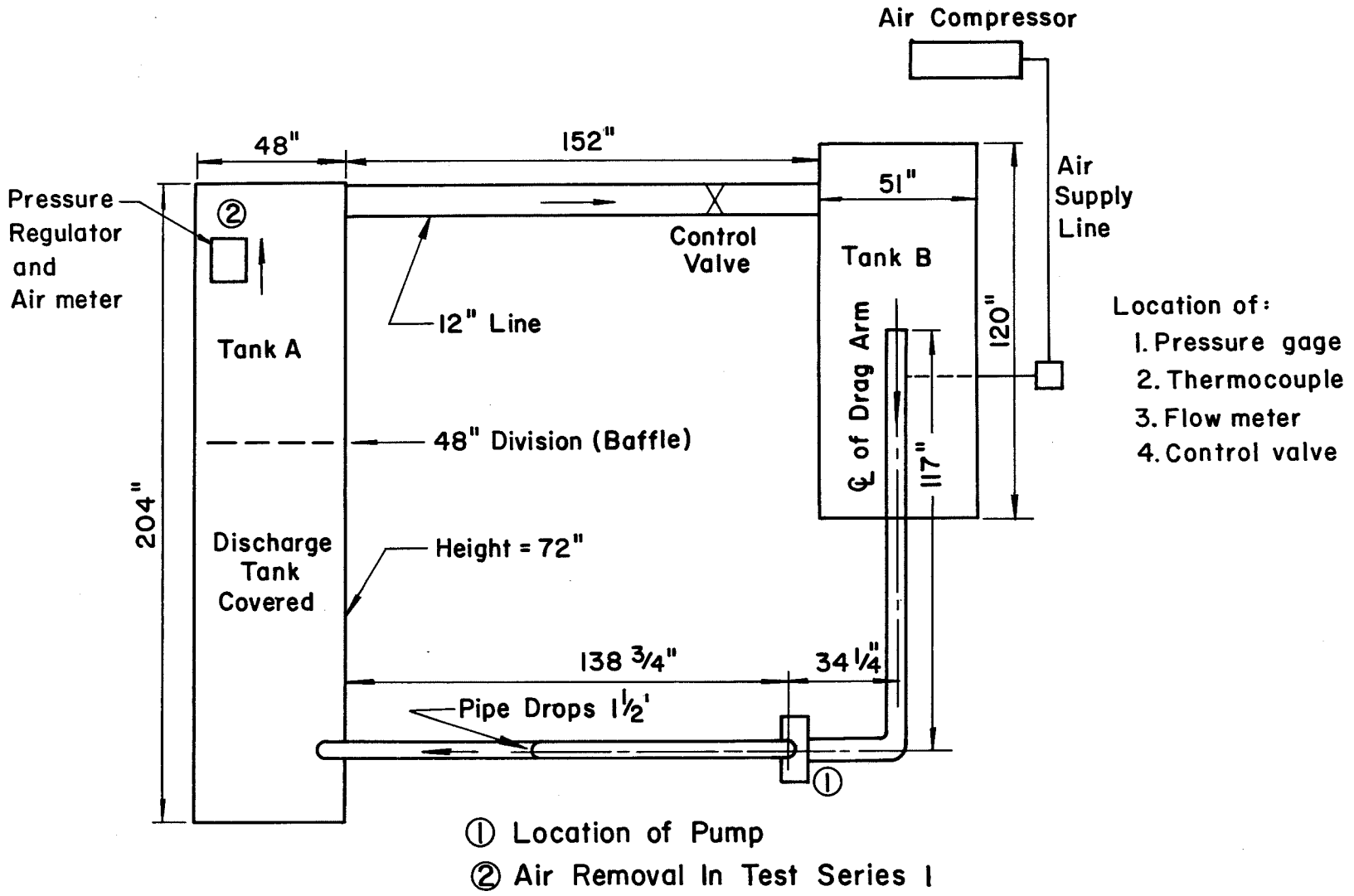
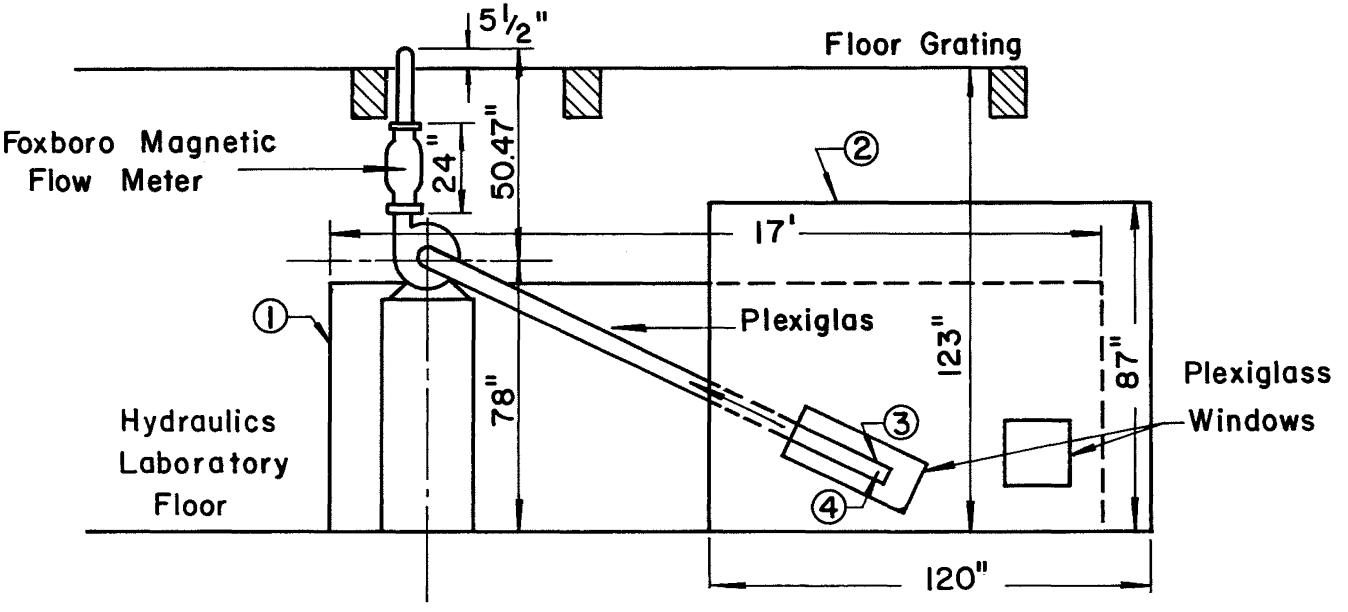


Figure 1 Floor Plan for test facility

Note: ① Location of Discharge Tank A
② Supply Tank B with Plexiglas Windows
③ Location of Orifice Plate
④ Point of Air Injection



Not To Scale
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Figure 2 Side elevation of test facility

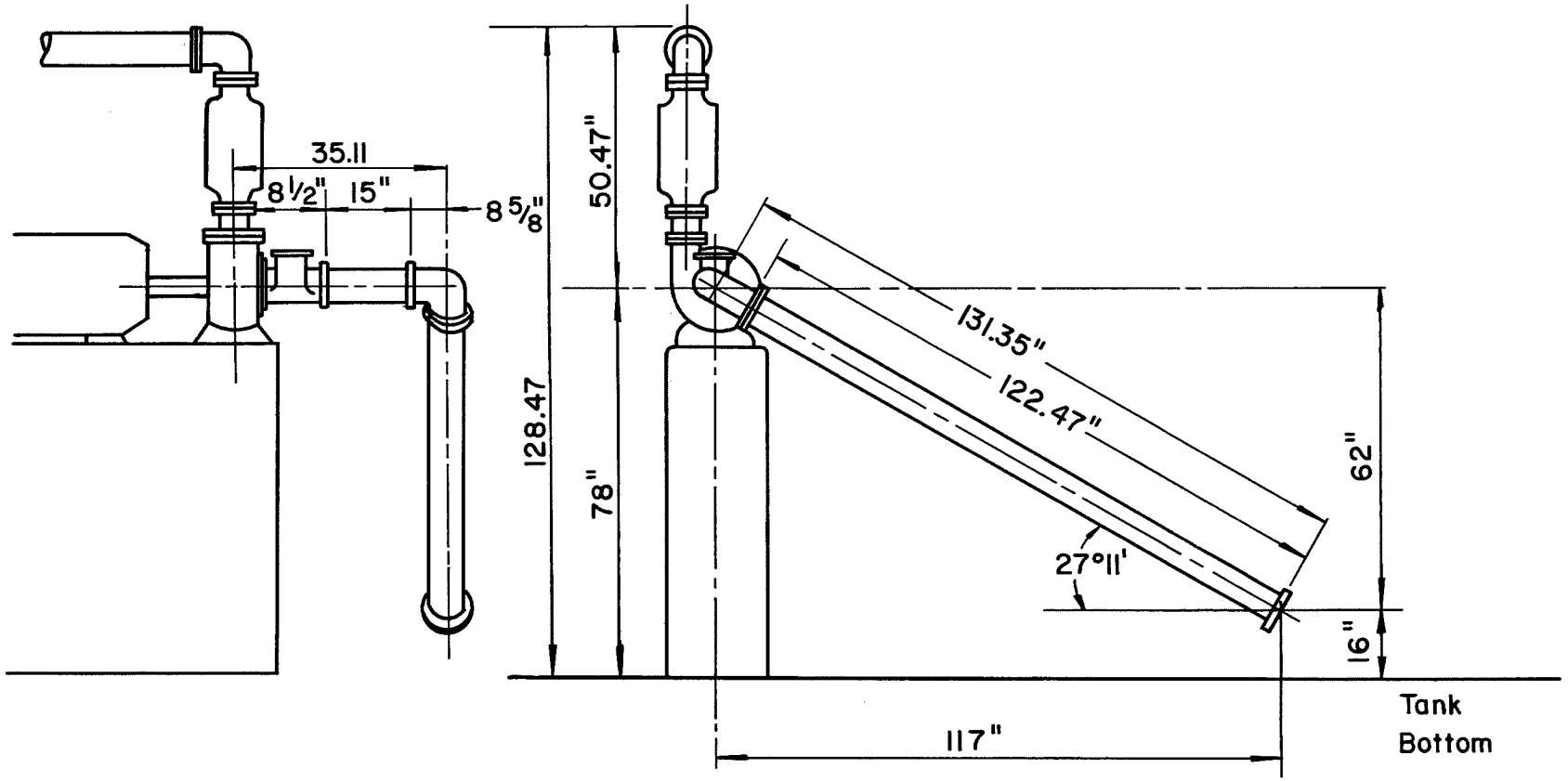

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Figure 3 Detailed side elevation of test facility

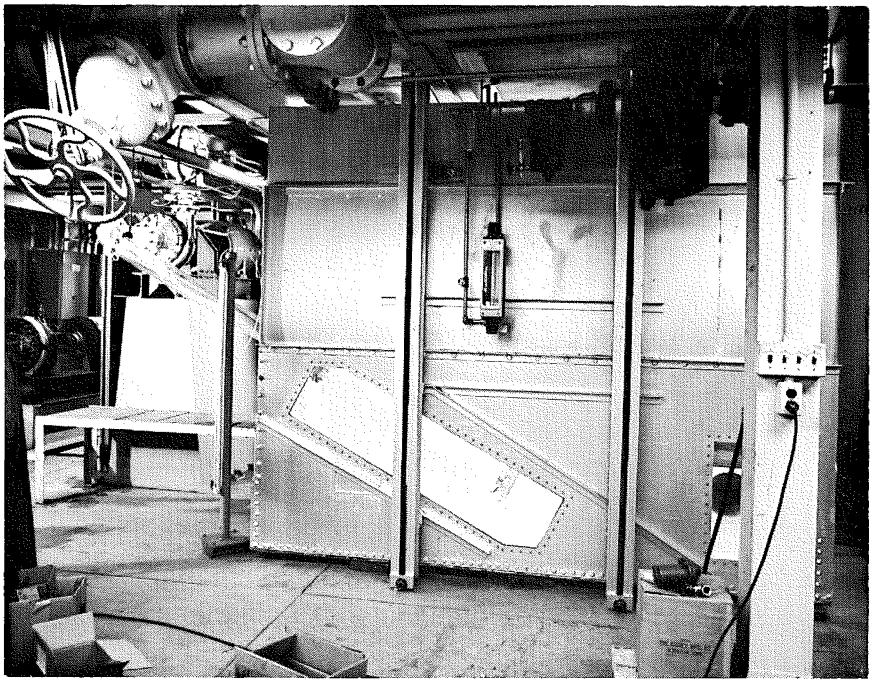

Figure 4 Front View Tank B

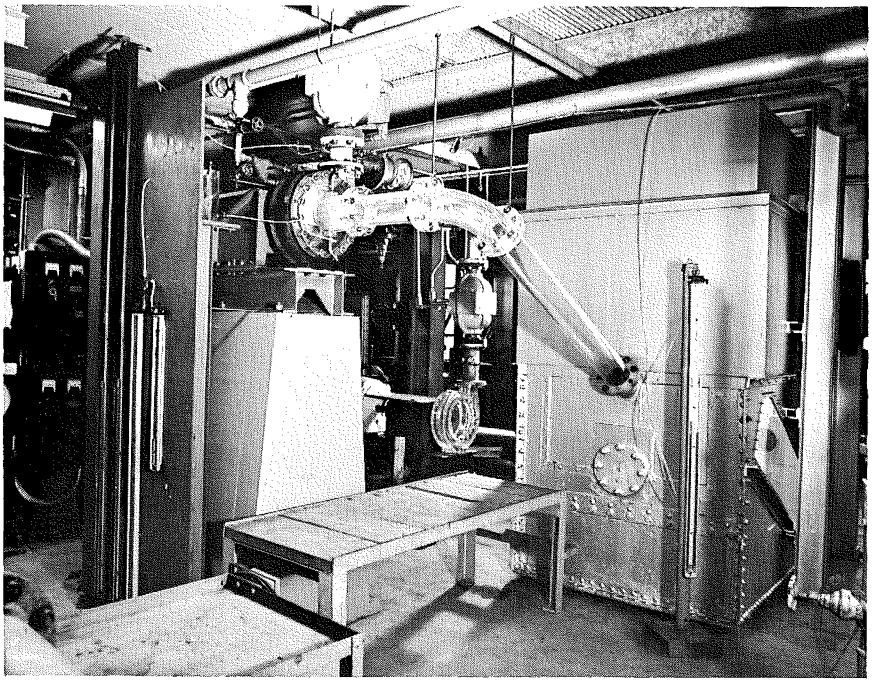

Figure 5 West side when Tank B and model dredge pump with transparent suction line.

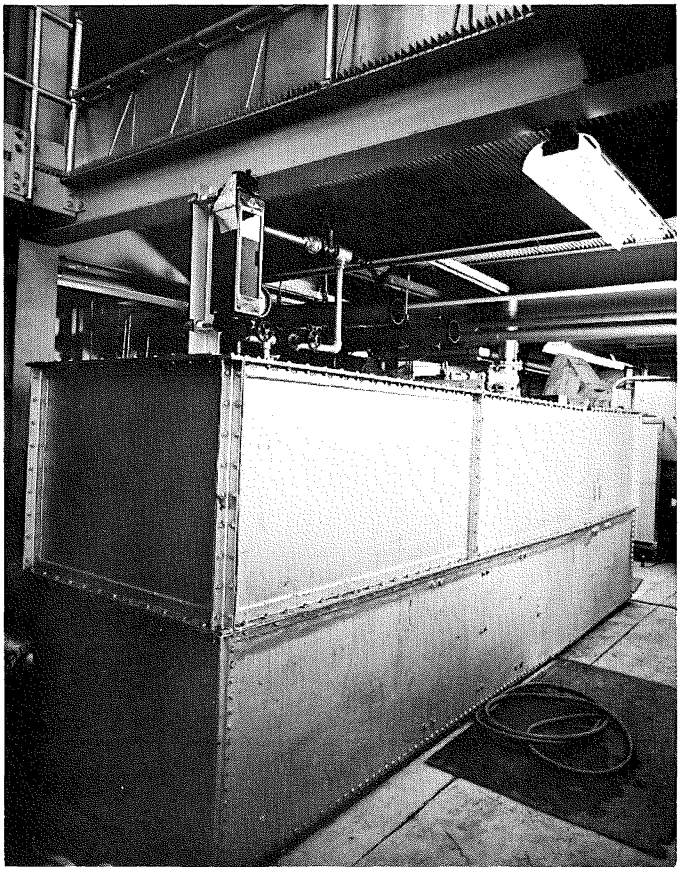

Figure 6 Rear view - Tank A with air flow measuring equipment

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