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**Pacific Northwest Laboratory
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December 29, 1951

PILE TECHNOLOGY TEST REPORT

FLAPPER NOZZLE ASSEMBLY

This document consists of

2 pages No. 14 of
16 copies. Serial A

I. OBJECT OF TEST

The object of this test was:

1. To study the functional operation of the flapper nozzle under simulated operating conditions.
2. To study the damage to slugs charged through the flapper nozzle under operating conditions.
3. To compare damage to slugs charged through the flapper nozzle and an H-type inlet nozzle under no flow conditions.
4. To determine the effect of the nozzle design on the stability of inlet pressures.

II. SUMMARY

The functional operation of the flapper nozzle was tested by charging slugs through it while water flow rates up to 48.4 gpm and inlet header pressures up to 400 psig. were maintained. Comparative damage to the slugs by the flapper nozzle and an H-type inlet nozzle was determined by charging slugs through the nozzles with a 105-D type air cylinder charging machine under conditions of no water flow or lubrication. The effect of the nozzle design on the inlet pressure fluctuations was determined while using 0.140", 0.200", and 0.285" inlet orifices as well as no orifice.

The flapper nozzle operated satisfactorily for all conditions tested, without leakage from the flapper valve or the needle valve. However, the flapper valve became loosened on the shaft after several operations, and it is felt that the design should be changed to insure that it is rigidly fastened to the shaft at all times.

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Damage to the slugs by either the flapper nozzle or the H-type inlet nozzle was negligible. The ribs of the process tube caused the normal parallel, longitudinal scratches the length of the slugs.

Maximum fluctuations of ± 5 psig were noted on the inlet pressure gauge reading, as compared with a maximum of about ± 7 psig for standard nozzle Panellit pressure.

III. BACKGROUND

With current methods of pile operation, the entire pile must be shutdown periodically to permit charging and discharging operations. Because of the loss of production incurred by this delay, it is very desirable that a system be developed that permits charging and discharging operations while the pile is operating at full power.

The design and development of the flapper nozzle (Figures 1 and 2) for the Chemical 14 - 92 system suggested the possibility of using a similar type nozzle for charging slugs, thus permitting the pile to remain at its full operating level.

To charge slugs, a specially designed charging machine is clamped on the inlet end of the nozzle to form a water-tight seal. After the machine is loaded with slugs, the pressures on each side of the flapper valve are equalized by opening the needle valve on top of the flapper nozzle. Once the pressure has been equalized, the flapper valve may be opened and the slugs charged through the nozzle with an appropriate charging ram. When the ram is withdrawn from the nozzle, the flapper valve and the needle valve may be closed, permitting more slugs to be loaded into the charging machine for additional chargings or withdrawal of the charging machine from the nozzle.

IV. PROCEDURE

A. Functional Operation of the Flapper Nozzle

The Chemical 14 - 92 flapper nozzle, (Figure 2), was modified as shown in Figure 3 so that the water could enter directly through the side. It was then attached to a 5' 8" long process tube by a special coupling flange. A standard H-type outlet nozzle was used at the outlet end of the process tube. Operation of the flapper nozzle under simulated operating conditions was tested by charging uranium, lead dummy, and perforated aluminum slugs through it as recorded in Table I. No lubrication was used in any of the charging operations.

TABLE I

<u>Water Flow Rate, gpm</u>	<u>Inlet Header Pressure, psig</u>	<u>No. of Uranium Slugs Charged</u>	<u>No. of Lead Dummies Charged</u>	<u>No. of Perforated Aluminum Slugs Charged</u>
9	37	0	56	8
46	300	0	48	4
Not Measured	350	0	11	2
46	400	0	11	2
48.4	400	53*	0	0

* In charging 53 uranium slugs, 3 slugs were charged once only, and 5 slugs were charged 10 times each. All were dyed with purple machinist's ink to facilitate detection of slug damage.

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Water flow rates were measured with a weighing tank and stop watch. The inlet header pressure was measured with a pressure gauge graduated in 5 psi intervals up to 600 psig. All slugs were charged with a specially designed hydraulic charging cylinder which is shown attached to the flapper nozzle in Figure 4. Five uranium and/or lead dummy slugs, or three perforated aluminum slugs could be loaded in the cylinder at one time. Throttle valves in the inlet and outlet lines of the system were used to control the inlet header pressure and water flow rate.

B Damage to Slugs by the Flapper Nozzle and the H-Type Inlet Nozzle

Uranium and lead dummy slugs were charged through the flapper nozzle and an H-type inlet nozzle with a 105-D type air cylinder charging machine as outlined below. All of these tests were conducted without lubrication or water flowing in the process tube. The uranium slugs were dyed with purple machinist's ink in these tests.

1. Chargings through the Flapper Nozzle

- a. One uranium slug charged once through the nozzle and a 5' 8" length of process tube.
- b. One uranium slug charged 10 times through the nozzle and a 5' 8" length of process tube.
- c. One uranium slug charged once through nozzle only.
- d. One uranium slug charged 10 times through nozzle only.
- e. One uranium slug charged 10 times through coupler between nozzle and charging machine only.

In the above tests, 272 lead dummy slugs were also charged.

2. Chargings through the H-Type Inlet Nozzle

All of the tests in (1), above, were repeated for the H-type nozzle except test (e). In addition, one uranium slug was charged once through the nozzle and process tube with the charging machine misaligned. In addition to the uranium slugs, 271 lead dummy slugs were also charged.

C. Stability of Pressure Gauge Readings

Orifices of 0.140", 0.200", and 0.285" were installed in the inlet adaptor in the conventional manner. With a header pressure of approximately 400 psig, fluctuations of the inlet pressure were noted. The inlet pressure gauge was mounted atop the flapper nozzle as shown in Figure 4. A test was also made with no orifice in the adaptor.

IV. RESULTS AND CONCLUSIONS

A. Functional Operation of the Flapper Nozzle

The flapper nozzle operated without incident under the conditions tabulated in Table I, whether the flapper valve was open or not prior to the charging of slugs. When the charging cylinder was removed from the nozzle, there was no leakage from the flapper valve or the needle valve at any time.

After operating the flapper valve a number of times, it became loose on the shaft. Although, during these tests, it did not interfere with the functional operation,

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it is possible that it could, with time, interfere with normal operation. Therefore, it is felt that a more positive method should be provided to insure that the flapper valve is rigidly fastened to the shaft at all times.¹

It would also be desirable to change the design of the needle valve so that it could be opened and closed more rapidly.

B. Damage to Slugs

Damage was very small for all slugs charged through the flapper nozzle under the operating conditions tabulated in Table I. The most significant damage was two normal longitudinal scratches caused by the ribs of the process tube. Some of the machinist's ink was rubbed off the slugs by the flapper nozzle but the surface was unmarred and the point of rubbing could not be detected after the ink was entirely removed.

In charging slugs through the flapper nozzle and the H-type inlet nozzle with a 105-D type air cylinder charging machine, the following results were noted:

1. Two parallel longitudinal scratches were prominent on those slugs charged once through either nozzle and the 5' 8" length of process tube.
2. A series of parallel longitudinal scratches was prominent on those slugs charged 10 times through either nozzle and the 5' 3" length of process tube.
3. There was negligible surface marring of all slugs charged 10 times through either the flapper nozzle or the H-type inlet nozzle only.
4. Misalignment of the H-type nozzle with the charging machine had no effect on damage to slugs. The results were the same as in (3) above. Misalignment was impossible between the flapper nozzle and the charging machine.

C. Stability of Pressure Gauge Readings

Table II below shows the effect of the inlet orifices on the inlet pressure gauge readings. The inlet pressure gauge was graduated in 5 psi intervals up to 600 psi.

TABLE II

<u>Orifice Size</u> <u>ID. Inches</u>	<u>Inlet Header</u> <u>Pressure, psig</u>	<u>Water Flow</u> <u>Rate, gpm</u>	<u>Pressure Gauge</u> <u>Reading in Flapper</u> <u>Nozzle, psig</u>	<u>Pressure</u> <u>Fluctuations,</u> <u>psig</u>
No Orifice	390	26	345	± 5
0.285	390	25	255	± 5
0.200	400	11	96	± 2
0.140	400	5	30	± 3

RES:rao


 R. E. Schilken
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1. In further tests on another project the flapper valve became so loose on the shaft that water entering the side of the nozzle forced it to jam against the opposite side, and prevented its opening.



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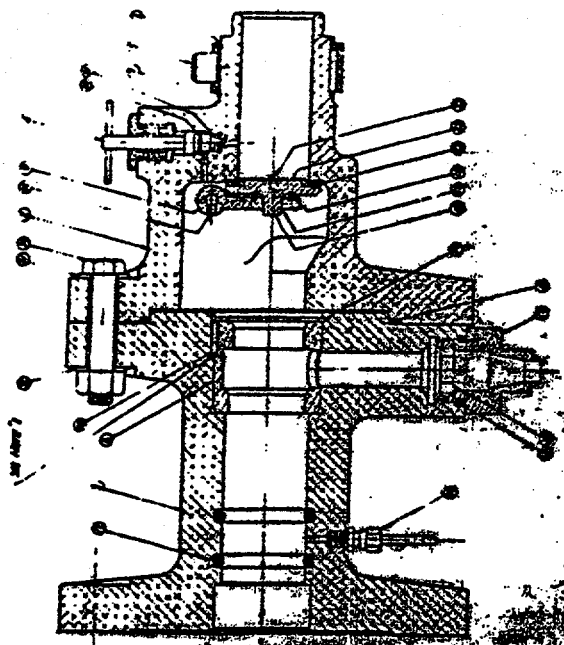
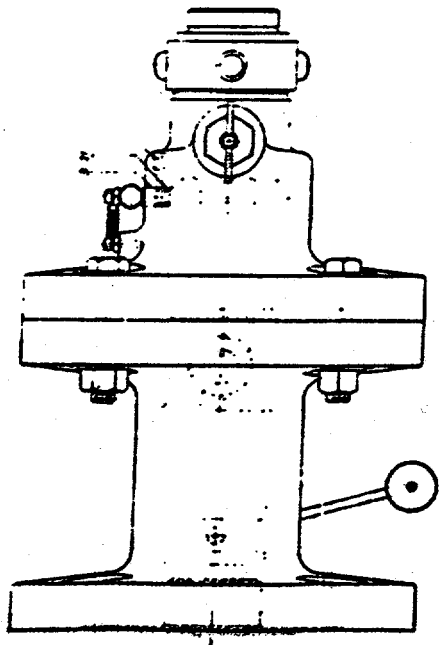
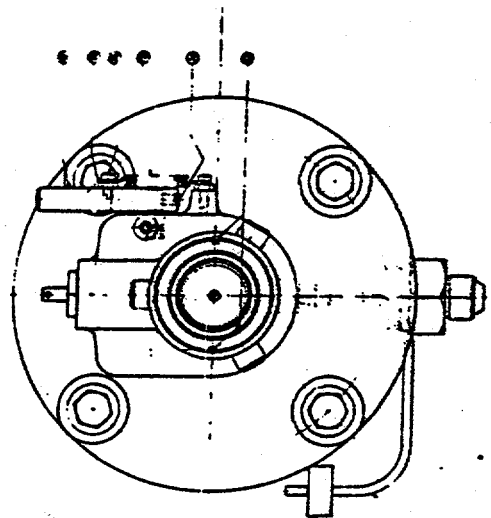
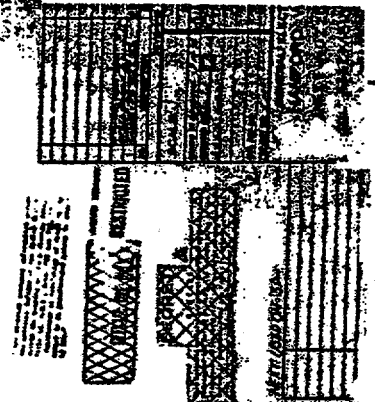
FIGURE 1
FLARE NOZZLE

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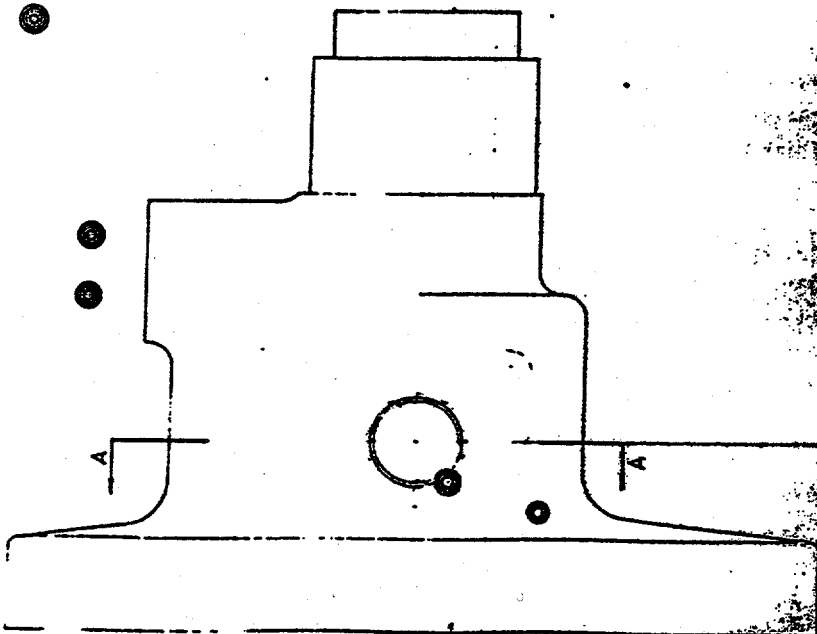
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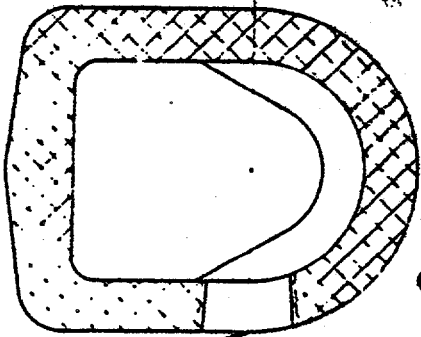


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