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PROGRESS REPORT ON THE PROJECT:

"FURTHER RESEARCH, DEVELOPMENT AND
COMMERCIALIZATION

OF THE HYDRO-PNEUMATIC APPARATUS FOR HARNESSING
ULTRA LOW-HEAD HYDROPOWER"

PERIOD COVERED: JANUARY 1, 1996 - JULY 31, 1996

Prepared by:
Alexander M. Gorlov, P.I.
Professor
MIME Department
Northeastern University
Boston, MA 02115

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Statement of Work
for the Period Covered
From January 1 to July 31, 1996

The main research thrust of this period was devoted to development, construction and preparation to laboratory testing of two new power converters of higher than the old converter capacity. These converters should develop substantially larger air flow rate to test our new air helical turbines, combined with air chambers.

Major tasks of this part of the project are:

- 1. Completion of the gate control mechanism.**
- 2. Continuation of the assessment of air turbine options including construction and testing a helical delta shape turbine for hydro-pneumatic power converters.**
- 3. Completion of construction of larger power converters including gates and control systems.**
- 4. Development of test plan.**
- 5. Procure test equipment.**
- 6. Preparation to the tests.**
- 7. Development and construction of a new converter with louvre-type gate system.**

The following is a detailed description of the tasks.

Task No.1

The gate control mechanism was described in detail in our previous report (July 1 - Dec. 30, 1995). During this period the gate control system was tested in various mechanical combinations. The tests validated reliability and integrity of the developed mechanism.

The design of the control system of Figures 2 and 3 (see the previous report) can be recommended for practical applications.

Phases of operation of the control system are shown in Fig.6.

Phase 1

Phase 2

Phase 3

Phase 4

Fig. 6 Kinematics of the gates' control

Task No. 2

A delta-blade air turbine was developed and built on the SLA-190 apparatus. This turbine represents another version of the helical turbine modified for application to hydro-pneumatic converter. The turbine with delta blades is shown in Fig. 7. The turbine is mounted on the top of the power converter taking air flows from the openings (ports) in the air chamber (Fig. 8).

It is expected that this new delta-blade air turbine will demonstrate an efficient performance in low-pressure air flow.

Fig.7 Delta turbine for Hydro-pneumatic power converter

Task No.3

A large power converter with new gate mechanism is designed and prepared for testing (Fig.8). The water flow rate of this converter is large enough to operate with the delta-blade air turbine described. Our original converter cannot allow the high enough water/air flow rate for experiments with low solidity helical-type air turbine.

Converter housing

Counterbalance

Fig. 8 Hydro-pneumatic power converter

Tasks No. 4, 5, 6

These tasks prepared conditions for future series of hydro-pneumatic experiments with new equipment, i.e. delta-blade helical turbine, large air chamber, gate control mechanism, louvre-type gate system. All the tests are planned to complete in the next year.

The major objective of the planned experiments are:

1. To obtain overall efficiency of the hydro-pneumatic apparatus with different air chambers and turbines.
2. To test performance of the gate mechanisms and controls.
3. To test performance of helical turbines in combination with hydro-pneumatic converter.
4. To select and test electric generators with air turbines.

Task No.7

The louvre-type gates were developed and built to reduce dimensions of moving parts of the gate and to reduce a drag force during the operation. Indeed, a large inflow/outflow port must be used to allow substantial water flow through the converter. However, the larger the gate, the greater turning moment is developed on the shaft by the drag forces.

The louvre gates break the port into number of small openings with correspondingly small gates, reducing resistance to rotation of the gates.

This new gate assembly is shown in Figures 9, 10 and 11.

1 - 1 View

Fig. 10 Louvre Gate Assembly

Fig. 11. Photographs of Louvre Gates Control System