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~~Aerojet-General~~ CORPORATION

AZUSA, CALIFORNIA

I N F O R M A L R E P O R T O F P R O G R E S S

Copy No. 6

11 June 1953

TO: Office of Naval Research
Department of the Navy
Washington 25, D. C.

VIA: Bureau of Aeronautics Representative
Aerojet-General Corporation
6352 N. Irwindale
Azusa, California

SUBJECT: Research, Development, and Testing
of Underwater Propulsion Devices

CONTRACT: N6ori-10, Task Order I
Project NR 220 003

PERIOD
COVERED: 1 May through 31 May 1953

This informal monthly progress report is
submitted in partial fulfillment of the
contract.

AEROJET-GENERAL CORPORATION

C. A. Gongwer
C. A. Gongwer, Manager
Underwater Engine Division

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I. TEST VEHICLE MOTOR USING 3.75-IN.-DIA GRAIN

A. Work is continuing on the improvement of the low-L* combustion chamber for the hydroductor. Turbulators made from a number of materials were tried and gave varied results. The best results were obtained with a turbulator button made of carbon. The button seems almost unaffected by the hot gases and gives thorough mixing with corresponding improvement of performance. All indications point to a satisfactory solution of the combustion chamber problems for the free-running hydroductor.

B. In order to improve the overall efficiency of the free-running hydroductor, a series of tests to determine the best configurations have been initiated on the static hydroductor test stand. The condensing chamber parameters are being varied and optimum points obtained.

C. The regular program of proof-checking the test-missile grain production continues. At least one out of every four grains pressed is static-tested to check performance.

D. Two grains have been static-tested after having been subjected to accelerations of 300 g. The runs were completely satisfactory and performance was consistent with previous tests.

E. The static test facility has been improved to allow variations in water-entry time delay. This will allow closer control and tests to determine the best sequencing procedure to simulate more closely the actual firing of a free-running test missile.

F. A total of forty-nine runs were made on the static-motor thrust stand.

II. ALCOLO-FIRED TEST STEAM GENERATOR

A. The steam generator was operated in a closed cycle. Mechanical difficulties in feeding the solid grain permitted operation for a total of only 2 minutes.

B. To all appearances the unit itself performed satisfactorily. A small quantity of smoke escaped from the furnace, but air leaks in the suction side of the cycle are being closed to prevent this. The bottom of the furnace has retained a considerable amount of KCl slag and loose ash; this keeps the troublesome portion of the combustion products from reaching other parts of the cycle. The boiler acquired a light coating of ash, which is to be expected and which, so far, does not appear detrimental to its operation. The dust collector removed a quantity of fly-ash ranging in size from fine powder to particles perhaps 1/16 in. in diameter. Fine, white powder has accumulated in the crevices of the fan outlet duct.

C. Changes are being made in the feeding setup to permit longer operation of the unit.

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III. ALCLO STUDIES

A. PROPELLANT STUDIES

1. Inspection of the interfaces of six 3.75-in.-dia grains was conducted to determine the soundness of the interface and to see if the small irregular cracks noted on the bottom face of the first press of some grains were repeated in other interfaces. In all cases, the interfaces were intact and would have required an approximate force of 50 to 150 lb in tension to separate adjoining increments. None of the small irregular cracks in the bottom face were repeated in the 30 interfaces of the 6 grains inspected.

2. Work was continued on the quality control of the ingredients of Alclo with particular attention to the powdered lead. Particle-size distribution data are obtained for each new shipment so that selection can be made to insure uniform performance.

B. VERTICAL STEAM GENERATOR

A new and improved model of the VSG Mk II was placed in operation. An accelerated program of burning-rate study will be conducted as part of the quality control of the Alclo ingredients.

C. 400-TON PRESS

Sixty-two 3.75-in.-dia grains were produced during May. The grains averaged about 8.25 in. long and weighed approximately 9 lb each. About 5 days of production were lost because of modification to the press building.

IV. GASOLINE AND COMPRESSED-AIR HYDROPULSE

A. Improvements in air-valve actuation and in fuel vaporization permitted a 50% increase in cycling speed (from 3.0 to 4.5 cps) and a 100% increase in thrust.

B. Figure 1 shows a pressure vs time curve for a typical hydropulse cycle during the present static operation of the motor. The curve is typical of those obtained in past hydropulse experience. The bubble overexpands to create an underpressure which draws in the next water charge.

C. The pressure trace shows the necessity for increasing the speed of valve closing. The opening rate appears satisfactory, but the slow closing permits the charge injected at 60 psi to expand to about 30 psi before it is ignited. Also, when pressures above 60 psig are used, the burned and expanded charge is so large that it fails to develop any underpressure, thus preventing the barrel from refilling with water for the next cycle. Necessary revisions to increase the valve operating speed are being considered, so that the charge can be ignited at peak injection pressure. This improvement will also permit the use of higher injection air pressure.

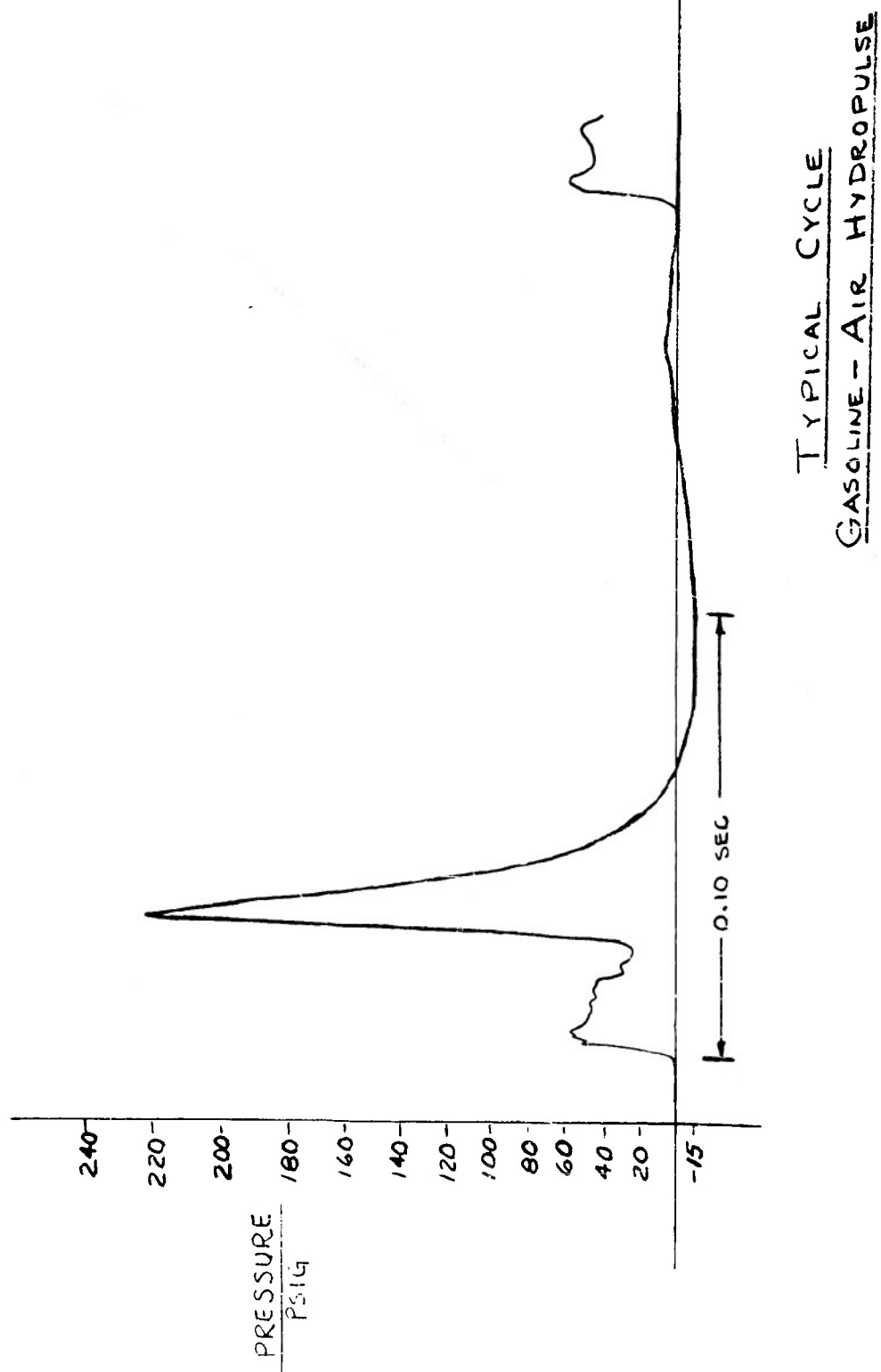


Figure 1

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