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REMOTELY PILOTED VEHICLE (RPV) TEST FACILITY.(U)
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REMOTELY PILOTED VEHICLE (RPV) TEST FACILITY

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John A. Chappell

July 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the Remotely Piloted Vehicle (RPV) Test Facility located at the Applied Technology Laboratory, Fort Eustis, Virginia. Included is a description of the current physical plant, instrumentation, and test capabilities.

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INTRODUCTION

The RPV test facility is designed to test twin-cylinder, two-stroke, and air-cooled engines of up to 50 horsepower for Mini-RPVs. The current tests used to determine the capabilities of these engines are propeller blade angle adjustment, endurance, and engine performance. These tests are performed with the following equipment:

- Dynamometer test stand
- Endurance test stand
- Propeller and engine static thrust stand
- Associated instrumentation

The facility can be modified to test gas turbine (shaft and jet), rotary, two-stroke, or four-stroke engines of up to 300 pounds thrust (50 hp).

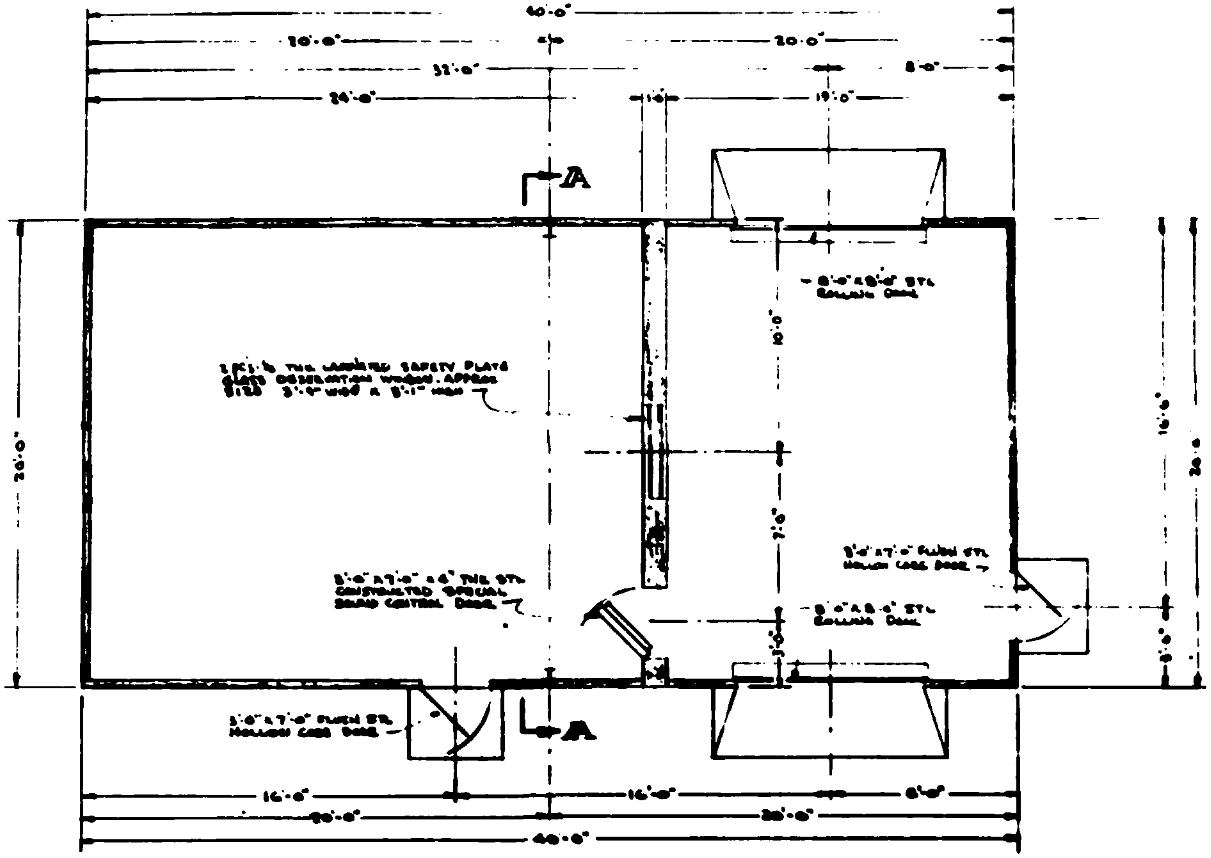
PLANT DESCRIPTION

The RPV test facility is housed in a 20x40-foot prefabricated metal building with a 10-foot eave height and mounted on a 4-inch reinforced concrete slab (see Figure 1). The electrical service provided includes a 200-amp, 3-phase, 4-wire system with an appropriate panel board.

The building is divided into two areas by a wall constructed of 12x8x16-inch hollow core concrete blocks filled with sand. The floor plan is shown in Figure 2(a). An observation window with twin laminated 1/4-inch safety plate glass and a 3-foot sound-control door are also part of this wall construction (Figure 2(b)). The smaller of the two areas is the test cell; the larger area contains the controls, instrumentation, assembly area, and office space. Besides safety considerations, the wall is constructed to suppress the high intensity sound levels emitted by test engines. Sound is also controlled by fiberglass insulation on the interior walls.

Two 8x8-foot steel rolling doors, one on each side of the test chamber area, provide for maximum physical access and ventilation. An exhaust fan in the test area provides 20 air changes per hour. The instrumentation control area is heated by electric base-board heaters thermostatically controlled, and it is cooled by a single 18,000-Btu wall-mounted air conditioner.

Figure 1. RPV test facilities building.

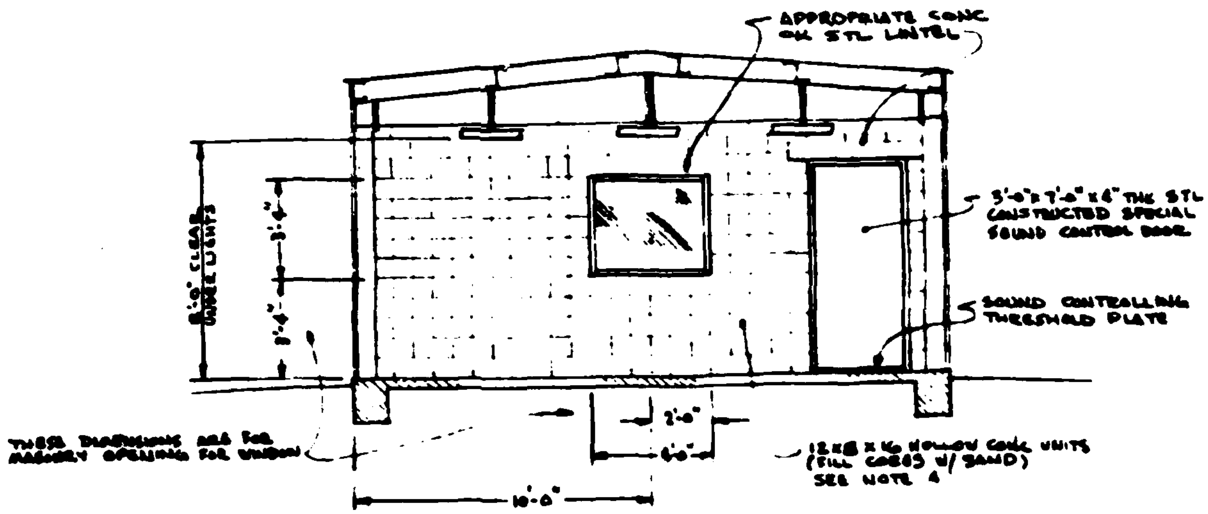


(a)

Figure 2. Floor plan.

FLOOR PLAN

SCALE 1/4" = 1'-0"



SECTION A-A

(b)

Figure 2. Continued.

TEST EQUIPMENT

Three types of test stands are used for engine testing. The dynamometer test stand is used to measure performance, horsepower, and fuel consumption. The endurance test stand is used to evaluate the engine's durability with a propeller installed. The propeller/engine thrust stand is used to measure dynamic thrust.

DYNAMOMETER TEST STAND

This test stand (shown in Figure 3) uses a 0-45 horsepower eddy current dynamometer (Zollner Model A-130) to measure net horsepower. The dynamometer operates by loading the engine under test with an electric motor that theoretically rotates in opposition to the engine. Varying field excitation of the electric motor at the control panel varies the amount of torque or load on the engine. By allowing the electric motor to pivot, a strain-gage load cell measures opposition torque at the support point.

A digital meter reads out torque in foot-pounds directly; the rpm indicator, by use of a magnetic pickup, reads rpm directly. Both readouts are located on the dynamometer control panel (Figure 4). The relationship between torque in foot-pounds and rpm is shown in Figure 5.

The dynamometer is water cooled by an auxiliary heat exchanger. The cooling water temperature should not exceed 160°F and the water pressure should not drop below 17 psi. Two sensors are tied in series: a 160°F (NC) thermostat and a 17-psi (NO) pressure sensor. If the temperature exceeds 160°F or the pressure falls below 17 psi, *the field excitation is removed from the dynamometer.* Simultaneously, the ignition system on the test engine is disabled. This interlock system insures that no damage occurs to the dynamometer or test engine due to a dynamometer cooling system failure.

The control system and readout devices are located in the instrumentation control area of the facility near the test stand viewing window (see Figure 4).

ENDURANCE TEST STAND

This stand (shown in Figure 6) is designed to test the overall endurance of an engine with a propeller installed. The propeller is enclosed in a cage (also shown in Figure 6) to provide for any possible failures. The engine under test is operated by a remote throttle to simulate actual flight conditions, e.g., takeoff, cruise, and landing.

A load bank with twelve 30 VDC 100-watt lights that can be switched in segments is used to simulate the alternator load. An on-line voltmeter and a shunt are used to read the load current via an HP multimeter.

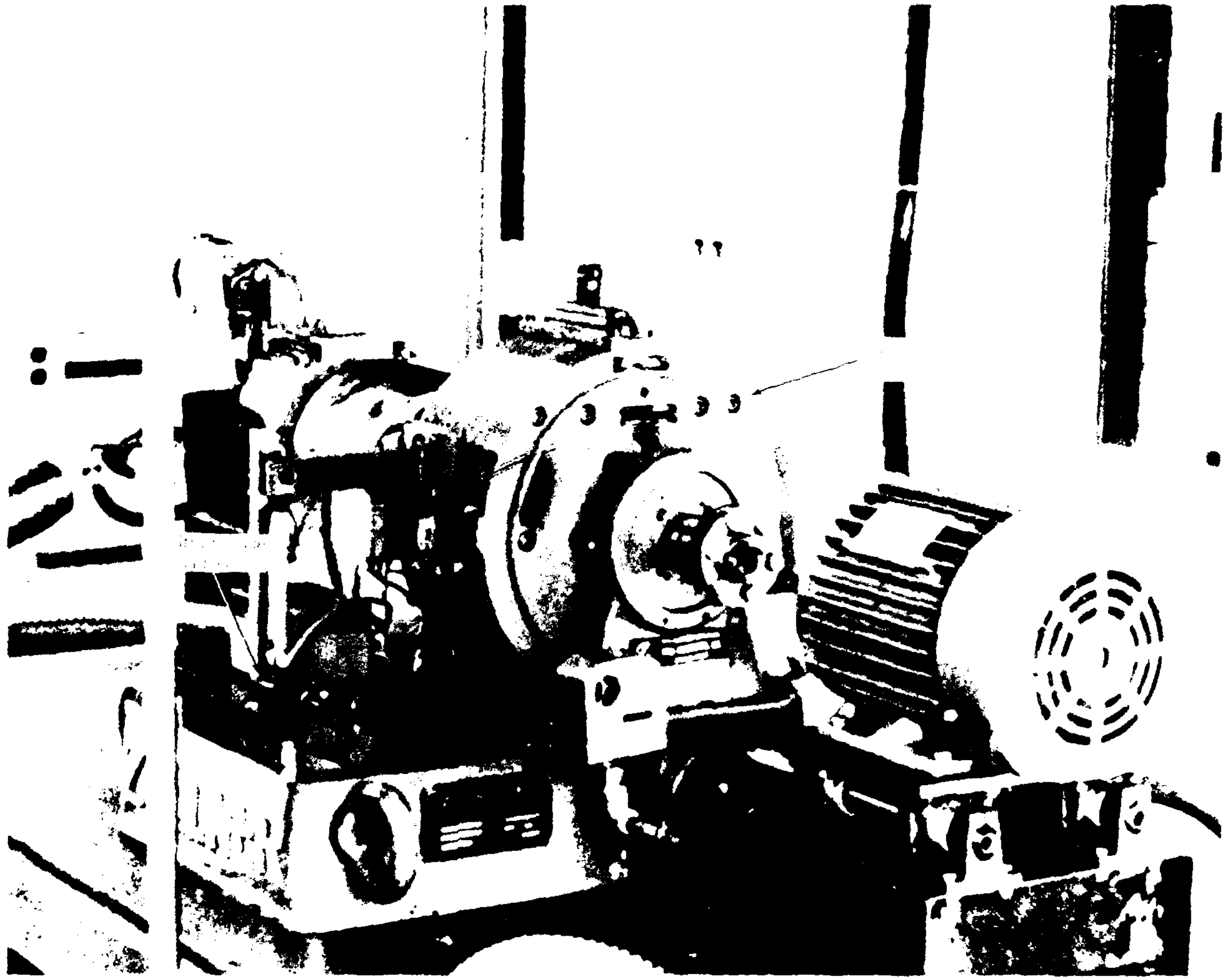


Figure 3. Dynamometer test stand.

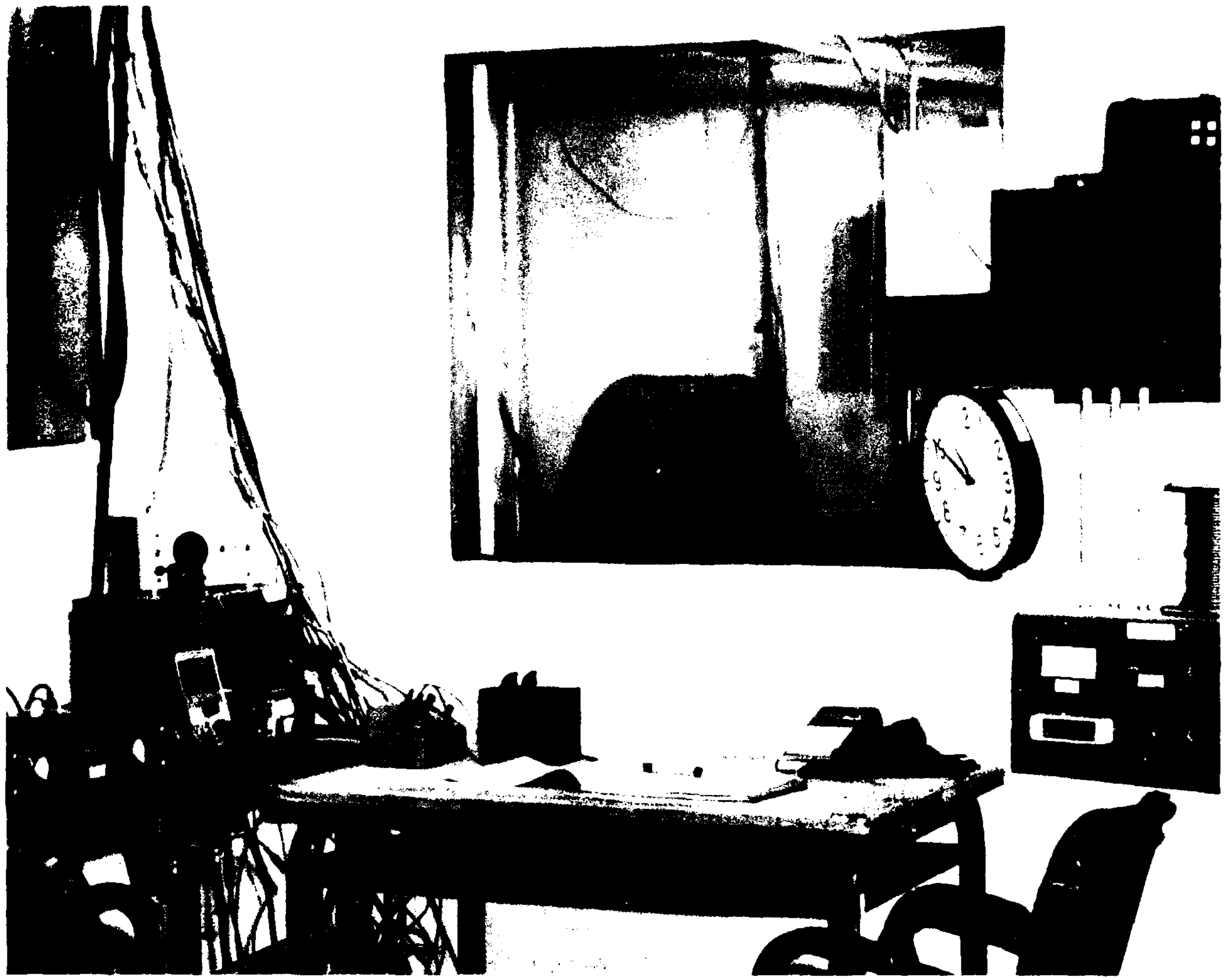


Figure 4. Dynamometer control panel.

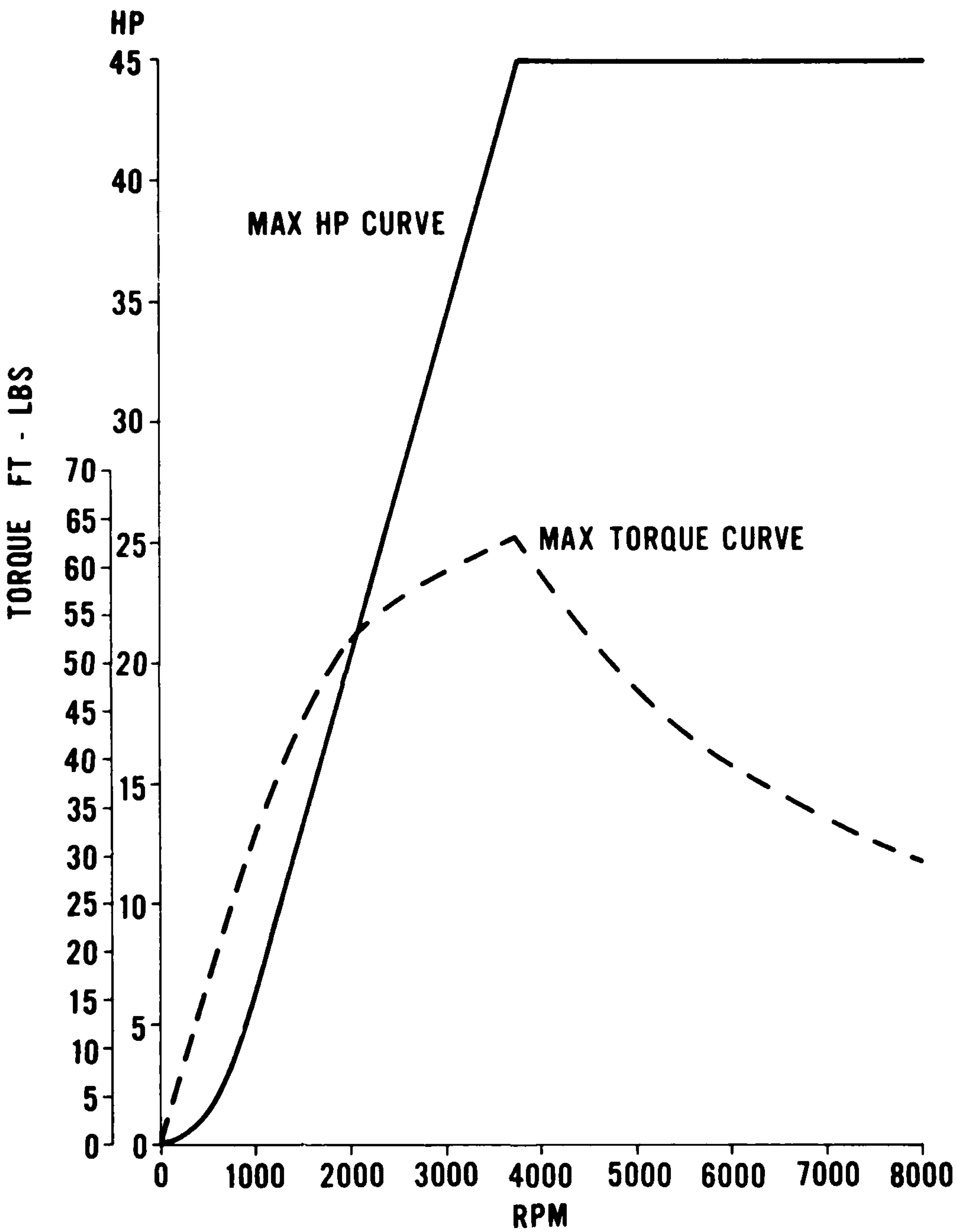


Figure 5. Eddy current dynamometer – relationship between torque and rpm.

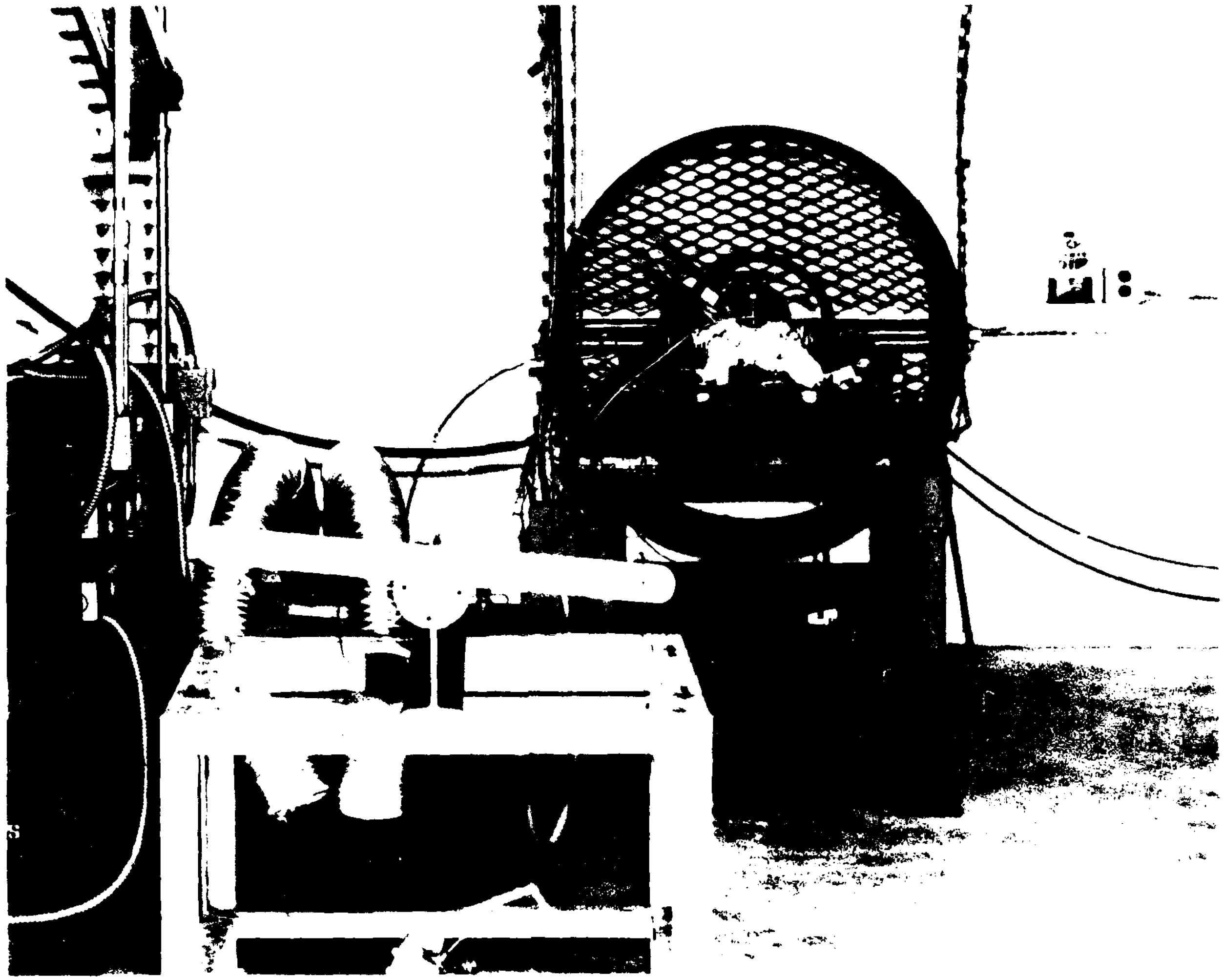


Figure 6. Endurance/propeller test stand.

PROPELLER TEST STAND

This test stand (also shown in Figure 6) is used to measure propeller performance. The stand consists of load cells for measuring thrust and torque. The engine is cantilever mounted so that there is little airflow interference between the stand and the propeller. Propeller performance can be calculated from the thrust, torque, and speed measurements. A screen that attaches to the stand and provides little blockage is used to protect personnel from the propeller. Engine speed is controlled using the cable from the endurance test stand.

ENGINE STARTING SYSTEM

The test engines require some type of external starting system. Two of the stands use a 208-volt 3-phase, 2-hp, 1700-rpm electric motor with an engagement shaft mounted on a sliding platform so that once the engine is running the starting system can be moved back. The engagement shaft is designed so that when the engine starts and is running properly, the starting system will be disengaged automatically. The third stand uses a hand-held go-cart starter powered by a 24-volt battery and has a similar engagement system.

FUEL MEASURING DEVICE

Fuel consumption is measured by a fuel measuring device developed by the US Army Mobility Equipment Research and Development Command (MERADCOM). This system uses the principle of timing the use of a specific amount of fuel at a known temperature.

A series of limit read switches in a cylinder with a known volume of fuel starts and stops a timer (Figure 7) to indicate the length of usage time. The graduated cylinder shown in Figure 8 is used to calibrate the system to determine the specific amount of fuel.

The temperature of the fuel is measured by a thermocouple in the fuel line. This system also has a bypass mode to allow changing engine settings by a remote throttle located in the control test area. This remote throttle is a speedometer cable type throttle.

The fuel supply system for both test stands is composed of two 18-gallon tanks with two different gas/oil mixtures. This is done so that the fuel supply can be switched from one ratio to another when engines are changed.

MISCELLANEOUS DEVICES

Temperatures such as cylinder head, exhaust, fuel, inlet, and cooling air are measured with the use of thermocouples and a reference junction connected through a switch to a digital voltmeter. The millivolts read are then converted to temperature via a conversion chart.

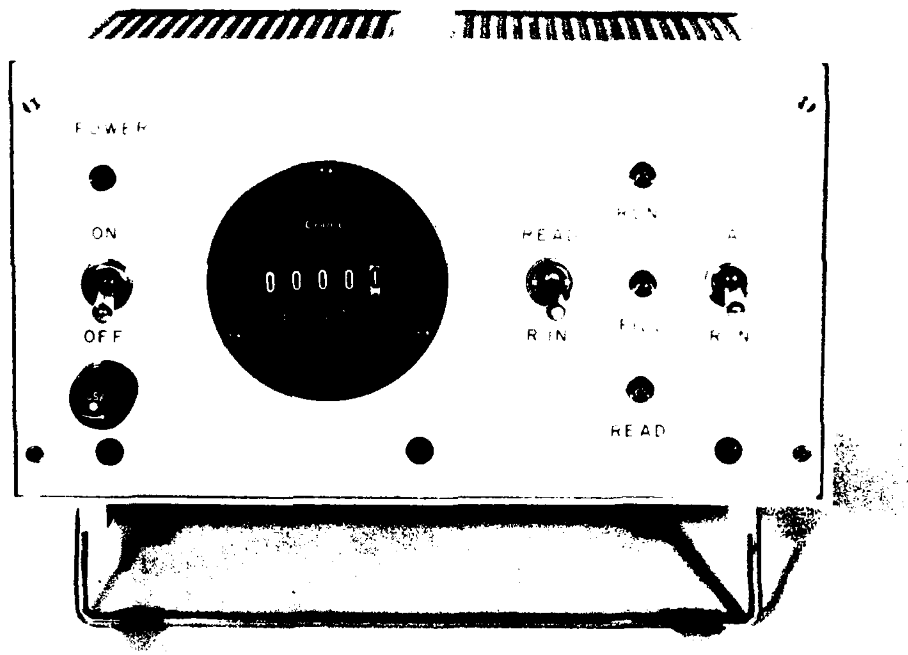


Figure 7. Fuel usage timer.

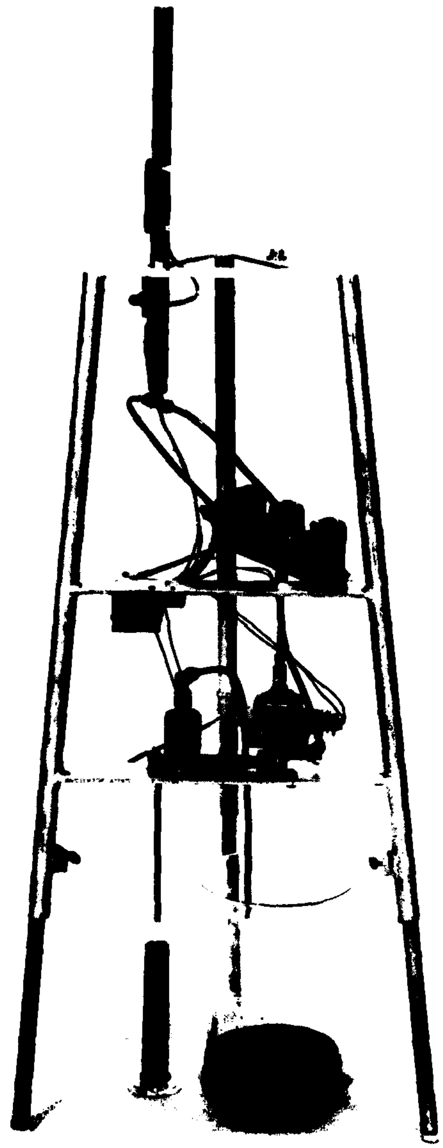


Figure 8. Fuel measurement cylinder.

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