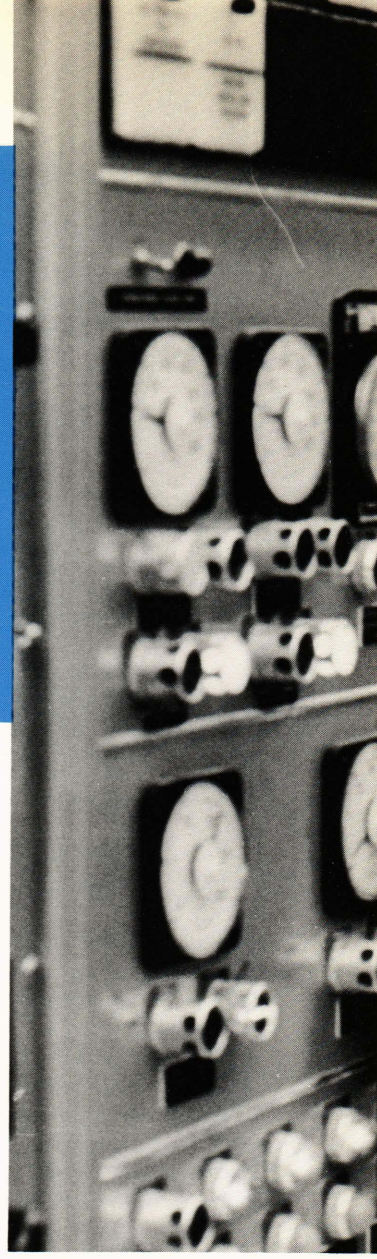
*A Photographic Essay of the APL*

# PROPULSION RESEARCH LABORATORY



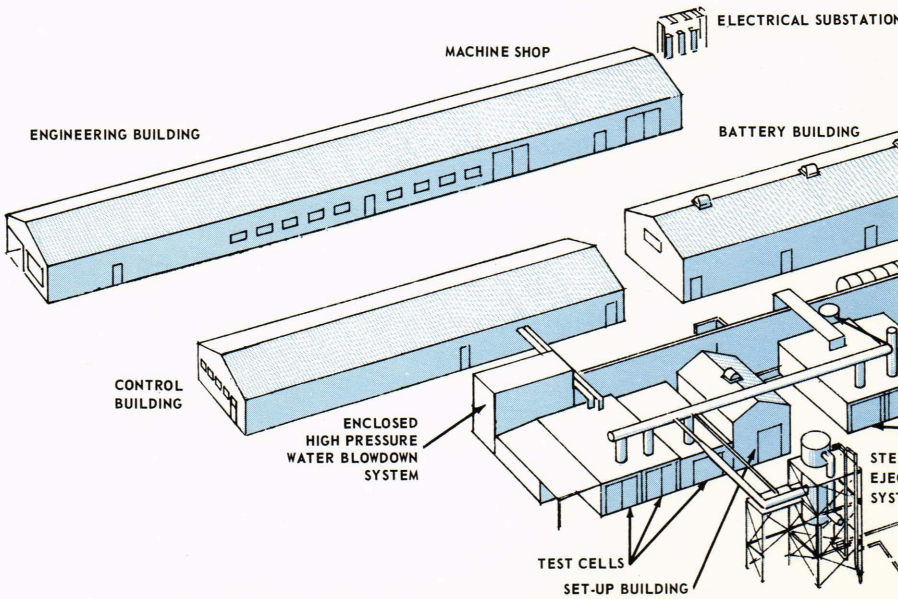
The Propulsion Research Laboratory provides an outstanding facility for the development and test of hypersonic propulsion systems and for the conduct of atmospheric reentry experiments.

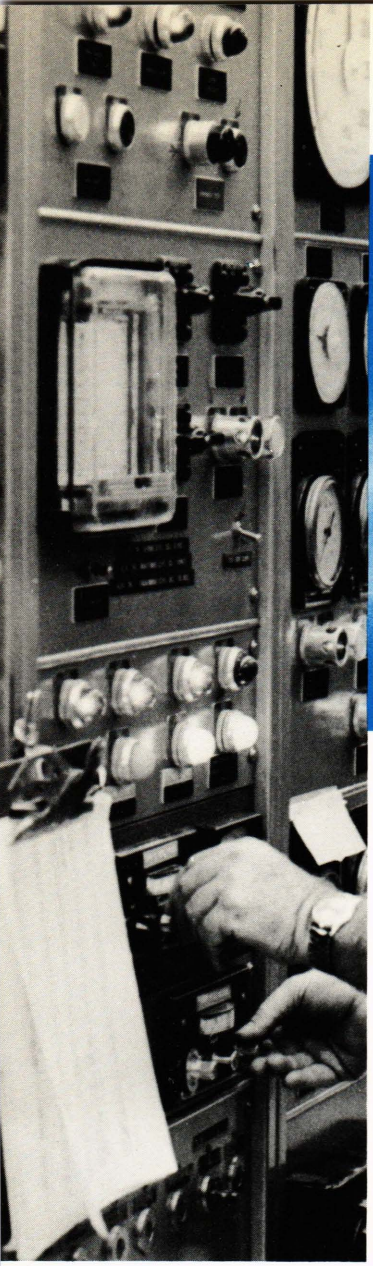
Experience in advanced propulsion testing at APL dates back to 1944, when Applied Physics Laboratory engineers designed the free world's first blowdown test facility. Those first facilities have been continuously updated for higher and higher Mach numbers and are capable of reaching Mach 9 in the free-jet tunnel and orbital velocities in connected pipe tests.

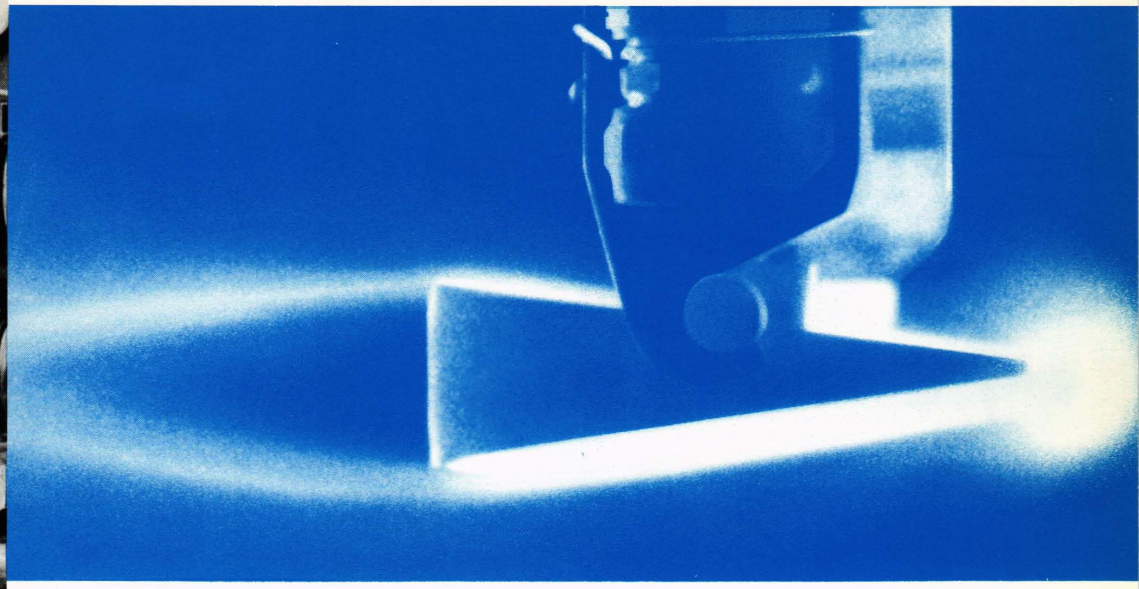
Free-flight conditions are simulated in the Laboratory's blowdown propulsion tunnels. In the blowdown facility, atmospheric air is stored at high pressure, heated to a temperature corresponding to the flight stagnation temperature, accelerated by a supersonic nozzle to flight velocity in a chamber evacuated to the simulated altitude, and then exhausted to the atmosphere. Air, steam, heat, and electrical energy are accumulated slowly and, then, during a test, expended rapidly. This is done as an alternative to the expensive equipment that would be necessary to provide continuous testing.

Some of the types of test carried out at the Propulsion Research Laboratory are:

- Supersonic ramjet combustor development—These tests are associated with the development of en-







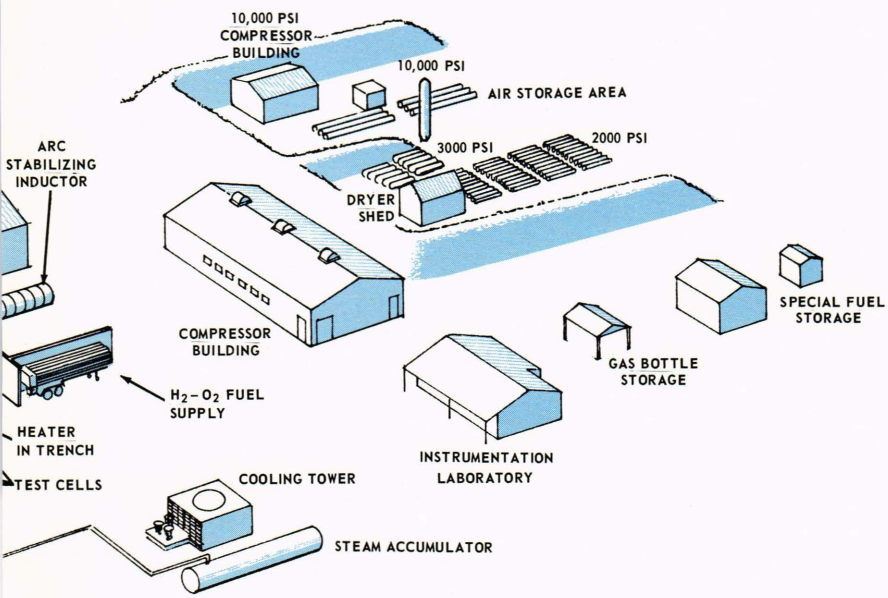
gines for hypersonic missiles. They include work on penetration and mixing of liquid and gaseous fuels in a supersonic air stream, fuel injection, ignition studies of special fuels, measurement of combustion efficiency and overall performance.

- Thrust augmentation—This test involves the introduction of additional air as oxidizer into a fuel-rich rocket exhaust.

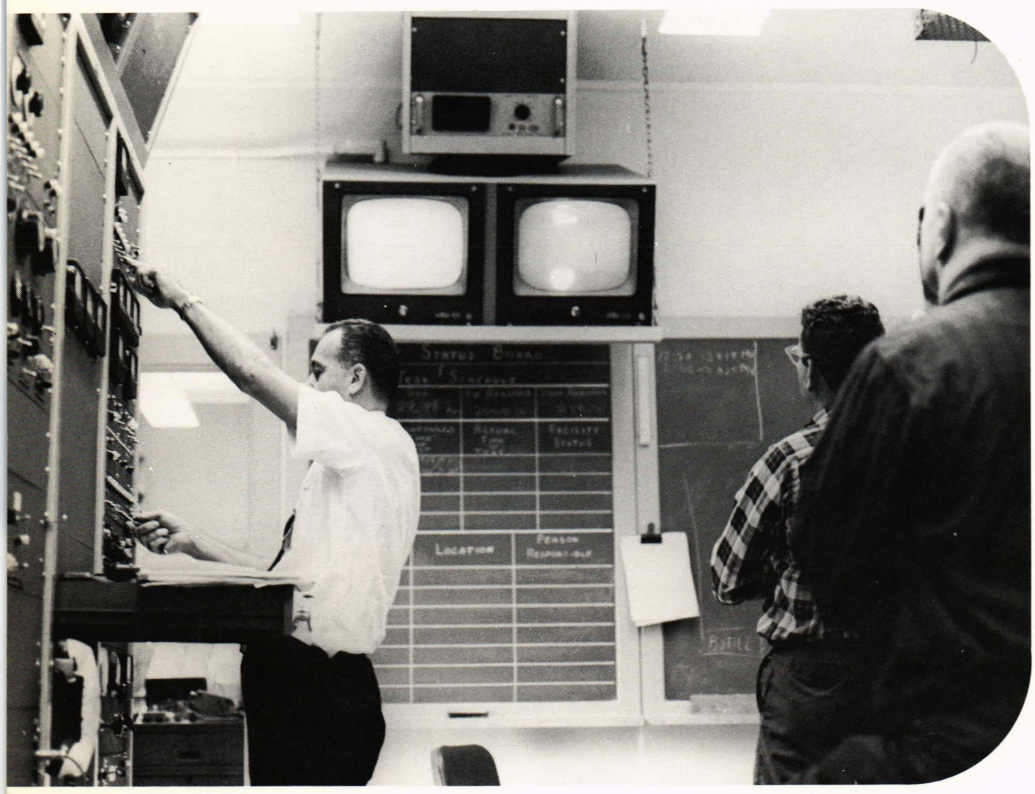
- Reentry studies—Studies are being conducted on both the effect of ablation products on wake characteristics and the effect of simulated reentry environments on heat shield materials.

- Arc heater development—These tests relate to the improvement of the existing arc heater technology to provide operation at both higher temperatures and pressures.

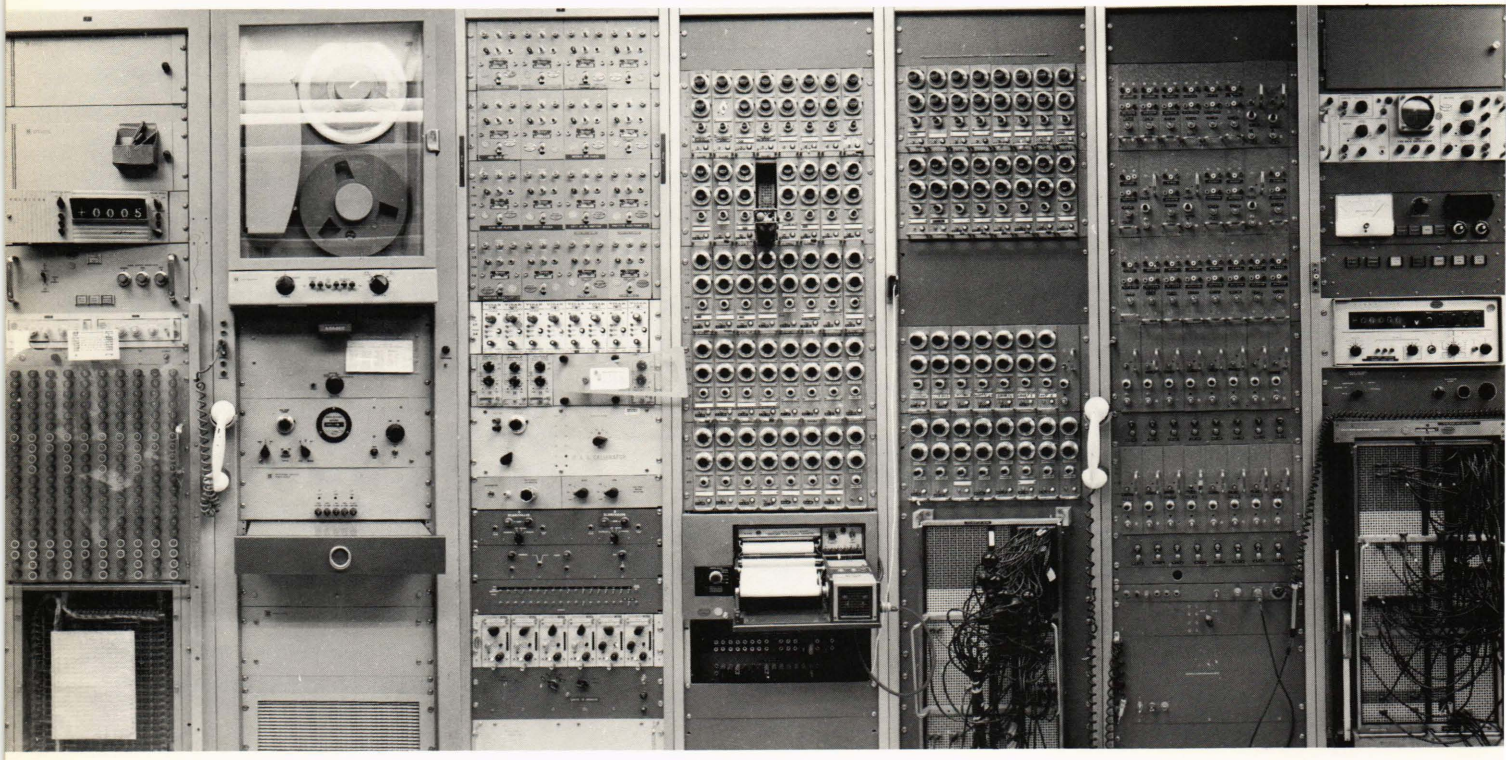
In addition to these major studies, the Propulsion Research Laboratory has conducted tests of a noise simulator subsequently used for shake tests of flight missiles, a rocket exhaust simulator for the study of the microwave attenuation problem, Terrier booster fins, catalytic igniters, leading edge materials, vectored plug nozzles, ablative materials, pressure regulators, turbulent pipe flow ablation, orifice and nozzle calibrations, hydraulic system preflight qualification, and proof firing of rocket motors.

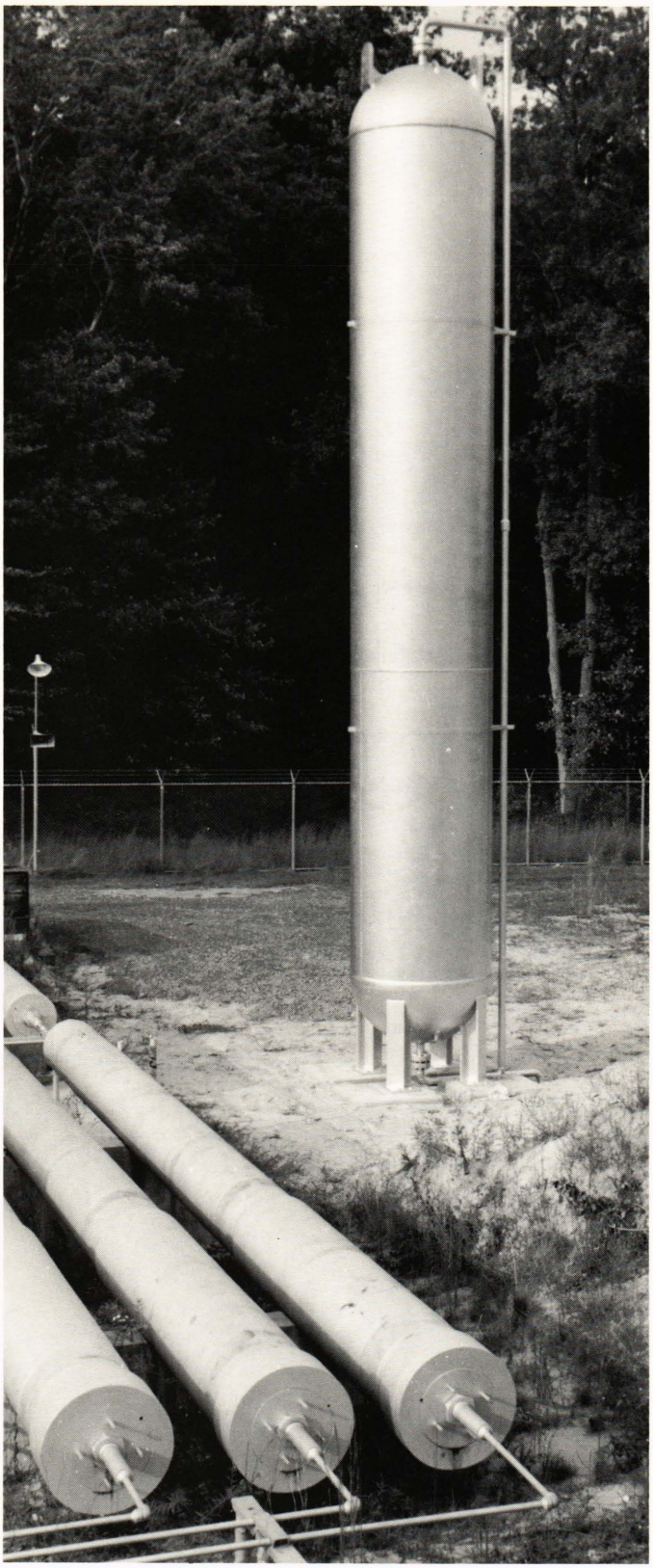



*Propulsion Research Laboratory Buildings*




*Instrumentation*
*In Control Building*

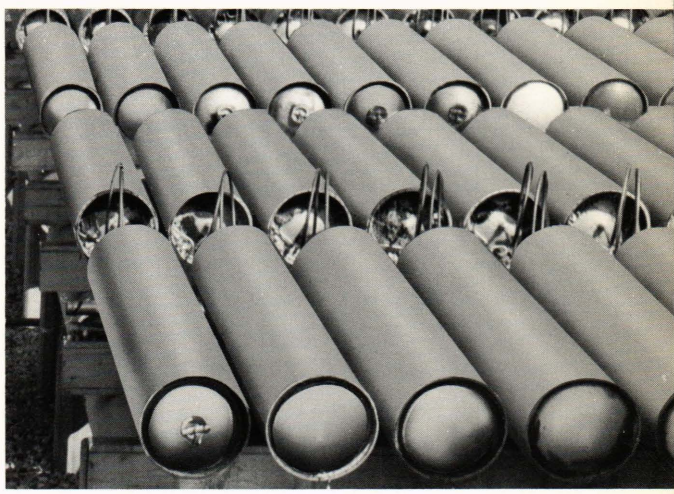


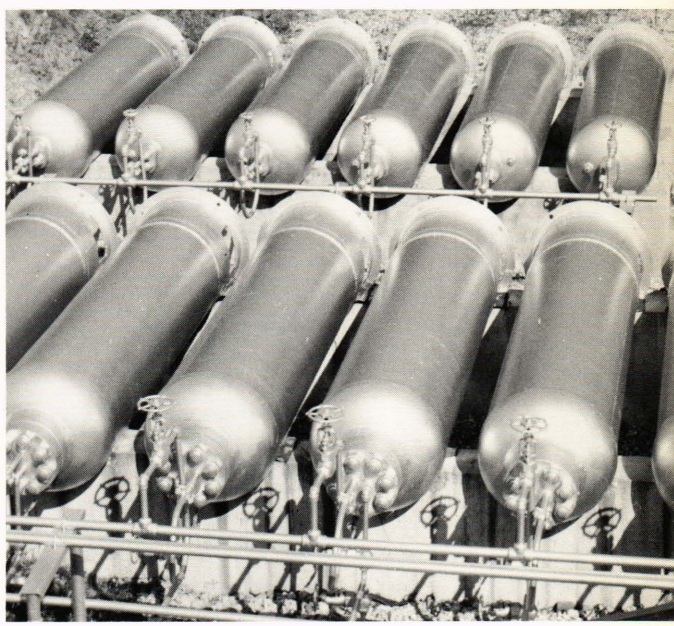


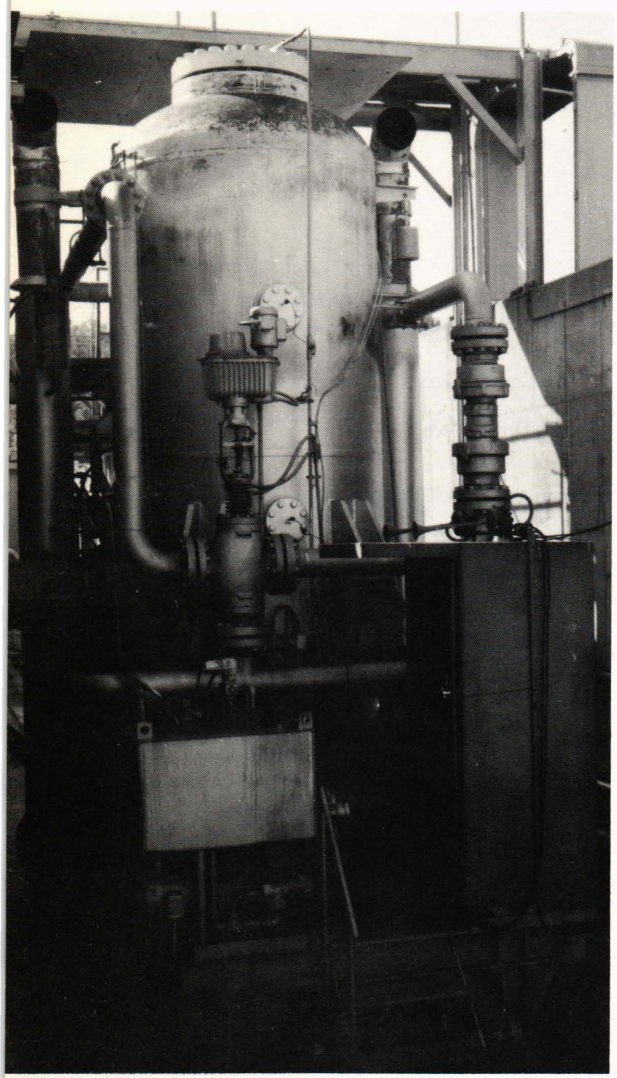
*Left, 4400-Psi Air Storage Tank Used For 2000-Psi Air Storage And 16-Inch Gun Liners Used For 10,000-Psi Air Storage In The Foreground*

*Upper, Torpedo Flasks Used For 2000-Psi Air Storage*

*Lower, Layered Tanks Used For 3000-Psi Air Storage*

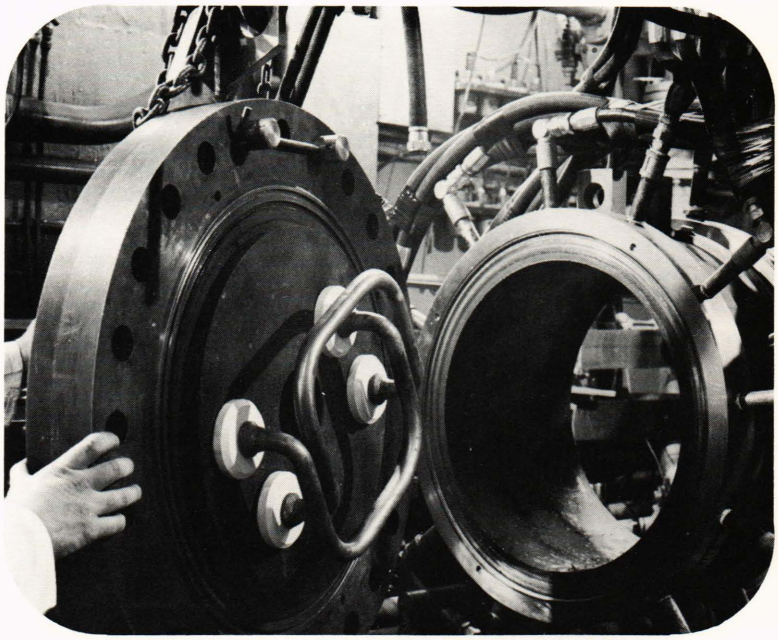




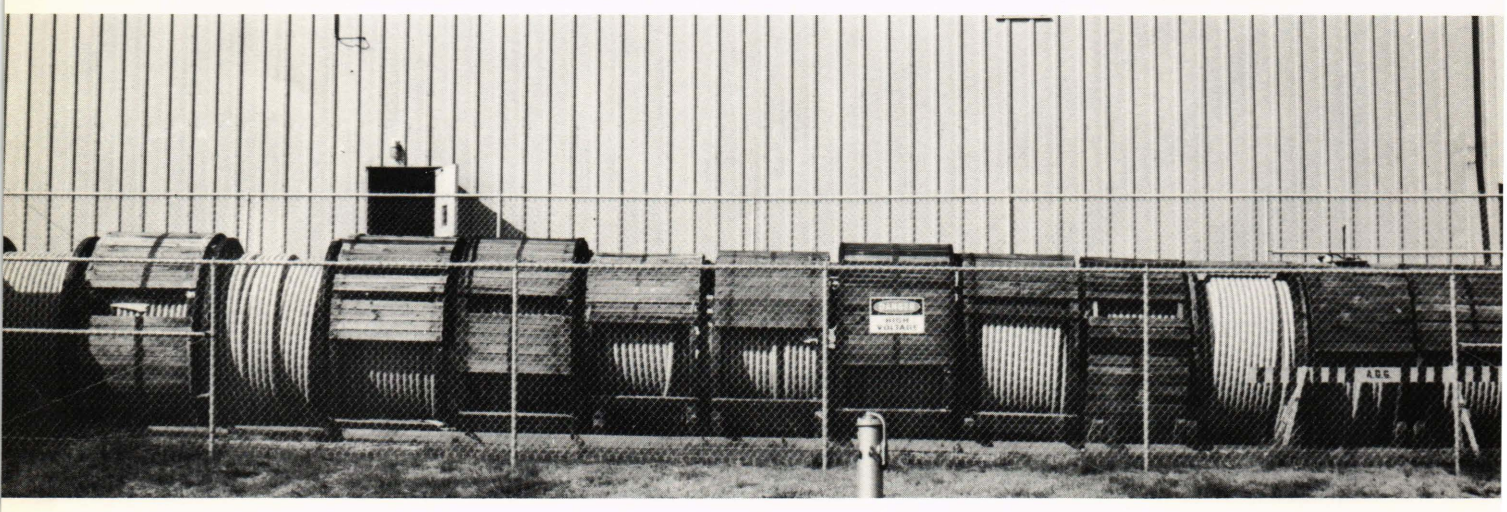


*Storage-Type Air Heater*

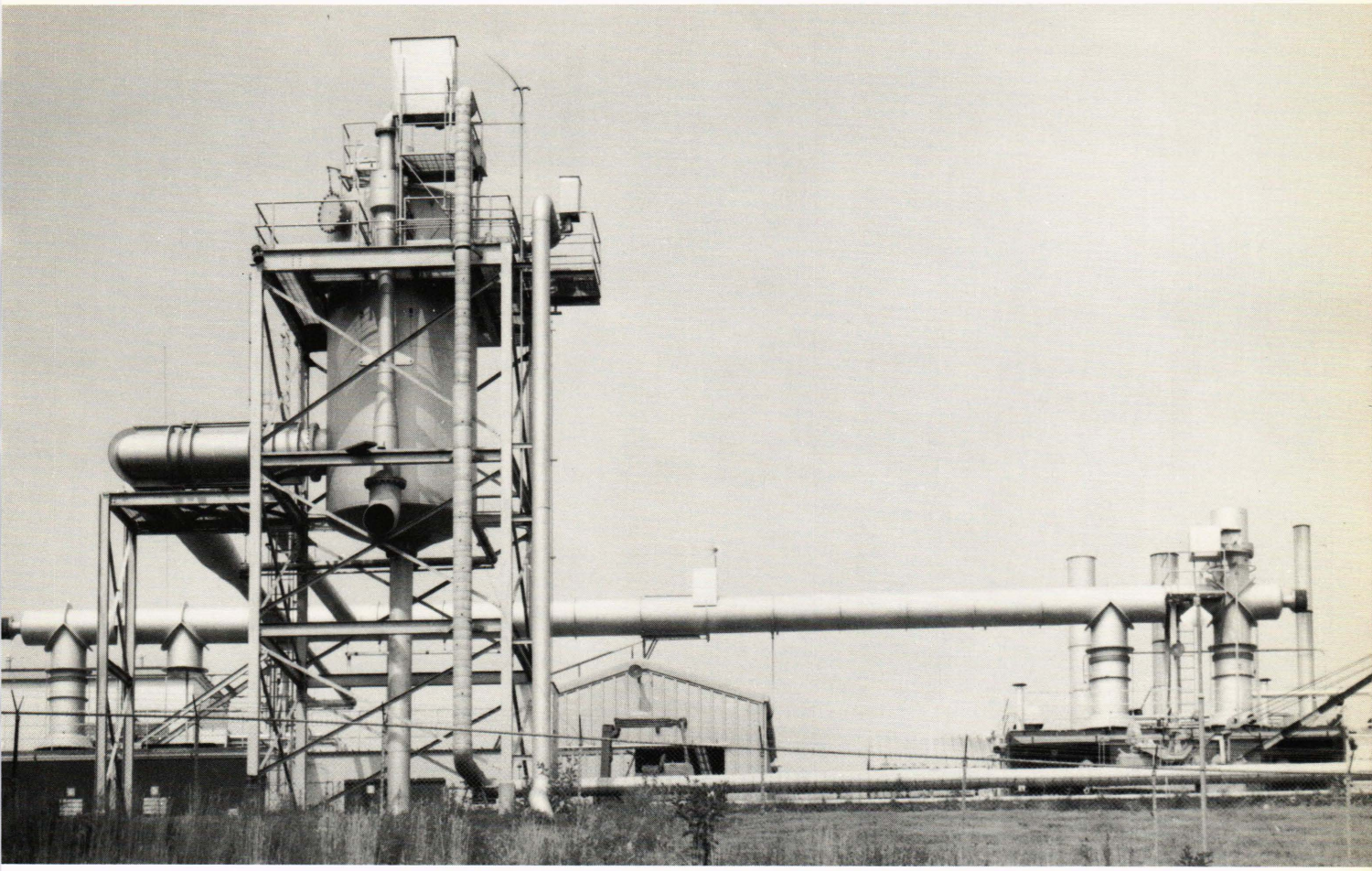
*Electric Arc Heater*



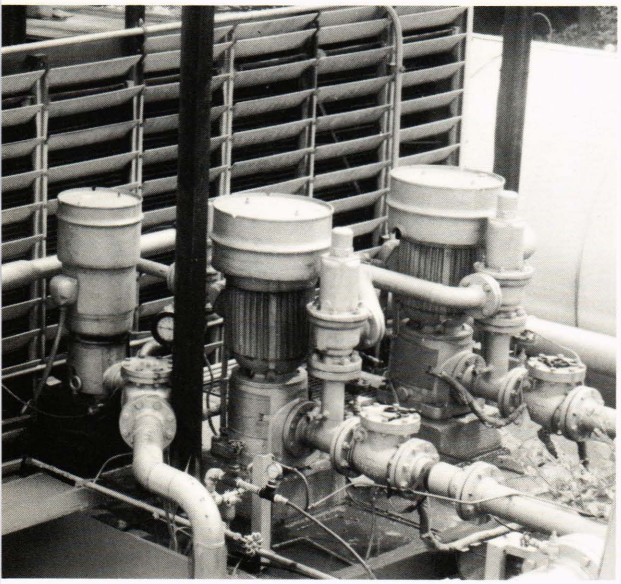
*Arc Heater Ballast Inductor*

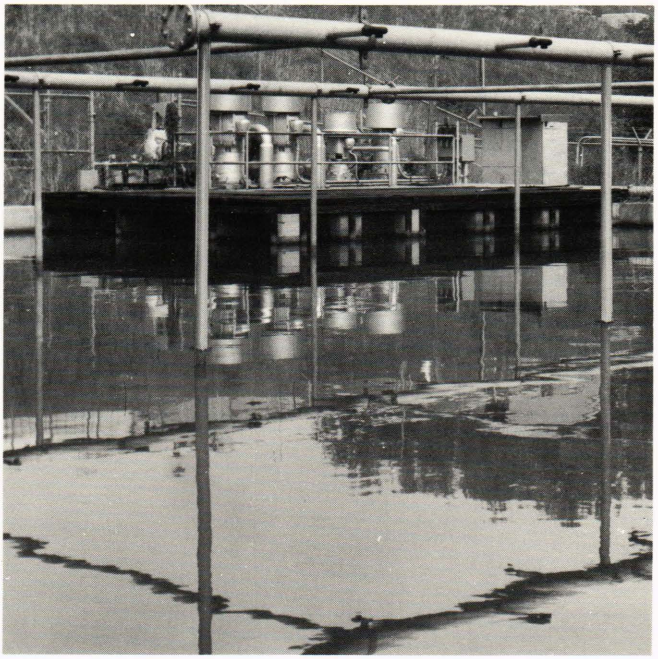


*Two-Stage Steam Ejector And Exhauster System*

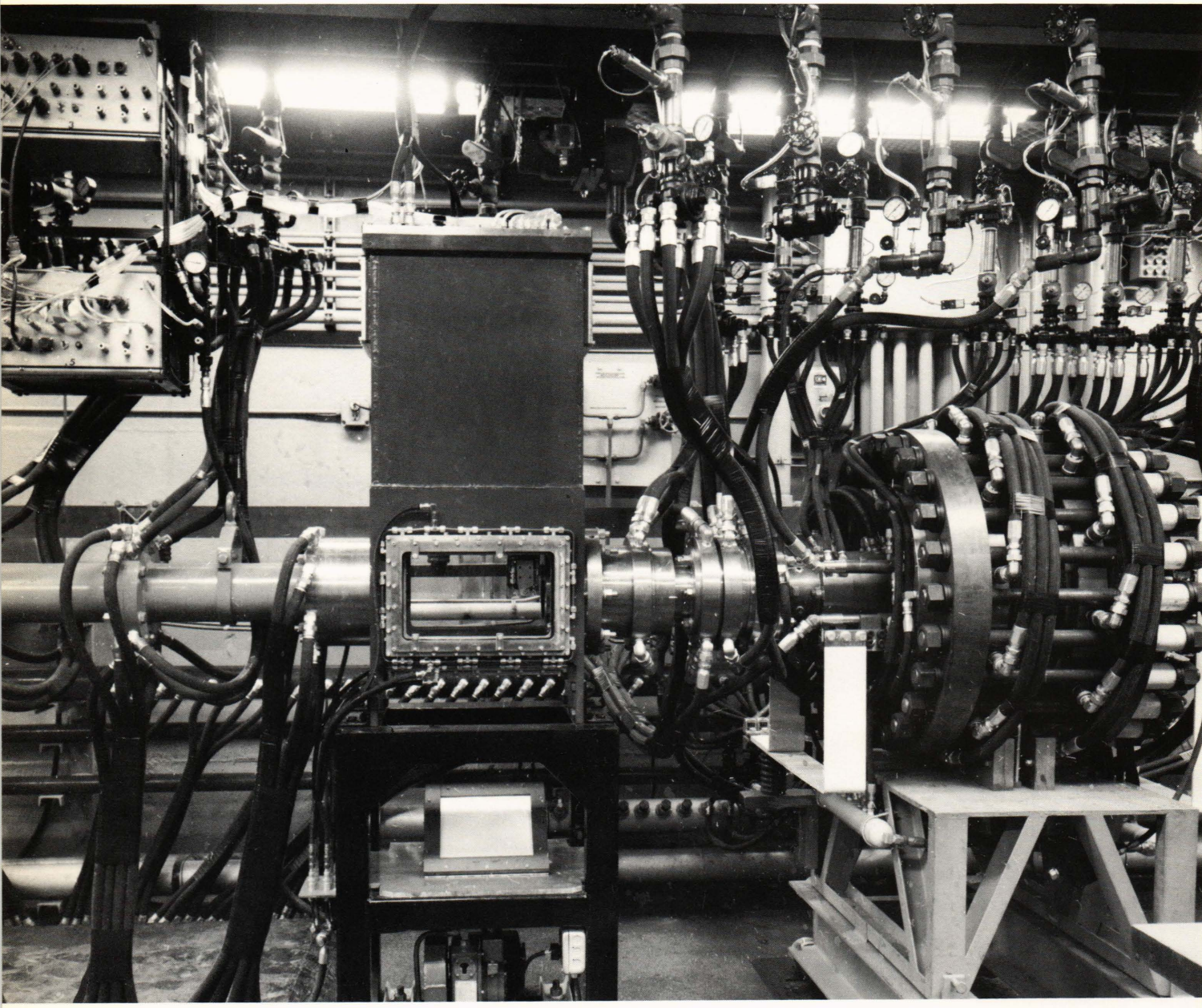


*50-Psi Cooling Water Pumps And Tower*





*Cooling Water Reservoir*



*Mach 6 Tunnel, Including Instrumentation, Diffuser, Test Cabin, Nozzle, And Arc Heater*