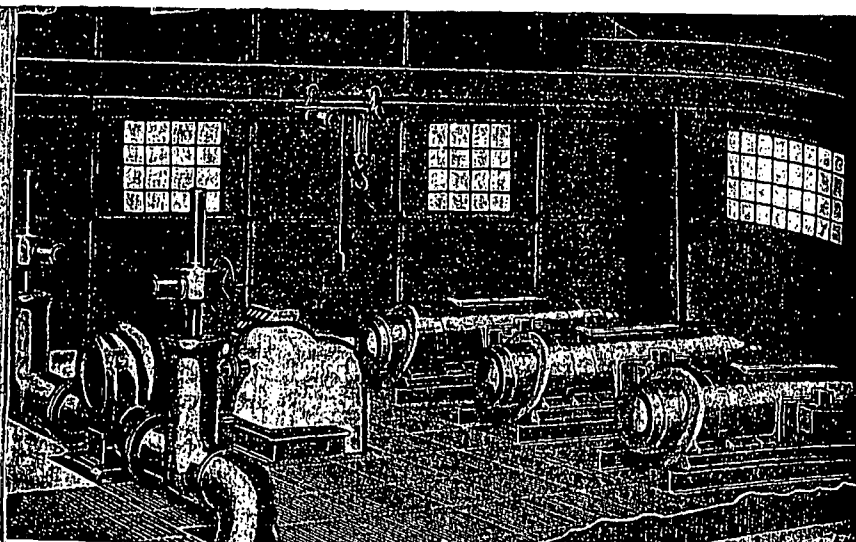
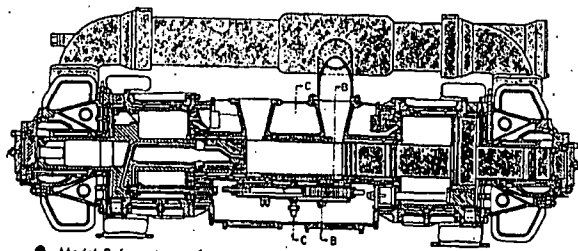
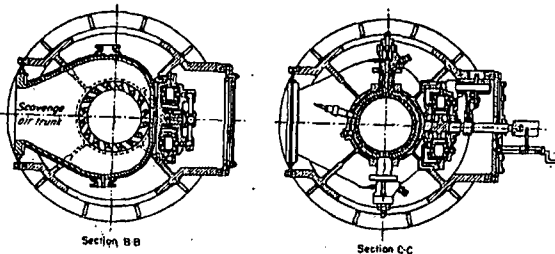




1 Compact arrangement and low head room mark this 5000-hp gas-line compressor station. Three free-piston gas generators, right, feed 1000-F 72.5-psig gas to turbine center, driving centrifugal gas-line compressor through



2 Model B free-piston generator compresses air on outward stroke. This Baldwin-Lima-Hamilton unit can develop 103-psig exhaust gas, run as fast as 1400 cpm



3 Cross sections through BLH Model B show arrangement of the air inlet to diesel cylinder, left, and fuel nozzles with synchronizing rocks and gear, at right

Free-Piston Engine: U.S. Development in High Gear

Adapting reciprocating machinery as power-gas generators for gas turbines takes several forms depending on the job to be done. Free-piston gas generators offer a promising road to achieving high overall efficiency with limited need for high-temperature alloys. European activities have blazed the trail for these developments in our country

Early reports of free-piston gas generator development in this country were created before the ASME spring meeting in Columbus, Ohio, April 28-30, 1952. In three papers, these are: (1) Performance of Free-Piston Gas Generators, by J. J. McMullen and R. C. Lewis, No. 53-S-18 (2) The Free Piston Gas Turbine Plant and Application, by J. J. McMullen and R. C. Lewis, No. 53-S-13 and (3) The Development of High Output Free Piston Gas Generators, by F. M. Lewis and R. A. Lewis, No. 53-S-34.

The basic theory of these engines are covered in the papers, Dec. 1952, pp. 104-105; Jan. 1953, pp. 79-81; Dec. 1942, pp. 888, 889.

These gas generators feeding a single turbine hold out the promise of achieving high thermal efficiency of the cycle, together with simplicity of turbine-shaft output. The papers report three designs of free-piston units.

Sigma gas generators based on the Pescara patents were built in France and have been applied to electric generation, locomotive drive and ship propulsion. These models use relatively low-pressure low-temperature gas (50 psig, 945 F) discharge from the free-piston unit to run the turbine. They are built for construction economy and low maintenance cost. Air compresses on the inward stroke, and no cylinder cooling is used.

Cooper-Bessemer generator works with outward compression, Fig. 5, and cylinder cooling. To gain competitive advantage it generates 72.5-psig 1000-F gas for the turbine, Fig. 6. It is primarily a heavy-duty unit for driving natural-gas pipeline centrifugal com-

pressors, electric generators and marine vessels where weight and space are not major considerations. Baldwin-Lima-Hamilton generators also use outward compression and cylinder cooling, Fig. 2 and 3. Designed for lightweight applications they discharge 90-psig 1300-F gas to the turbine. As a result, the diesel cylinder runs at higher operating conditions than those of usual reciprocating engines. This gives it a higher specific power than the generators mentioned before. The BLH units are being specifically developed for Naval combat vessels where weight and space are primary considerations.

Test data on the Sigma gas generator figured at 85% turbine efficiency showed it would develop 1255 shaft hp at a maximum thermal efficiency of 52.4%.

More on next page

4 These three views show details of a 1500-hp pipeline compressor station with one unit. A single free-piston power-gas generator supplies the driving turbine spinning at 14,400 rpm. Concrete mat supports all equipment. Column footings raise main machinery so that operating floor has a 4-ft space underneath to accommodate all connecting piping. This Cooper-Bessemer design and one in Fig. 1 take in air through air silencer standing outdoors. Turbine exhausts through the neighboring stack. All auxiliaries have separate power drives, simplifying starting procedure

