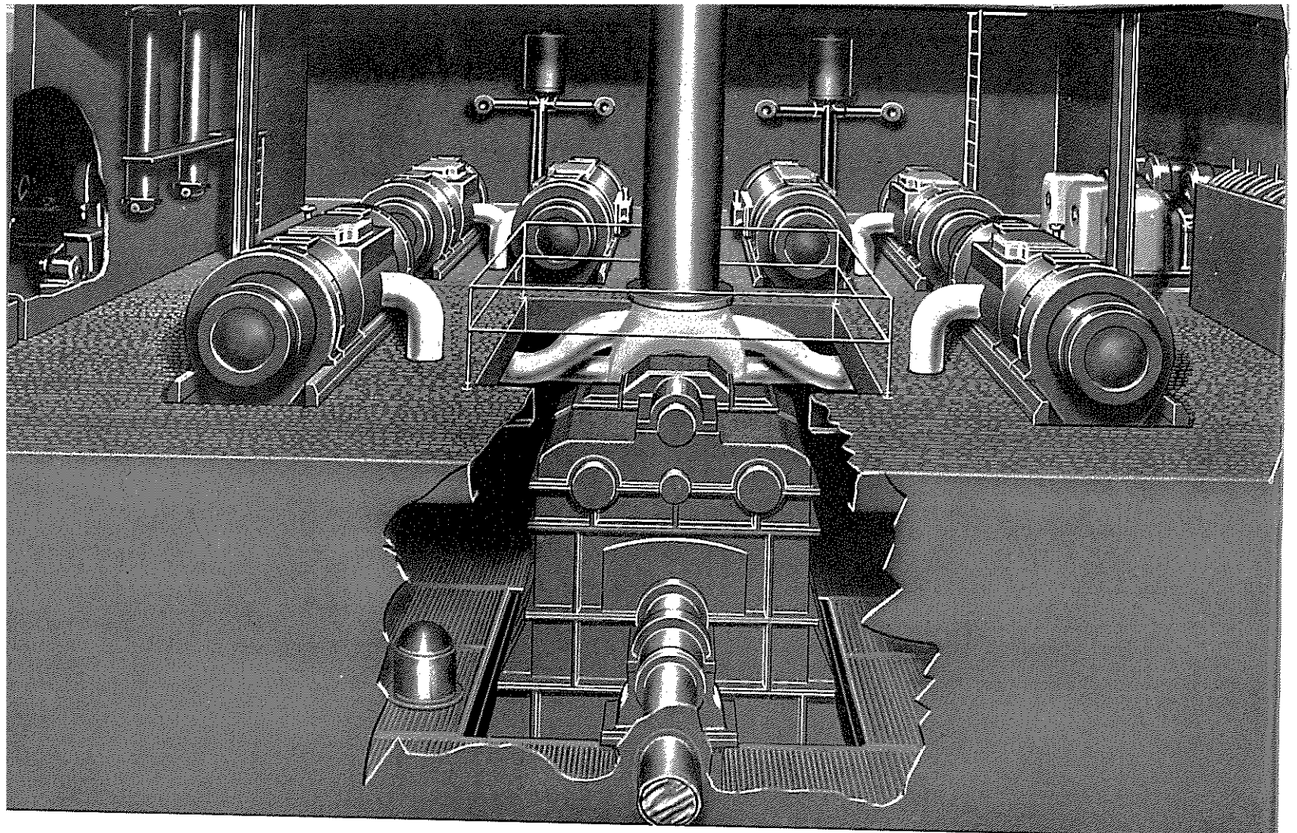

More Horsepower Per Gallon of Fuel

A new machine given much publicity in American trade magazines and Newsweek has raised much interest. The Cooper-Bessemer Corporation in Ohio has already built a pilot model.

Impressive claims are being made for Cooper-Bessemer's new free-piston gas generator in combination with a gas turbine. A 1,500 horsepower model has been built—and the company says it will deliver twice as much power per fuel unit as other engines. The company says it will save from 10 to 25% in installation costs and will need between 30 to 60% less space in a plant. With these facts in mind, we find a cargo ship will be able to double its range on a single fuel supply, a fascinating fact in these days of rising costs. A cargo ship equipped with free pistons and gas turbines instead of conventional engines will use only half as much fuel—and the absence of boilers, pumps, etc., in a steamship would not only double her range but increase her cargo capacity by a great deal.

HOW DOES IT WORK?

Briefly, what Cooper-Bessemer has done is to replace the conventional rotary compressor in gas turbines by a higher efficiency free piston compressor. Instead of the compressor being driven by the turbine and taking four-fifths of the turbine's output, the free piston compressor is driven by the burning gases themselves, and the exhaust of the free piston compressor drives the turbine.

Inside the free piston gas generator, two pistons operate in a common chamber. Combustion takes place between them and moves them outward. Each of these pistons is directly connected to another piston, operating in chambers on each end of the machine. These end chambers are closed; and the compressed air in the chambers made by the end pistons moving outward serves to "bounce" the end pistons and therefore the center pistons back toward each other again. A valve opens in the center chamber, and as the two center pistons approach each other, the 1,000 deg. F. gas is pushed into the turbine inlet. At the same time a new charge is pushed into the center chamber by reciprocal action and combustion begins all over again. Thanks to having combustion take place *outside* the turbine casing, this turbine runs much cooler as compared with other gas turbines (1,000 deg. F. as against 1,350 deg. F.) and the machine can be built from metals with ordinary properties. Also all power developed by the turbine is taken off its shaft; it is not expending four-fifths of its energy driving a rotary compressor of comparatively low efficiency.

Eighteen months of tests showed that the free pistons had efficiencies as high as 40%, as against 20% for present gas turbines. Also the efficiency stays at a high level with varying load. From an engineer's point of view, this engine combines the smooth rotary power of turbines with the fuel economy of a diesel.

For a very large installation, a group of free piston compressors can serve one turbine. As the turbine is called upon to deliver more power, additional compressors can be cut in to the inlet. A large installation in this way can be made very flexible, keeping thermal efficiency high.

A Marine Installation

Robert P. Ramsey, Consulting Engineer for Cooper-Bessemer and Commander J. J. McMullen of the U. S. Navy's Bureau of Ships, discuss a typical installation of the free piston machinery in a cargo vessel of the C3 type.

The outstanding advantages of a free piston turbo-motor ship are:

a Combination of reliability and high thermal efficiency with reduced weight and space requirements.

b Low installed cost with low maintenance and other operating costs.

c Great flexibility of arrangement. The gas generators may be placed in a wide variety of positions since the coupling to the gas turbine consists merely of pipes to carry hot gas. Underway maintenance to individual gas generators can be accomplished, since they can be shut down individually.

d Instant availability of power. No particular warm up period is required to get the plant in operation.

e Easy access for repair and maintenance. Headroom of only seven feet above deck level is required to remove major components. Low number of moving parts, all easy to reach.

f Complete absence of mechanical vibration. Foundations can be light and simple.

g Low center of gravity for installed machinery.

h Astern operation easily accomplished by astern rotors in turbine casing with a 1% loss in overall efficiency. Free piston generators need not be shut down.

i Rapid response characteristics well suited to maneuvering.

j Good part-load performance. In addition to high part-load efficiency of the individual gas generators, it is necessary to operate only the number required to meet load requirements. The shut down units can be started immediately as required.

k Elimination of many of the complications of diesel engines, yet with all the outstanding features of the motorship. Simple equipment.

l Relative freedom from smoke under all normal conditions.

m Adaptable to all types of ships.

n Reserve torque overload capacity comparable to steam turbine plant. The gas generator, for instance, can be made to deliver great overloads in mass flow

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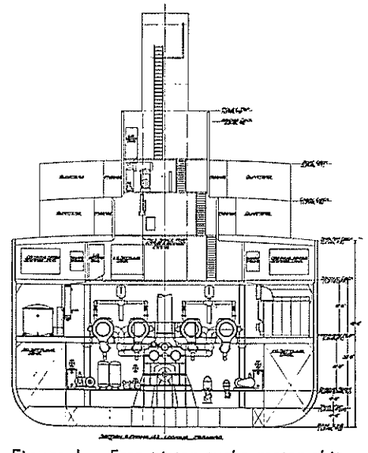

Figure 1. *Free piston turbo-motor ship. C-3 Cargo Vessel.*

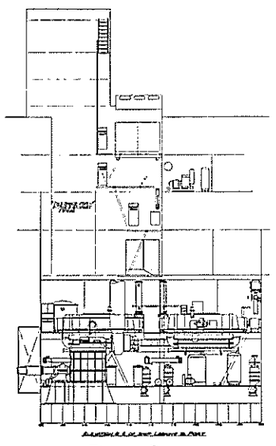

Figure 2.

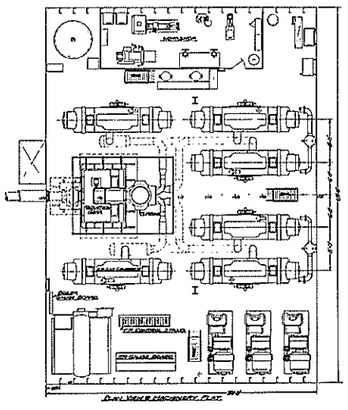

Figure 3.