Discussion

A. K. Antonsen[3] and T. L. Sherman.[4] This paper is an excellent contribution to the understanding of this little used type of prime mover.

The authors state a machine built in accordance with Fig. 1 is not attractive because of its large size. This is controversial because in comparing Fig. 1 with Fig. 6, a late model, it would seem that if one type tends to give machines of large diameter then the other is handicapped by greater over-all length.

It has been stated frequently that multiple gasifiers have an advantage over conventional reciprocating engines in that each can operate at full-load efficiency throughout the combined load range. For example, a group of four units would have all operating at from 75 per cent to full load. Three units would be in operation at 50 to 75 per cent, two units at 25 to 50 per cent, with only one operating at lighter loads. At load changes of any magnitude, gasifiers should stop and start as required, thereby demanding considerable excellence and reliability in what is admitted to be a quite involved problem.

For such an arrangement, it would seem that starting from combend offers best possibilities because cylinder-charge conditions are more favorable for the first combustion. How are starting conditions in a Baldwin-Lima-Hamilton gasifier taken care of when units in multiple arrangement are started and stopped during load changes?

The problems involved in the exhaust system of a multiple-unit installation are also considerable. A unit cannot be left open for long intervals because of the liability of being seriously fouled, particularly when the outlet is vertically upward. Has any work been done in this direction?

One of the real weaknesses in the free-piston gasifier is the liability of damage to rings and pistons because of high rates of pressure rise and magnitude of peak pressures. The modern diesel finds this a distinct problem, but it is much accentuated in the gasifier.

Paul Shirley.[5] The writer is honored in being invited to discuss this well-organized and presented paper upon a subject that is very complex and comparatively new. Having had a part in this program at its start in 1943, and for several years thereafter, he would like to make the following comments.

As the authors state, the highest output and efficiencies will be obtained by operating the gasifiers at the highest possible pressure and temperature levels. The optimum for these conditions will be realized by designing for streamlining for mass flow and holding shock losses in the system to a minimum. For any one operating pressure the lowest operating temperature will produce the lowest fuel consumption and highest efficiency for the power plant.

The size and number of gasifiers for a certain power output can be reduced by the use of supercharging or boosting the air pressure and mass flow of air to the gasifier-suction inlet and, with the use of moderate intercooling, a slight increase of efficiency may be attained with the system operating at a higher pressure level and with no increase in operating temperatures. Comparatively low boosting pressures will permit a considerable gain in power output.

Synchronization of a multiplicity of gasifiers to one or more turbines simplifies the suction ducting to the gasifiers and the piping between the gasifiers and the turbine and reduces interferences between gasifiers to a minimum in regard to scavenging, air mass flow and gas flow to the turbine. The arrangement amounts to much the same as is encountered in high-pressure charging of turbocharged engines of the two-cycle type.

The future of this type of power plant depends upon its ultimate dependability, availability, and how it will fit into our economic picture.

C. F. Taylor.[6] In supercharged diesel-engine practice to date, it apparently has not been found possible to secure satisfactory reliability and durability with inlet pressures greater than about 2 atm abs, with the fuel-air ratios required to yield exhaust temperatures in the range indicated in the paper. Apparently, these limitations are set by cylinder, piston, and piston-ring characteristics rather than by the crankshaft-connecting-rod system. In view of this experience, it seems optimistic to hope that the free-piston diesel cylinder can be made durable and reliable at inlet pressures up to 6 or 7 atm, as indicated in Fig. 16. Would the authors care to comment on this question?

Authors' Closure

The use of a direct-bounce cylinder does not necessarily involve greater over-all length. This is indicated by Fig. 3 which depicts an even later model than Fig. 6.

Messrs. Antonsen and Sherman, and Professor Taylor, note that the load limits of a gasifier depend largely upon the performance of piston rings and cylinder liners. We have ourselves emphasized this fact in the text and note that a load of, say, 70 psi or more is required for performance which is competitive with that of present diesel engines. We disagree with the two atmosphere absolute limit noted by Professor Taylor. The most recent model has already had a ring life in excess of 500 hours at six atmospheres absolute, and is expected to demonstrate further improvement. Supercharging pressures for diesels are continually rising and may ultimately reach values now being used in gasifiers. It is hardly safe to say what the limits are for either free piston machinery or diesels.

In the case of the gasifier, as in the case of any worthwhile development, certain problems must be met and overcome. Many have already been brought to satisfactory conclusions, and experience indicates that others also can be solved.

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