

possible to be used by the main pumps of the engine. The air pump with the speed as moderate as pumping engine, better be driven from the main engine unless there exists some special reason to the contrary; in fact, general economy points to the driving of all auxiliary pumps from the main engine as a broad principle.

The question of an exhaust feed water heater between the low pressure and the condenser depends for the most part upon surrounding conditions, but it will generally pay to use such an appliance.

The steam cylinders and all piping connected with the engine together with the receivers and all other parts where radiation of heat will represent loss, should be covered to prevent radiation, and where practicable or desirable, to do so, lagged with some suitable material.

The various parts of the machinery should be of plain and substantial design with appropriate shapes and forms adapted to the special purposes. The principal aim being for ample strength, great reliability, good mechanical effects, etc.

Where the design is made by the builder, there is not very much to say when the work is in competent hands, but there is no harm for the buyer or his representative to know that the bed plates and framing should be designed so as to prevent loss of alignment, or undue strains, or changes of load distribution, from variations of temperature or other causes, castings so designed as to avoid objectionable changes of section with reference particularly to shrinkage strains; reinforcement of the body of the castings next to the flanges, proper fillets, round corners, re-entering angles and all such details which may just as well be had at the same price as something less desirable. The desirable machinery coming as much or more from a thorough knowledge of designs and construction, than from the advance in price asked by the builder.

The steam cylinders to be thoroughly steam-jacketed, and all steam distribution valves so designed and located that the steam and exhaust ports are correctly proportioned to cylinder volume, and piston speed affording easy inductions and release of steam with the least friction consistent with minimum clearance.

There are examples of close clearance down as low as the following percentages:—

High pressure cylinders.....	1.4 per cent.
Intermediate cylinders.....	.6 per cent.
Low pressure cylinders.....	.5 per cent.

The above clearances are about the lowest known and are found in some of the well known three cylinder vertical triple expansion pumping engines.