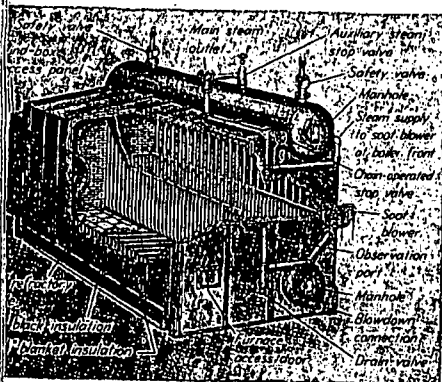
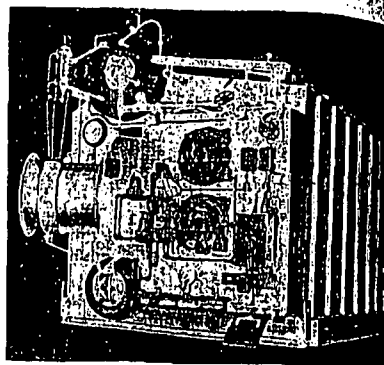




2 Fan mounting on twin-burner design, above, lets you service fan from floor level, while reducing noise and draft loss



3 Materials of proper type, adequate auxiliaries give a working boiler of high availability, long service life

about the same widths and heights. With such a rigid limitation on furnace width your burner selection ought to be one in which the flame shape does not impinge on boiler side walls.

You can get burners that give a narrow (small included angle) flame cone, but combustion efficiency suffers from poor, ineffective air mixing. Theoretically a 180-degree flame cone is perfect since air supplied behind this flat angle comes in instant contact with the atomized fuel to give complete mixing. The narrower the flame angle, the greater chance for stratification and low  $CO_2$ .

With this understanding of oil-burner flame propagation we feel two burners, with relatively short, wide-angle flames rather than a single burner of any design, will give improved combustion efficiency, broader flexibility and less danger of flame impingement for larger-steam-capacity units (preferably above 20,000 lb per hr).

We know operating engineers who've suffered problems from a loss of steam production when they've changed tips for higher firing rates or replaced dirty atomizers. A fouled burner inevitably shows up at high steam loads. Along this same line, loss of a burner on a single-burner unit because of unforeseen accidents means shutdown. A 2-burner selection, Fig. 2, avoids this.

Manholes. While we're on the subject of servicing, let's look at the selection points for manholes. In all instances, packaged steam generators are longitudinal designs ranging in length from 8 to 23 ft, depending on boiler capacity. Boilers with two manholes per drum permit ventilating by fans, allow

a speed-up in cleaning, inspection or servicing not possible with a single manhole. The small additional cost pays for itself during the equipment life.

Access Doors, Registers. Engineers generally prefer that burner registers be hinged so you can get at register flanges and burner-diffusers without removing the windbox mounting. Operating engineers, though, do not like using burner openings as access doors. Field reports show servicing costs run high for units of this type. We suggest hinged registers and refractory-lined doors.

Construction Details. Packaged steam generators are highly competitive. You'll find, as a rule, recognized manufacturers pretty much provide units that give satisfactory operation under normal conditions. We feel, however, that good design requires consideration of conditions beyond normal. Industry shares this feeling and expects a high availability from these packaged boilers. As such we recommend first-quality fire-clay tile as waterwall backing to give safe operation in a tube failure.

Bureau of Yards and Docks, U.S. Navy, covers the above point in its recommendations for military purchases of packaged watertube steam generators in this way: "Refractory behind waterwalls shall be of a quality and construction that, in event of watertube failure, no damage will result to refractory, insulation or casing."

Baffles are another item that may cause confusion when you are selecting packaged boiler. All engineers agree they prefer a unit that produces equal efficiencies without any baffling. Here is why. Draft loss, fan size and con-

nected motor load as well as servicing needs are much less and, what's more, no gas pockets can form.

Soot blowers, to our way of thinking, should be valve-in-head with a chain-operated valve for control from the operating floor in addition to auxiliary steam stop-valves on all connecting piping. Drain valves ought to be supplied so all condensate can be removed before using the soot blowers. If you run into a packaged boiler requiring soot blowers over 18 ft, we suggest use of shorter blowers from both ends.

Valve bypasses, also, are special items that engineers believe should be made a part of every bid. In order of importance they rate these points as most in need of bypass protection: (1) feedwater-regulator control valve (2) fuel-control valve, gas or oil, or combination (3) atomizing-agent control valve. What's more, they prefer that valves be plant assembled, piped and mounted to eliminate field labor. In some instances, as in large-sized valves and piping used for gas or feedwater control, or both, for high-pressure units, they may be plant assembled and removed as an assembled unit for railroad clearances.

Operation. All too often both consultants and operating engineers find form of operation badly confused with form of combustion control. But they are distinct and separate. Operation may be manual, semi-automatic or fully automatic. Combustion control, on the other hand, can be the automatic regulation of the combustion components with any of the choices of operation.

For industrial installations a qualified

#### Automatic vs Semiautomatic

How can Q&A on choosing operating type:

- Q1: Is there a heating load needing operation pressure at 15 psig or lower on week days with no engineer in attendance?  
A1: Use fully automatic.
- Q2: What is load type? Will wide operator come (about 8 to 1) prove best?  
A2: Use semiautomatic.
- Q3: Is an engineer in attendance?  
A3: Use semiautomatic.
- Q4: Will peak boiler load reach or go over 20,000 lb per hr?  
A4: Use semiautomatic.
- Q5: Would it pay to avoid boiler shutdown through burner accident or fouled tips by having more than one burner?  
A5: Yes. Use semiautomatic.

#### Auxiliaries and Construction

Refractory, insulation should be top grade. Ask supplier for detailed list of materials for each specific wall.

Forced-draft fans should have reasonable safety factors and overload capacities. Look for type designation of fan, motor rating, volume and static pressure data to guard against large connected motor loads, excessive draft losses.

Valves, fittings, trim cannot all be the same material. See that the boiler manufacturer states size, type, catalog number and manufacturer when listing valves. Thus you avoid bronze or cast-iron selections where their service may be questionable, as in the feedwater line.

Soot blowers. Check closely so you know whether you're getting valve-in-head or re-venting designs. See, too, that soot-blower head material, cast iron or steel, is definitely specified.

Instruments, panels can stand a word of caution. Be sure you get the basic instruments of draft gage, steam flowmeter, flue-gas temperature indicator, steam pressure, inlet fuel pressure and temperature gages. Study all extras fairly close as to whether their advantage outweighs their maintenance.

operating engineer is practically mandatory. Controls cannot take the place of a competent engineer. They are meant to produce efficient operation at minimum cost under various load conditions. Even though package units carry automatic devices to start, purge, recycle with automatic restart, and so on, you still need a good operator.

With possibly one exception watertube and firetube packaged-boiler manufacturers employ rotary-cup burners, approved by the Underwriters' Laboratories, Factory Mutual, and similar agencies. Boiler units, not including approved firing equipment, when designed for automatic stop and start have to be examined and approved at the installation point. Control systems that do not bear type approval must employ component parts passed by the Underwriters' Labs or Factory Mutual.

Steam generators, with capacities up to 20,000 lb per hr, working pressures up to a 300-psig maximum, and with single rotary-cup burner approved by Underwriters' Laboratories, usually operate fully automatic with full combustion control.

This fuel combustion control, usually electrically run, supplies these functions: ignition, purge, preignition trial run, low fire start, flame-failure protection, shutdown on override pressure, recycle and start, operation at any pressure at or below design pressure.

This last operating factor at reduced pressure is an important one. Small plants working at high pressures for the normal 5-day run find a fully automatic-controlled unit capable of lower-pressure service highly desirable for

week-end heating loads. Many states, in fact, with this form of equipment permit lower pressure, heating service (below 15 psig) without an attending operating engineer. But you can't use a burner where steam at 50 psi serves as the atomizing medium for pressure duty below 50 psi.

Semi-automatic combustion controls work well on fully-automatic-operated, packaged steam generators with these characteristics: (1) all capacities within listed limits of packaged designs (2) pressures limited only by the unit design (3) initial start-up by manual means. For best results you want the burners, single or multiple, to have wide-range controls (about 8 to 1) so the boiler can run continuously without frequent stops and starts, and accompanying heating and cooling losses. Further, you get best results with a fully modulating control with an inertia stabilizer. This form of modulating control has a responsiveness and sensitivity that can't be matched by less expensive high-low, on-off controls, occasionally designated improperly as modulating equipment.

The semi-automatic unit just described provides all similar features of an automatically operated-and-controlled steam generator except automatic ignition and recycling (restarting). But you do get the advantages of greater overall efficiencies, lower maintenance and higher availability.

Ignition. The fully automatically controlled-and-operated boiler (up to about 20,000-lb-per-hr capacity) has to have an automatic ignition as part of the basic purging and low fire start.

For the industrial installation, though,

employing semi-automatic units there is a choice of ignition methods—a torch of saturated waste, a gas torch, a manually operated gas-electric ignition tied into a flame-failure circuit.

The inexpensive saturated waste torches, in use for years, work well enough, except they do dirty up the firing aisle. A gas torch does a similar job in a much cleaner way.

The manually operated gas-electric ignition system, with its electrical interlocking to a flame-failure safety circuit, has become increasingly popular. During starting cycles an automatic time or foot-treadle switch holds the flame-failure circuit open while the transformer and gas solenoid valve of the gas-electric system stays energized.

The combustion controls on these semi-automatic designs may be actuated by electric, pneumatic or hydraulic means. They may be modulating-positioning or modulating-metering. Properly arranged, all forms give equivalent performance. Some systems offer a combination of electric-pneumatic or electric-hydraulic, and employ the electricity for the safety-protection phase.

The pneumatic or hydraulic energy is said to prevent shutdown during power failure. In this event the operating engineer takes over the safety phase.

We feel electric power failures constitute so minor a risk that we would prefer to have our electric-protection circuit function as it is meant to, that is, to complete boiler shutdown. A portable, standby gasoline-driven single-phase 60-cycle generator provides enough low-cost energy to serve combustion controls in rare power failures.