

3. Direct impingement of too intense local heat upon any part of the boiler surface, as with oil burners, should be avoided by protecting the surface with firebrick or other refractory material.

4. Condensation must flow back to the boiler as rapidly and uniformly as possible. Return connections should prevent the water from backing out of the boiler.

5. Automatic boiler feeders and low water cut-off devices which shut off the source of heat if the water in the boiler falls below a safe level are recommended for boilers mechanically fired.

Boiler Troubles

A complaint regarding boiler operation generally will be found to be due to one of the following:

1. *The boiler fails to deliver enough heat.* The cause of this condition may be: (a) poor draft; (b) poor fuel; (c) inferior attention or firing; (d) boiler too small; (e) improper piping; (f) improper arrangement of sections; (g) heating surfaces covered with soot; and (h) insufficient radiation installed.

2. *The water line is unsteady.* The cause of this condition may be: (a) grease and dirt in boiler; (b) water column connected to a very active section and, therefore, not showing actual water level in boiler; (c) boiler operating at excessive output.

3. *Water disappears from gage glass.* This may be caused by: (a) priming due to grease and dirt in boiler; (b) too great pressure difference between supply and return piping preventing return of condensation; (c) valve closed in return line; (d) connection of bottom of water column into a very active section or thin waterway; (e) improper connections between boilers in battery permitting boiler with excess pressure to push returning condensation into boiler with lower pressure.

4. *Water is carried over into steam main.* This may be caused by: (a) grease and dirt in boiler; (b) insufficient steam dome or too small steam liberating area; (c) outlet connections of too small area; (d) excessive rate of output; (e) water level carried higher than specified.

5. *Boiler is slow in response to operation of dampers.* This may be due to: (a) poor draft due to air leaks into chimney or breeching; (b) inferior fuel; (c) inferior attention; (d) accumulation of clinker on grate; (e) boiler too small for the load.

6. *Boiler requires too frequent cleaning of flues.* This may be due to: (a) poor draft; (b) smoky combustion; (c) too low a rate of combustion; (d) too much excess air in firebox causing chilling of gases.

7. *Boiler smokes through fire door.* This may be due to: (a) defective draft in chimney or incorrect setting of dampers; (b) air leaks into boiler or breeching; (c) gas outlet from firebox plugged with fuel; (d) dirty or clogged flues; (e) improper reduction in breeching size.

Cleaning Steam Boilers

All boilers are provided with flue clean-out openings through which the heating surface can be reached by means of brushes or scrapers. Flues of solid fuel boilers should be cleaned often to keep the surfaces free of soot or ash. Gas boiler flues and burners should be cleaned at least once a year. Oil burning boiler flues should be examined periodically to determine when cleaning is necessary.

The grease used to lubricate the cutting tools during erection of new piping systems serves as a carrier for sand and dirt, with the result that a scum of fine particles and grease accumulates on the surface of the water in all new boilers, while heavier particles may settle to the bottom of the boiler and form sludge. These impurities have a tendency to cause foaming, preventing the generation of steam and causing an unsteady water line.

This unavoidable accumulation of oil and grease should be removed by blowing off the boiler as follows: If not already provided, install a

surface blow connection of at least $1\frac{1}{4}$ in. nominal pipe size with outlet extended to within 18 in. of the floor or to sewer, inserting a valve in line close to boiler. Bring the water line to center of outlet, raise steam pressure and while fire is burning briskly open valve in blow-off line. When pressure recedes close valve and repeat process adding water at intervals to maintain proper level. As a final operation bring the pressure in the boiler to about 10 lb close blow-off, draw the fire or stop burner and open drain valve. After boiler has cooled partly fill and flush out several times before filling it to proper water level for normal service. The use of acids, alkalis and salts for cleaning is not favored by boiler manufacturers because of difficulty of complete removal and the possibility of subsequent injury.

Insoluble compounds have been developed which are effective, but special instructions on the proper cleaning compound and directions for its use in a boiler, as given by the boiler manufacturer, should be carefully followed.

When soda ash solution is to be used the procedure is to add about 5 lb of soda ash for each 1000 sq ft of connected radiation. Fill the boiler with water until it just overflows from the surface blow outlet pipe and then fire sufficiently to raise the water temperature to the boiling point without getting up steam pressure. Crack the boiler feed valve so that a steady trickle will run out of the overflow pipe. Allow the boiler to simmer from 2 to 4 hours. At the end of this time the grease and sediment should have passed off through the overflow pipe or loosened sufficiently to drain off through the bottom blow. Extinguish the fire—preferably by letting it burn out and then dumping any live coals into the ashpit where water can be applied with a hose—and open the bottom blow wide. Rinse with fresh water and refill to the normal water level. If the water in the gage glass then does not show clear, repeat the process using a stronger soda ash solution and boiling for a longer time. It sometimes is necessary to repeat this process several times to completely rid the boiler of grease. Failure to thoroughly eliminate grease usually results in an unsteady water line and danger of damaging the boiler through having the crown-sheet uncovered.

It is common practice when starting new installations to discharge heating returns to the sewer during the first week of operation. This prevents the passage of grease, dirt or other foreign matter into the boiler and consequently may avoid the necessity of cleaning the boiler. During the time the returns are being passed to the sewer, the feed valve should be cracked sufficiently to maintain the proper water level in the boiler.

Care of Idle Heating Boilers

Heating boilers are often seriously damaged during summer months due chiefly to corrosion resulting from the combination of sulphur from the fuel with the moisture in the cellar air. At the end of the heating season the following precautions should be taken:

1. All heating surfaces should be cleaned thoroughly of soot, ash and residue, and the heating surfaces of steel boilers should be given a coating of lubricating oil on the fire side.

2. All machined surfaces should be coated with oil or grease.