

steam path may be washed with saturated steam without dismantling the turbine. For deposits consisting mostly of silica scale or other insolubles, mechanical cleaning is the most satisfactory; this requires dismantling the unit.

During the war some shipyards and chemical-cleaning concerns on the West Coast removed turbine rotors and cleaned them in vats of cleaning solvents and weak acid solutions. Excellent results were reported. This method should be satisfactory if proper neutralizing solutions are used after the cleaning process. Air blast entraining flyash and other abrasives have also been used.

LUBRICATING SYSTEM

Oil temperatures leaving the bearings should be recorded on the log sheet. This gives a running check on the lubricating-system operation. A gradual increase in this temperature may be caused by (1) rising cooling-water temperature or (2) oil-cooler fouling. An increase in the oil temperature rise through the bearing (temperature difference of bearing and oil-cooler outlets) may be caused by (1) increased bearing loading from a change in alignment (2) increased bearing friction from oil deterioration (3) decreased oil-flow rate (4) partial wiping by dirt entrained in the oil.

These events call for prompt action. Look for steam blowing along the shaft from packing boxes. This steam finds its way into bearing housings and the condensate will deteriorate the oil. The lubricating system must be kept as free from moisture as possible.

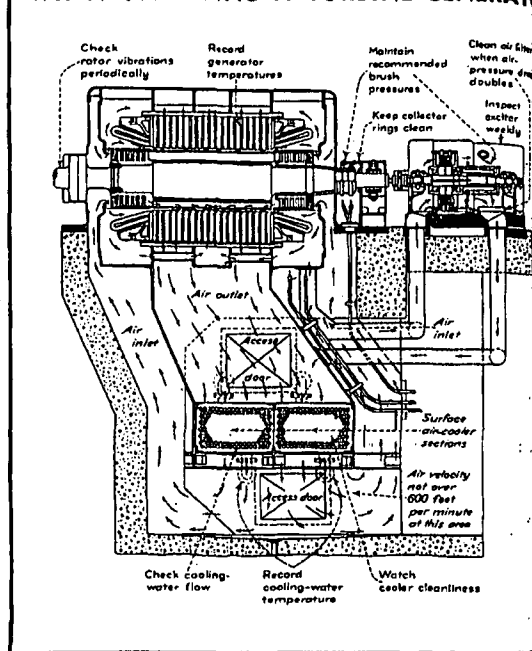
TURBINE VIBRATION

An operator accustomed to the natural hum of a turbine can usually detect increased vibration by the change in sound, but he should be equipped with instruments to measure vibration amplitude. Readings should be taken at one point daily, say on the No. 1 bearing, and recorded. When vibration increases occur, take additional readings and prompt steps to locate the cause.

The manufacturer's representative should be called in to investigate when vibrations approach a detrimental magnitude. At least six types can occur:

1. Vibration at running-speed frequency, cause: rub or unbalance.
2. Whipping, a vibration of critical-speed frequency, happens when the unit operates at a speed other than the critical. This form of vibration, primarily caused by oil action in the bearings, can be determined by Frahm indicators.
3. Half-speed frequency vibrations

ACCESSORIES AND CONDITIONS TO WATCH WHEN OPERATING A TURBINE-GENERATOR



GENERATOR AND EXCITER require as careful followup during operation as the turbine even though mechanical construction is simpler and temperatures lower.

take place when the critical speed is other than about half running speed. A packing rub generally causes it.

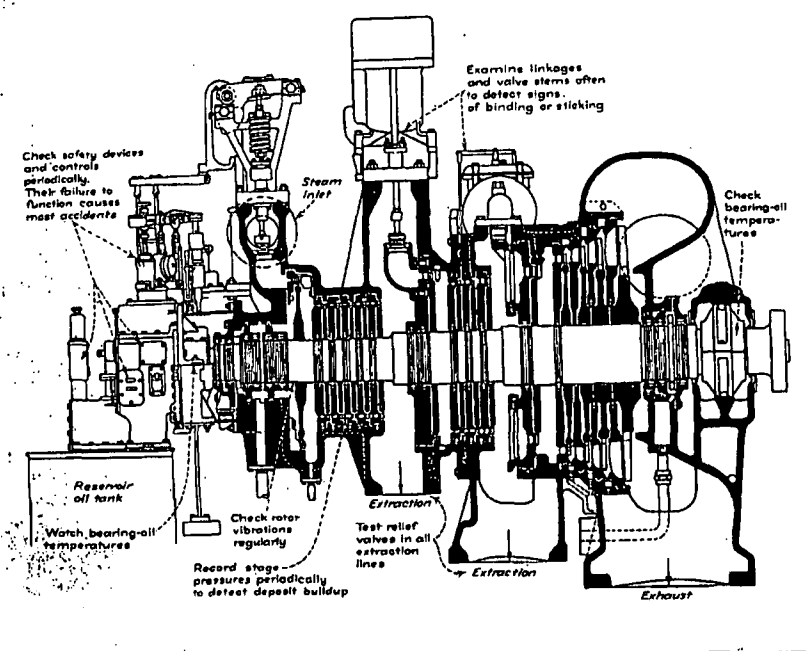
4. Double-frequency vibrations on the rotor are of such small amplitude that they are hard to detect. These are caused by difference in flexibility of a 2-pole generator field in a plane through the pole-piece centers and a plane at right angles to it. In 2-pole machines the double-frequency vibration appears in the stator frame when the field is applied. The poles, 180 deg apart, exert a magnetic force on the stator frame tending to distort it into an ellipse. The distortion rotates with the field and the two high and two low points on the ellipse's circumference cause the vibration.

5. Vibrations of very low frequency result from restricted bearing-oil flow.

6. The pump-frequency vibrations are caused by incorrectly cut pump gears or by the gears rubbing on their casing. Unbalance causes most common vibrations, but balancing does not eliminate the other types of vibrations.

GENERATOR OPERATION

Generator temperatures should be regularly read and recorded. In a closed ventilating system, rising temperatures with a constant electrical load may be caused by (1) reduced cooling-water flow (2) increased cooling-water temperature (3) fouled air-cooler tubes. Steps should be taken to correct rising temperatures before they reach the maximum value allowed by the manufacturer. Most generators are designed to operate at the following temperature rises:



FREQUENCY OF INSPECTION varies from hourly, for such readings as oil temperatures, to annually or longer when unit is dismantled for internal examination. Here are some vital points to watch, insuring safety and economy

Armature, 60 C measured by imbedded detectors.

Field, 85 C by resistance.

Temperature rises are based on an ambient temperature not exceeding 40 C.

In open-ventilation systems, atmospheric air enters the generator through a screen or filter. Here a gradual rise in generator temperature for the same load and inlet-air temperature indicates that dirt accumulates in air passages.

Keep collector rings clean, and maintain brush pressures within limits specified in manufacturer's instruction books.

Exciters. Most modern exciters are totally enclosed and pipe-ventilated from the main generator, see illustration. The air filter, mounted over the air outlet at the exciter-commutator end, should be replaced when the accumu-

lated dust doubles the pressure drop of the air flowing through it.

Any accumulation of dirt or metal dust inside the exciter housing should be prevented. When fitting new brushes or cleaning the commutator, take special precautions to remove all traces of carbon or copper dust from all parts of the exciter. Compressed air cleans most effectively, but be sure no water is entrained.

Should dirt and dust be lodged with oil, clean it out with carbon tetrachloride and carefully dry the surfaces. Carbon tetrachloride vapor has detrimental effect on commutation, so all traces must be removed before starting the machine. Wipe studs and leads and clean the brush holders to remove all traces of metal dust. See that brushes move freely in the holders.

Brush pressure should be maintained within manufacturer's limits, about 3 to 3½ psi of contact surface.

New brushes should be fitted carefully on the commutator. Keep the commutator clean and maintain its polished surface; wipe it occasionally with a piece of hard canvas.

ACCESSORY DEVICES

Failure of safety devices to function causes practically all steam-turbine accidents. It is important that these devices be checked periodically to insure their being in working order.

The emergency overspeed governor must be examined and tripped at regular intervals. Whenever a machine is shut down this should be done by the hand trip rather than by manual close. (Continued on page 150)