CONTROL AND OIL SYSTEM

The relation of the various elements which comprise the complete governing (or control) system, is shown diagrammatically in Figure 1. The throttle valve, overspeed trip, governing valves, emergency trip, governor anticipator, exhaust pressure regulator, auxiliary pumps and regulators (all of which are shown on the diagram) are described in separate leaflets. In order to simplify the description, the oil system can be divided into two parts, namely:-

1. High Pressure Oil System
2. Lubrication System

Two oil impellers (or pumps) are mounted on the turbine shaft. In Figure 1 the main oil pump is shown on the left, while the governing oil impeller is shown on the right.

High Pressure Oil

The oil discharged by the main oil pump is used for the following purposes:

1. To operate the ejectors which supply the main pump impeller suction.

2. To operate the throttle valve. The line supplying the throttle is in turn connected to the overspeed trip valve and the governing valve emergency trip plunger. An orifice is used in the supply line to the throttle valve to reduce the actual flow in order to insure positive action of the trip mechanism.

3. To operate the governor servo motor operating piston which opens and closes the governing (steam inlet) valves.

4. To supply oil through the coolers to the bearings. An orifice is used in this line to reduce the flow to the proper amount.

5. To drive the hydrogen seal main oil pump. The discharge from this hydraulic turbine is led into the bearing supply line.

6. To operate the auxiliary oil pump regulator.

7. As a control medium for:

   a - Governing Impeller
   b - Governor Transformer
   c - Exhaust Pressure Regulator
   d - Governing Valve Emergency Trip
   e - Governor Anticipator
   f - Load Limit Valve

Lubrication System

The oil supplied to the lubrication system (as noted above) passes through the oil cooler and thence to the main bearings, thrust bearing and turning gear.

A connection from the bearing supply line is led to the auxiliary oil pump regulator to actuate the regulator. This regulator serves also as a relief valve and by-passes oil to the reservoir, when necessary, to maintain the desired bearing supply pressure.

Provision is made for cartridge type strainers to be installed in the oil supply line to the bearings, for use when preparing the unit for service after a general inspection or major repair. At such times, these strainers should be installed and used while circulating oil through the system preparatory to starting up, but they must be removed before the unit is actually operated.

During the starting and stopping periods, all oil pressure requirements are supplied by the steam driven auxiliary oil pump. This pump is connected to the system by suitable check valves as shown in Figure 1. It is controlled automatically by the auxiliary oil pump regulator, and starts up whenever the bearing line pressure drops below that for which the regulator is set.

In addition, a motor driven auxiliary oil pump is provided to supply lubrication to the bearings and turning gear when the unit is being rolled at low speed by the turning gear during shutdown periods. In case of an emergency such as failure of the steam driven auxiliary pump, this motor driven pump will supply sufficient lubrication for shutting down the unit. However, it is manually controlled and has no automatic connection. Consequently, it must not be depended upon as a substitute for the steam driven auxiliary pump. It should also be noted that the motor driven pump does not have sufficient capacity for starting the unit.

Enough oil should be provided so that when the turbine is running at full speed the oil level in the reservoir, as shown by the gauge, is within the limits given on the indicator plate. Although there is a strainer in the oil system, it is desirable as a precaution to strain the oil through a fine mesh screen or cloth just before putting it into the reservoir.

The amount of water circulated through the oil cooler should be regulated to maintain the temperature of the oil leaving the cooler between 100 and 110°F. The correct criterion of oil cooler water supply is, of course, the temperature of the oil leaving the hottest bearing. This temperature will vary with different units and operating conditions. However, in general, oil return temperatures of 140 to 160°F. are considered good practice. When starting a turbine, the oil cooler water should not be turned on until the oil temperature has increased to the approximate limits given above.

The oil used in the generator hydrogen seals is supplied from an auxiliary reservoir which is built integrally with the main reservoir but separated from it by suitable baffles. A small part of the oil returning to the main reservoir is led to the auxiliary reservoir through a trap. The oil drains from the hydrogen seals are led to separate drain tanks which are vented to atmosphere. The overflows from these tanks are, in turn, led to the main reservoir. This arrangement insures a supply for the hydrogen seals, free of entrained air or hydrogen gas. Two pumps are provided for supplying oil to the hydrogen seals. One hydraulically driven by high pressure oil from the turbine main pump, is for use during normal operation; and the other, motor driven, is for use when the main unit is shut down. These pumps and the generator hydrogen seals are described in separate leaflets.

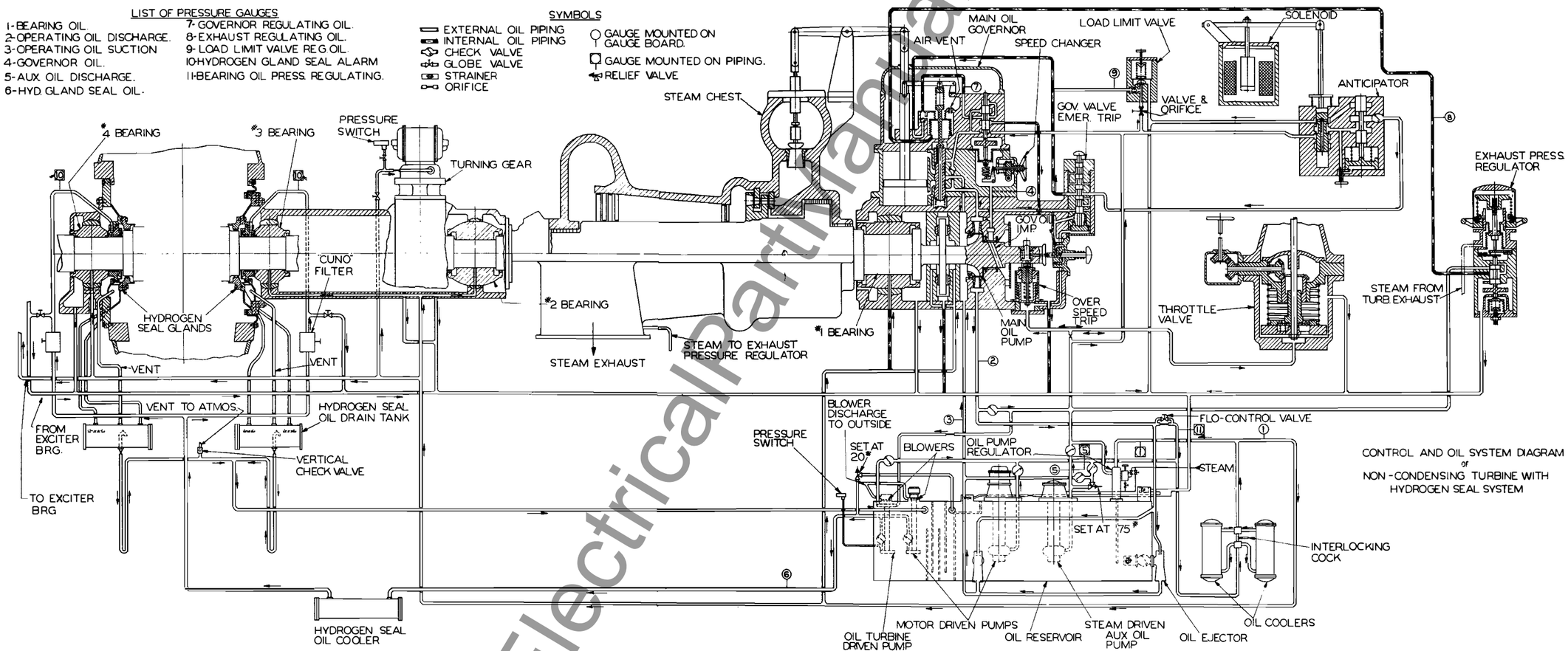
One oil cooler is sufficient for normal operation. The piping connecting the coolers is arranged with an interlocking cock so that either cooler can be used and that continuous flow is insured when changing from one cooler to the other.

Air vents from the top of the coolers to the reservoir are used when there is a drop in the main oil line from the cooler. If this piping can be arranged to eliminate all possibility of trapping air, the separate vent lines are not required.

Load Limit Valve

An adjustable load limiting valve is provided, with which it is possible to make adjustments so that under no condition of system frequency swing can the turbine governor open and increase the steam flow beyond the desired point. This is a high grade oil pressure regulating valve connected to the system as shown in the diagram. It is supplied with oil from a high pressure line through an orifice and connects the controlled and adjustable pressure to the governor regulating pressure system in such a way that it limits the pressure to which the regulating system may be decreased.

It will be recalled that in the governing system, the regulating oil pressure decreases to open the steam inlet valves, and that the steam flow varies closely in proportion to this regulating oil pressure change. The limit valve may be set for any pressure between the limits corresponding to no load and full load, and when the regulating pressure drops to that held by the limit valve, further governor travel and steam valve opening is prevented.



CONTROL AND OIL SYSTEM DIAGRAM
or
NON-CONDENSING TURBINE WITH
HYDROGEN SEAL SYSTEM

Figure 1