# EXHAUST REGULATOR

This mechanism automatically controls the main governor so as to maintain the pressure in the turbine exhaust line within the desired limits. It is in reality a pressure transformer which transforms steam pressure changes in the turbine exhaust into oil pressure changes which actuate the main governor.

The assembly of the mechanism is shown in the illustration and a diagramatic sketch is also included to simplify the description of its operation.

The principal parts are the bellows "8", the loading spring "13", the cup valve "6", and the compensator piston "27" with its connecting linkage.

High pressure oil supplied through the hole shown in Section A-A passes through the Cuno filter "48", shown in Section B-B and then through the needle valve "40" and fixed orifice "37", shown in Section B-B. From the needle valve the oil goes to the cup valve "6" and to the governor through the check valve "50" shown in Section C-C.

Uncompensated operation is as follows: Exhaust steam pressure acting downward on the bellows area "8" is balanced by the load spring "13" plus the governor control oil pressure on the cup valve area, both acting upwards.

If the exhaust steam pressure increases, the additional load on the bellows area "8" acting downward on the bellows stem "14" moves the stem downward slightly, moving the cup valve "6" closer to its seat. The governor control oil pressure under the cup will increase as the cup moves closer to its seat and decreases the amount of oil passed by the cup valve to drain. The increased oil pressure acting upward on the cup valve area plus the increase in the spring compression as the bellows stem "14" moves downward will balance the increase in exhaust steam pressure acting downward on the bellows area "8". Thus for each steam pressure, there is a corresponding governor control oil pressure for a constant setting of the handwheel "9".

Adjustment of the handwheel "9" in a clockwise direction (looking downward on the regulator) decreases the compression in the spring "13" and results in a lower steam pressure necessary to maintain a fixed load (or governor control oil pressure). Counter-clockwise motion results in an increased steam pressure. The spring nut "15" is adjustable on the shaft "14" for rough adjustment of the pressure range.

The scale of the regulator spring (no load to full load exhaust pressure change at constant handwheel position) for full stroke of the regulator is too great for most applications.

Consequently a compensating device is used to obtain a reasonable scale. Governor control oil pressure is admitted through the needle valve "33" to the compensator piston "27". The movement of the piston upward results in compression of the spring "24", which causes an increase in force on the right end of lever "22" and an increase in force acting downward on the bellows stem "14". This increase in force acting downward on the bellows stem for a given change in governor control oil pressure can be varied by changing the position of the fulcrum "21". Thus any increase in the exhaust steam pressure increases the governor control oil pressure which, in turn, acting through the compensator piston "27" and its linkage, produces an additional force downward on the bellows shaft "14" to reduce the scale of the regulator spring required for the corresponding regulator stroke.

Moving the fulcrum "20" to the left decreases the regulator spring scale and increases compensation. Moving the fulcrum to the right increases the scale and decreases compensation.

In order to obtain stable operation with the compensator in service, it is necessary to delay the action of the compensator so that the regulator will act with a large scale for sudden changes and gradually compensate to the correct exhaust steam pressure. To do this the governor control oil to the compensator piston "27" is controlled by the needle valve "33" and air bell "29" connected as shown in Section A-A. The position of this needle valve determines the time delay which should be as great as practicable. The closer the needle valve is to its seat the greater the time delay will be. Due to leakage past the compensator piston "27", the amount of compensation is reduced as the needle valve "33" is closed since the pressure drop across the needle valve prevents the pressure under the compensator piston building up to the full governor control oil pressure. After this needle valve has been adjusted to give the desired time delay, it should be locked in this position by the locknut "31".

The needle valve "40", Section B-B and the fixed orifice "37" should pass as large a flow of oil to the cup valve "6" as practicable consistent with good operation without having the cup valve spray excessive amounts of oil.

An oil filter "48" is used in the Hp. oil supply to the regulator. The filter body is an integral part of the regulator body. The filter element complete consists of a stack of round, thin, perforated discs, each one separated from the other by a very thin metal spacer, the thickness of the spacer determining the fineness of filtration. Oil enters the cartridge from the outside, passes through the spaces, goes through the interior of the discs and out to the discharge. These discs are assembled with stationary cleaning fingers so that revolving the handle scrapes the cartridge clean. The solid matter drops and settles to the bottom of the body. A relief valve is incorporated in the filter unit to prevent failure of the oil supply if the filter cartridge should become fouled. To keep the filter clean the handle should be turned frequently, when the unit is first put in service and following any major overhaul. Thereafter, once a week should be sufficient.

The exhaust pressure maintained by this regulator can be varied by changing the compression of the upper load spring "13". This can be done by means of the handwheel "9". Before connecting the regulator to the steam line, the chamber around the bellows "8" and the connecting pipe should be filled with water. In order to take the regulator out of service (that is, to render it inoperative) close the valve in the steam line which connects it to the exhaust and open the valve in the adjacent branch line to atmosphere so as to put atmospheric pressure above the bellows "8".

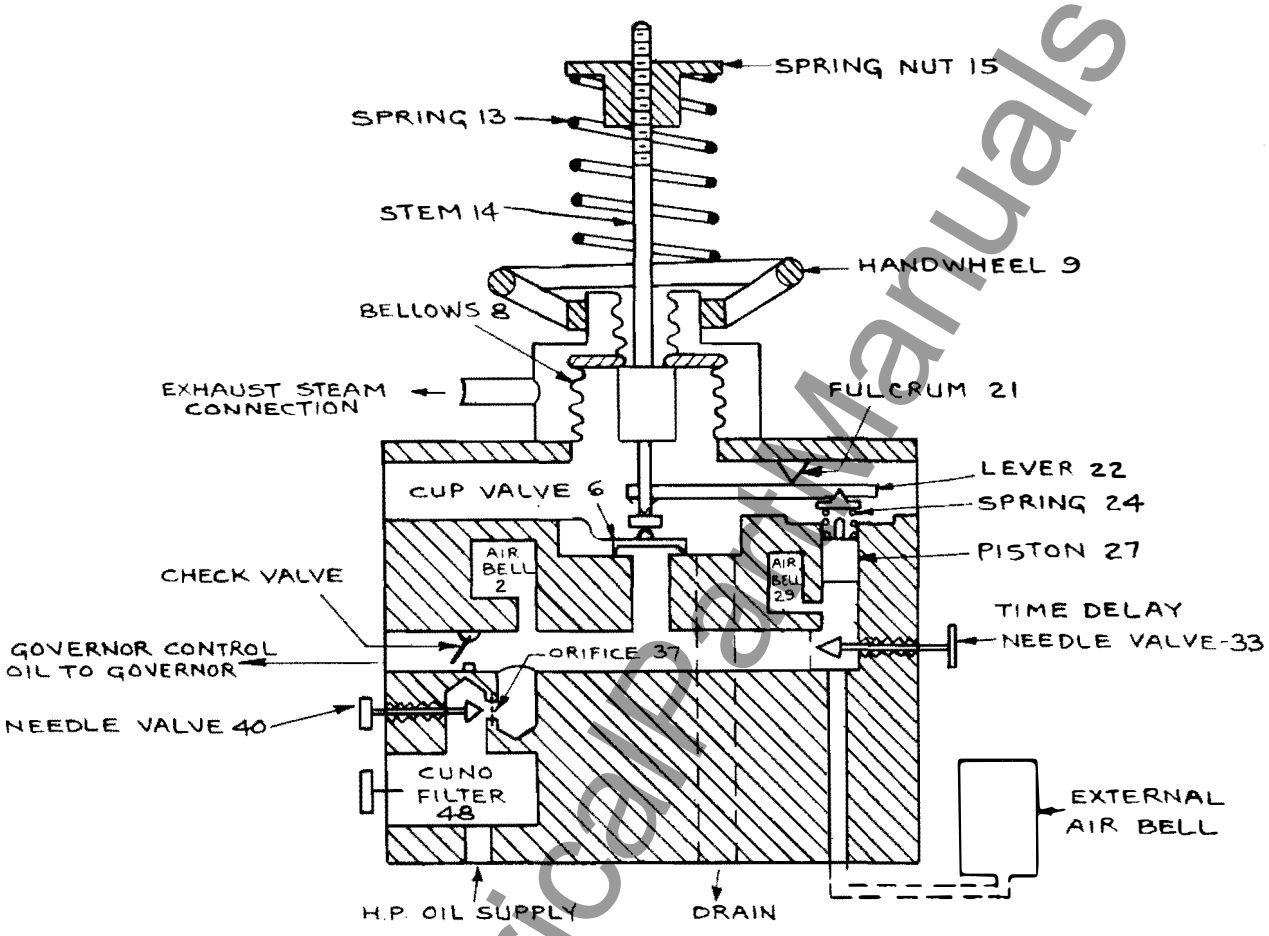
The following list has been compiled to facilitate ordering spare or renewal parts by item number and name, together with the serial number of the turbine.

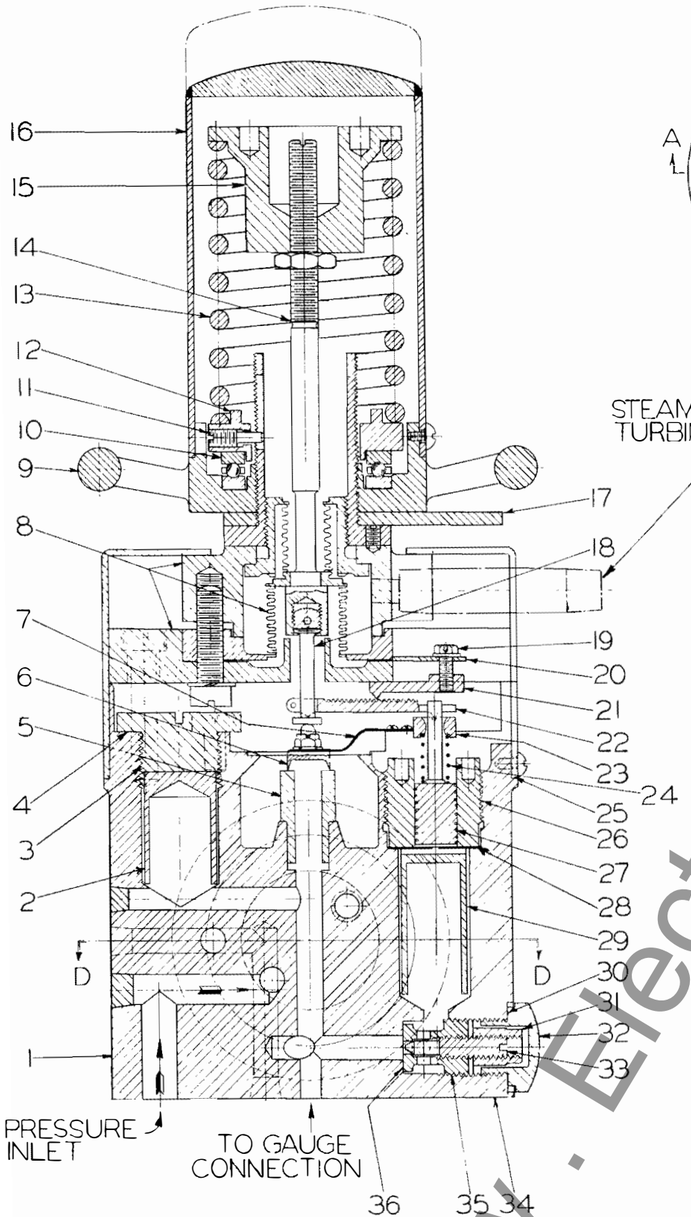
FIGURE 1

| Item No. | Name |
|---|---|
| 1 | Body |
| 2 | Air Bell |
| 3 | Air Bell Cap |
| 4 | Copper Gasket (1/32 Thick) |
| 5 | Cup Valve Seat |

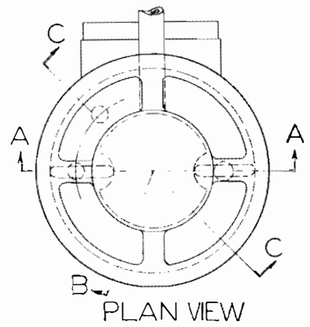
FIGURE 1 - Continued

| Item No. | Name |
|---|---|
| 6 | Cup Valve |
| 7 | Cup Valve Spring Support |
| 8 | Bellows (Complete) |
| 9 | Handwheel |
| 10 | Bellows Spring Seat Ball Bearing |
| 11 | Bellows Spring Seat Lock Screw |
| 12 | Bellows Spring Seat (Lower) |
| 13 | Bellows Spring |
| 14 | Bellows Stem |
| 15 | Bellows Spring Seat (Upper) |
| 16 | Bellows Spring Cover |
| 17 | Handwheel Locknut |
| 18 | Bellows Stem Extension |
| 19 | Adjusting Bolt |
| 20 | Stop Plate |
| 21 | Fulcrum |
| 22 | Lever |
| 23 | Lever Seat |
| 24 | Compensator Piston Spring |
| 25 | Gasket (1/16 Thick) |
| 26 | Compensator Piston Bushing |
| 27 | Compensator Piston |
| 28 | Copper Gasket (1/32 Thick) |
| 29 | Air Bell |
| 30 | Copper Gasket (1/32 Thick) |
| 31 | Needle Valve Locknut |
| 32 | Needle Valve Cap |
| 33 | Needle Valve |
| 34 | Gasket |
| 35 | Needle Valve Seat |
| 36 | Copper Gasket (1/32 Thick) |
| 37 | Orifice Plug |
| 38 | Copper Gasket (1/32 Thick) |
| 39 | Needle Valve Seat |
| 40 | Needle Valve |
| 41 | Needle Valve Locknut |
| 42 | Needle Valve Cap |
| 43 | Copper Gasket (1/32 Thick) |
| 44 | Cover |
| 45 | Cover (Complete) |
| 46 | Vent Plug |
| 47 | Gasket (1/32 Thick) |
| 48 | Cuno Filter (Complete) |
| 49 | Ball |
| 50 | Ball Check Valve Body with Pin |

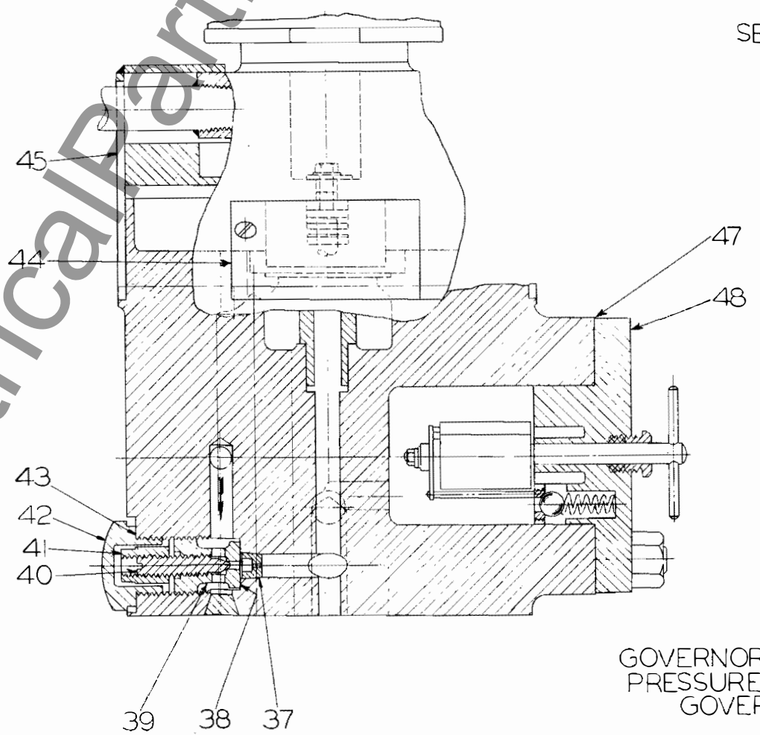




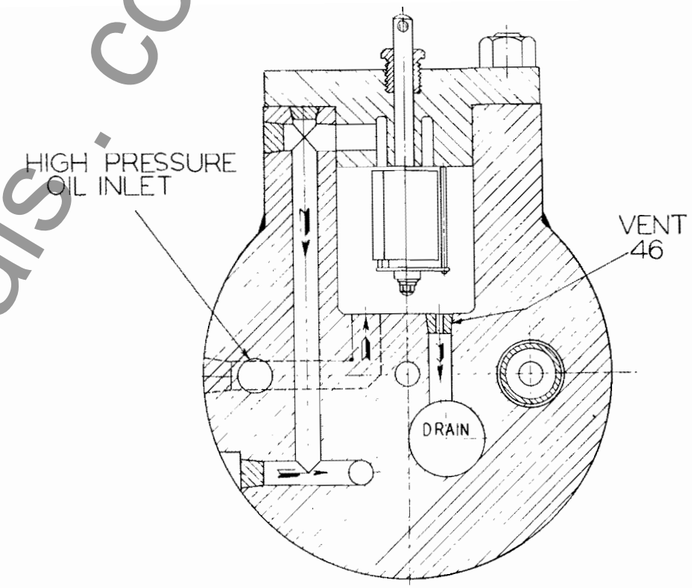

SECTION A-A



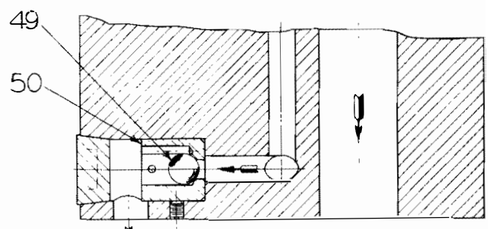

PLAN VIEW




SECTION B-B




SECTION D-D




GOVERNOR CONTROL PRESSURE OIL TO GOVERNOR

SECTION C-C

Figure 1