EXTRACTION VALVE SERVO-MOTOR

The extraction valve servo-motor (or operating mechanism) is shown in Figure 1. It consists essentially of a double acting operating piston "9" which is controlled by a relay mechanism. High pressure oil, delivered by the main oil pump, is admitted to the relay, as shown in Section A-A, for operating the piston. Upward movement of the relay uncovers ports connecting the oil inlet to the space above the piston and connecting the space below to the outlet, thus moving the piston downward. Downward movement of the relay uncovers ports connecting the space below to the inlet and the space above to the outlet, thus moving the piston upward. The piston rod "2" is connected to the extraction valve so that upward movement of the piston opens the valve, and downward movement of the piston closes it.

The principal parts of the relay mechanism are: the main relay "16", the cup valve "18", the flexible metal bellows "27", and the spring "30", as shown in Section A-A. A small orifice hole "B" drilled in the bottom of the main relay connects the high pressure oil inlet to the chamber below the relay. Also, the central hole through the entire length of the main relay connects this chamber below it to the drain. The cup valve seats against the bottom of the relay around the hole which leads to the drain. The small orifice from the high pressure oil supply builds up a pressure in the chamber below the relay. The cup valve controls the flow of oil from this chamber to the drain, thereby controlling the pressure so as to just balance the downward force of the spring "14" above the relay, and causes the main relay to move instantly as the cup valve is moved by the regulating pressure changes on the bellows. Since there is a continuous flow of oil through the orifice "b" in the relay to the chamber below the relay, there will also be a continuous flow through the cup valve to the drain in order to maintain a balanced relay. Therefore, it is evident that downward movement of the cup valve increases the flow through it to drain, thereby decreasing the pressure below the relay. Conversely, upward movement of the cup valve decreases the flow through it to drain, thereby increasing the pressure below the relay. These pressure changes below the relay, together with the spring force above it, cause the relay to closely follow all movements of the cup valve as it would if a rigid connection were used. It has the advantage over a rigid connection that power for moving the relay is supplied by the oil, and the load on the bellows is limited to moving the cup valve.

The cup valve "18" is secured to the bellows cover and also to the spring "30" by suitable linkage. The position of the cup valve (and hence the main relay) is, therefore, determined primarily by the differential pressure acting on the bellows. High pressure oil is supplied through an external orifice to the space above the bellows, thus building up a pressure on top of it. From this chamber above the bellows, the oil is led to the reservoir through the relief valve of the "extraction pressure regulator" (which is described in a separate leaflet). Consequently, the oil pressure maintained above the bellows is controlled by the "Pressure Regulator". In addition, the main governor secondary governing oil pressure is connected to the chamber below the bellows.

From the above it will be seen that the position of the bellows "27" (and hence the main relay "16") is determined by three forces:

1. The extraction control pressure, above the bellows "27" acting downward, which is varied by the "Pressure Regulator".

2. The secondary governing pressure below the bellows acting upward, which varies as the square of the turbine speed.

3. The tension of the spring "30" acting downward.

In normal operation, the principal actuating force is the extraction control pressure above the bellows which is controlled by the "Pressure Regulator". If the regulator moves to increase this oil pressure, the relay moves downward, thus admitting oil below the operating piston and opening the steam valve. If the regulator moves to decrease this oil pressure, the relay moves upward, admitting oil above the piston and closing the steam valve.

Due to the fact that the secondary governing pressure below the bellows varies as the square of the turbine speed, if other conditions remained constant, this mechanism will respond to changes in speed in the same manner as a standard governor. The bellows loading springs "45" are generally required to drop the range of the secondary governing pressure to a low value to insure easy control.

From the above description, it will be noted that following any movement of the relay, the operating piston moves in the opposite direction. The fulcrum arrangement of the follow-up lever "38", which connects the operating piston rod and the follow-up spring, stretches the spring and pulls the relay back to neutral after a deflection starts the piston moving. Hence there will be a definite piston position for each value of pressure imposed on the bellows. For this position the oil pressures and the spring stretch are balanced.

If the follow-up lever is dismantled, it is important to reassemble the fulcrum pin "41" in the same hole as found originally, in order to maintain the same regulation. Changing the fulcrum pin so as to increase the relay movement per unit of piston movement will increase the regulation and vice versa.

As shown in the illustration, the chamber above the operating piston is vented into the drain chamber above the relay in order to eliminate any accumulation of air.

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.

Item No.	Name
1	Operating Piston Rod Pin Bushing
2	Operating Piston Rod
2-A	Gasket
3	Operating Cylinder
4	Drip Pan
5	Operating Piston Rod Oil Seal Retainer
6	Operating Piston Rod Oil Seal
7	Operating Piston Rod Oil Seal Ring
8	Operating Piston Rod Bushing
9	Operating Piston
10	Operating Piston Ring
11	Gasket
12	Operating Cylinder Cover
13	Relay Spring Seat (Upper)
14	Relay Spring
15	Relay Bushing
16	Relay
17	Bellows Rod Ball End
18	Relay Cup Valve
19	Bellows Rod Seat (Upper)
20	Gasket
21	Bellows Rod Seat Retaining Nut
22	Bellows Rod Seat (Lower)
23	Copper Gasket
24	Bellows Body

Item No.	Name
25	Bellows Rod
26	Bellows Rod Spring Bolt Insert
27	Bellows (Complete)
28	Bellows Spring Bolt (Upper)
29	Bellows Spring Nut (Upper)
30	Follow-Up Spring
31	Follow-Up Spring Nut (Lower)
32	Follow-Up Spring Bolt (Lower)
33	Follow-Up Lever Shoulder Pin
34	Follow-Up Lever Link (in pairs)
35	Follow-Up Lever Link Pin
36	Follow-Up Lever Link Spacer
37	Follow-Up Lever Spacer Bolt
38	Follow-Up Lever (in pairs)
39	Follow-Up Lever Crosshead
40	Follow-Up Lever Crosshead Ball Bearing
41	Follow-Up Lever Fulcrum Pin
42	Follow-Up Lever Spacer
43	Bellows Rod Spring Nut
44	Piston Position Indicator
45	Follow-Up Loading Spring Flange (Complete)
46	Follow-Up Loading Spring
47	Follow-Up Loading Spring Seat (Lower)
48	Follow-Up Loading Spring Adjusting Stud
49	Piston Position Indicator Plate

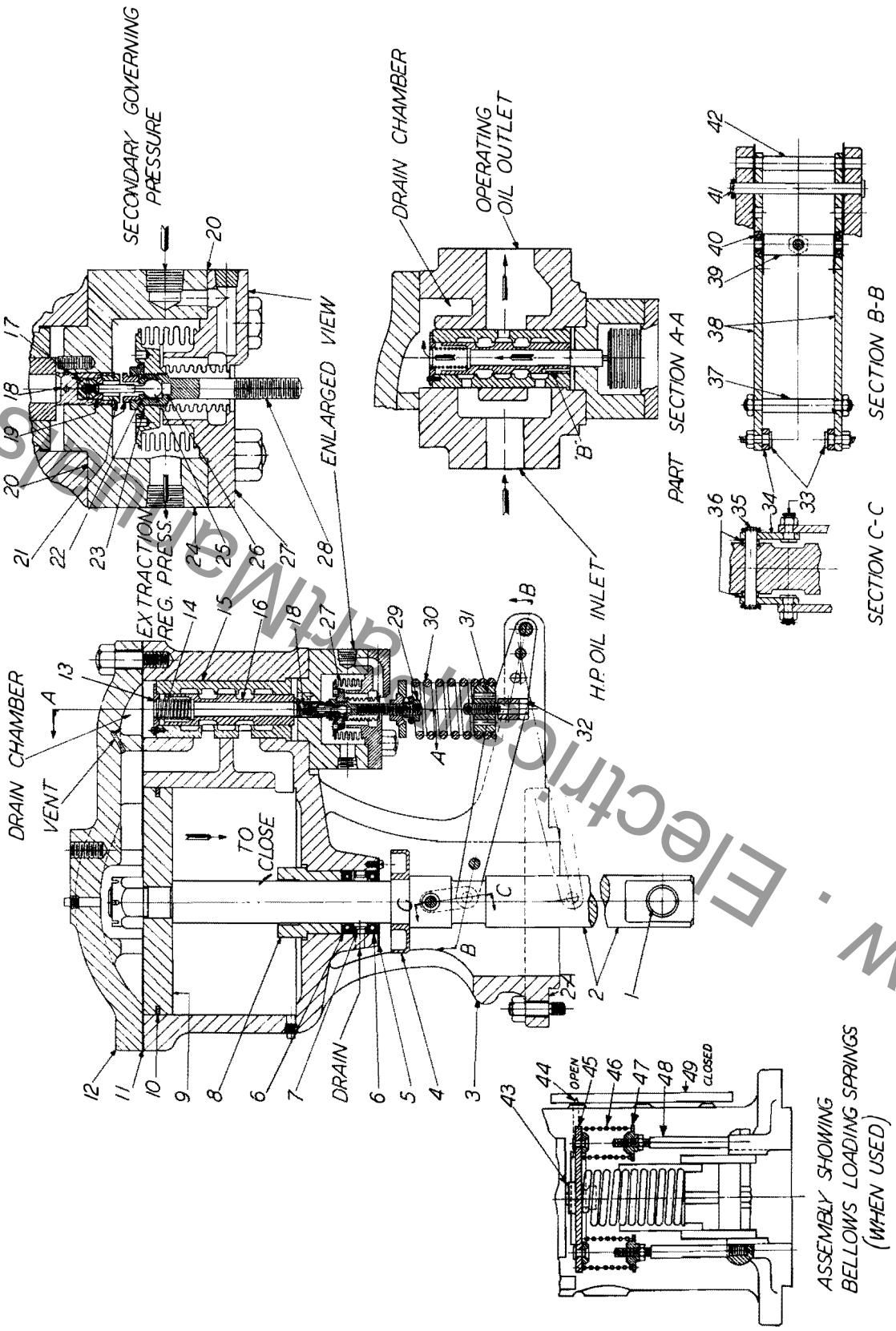

Figure 1

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