

Governor, Steam Chest and Throttle Valve

The mechanism described below comprises a vertical shaft centrifugal governor, a gear oil pump, a balanced double seated steam chest valve, operated by means of a relay and power cylinder, and a manually operated throttle valve with quick closing device arranged to be actuated by the overspeed trip mechanism on the turbine shaft. The combined mechanism is shown in section in Fig. 1.

Governor

The governor is driven from the horizontal turbine shaft by means of skew bevel gears. The governor drive shaft "7" carries at its lower end, the main oil pump gear "2" and is guided in the steady bearing "5" in the pump housing "4". The skew bevel gear "8" is keyed on the shaft against a shoulder and the governor hub "19" is secured to the upper end with a nut, washer, and cotter. Between "8" and "19" are located thrust collars "11" and "15", adjustable by liners "9" and "16", which bear against the faces of the combined thrust and steady bearing "13" and "14".

Three governor weights "20", 120° apart on the circle, are carried in the case "34" on ball bearings "21" and pins "22". The cam-shaped contacting surfaces of the weights bear against the follower "23" secured to the governor spindle "27". The governor spring "25" reacts against the adjusting nut "26".

The governor spindle "27" is connected through the ball bearing "29" to the governor lever "32" which fulcrums on the pin "35" mounted in a bracket which is part of the housing "33".

The outer end of the governor lever carries the knurled speed changer screw "36" which bears against the top of the relay "38". The latter slides within a ported extension of the operating piston "41" and its motion relative to "41" uncovers ports which admit operating oil above or below the piston, as the case may be, and open the opposite side to drain.

The relay has pinned to it the spring retainer "39" and the compression spring "40" acts between the retainer and the extension of piston "41" and supplies the force to make the relay follow and remain in contact with the screw "36" in the upward direction. Any piston movement, following a relay movement, restores the mechanism to neutral position.

The operating piston "41" is connected to the valve stem "50" through "46", "47" and "48". This connection consists of the valve stem head "46", a spacer "47" which screws on the valve stem "50" and a retainer "48" which screws into the head and locks the assembly together. The stem is prevented from backing out of the spacer by an offset pin which passes through the head, through a slot in the spacer and through a cut-away in the end of the stem.

Adjustment of the governor is accomplished as follows:

With the unit at rest and the governor weights in inmost position as shown in the figure but with the valve stem "50" disconnected from the head "46", the valve will be held closed by its own weight. In this position scribe a mark on the stem "50" level with the top of the bushing "75". Then raise the stem and spacer into the head and lock by running up the retainer, and measure the distance from the scribe mark on the stem to the top of the bushing "75". This distance should be 5/16". If it is not the spacer must be screwed up or down on the stem to make it so.

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It should be noted that as the pin in head 46 is off set, the spacer must be adjusted one full turn at a time. If a full turn will not make the valve lift exactly $5/16$ " the remaining slight adjustment can be made by means of the screw "36". After adjustment the stem spacer and head should be pinned as described above and the retainer jammed up tight.

It will be noted that in Fig. 1, the governor is shown in the position of rest with weights in their inmost position, and the governor valve is shown wide open. The throttle valve is also shown wide open which is, of course, a combination not possible in service.

The operation of the governing mechanism is as follows:- As the turbine speed increases, upon opening the throttle, the governor weights move out from their inmost position and in doing so, raise the governor weight follower "23" vertically. This motion is translated by the governor lever into a downward movement of relay "38". This permits oil admitted through a drilled passage in the relay to pass through the center port "A" to the upper side of the operating piston, forcing it downward and partly closing the governing valve to regulate the steam flow to maintain no load speed.

If in normal operation, the load decreases, a similar movement will take place except that it will be small in magnitude. If the load increases, the turbine will tend to slow down and the opposite sequence of events will transpire. The governor weights will close in under the compression of the governor spring, the follower "23" will move downward, the screw "36" and the relay "38" will move upward and this motion will admit oil from port "A" to the underside of the operating piston, thus opening the governing valve sufficiently to restore normal speed corresponding to the new load condition.

The following points should be noted:

1. The pin "35" is shown in the middle hole of three indicated in the bracket on housing "33". This pin is placed in the proper hole at the factory, but not necessarily in the middle one. Whichever hole the pin is found in when the unit is installed is the proper one for that installation and if the governor is dismantled and reassembled care should be taken to mark the pin and the bracket and to replace the pin in the proper hole when reassembling. Changing from one hole to another would change the speed regulation of the governor.

2. If the bearing bracket cover "12" must be removed do not attempt to remove it with the governor in place as this might result in bending the shaft "7". First remove the governor lever "32". Then the housing "33". Next remove the cap screws which secure the thrust bearing "13", "14". Then lift out the entire governor assembly after which the bracket cover "12" may be removed. The governor gears are match marked, the driver with an X on one tooth and the driven gear "8" with X's on two adjacent teeth. The marked tooth on the driver must come between the two marked teeth of the driven gear in reassembling. The marks may be observed through a hole in the bearing plate "14" and a flashlight may be spotted on the gears by removing a pipe plug from a hole on the left hand side of the bracket (facing the turbine) which is placed there for that purpose.

Governing Valve

The steam chest valve "77" is pinned to the stem "50" and seats in the cage "79" with line contact at both seats, since at the top seat the valve has a 45° chamfer and seats against a right angle face in the cage, while the lower end of the valve has a right angle face and seats against a

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45° chamfer in the cage. These seats must never be ground in, as this would destroy the balance of the valve. When worn, the valve and cage should preferably both be replaced but if no replacements are available, the valve and cage should be removed and an equal amount should be turned from the 45° chamfer on the valve and the 45° chamfer in the cage, until line contact is restored. If the right angle edges have been cut, equal amounts should be faced off the bottom of the valve and the top of the cage. In this way, the contact diameters are maintained and the valve will remain balanced.

Throttle Valve

The throttle valve is of the manually operated type with spring actuated quick closing device. The single seated valve "71" is guided in, and closes against the seat "72". A head on the end of the stem "63" engages a "U" slot in the valve, resting against the hardened disc "69". The spring "67" prevents chattering of the valve in the opened position. The valve is surrounded by the steam strainer "70" which may be removed by closing the bulkhead stop valve and removing the throttle valve bonnet.

The valve stem stuffing box contains no packing but two accurately machined bronze bushings with a leak-off space between them prevent leakage of steam into the engine room. The valve stem screws through a cylindrical bronze nut "59" which has a flat on one side and is prevented from rotating by the pin "60-A". When the hand wheel "56" is turned in the closing direction, the nut "59" screws up on the stem until the trip lever "62" can be latched under the hardened latch plate "61" on the nut. If now the hand wheel is turned in the opening direction, the nut cannot move downward, being restrained by the trip lever "62" and consequently the stem rises, opening the valve. If the hand wheel is turned in the closing direction, the valve will close. Now if for any reason the unit speeds up to the overspeed trip limit, the trip lever "82" will be unlatched, permitting spring "53" to pull lever "51" to the right. When this happens, the weight "54" on the rod "55" strikes the lower end of the trip latch "62" a heavy blow knocking its upper end out from under latch plate "61". This allows the compression spring "58" to force the nut "59" downward, carrying the valve stem and valve with it.

The valve may be reset by turning the hand wheel in the closing direction as far as it will go and then relatching the trip latch "62".

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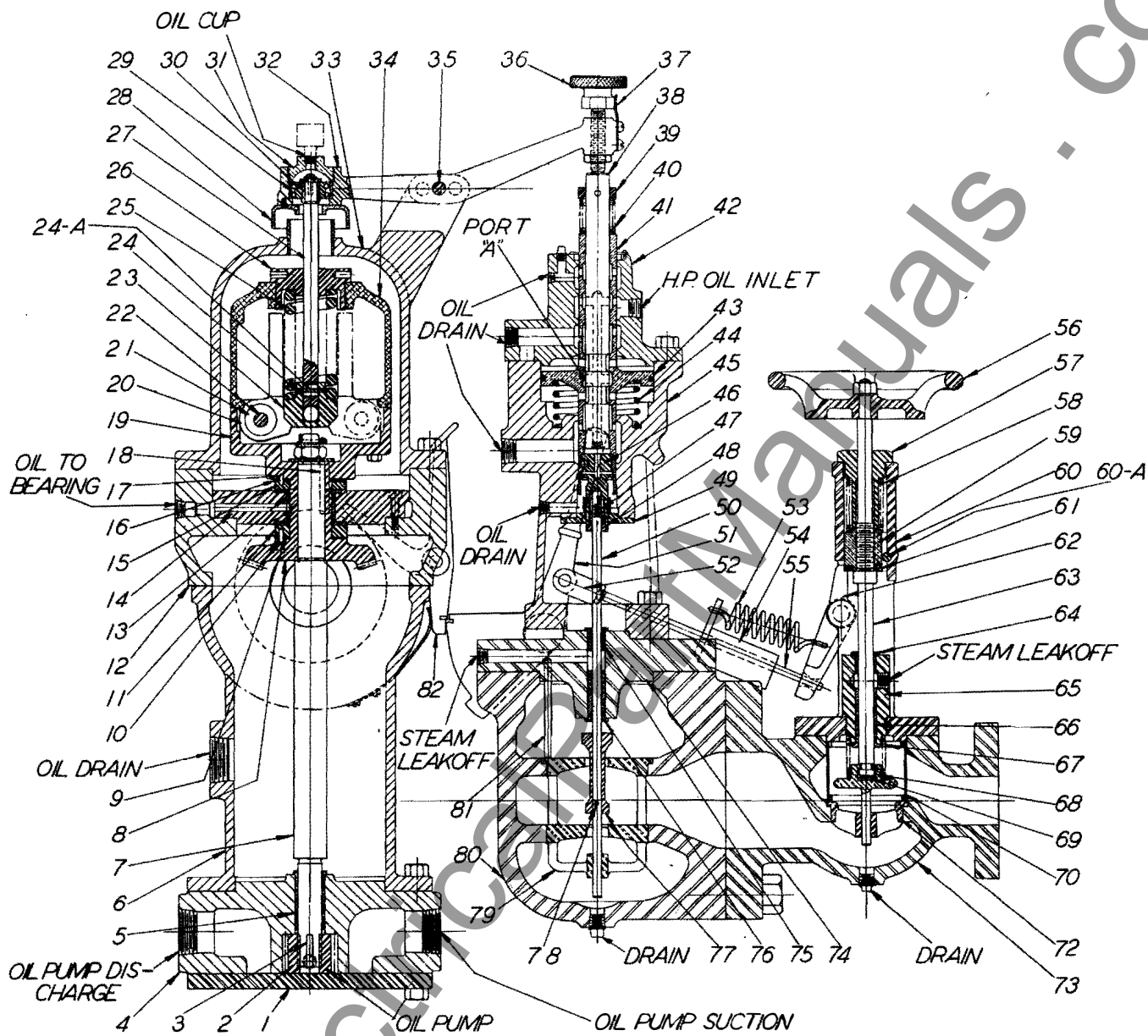


Fig. 1 - Assembly (Cross-Section Through Governor and Throttle Valve)

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

<u>Item No.</u>	<u>Name</u>
1	Oil Pump Body Cover
2	Oil Pump Gear (Driver)
3	Governor and Pump Shaft Key (Gear)
4	Oil Pump Body
5	Oil Pump Body Bushing
6	Bearing Bracket (Inlet End)
7	Governor and Pump Shaft
8	Governor Gear (Driven)
9	Governor Thrust Collar Liners
10	Governor Thrust Collar Pin
11	Governor Thrust Collar (Lower)
12	Bearing Bracket Cover
13	Governor Thrust Bearing Babbitt
14	Governor Thrust Bearing Plate
15	Governor Thrust Collar (Upper)
16	Governor Thrust Collar Liners
17	Governor Thrust Collar Pin
18	Governor and Pump Shaft Key (Governor Body)
19	Governor Hub
20	Governor Weight
21	Governor Weight Ball Bearing
22	Governor Weight Fulcrum Pin
23	Governor Follower
24	Governor Spring Retainer Lock Spring
24-A	Governor Spring Retainer Straight Pin
25	Governor Spring
26	Governor Spring Adjusting Nut
27	Governor Spindle
28	Governor Dust Guard
29	Governor Spindle Ball Bearing
30	Governor Spindle Ball Bearing Bushing
31	Governor Spindle Ball Bearing Retainer
32	Governor Lever
33	Governor Housing
34	Governor Case
35	Governor Lever Fulcrum Pin
36	Governor Speed Changer Screw
37	Governor Speed Changer Screw Lock Plate
38	Governor Relay
39	Governor Relay Spring Retainer
40	Governor Relay Spring
41	Steam Chest Valve Operating Piston
42	Steam Chest Valve Operating Cylinder Cover (Upper)
43	Steam Chest Valve Operating Piston Ring
44	Steam Chest Valve Operating Piston Spring
45	Steam Chest Valve Operating Cylinder
46	Steam Chest Valve Stem Head
47	Steam Chest Valve Stem Head Spacer
48	Steam Chest Valve Stem Retainer
49	Steam Chest Valve Operating Cylinder Cover (Lower)
50	Steam Chest Valve Stem

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