

9000 KW. TURBO ALTERNATOR FOR
P. & O. s.s. "VICEROY OF INDIA"

SYSTEM OF CONTROL ON TURBINE

Referring to B.P., the two control levers for turbine are shown. The lever nearest to observer controls turbine governor from maximum speed of 3110 RPM. down to approximately 622 RPM. The lever adjacent to above controls speed by means of oil pressure from approximately 622 RPM. down to zero speed. The first-mentioned lever, after half travel, ceases to operate on governor of turbine and controls field of turbo-alternator.

CONTROL OF SPEED FROM 3110 RPM. DOWN TO APPROXIMATELY 622 RPM

Movement of lever, from maximum speed position, operates through rods (37), cranks (51) and (50), moves pilot valve (49) of servo-motor (56), which is attached to governor casing. Servo-motor (56) moves lever (47) upwards. Lever (47) is attached to spring carriage (29) which travels in curved links (46) in an upward direction. The tension on spring (35) is thereby reduced.

Spring (35) is connected to moveable carriage (29) at one end and to lever (31) at other end. The governor weights (28) press against sliding sleeve (21) due to their centrifugal force, and sliding sleeve (21) in turn presses against end of lever (20) which is keyed rigidly to shaft (30), to which lever (31) is also rigidly keyed.

As tension of opening (35) has been reduced, weights (28) move out further and position of lever (20) is changed, and therefore also link (19) is depressed, which is attached to lever (20).



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Link (19) is connected to floating levers (13). The other end of floating levers (13) is attached to link (12) which is operated by a return motion rack on cam shaft of servo-motor (7).

Movement of levers (13) by link (19) causes the sleeve (15) of pilot valve (24) to take up a new position. The effect of this is to cause pilot valve (24) to move so that oil is admitted and released on the two sides of the servo-motor revolving shutter contained in servo-motor casing (7).

The rotation of the cam (4) on servo-motor shaft (7) is such that rocker (3) causes lever (1) through links (2) to be depressed, and the steam admission valves (6) which admit steam through passage (11) to first stage nozzles of turbine, are closed to a certain extent. The extent of closing of these valves after the operating lever has been set in a fixed position, will be such that the turbo-alternator will be running on the governor and operating on steam admission valves to maintain within limits the speed of set constant at the new speed setting.

The above system of operation will hold for all settings of speed control lever down to approximately 622 RPM. when travelling carriage (29) will be in its highest position, and there will be minimum tension on spring (35).

For speeds lower than approximately 622 RPM. the Engineers will commence to move the slow speed lever which controls speed from approximately 622 RPM. downwards.

OPERATION FOR SPEEDS FROM APPROXIMATELY 622 RPM. DOWNWARDS

Movement of lever to give lower speed than approximately 622 RPM. operates through rods (45) & (55), and bell cranks (52) & (54) on to lever (40).



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The coupling rod between bell crank (54) and lever (40) acts against a compression spring (43) resting against a fixed abutment (41).

Movement of the low speed lever causes lever (40) oscillating on fulcrum (39) to close needle valve (22).

The slow speed running oil pump (36) which is driven from main governor drive, circulates oil at bearing line pressure through pipe (53) and casing (38), as long as needle valve (22) remains in open position.

Closure of needle valve (22) causes pressure in top of piston (32) to rise. Piston (32) is depressed against compression of spring (23).

Piston rod (18) coupled to floating levers (14) then operate on sleeve (15) of pilot valve (24).

The point of floating levers (13) to which link (19) is connected being a fixed fulcrum as governor is out of operation, sleeve (15) adjusts port (25) so that pilot valve (24) operates to admit oil to servo-motor (7) to still further close steam admission valves (6) to first stage of turbine.

With the operating lever set for a fixed position of needle valve (22), the turbo-alternator will operate to maintain constant speed within limits for the following reasons:-

A rise in turbine speed will cause oil pressure delivered by pump (36) to rise, and consequently pressure on piston (32) will rise to a higher value and cause partial closure of steam admission valves to turbine by operating through floating lever system (14), pilot valve sleeve (15), pilot valve (24), etc. The reverse is the case if the turbine speed tends to drop.



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The compression of spring (23) will cause piston (32) to rise due to lowered oil pressure.

Operation of the slow speed running lever by Engineers can cause steam admission valves to be practically entirely shut. By this means, very slow speed running can be obtained of main propeller motors when running through Suez Canal or manoeuvring, and speed of turbo-alternator will at all times be automatically controlled. Furthermore, this slow running gear prevents the reversing of the main generating units in case of reversal of main motors at very slow speeds.

Reversal of the main motors at very slow speeds of motor, and therefore of turbo-generator sets, might cause reversal of rotation of main driving units due to energy contained in motors and power transmitted from propellers due to "way" on the ship.

With the slow speed running gear set for 5 revolutions on the propellers, or approximately 145 revolutions on main driving unit, if reversal of main motors takes place, speed of driving unit would tend to fall but this would cause a drop in oil pressure delivered by pump (36) with a consequent drop in pressure on piston (32). The spring (23) would, therefore, tend to raise pistons and operating through floating levers (14), pilot valve sleeve (15), pilot valve (24), etc. would cause more steam to be admitted to turbine to counteract the effect of the pumping back of energy from and by the main propelling motors.

MEANS FOR PREVENTING OVERLOADING OF MAIN PROPELLING MOTORS
WHEN ONE TURBO-ALTERNATOR DRIVES ONE MAIN PROPELLING MOTOR.

The maximum load obtainable from each
turbo-alternator/



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is 9000 KW. The maximum power required when one turbo-alternator drives one main propelling motor at maximum speed is 6536 KW. at a speed of 3110 RPM. on main turbo-alternator set. Automatic precautions must, therefore, be taken to prevent ships' Engineers from putting 9000 KW. on main propelling motor when one turbo-alternator drives one main motor. This is automatically carried by roller (34) on lever (47) coming into contact with pedal lever (44) which is keyed on same spindle as lever (42).

Lever (47) is moved down by servo-motor (56) when ships' Engineers are raising speed of turbo-alternator, thereby increasing tension of spring (35). This causes governor weights(28) to be forced in and more steam is admitted to turbine until unit operates at a speed at which equilibrium of the governor weights(28) against the force of spring (35) is reached.

When carriage (29) travelling down curved links(46) passes the corresponding position for a speed of 2690 RPM. on main turbo-alternator roller (34) commences to depress pedal-lever (44) and through shaft to which it is keyed, lever (42) is raised and also moves pilot valve liner (33) up against the force of compression spring (26). The effect of the movement of the pilot valve liner is to admit oil to servo-motor cylinder (7). Rotation of cam shaft and cams (4) then takes place to close off permanently a certain proportion of steam admission valve area, and so limit the power output from the turbo-alternator.

This state of affairs holds good as long as Ship's Engineers keep their control lever set for any speed higher than 2690 RPM. The main governor still functions to keep speed



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constant within limits with this setting of the pilot valve liner (33) as also holds for the cases where pedal lever (44) is not depressed by roller (34), i.e., for speeds of main turbo-alternator set lower than 2690 RPM.

It will be seen that this operation is entirely automatic and altogether prevents accidental or premeditated overloading of propelling motors.

INTERLOCKING OF MAXIMUM SPEED TO 1/5 MAXIMUM SPEED LEVER AND 1/5 MAXIMUM SPEED TO DEAD SLOW SPEED LEVER.

These two levers are so interlocked that it is impossible to operate slow running lever unless lever controlling spring loaded governor is in 1/5th speed setting. It is also impossible to operate servo-motor spring loaded governor to change speed unless slow running lever is set for 1/5th full speed, i.e., needle valve (22) wide open.

R. H. COLLINGHAM

27th July 1928.

RHC/AF/KR
2nd August 1928.



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