LECTURE 8

TURBINE OPERATION
PART LOAD OPERATION

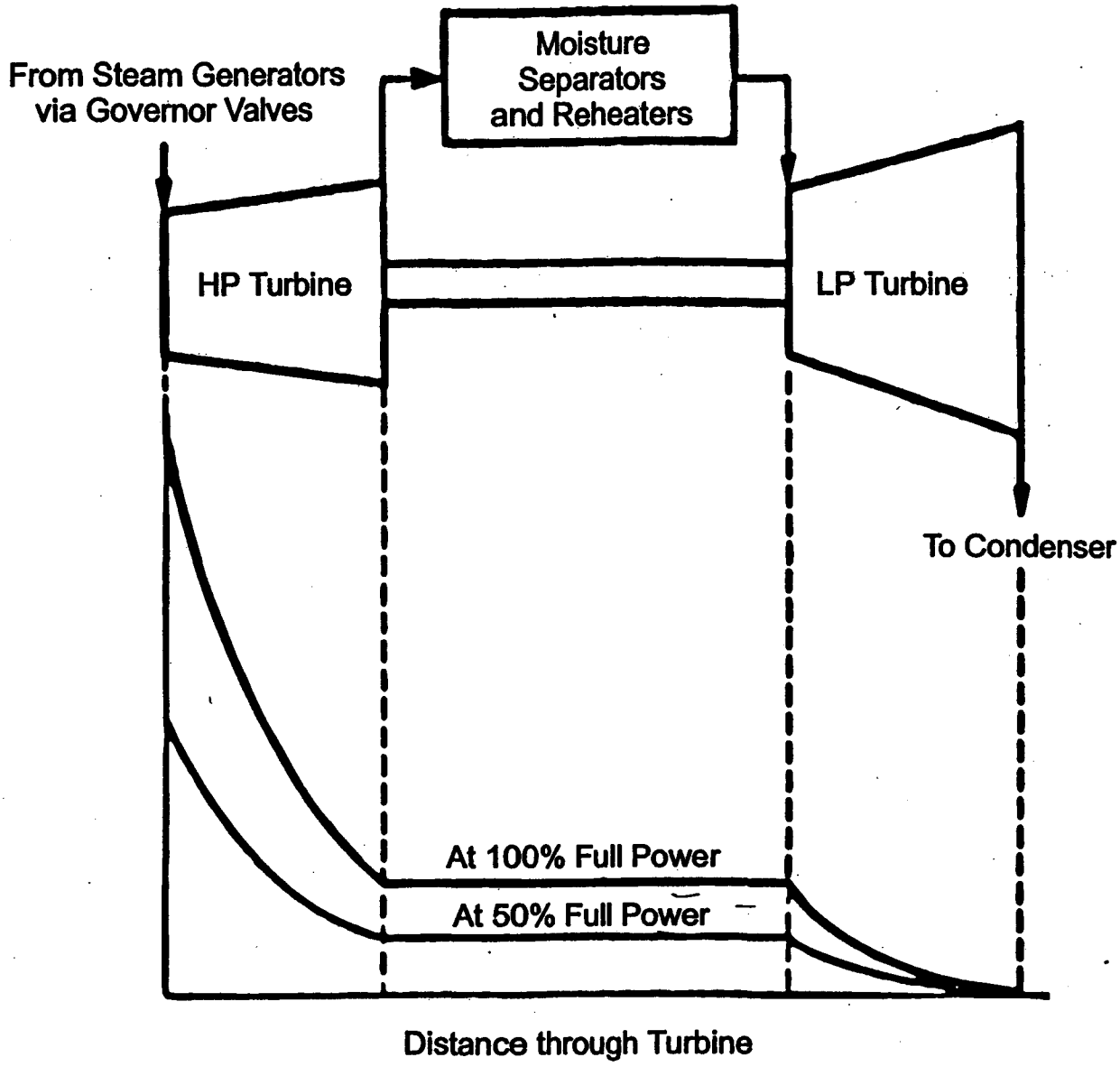


Figure 14 Steam pressure variation through turbine

PRESSURE GRADIENT THROUGH A TURBINE UNIT

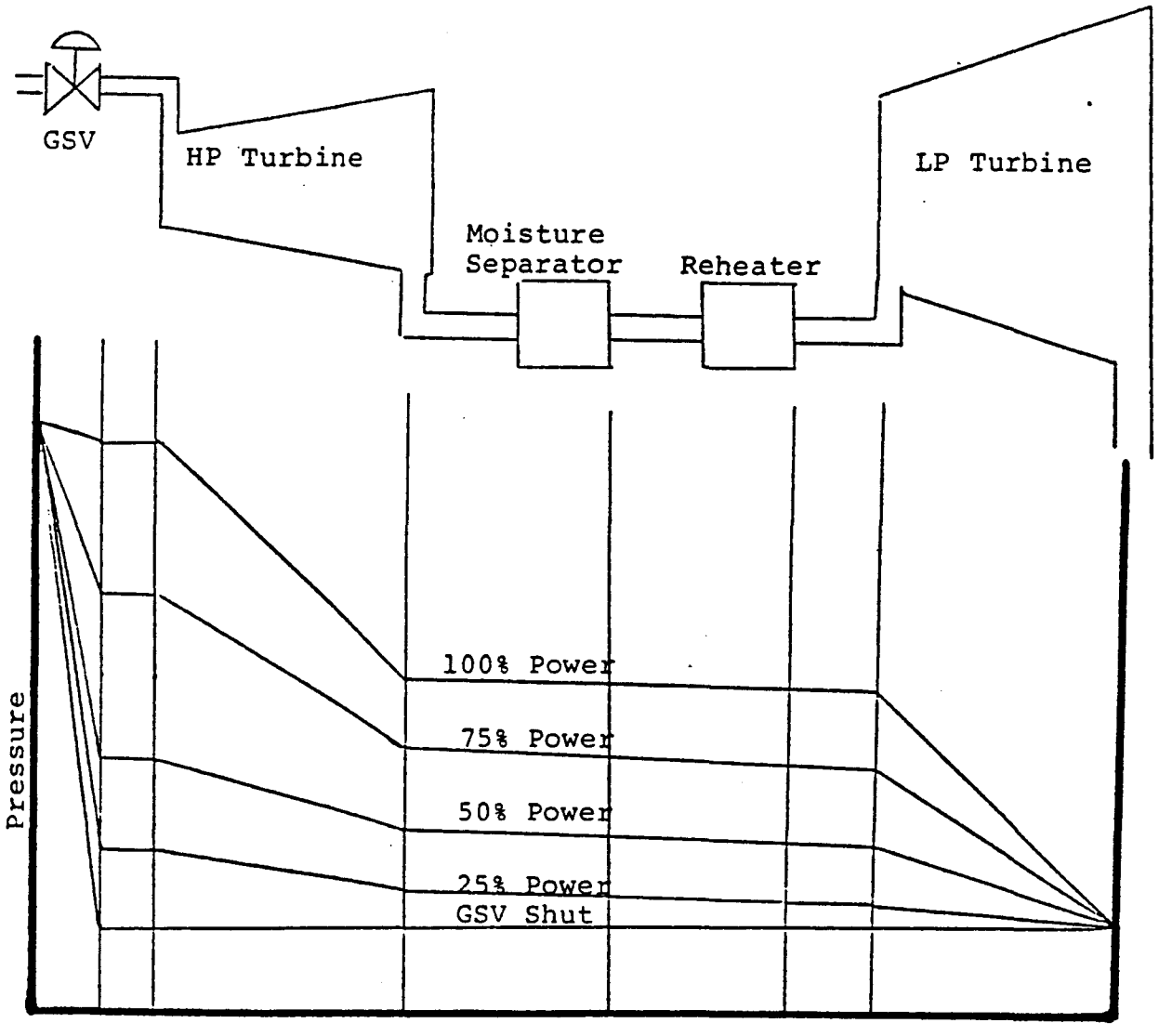


Figure 1.16

FIGURE 6.37

FIGURE 7.19

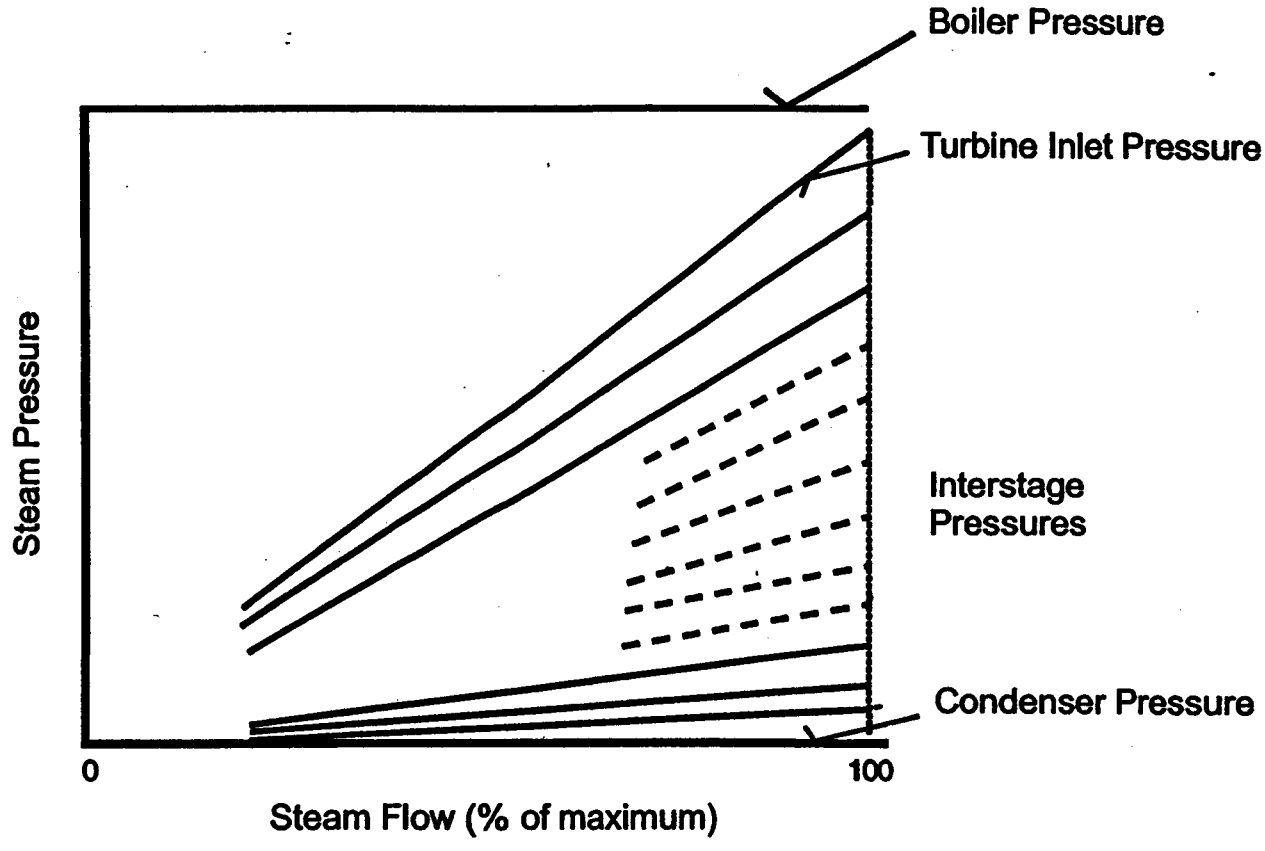


Figure 15 Steam pressure variation with load change

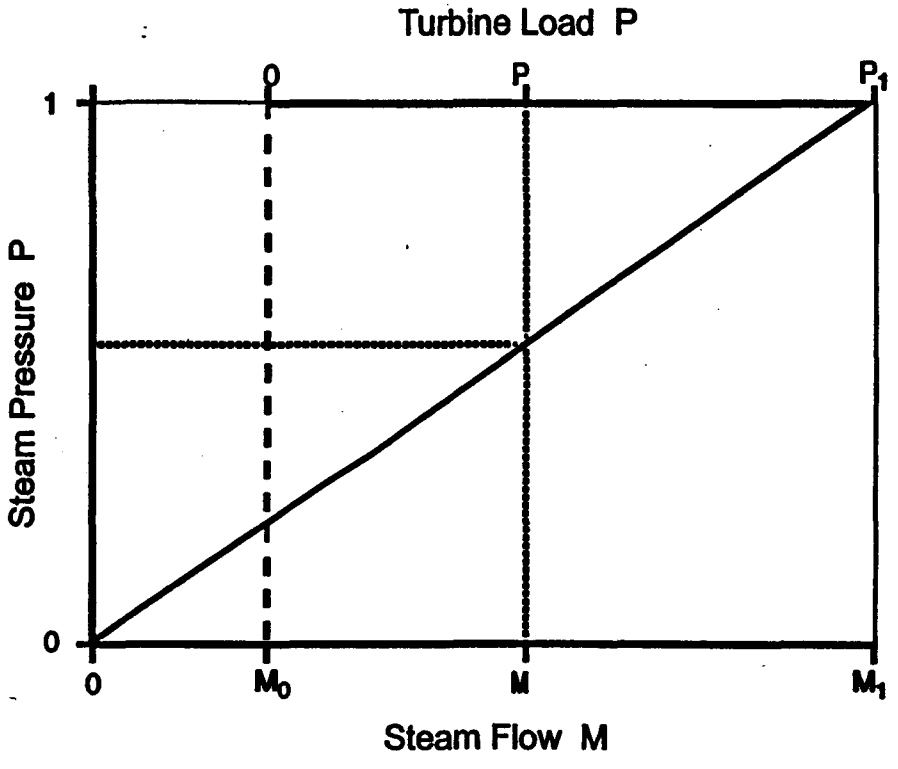


Figure 16 Steam pressure - steam flow - turbine load relationship

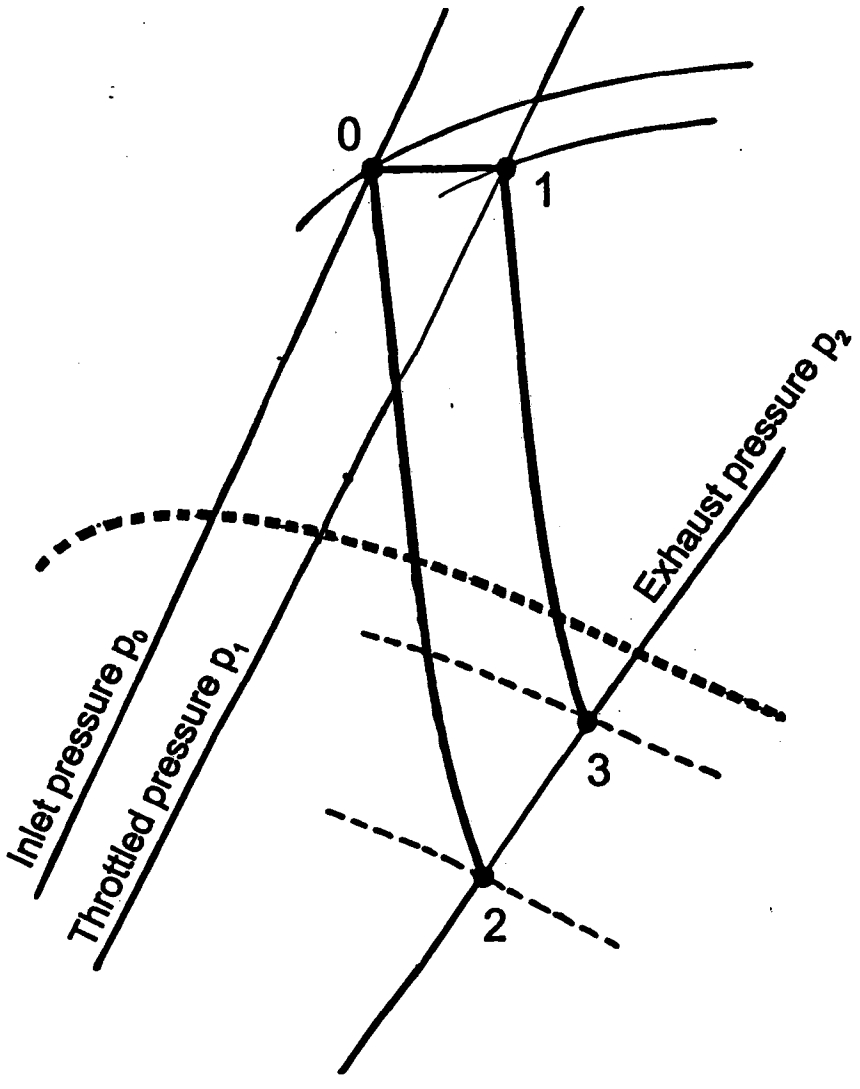


Figure 17 Effect of throttling on turbine expansion line

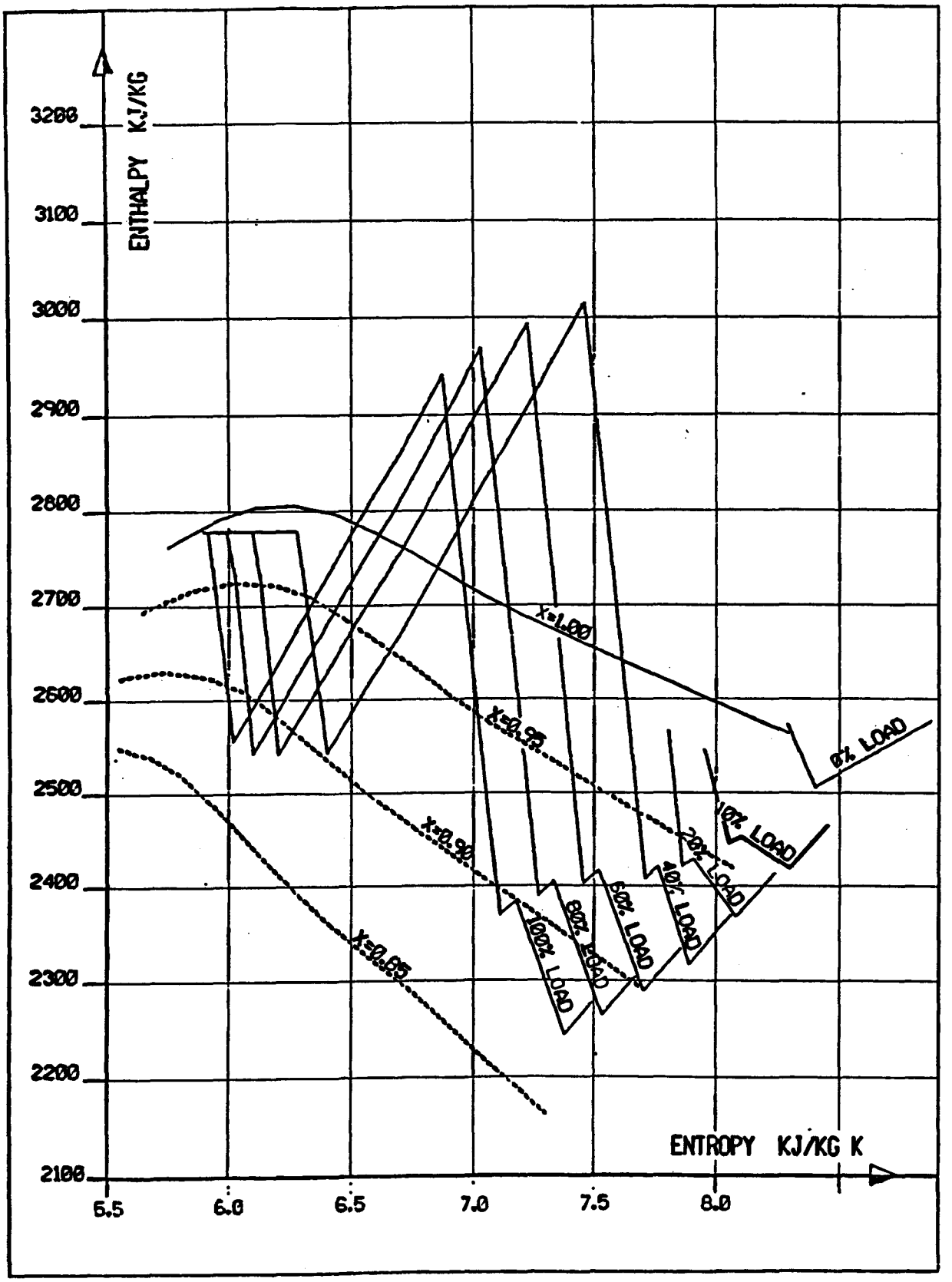
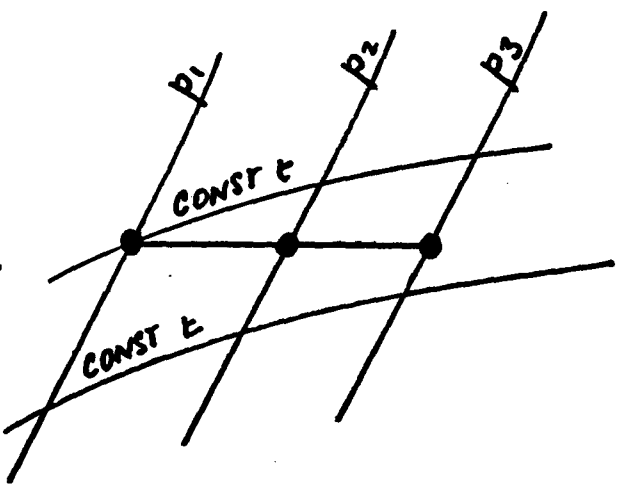


Figure 18 Part load turbine expansion lines (adapted courtesy of Eskom)

STEAM FLOW IN BLADING

MOLLIER CHART



THROTTLING AT GOVERNOR VALVE IS AT NEARLY CONSTANT TEMPERATURE

$\therefore \quad p_1 v_1 \approx p_2 v_2 \qquad (n \approx 1)$

TURBINE FLOW (REDUCED BY THROTTLING)

IF $p_2 = \frac{1}{2} p_1$

$v_2 = 2 v_1$

$M_2 = \frac{1}{2} M_1$ SINCE MASS FLOW $M \propto p$

$\rho_2 V_2 A_2 = \frac{1}{2} \rho_1 V_1 A_1$ (SEPARATE CONDITIONS)

$v_1 V_2 = \frac{1}{2} v_2 V_1$ SINCE AREA IS THE SAME

$v_1 V_2 = \frac{1}{2} (2 v_1) V_1$

$V_2 = V_1$

VELOCITY OF STEAM IS UNCHANGED

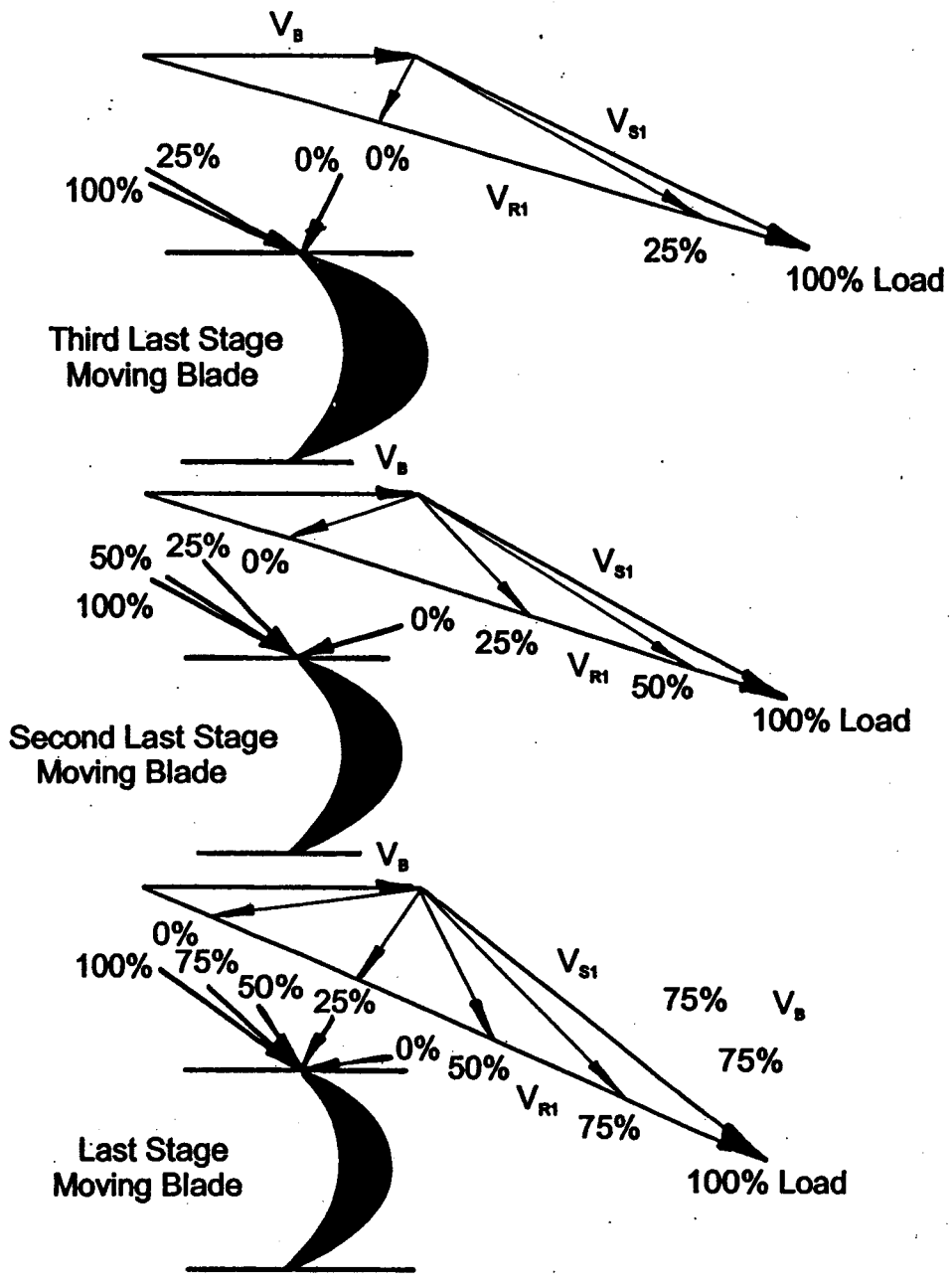


Figure 19 Variation in velocity diagrams at various loads (adapted from Kearton)

Velocity Diagrams at Various Loads

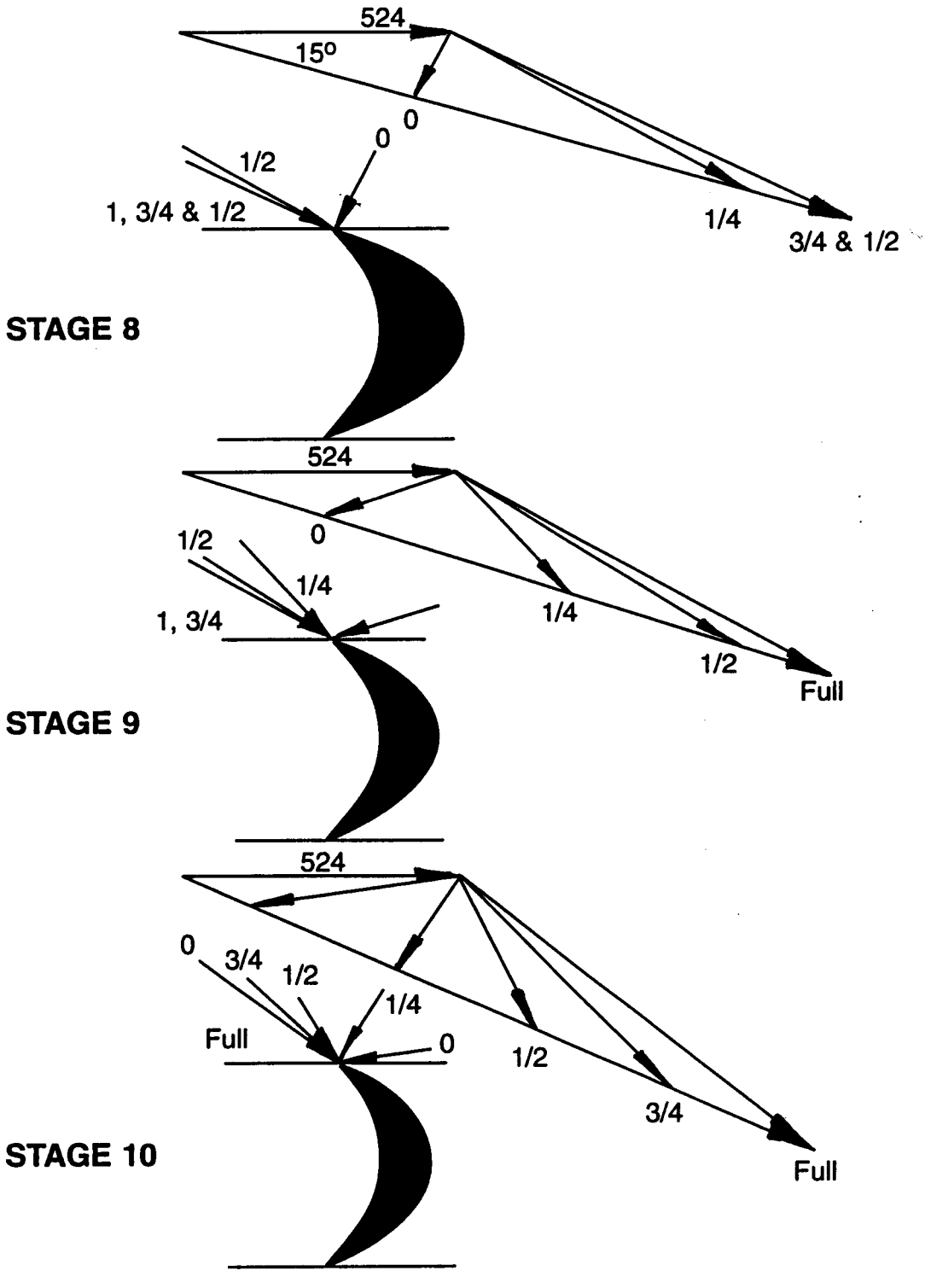
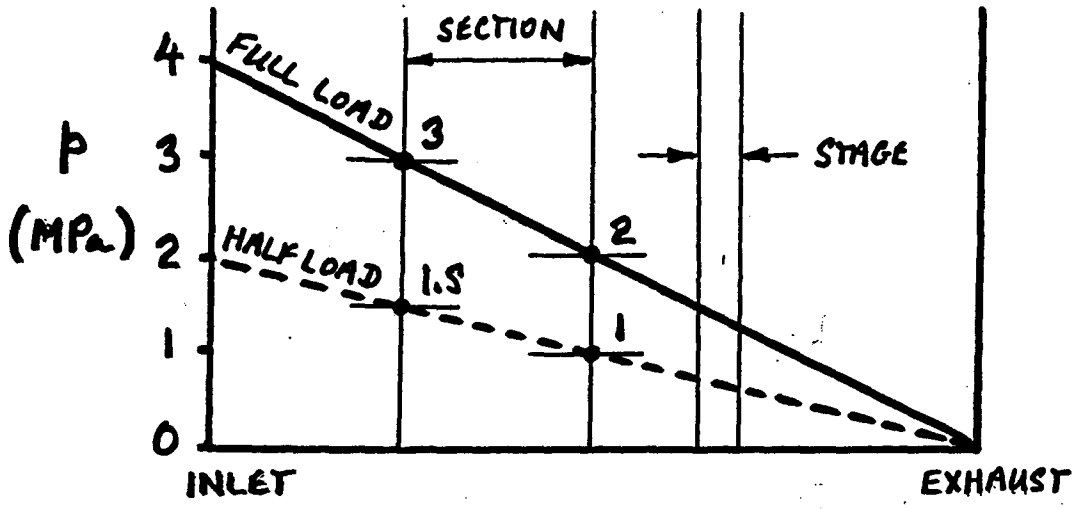


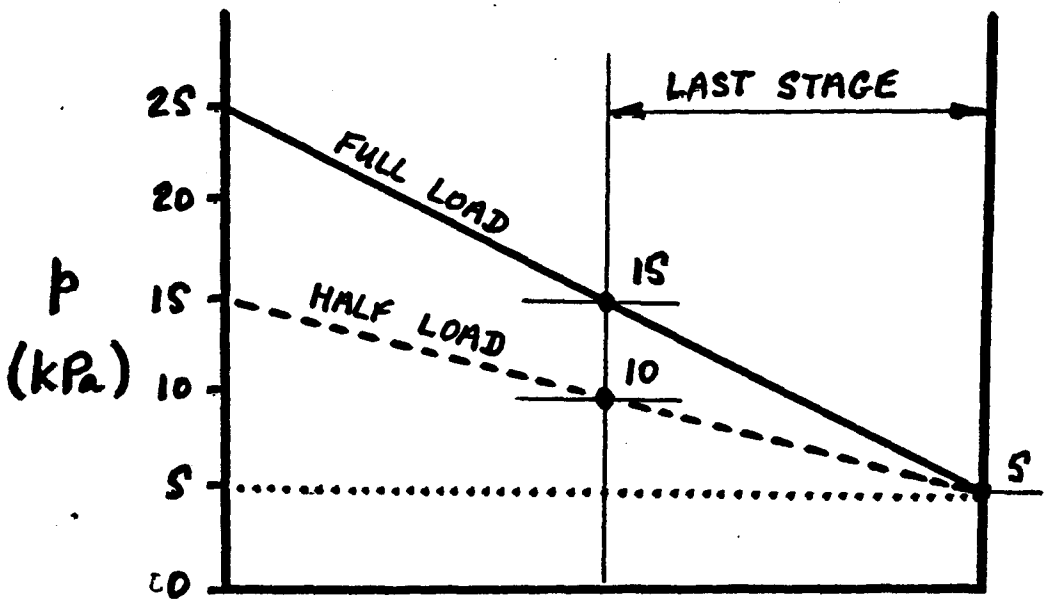
Figure 1.29

LAST STAGE CONDITIONS



PRESSURE RATIO AT FULL LOAD = $3/2$ = 1.5

PRESSURE RATIO AT HALF LOAD = $1.5/1$ = 1.5



PRESSURE RATIO AT FULL LOAD = $15/5$ = 3

PRESSURE RATIO AT HALF LOAD = $10/5$ = 2

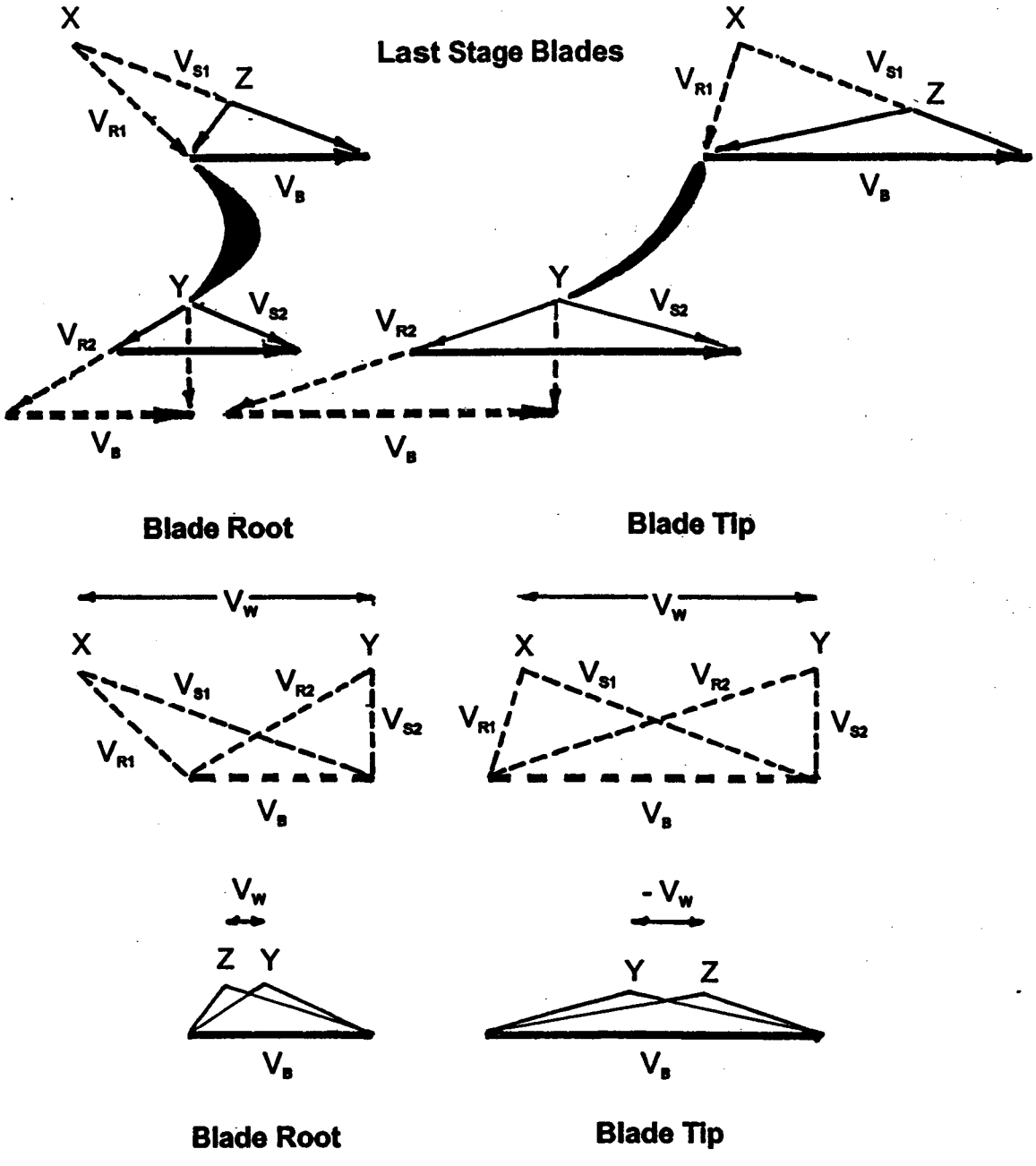


Figure 20 Change in whirl velocity at low loads

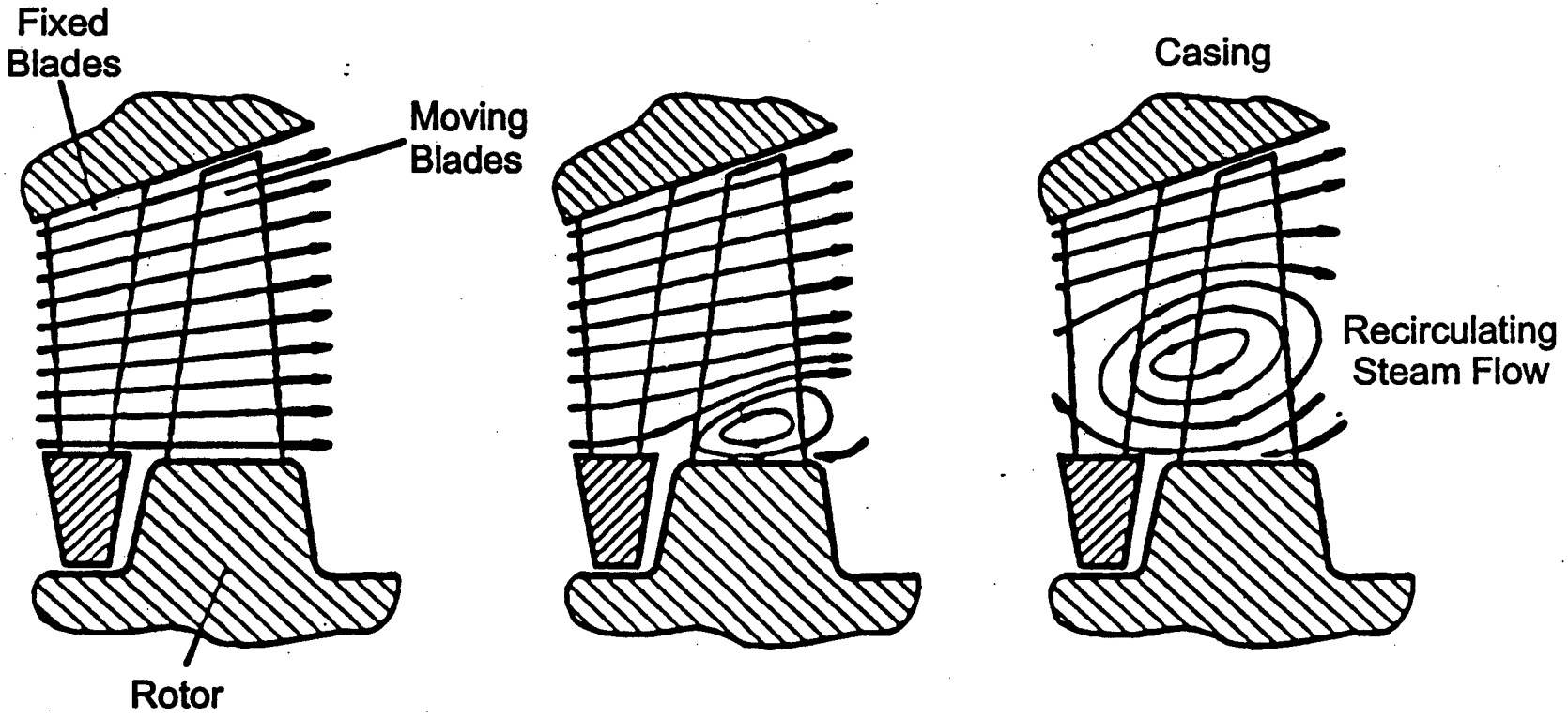


Figure 21 Recirculation of steam at low loads (courtesy of NB Power)

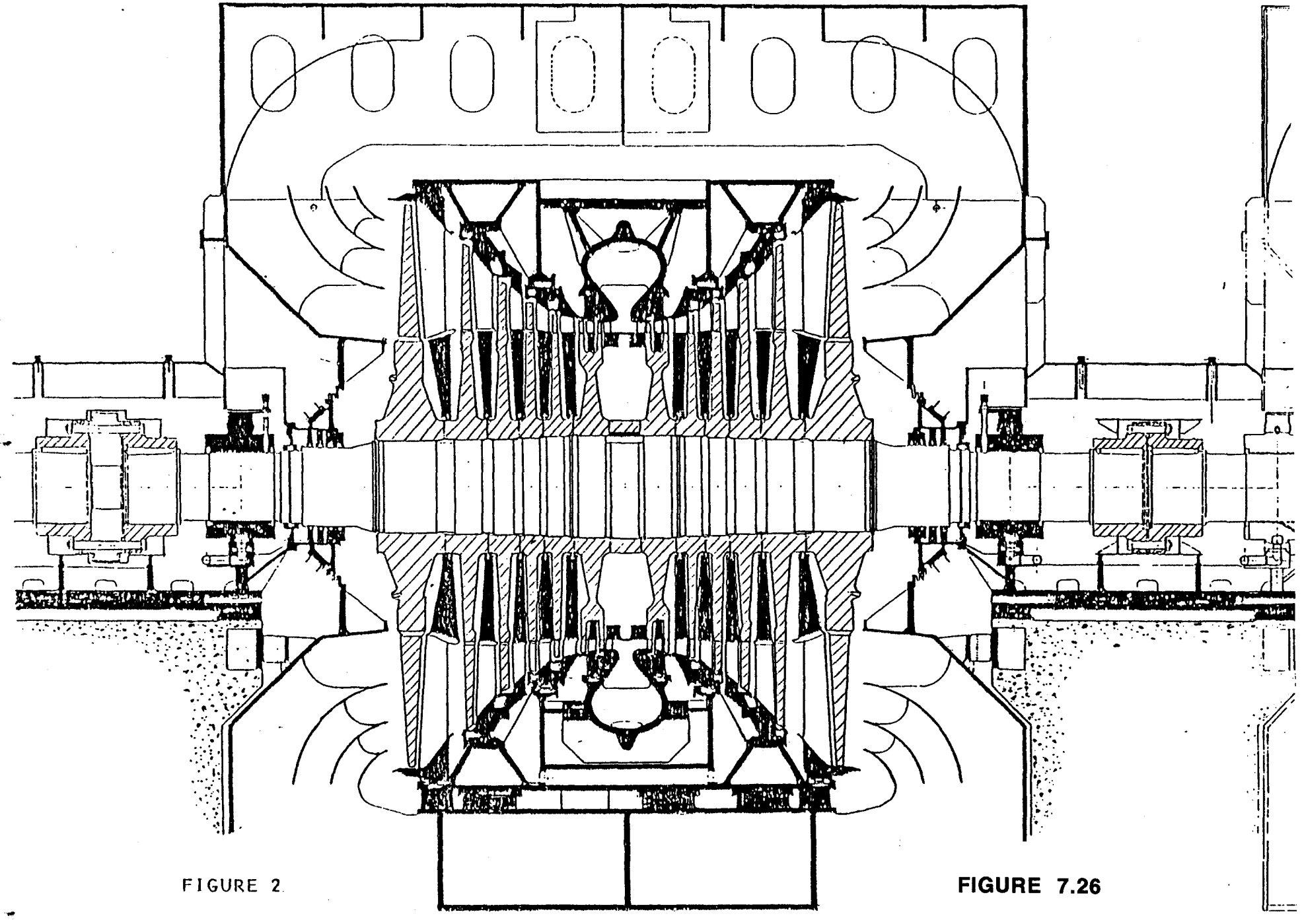


FIGURE 2

FIGURE 7.26