KENICHI YAMAMOTO. 'ROTARY ENGINE'. 1981
CHAPTER 4 - PERPORMANCE and COMBOSTION MAZDA

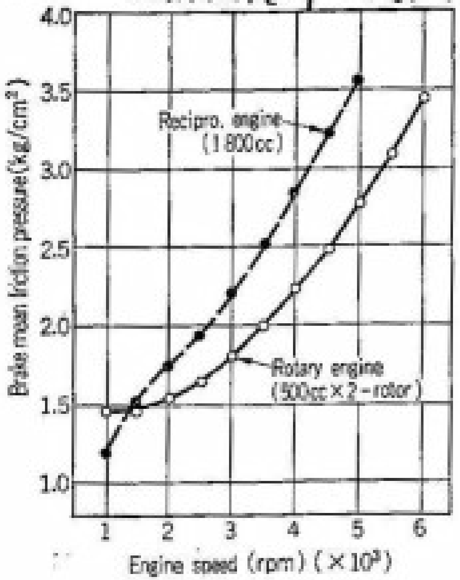


Fig. 4.1 Comparison of friction loss

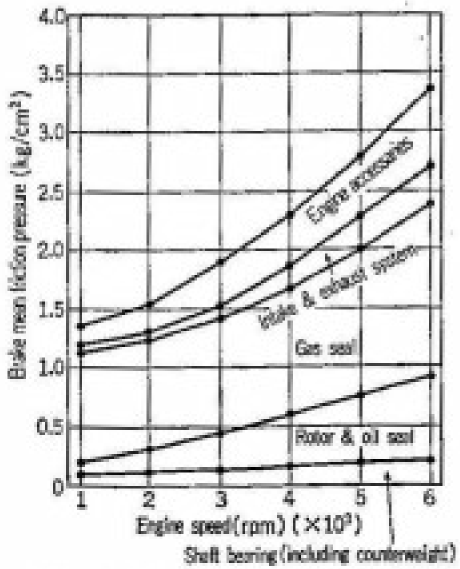


Fig. 4.2 Analysis of friction loss

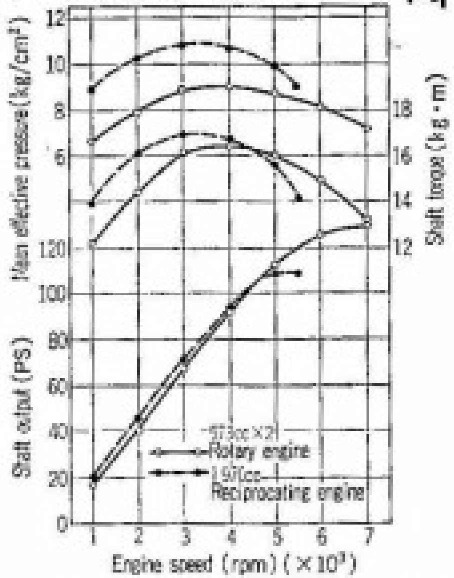


Fig. 4.3 Comparison of performance at W.O.T.

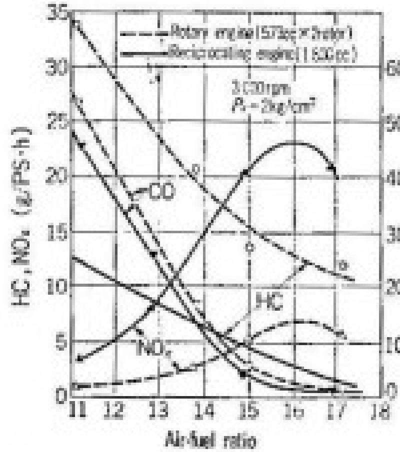


Fig. 4.4 Comparison of exhaust emission characteristics

RE has a slightly lower output at low-speeds but develops high performance at high-speeds.

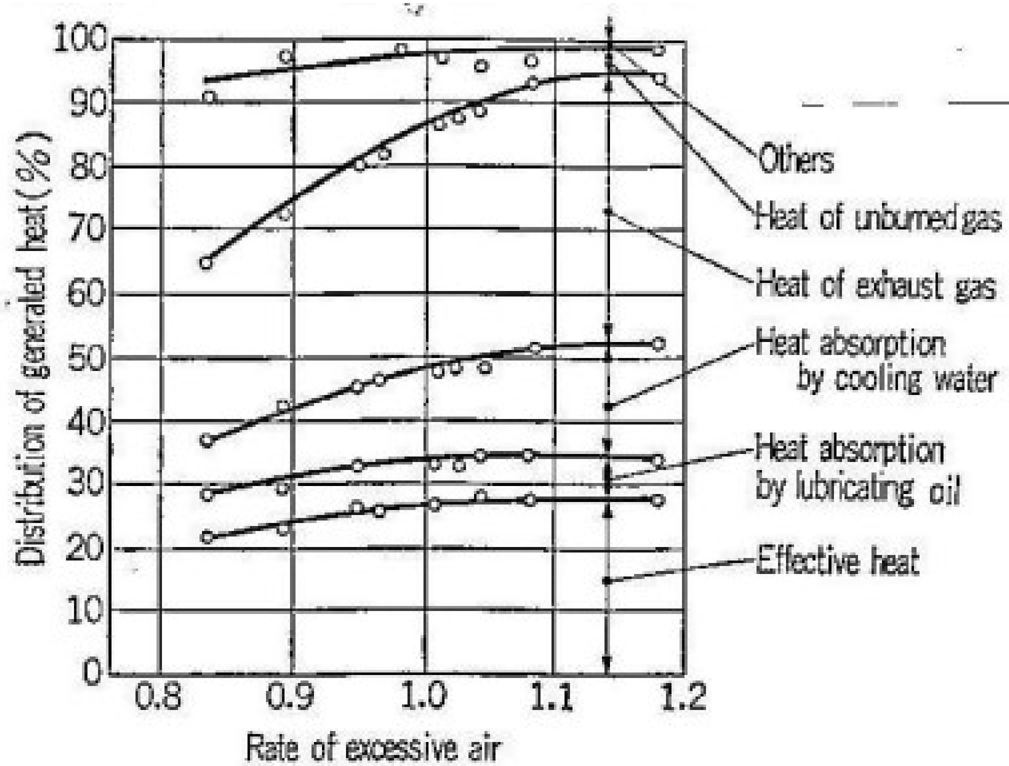


Fig. 4.5 Heat balance of rotary engine

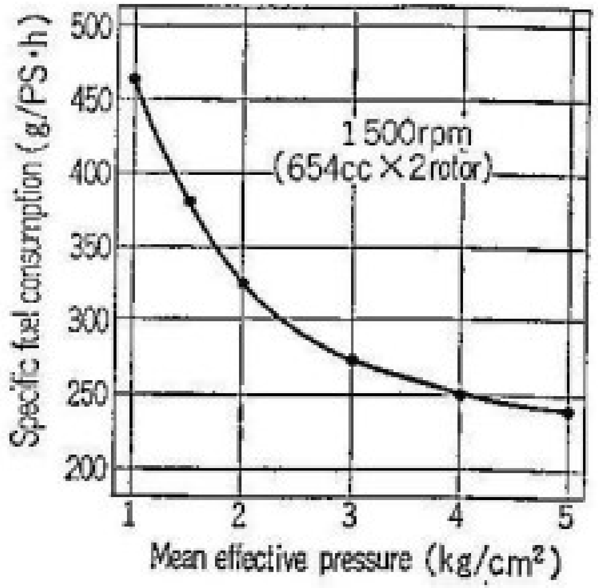
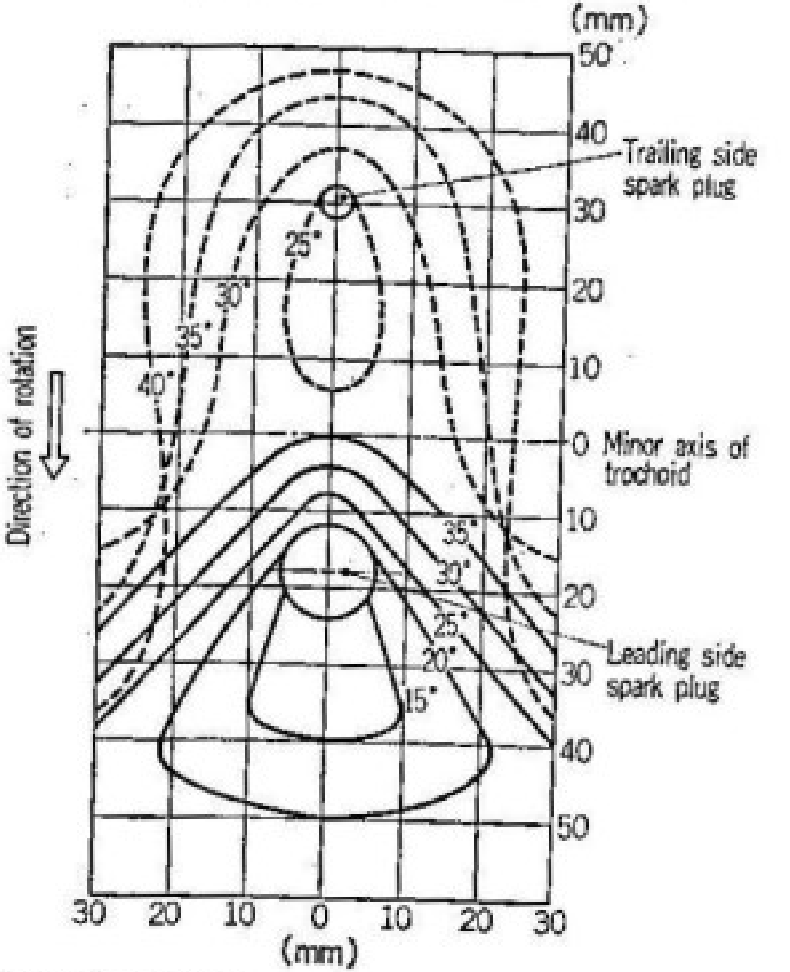


Fig. 4.6 Specific consumption of rotary engine



Engine speed : 1500rpm
Charging efficiency : 60%
Ignition timing : T-side BTDC20°
L-side BTDC30°

Figures in diagram show angle of rotation of the output shaft which indicates the respective flame propagations

Fig. 4.18 Flame propagation of rotary engine

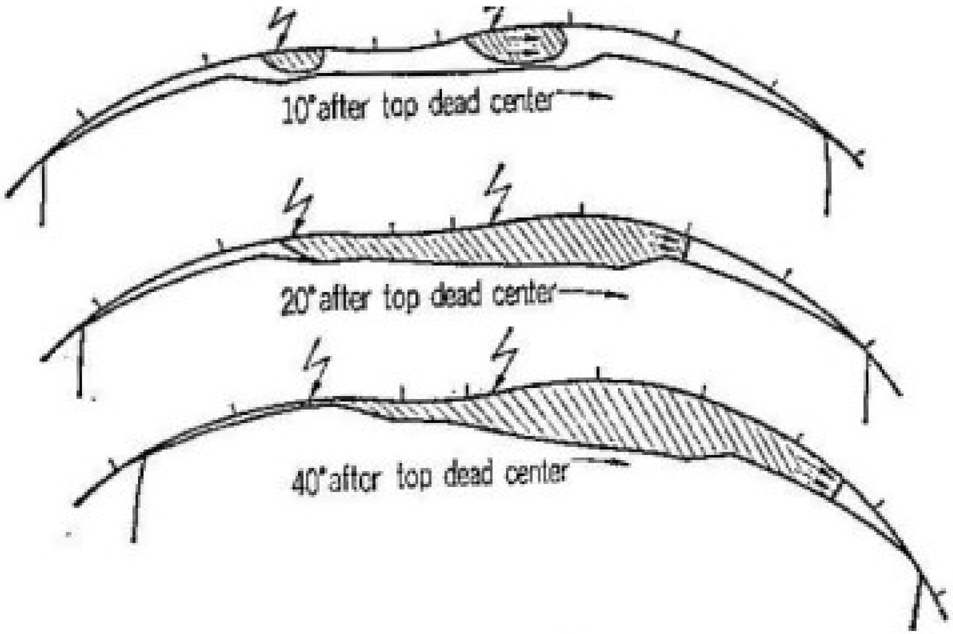


Fig. 4.19 Mode of flame propagation

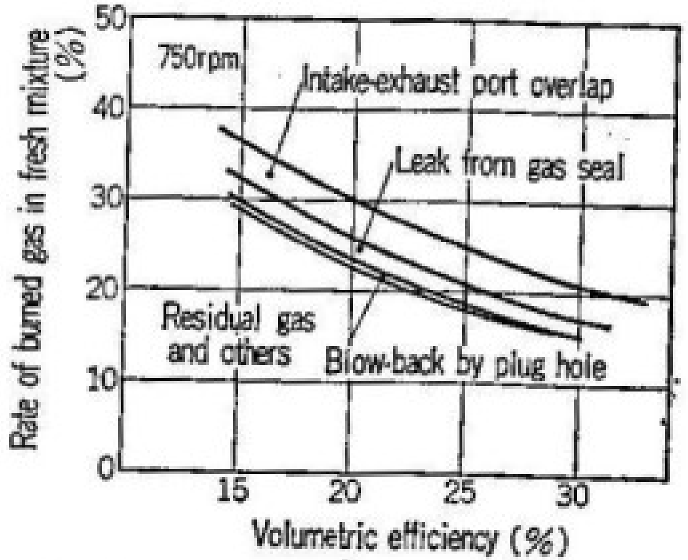


Fig. 4.20 Main analysis of inclusion of burned gas

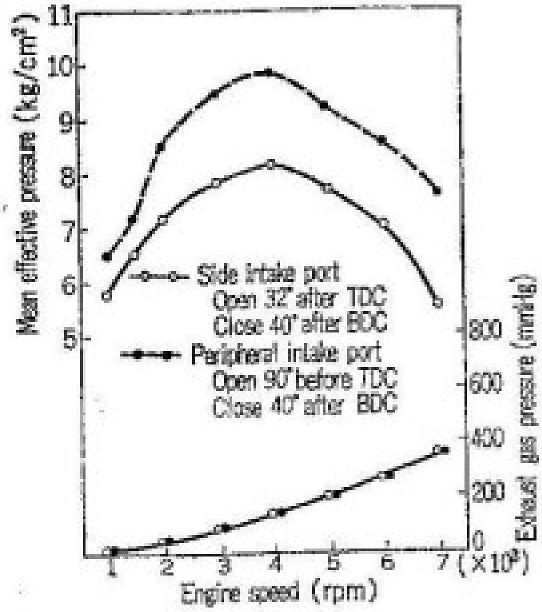


Fig. 4.26 Comparison of W.O.T. performance

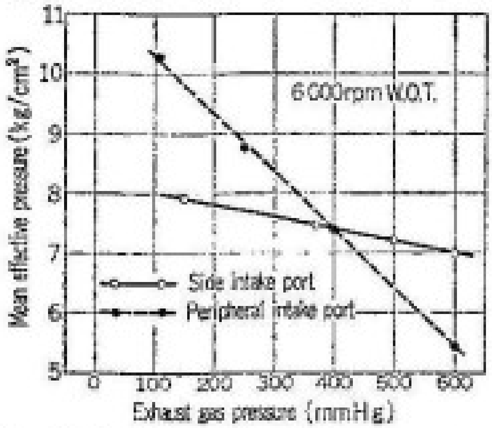


Fig. 4.27 Effect of exhaust pressure on W.O.T. performance

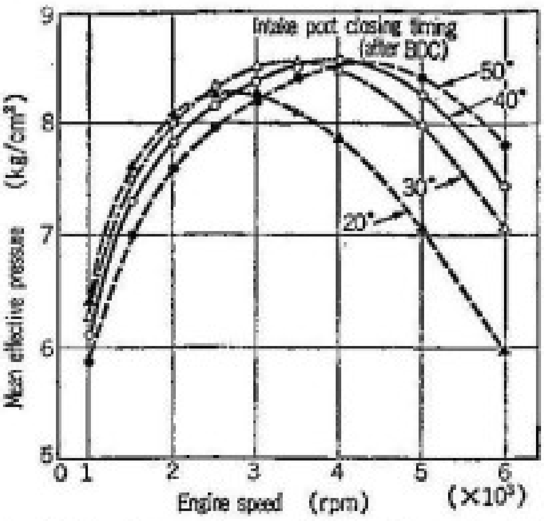


Fig. 4.28 Comparison of W.O.T. performance

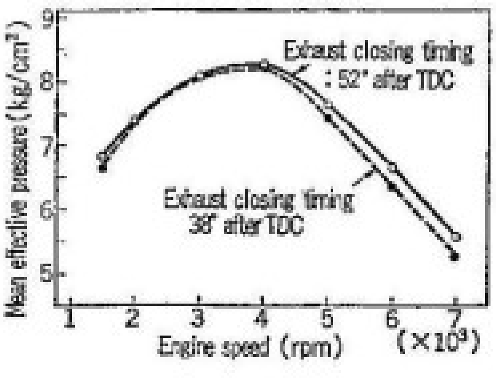


Fig. 4.29 Comparison of W.O.T. performance

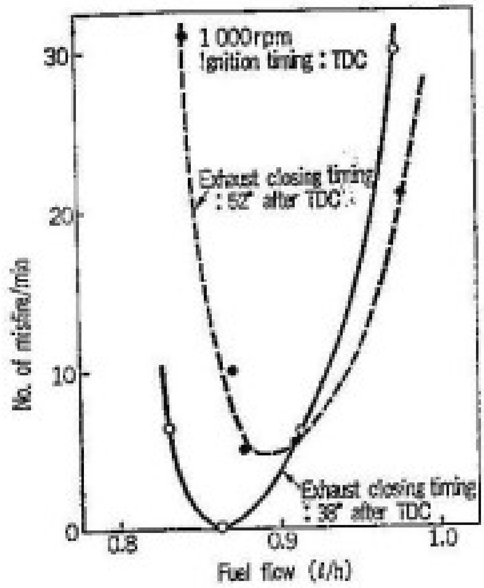


Fig. 4.30 Comparison of stability of idling

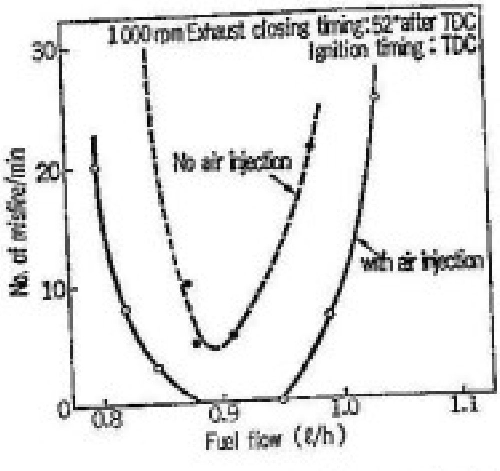


Fig. 4.31 Effect of air jet into exhaust port

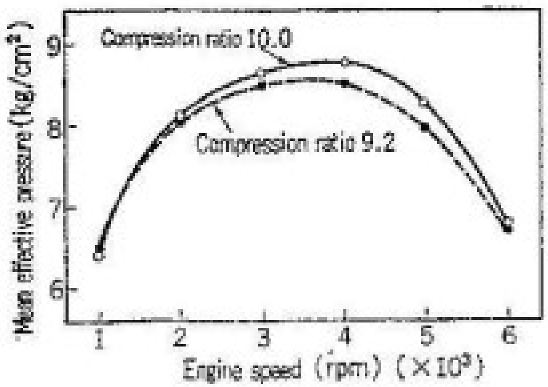


Fig. 4.37 Comparison of W.O.T. performance

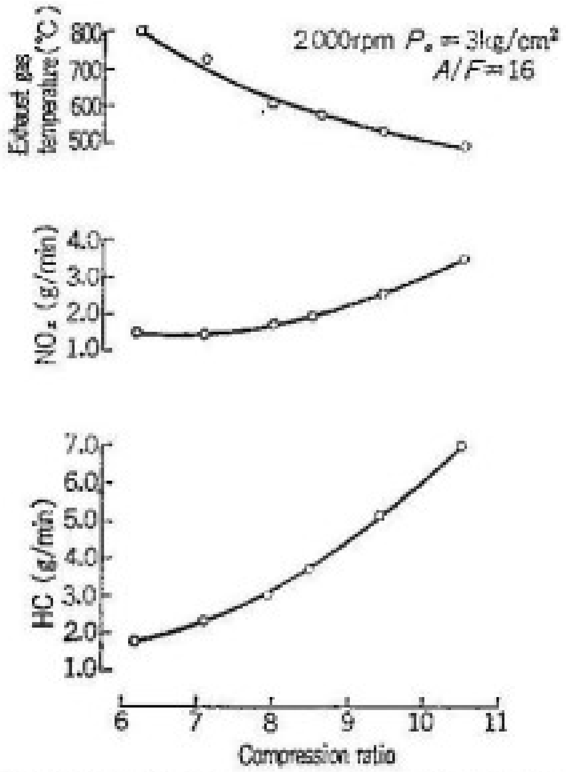


Fig. 4.38 Compression ratio and exhaust emission

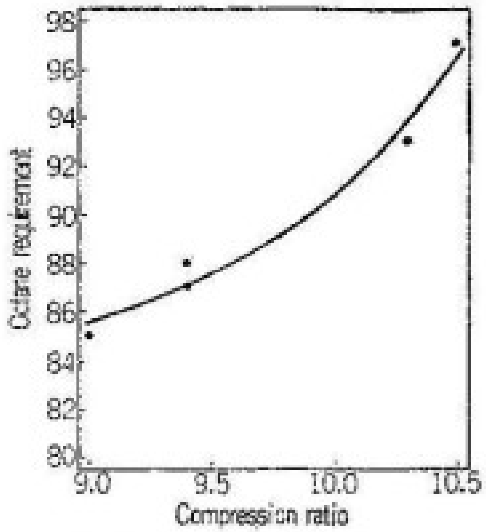


Fig. 4.39 Compression ratio and research octane number

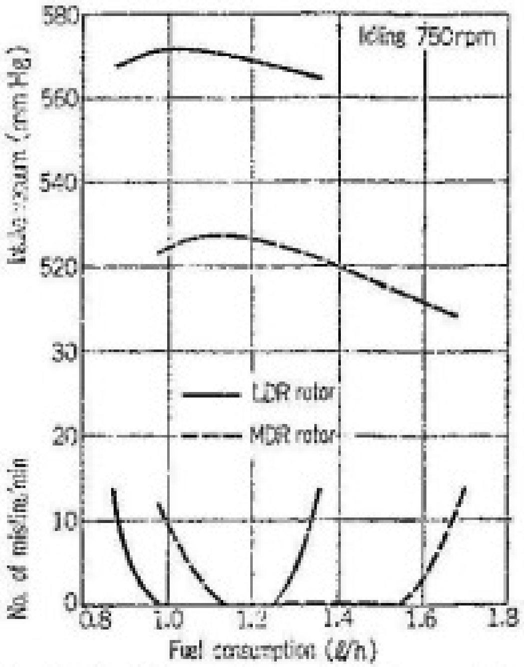


Fig. 4.40 Comparison of idling stability

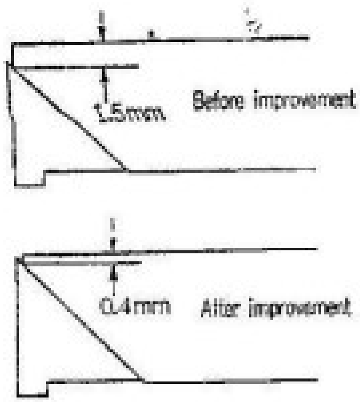


Fig. 4.41 Improved apex seal

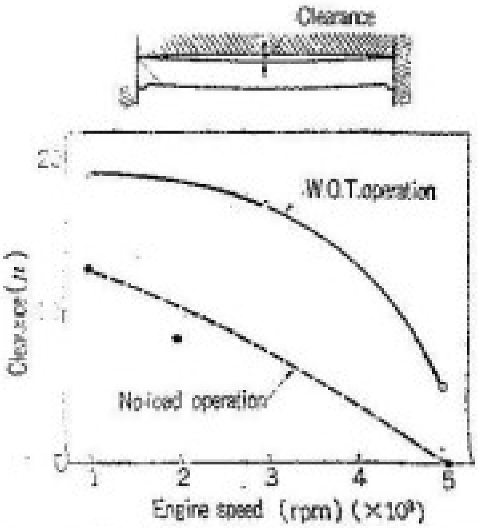


Fig. 4.42 Clearance between apex seal and rotor housing

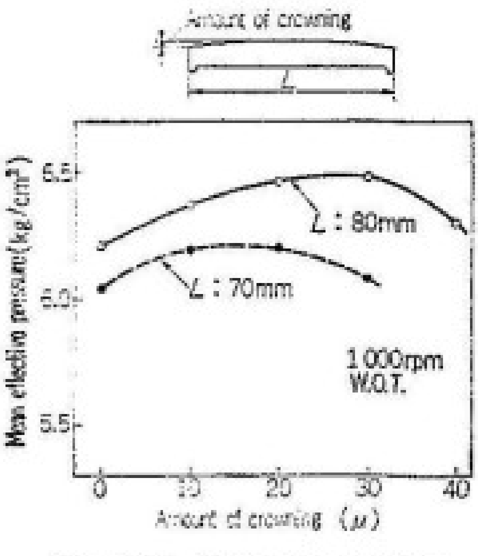


Fig. 4.43 Effect of crowning

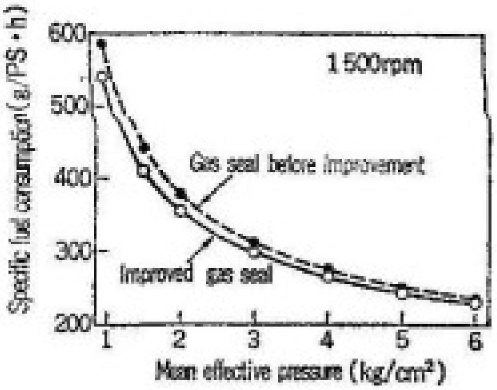


Fig. 4.44 Comparison of fuel consumption rate

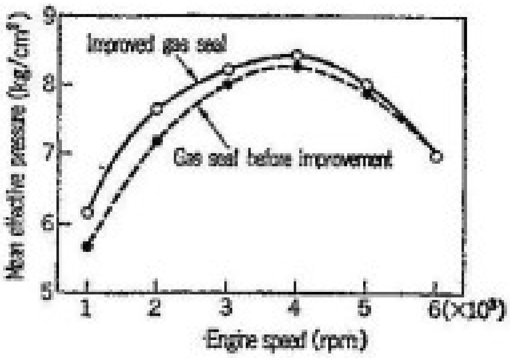


Fig. 4.45 Comparison of W.O.T. performance

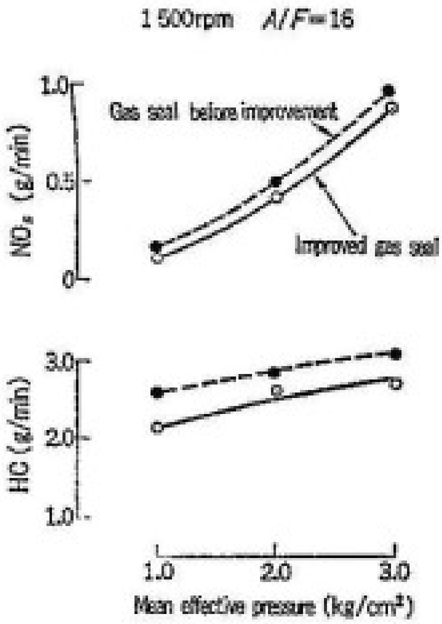


Fig. 4.46 Comparison of exhaust emissions

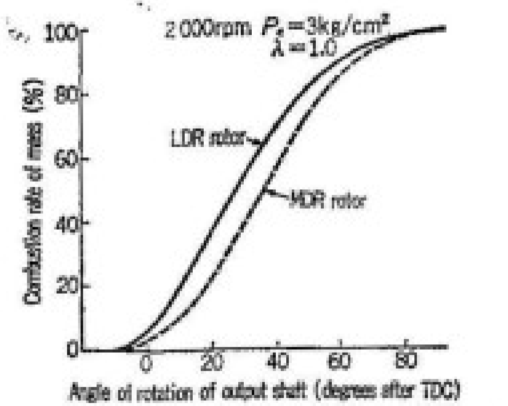


Fig. 4.32 Comparison of combustion speed

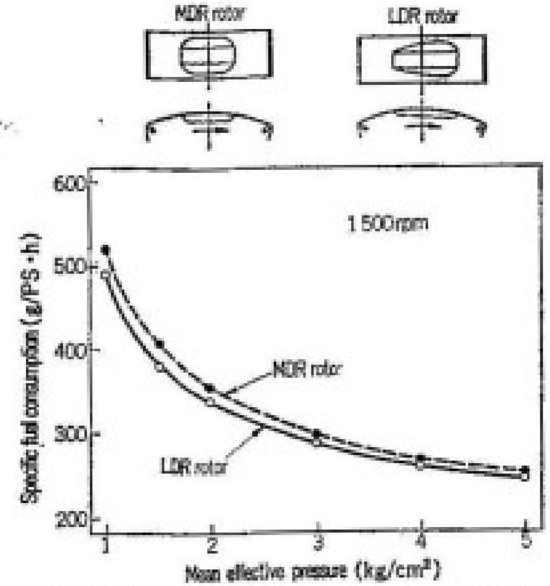


Fig. 4.33 Comparison of specific fuel consumption

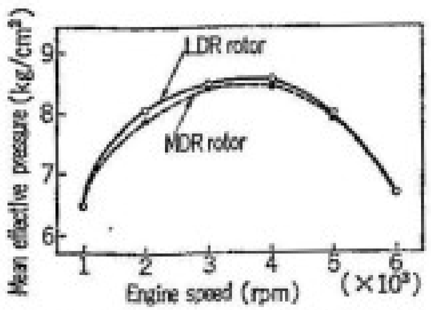


Fig. 4.34 Comparison of W.O.T. performance

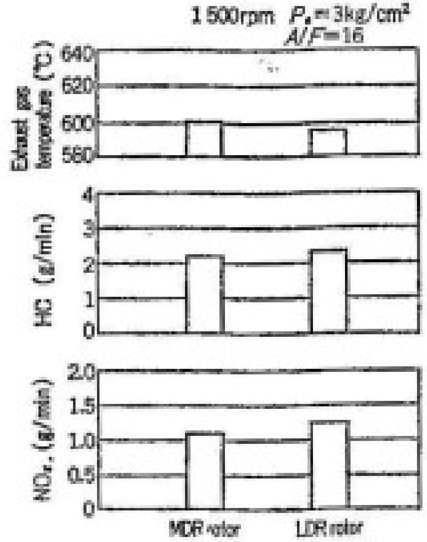


Fig. 4.35 Comparison of emission of exhaust gas

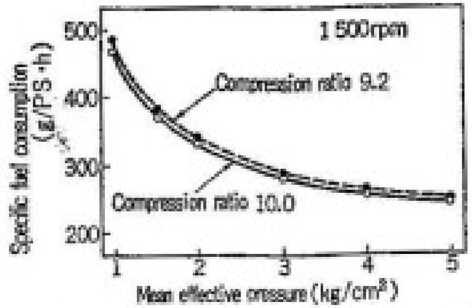


Fig. 4.36 Comparison of specific fuel consumption rate

Fig. 4.32 shows a comparison of burning speeds between the LDR rotor and the MDR (Medium Deep Recess) rotor that has a volumetric center on its center.

Fig. 4.33 through **4.35** show comparisons of specific fuel consumption, performance at W.O.T. and emission of exhaust gas.

The LDR rotor increases the amount of NO_x emission due to higher burning speed, while the amount of HC emission is not related to the location and configuration of the rotor recess as NO_x because of its dependence on a relatively later stage of combustion after the working chamber volume has been expanded.

M: rotor mass, e: eccentricity, $m_F r_F$, $m_R r_R$: capacity of counterweight for perfect balance

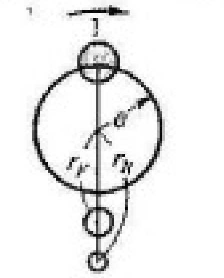
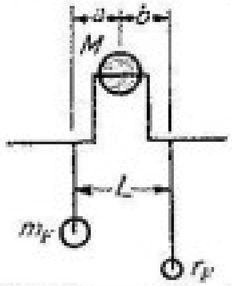
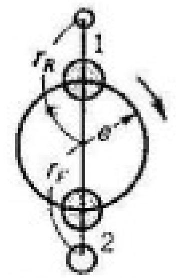
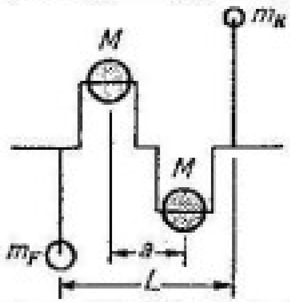
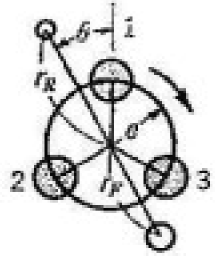
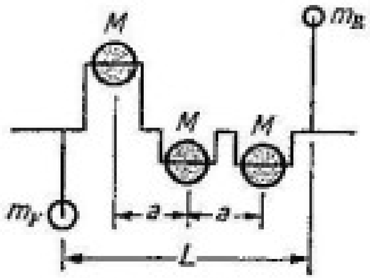
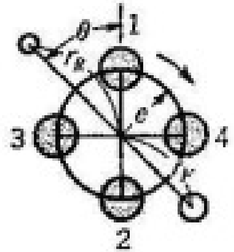
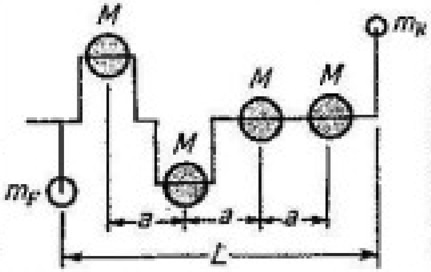
No. of rotor	Rotor & counterweight (clockwise rotation)	Output shaft	Balancing condition
1-rotor			$m_F r_F = \frac{b}{L} Me$ $m_R r_R = \frac{a}{L} Me$
2-rotor			$m_F r_F = m_R r_R = \frac{a}{L} Me$
3-rotor			$m_F r_F = m_R r_R = \sqrt{3}\frac{a}{L} Me$ ($\theta = 30°$)
4-rotor			$m_F r_F = m_R r_R = \sqrt{2}\frac{a}{L} Me$ ($\theta = 45°$)

Fig. 3.23 Balancing condition of rotary engine

Table 4.1 Formulas for calculating rotary engine output

Total displacement $V(\ell)$	$V=Z\cdot V_H$ Z: number of rotors V_H: Volume of single working chamber (ℓ)
Indicated mean effective pressure $P_{mi}(kg/cm^2)$	$P_{mi}=\frac{1}{V_H}\cdot\int_{\theta=0^\circ}^{\theta=1080^\circ} PdV_\theta$ P: gas pressure in working chamber (kg/cm^2) θ: output shaft angle of rotation V_θ: Volume of single working chamber when output shaft angle of rotation is θ° (ℓ)
Indicated horsepower N_i(PS)	$N_i=P_{mi}\cdot\frac{V\cdot n}{450}$ n: number of revolutions of output shaft (rpm)
Shaft horsepower N_e(PS)	$N_e=\eta_m\cdot N_i=\eta_m\cdot P_{mi}\frac{V\cdot n}{450}=P_{me}\frac{V\cdot n}{450}$ η: mechanical efficiency
Net mean effective pressure $P_{me}(kg/cm^2)$	$P_{me}=\eta_m\cdot P_{mi}=\frac{450\cdot N_e}{V\cdot n}$
Shaft torque $T_e(kg\cdot m)$	$T_e=\frac{10V\cdot P_{me}}{2\pi}=\frac{4500\cdot N_e}{2\pi\cdot n}$