Fundamentals of Turbocharging

Nicholas C. Baines

Contents

Preface Acknowledgments Nomenclature		vii xi xii
1.	Introduction to Turbochargers and Turbocharging 1.1 Turbocharging the internal combustion engine 1.2 The turbocharger 1.3 Turbocharging requirements 1.4 The principles of operation of turbomachines 1.5 Exhaust gas energy utilization 1.6 Charge air cooling 1.7 Other applications of turbochargers References	1 2 5 6 13 19 33 37 47
2.	The Centrifugal Compressor 2.1 Introduction 2.2 Performance 2.3 Impeller design 2.4 Diffusers 2.5 Volute 2.6 Stability, range, and range extension 2.7 Mechanical design features References	49 49 53 56 61 65 66 72 79
3.	The Turbine 3.1 Axial turbines 3.2 Radial and mixed flow turbines 3.3 Turbine testing References	81 83 92 108 111
4.	Mechanical Design of Turbochargers 4.1 Bearings 4.2 Shaft seals 4.3 Bearing or centre housing References	113 114 127 129 131
5 .	Matching the Engine and Turbocharger 5.1 Introduction 5.2 Matching an engine and turbocharger at a given operating condition 5.3 Modelling a turbocharged engine 5.4 Turbocharged engine operation References	133 133 134 145 165 178

6.	Turbocharging System Developments	181
	6.1 Exhaust waste gate	181
	6.2 Variable geometry systems	184
	6.3 Turbocompounding	197
	6.4 Waste gate, variable geometry, and compound systems compared	205
	6.5 Exhaust gas recirculation	207
	6.6 Electric drive turbocharger	210
	6.7 Two-stage, or series, turbocharging	212
	6.8 Sequential turbocharging	217
	6.9 Comprex, Hyperbar and other systems	222
	References	230
7.	Pulse Flow Performance of Radial Turbines	233
	7.1 Introduction	233
	7.2 Partial admission	235
	7.3 Pulse flow performance	244
	7.4 Modelling turbine pulse flow performance	253
	7.5 Unsteady performance measurement techniques	257
	References	260
Ind	Index	
Ab	out the Author	
About the Publisher		